Effect of backward masking on *same-different* judgments

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Subjects judged whether two adjacent letters were identical or different. The letter pair was presented briefly, followed by a superimposed patterned mask (Experiments 1 and 2) that was intended to terminate processing early. Previous work using variation in speed stress (Krueger & Chignell, 1985) had indicated that false-*same* errors (i.e., on *different* pairs) predominate in early processing (missing-feature principle), whereas false-*different* errors predominate in late processing (internal-noise principle). The mask did not terminate processing early, however, because it produced a large preponderance of false-*different* errors (9%). Also, both response time (RT) and the standard deviation of RT increased as the stimulus-onset asynchrony between letter pair and mask decreased. The results indicate that backward masking works by integration (C. W. Eriksen, e.g., 1966) rather than by interruption (Sperling, 1963), and is a graded rather than all-or-none phenomenon. Consistent with the internal-noise principle, a lateral mask (Experiment 2) produced a large preponderance of false-*different* errors (7%) and a large fast-*same* effect (50 msec).

When subjects must judge whether two letters are identical or not, *same* judgments typically are faster than *different* judgments and more errors occur on *same* trials; that is, false-*different* responses predominate. According to the noisy-operator theory (Krueger, 1978), internal noise more often changes physical matches into spurious perceived mismatches than vice versa. As a result, *different* judgments are slowed, due to more rechecking of perceived mismatches, and subjects make more false-*different* responses.

Under high speed stress, however, the error effect reverses, and there are more false-*same* responses, particularly on similar *different* pairs (Krueger & Chignell, 1985). The missing-feature principle (C. W. Eriksen, O'Hara, & B. A. Eriksen, 1982), rather than the internal-noise principle, predominates in early processing. According to C. W. Eriksen et al., matching features on similar *different* pairs produce a response tendency toward "same" and "errors on *different* trials occur when the subject's criterion is set so low that a *same* judgment is made before the percept has developed enough to permit discrimination or detection of all the relevant characteristics of the stimuli" (p. 263). In early processing, the absence of a feature may simply be taken to indicate a delay in its arrival, and spurious differences due to missing or unresolved features at encoding or comparison may be disregarded. Distinguishing features seemingly are added quite late (300+ msec) in processing; Krueger and Chignell (1985) found that errors on *same* trials exceeded those on dissimilar *different* pairs only when the response time (RT) exceeded 300 msec.

Krueger and Chignell varied speed stress by using different, 50-msec ranges, and providing corrective feedback ("too slow" or "fast" messages) when needed. Their task was difficult and demanding, and it required much practice. The present study tested whether backward masking, which is less demanding and requires less practice, could be used instead. Insofar as a patterned, superimposed backward mask erases the icon of the test stimulus (Sperling, 1963), or in some other way interrupts and terminates its processing (Turvey, 1973), processing ought to be restricted to the early percept, which looks very similar from one letter to another (C. W. Eriksen et al., 1982; Krueger & Chignell, 1985).

However, if the icon is not a separate memory system, but just persistence (C. W. Eriksen & Schultz, 1978; Haber, 1983), then montage-like effects, rather than interruption, would be expected; because of the limited temporal resolution capacity of the visual system, the mask would simply be summated with the letter pair (C. W. Eriksen, 1966; C. W. Eriksen & Collins, 1967; C. W. Eriksen & Hoffman, 1963; Kahneman, 1965; Kinsbourne & Warrington, 1962; Schultz & C. W. Eriksen, 1977). If processing continued after the arrival of the mask, then a late percept would be established, and the letters would look less similar to each other, since spurious differences due to missing or unresolved features would be taken seriously. The mask would make processing more difficult or noisy, and under difficult or noisy conditions errors typically increase more on *same* than on *different* trials (e.g., Krueger & Allen, 1987; Krueger & Gott, 1985), consistent with the internal-noise principle.

Chignell and Krueger (1984) and Proctor and Rao (1983) found that *same-different* judgments of simultaneously presented letter pairs were not affected by a superimposed patterned mask when the stimulus-onset asyn-

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chrony (SOA) between letter pair and mask was 200 msec. Preliminary testing for the present study indicated that performance would approach the chance level with a 50-msec SOA, and that any further decrease in the SOA would not produce additional useful information, but would merely fatigue and possibly frustrate the subjects. Therefore, the SOA range used in Experiment 1 was 50 to 200 msec. The SOA was sufficiently short, so that if the mask was effective in stopping processing, the processing would be limited to the initial, 300-msec interval, during which the missing-feature principle predominates (Krueger & Chignell, 1985).

The backward-mask character (superimposed H, S, T, X) and letter set (D, H, M, O, V, Y) used here were the same as those used by Chignell and Krueger (1984). They intermixed three dissimilar *different* pairs (HV, OM, DY) and three similar *different* pairs (HM, OD, VY), but six dissimilar and six similar *different* pairs, that is, both orders of each pair, were used here, just as in the Krueger and Chignell (1985) study. False-*same* errors increased first and foremost for similar *different* pairs under increased speed stress (Krueger & Chignell, 1985), and the present study tested for this and other patterns under backward masking.

In addition to errors, RT also was measured. If the mask erases the icon and terminates processing, then RT ought not to increase as the SOA decreases. The sooner processing is terminated, the more compelling should be the similarity evident in the early percept, and the more confident, if less well-founded, the "same" response. In previous studies, shortening the duration of a brief stimulus reduced RT, and increased errors (Chignell & Krueger, 1984; Proctor & Rao, 1983). "Apparently, stimulus offset acted as a cue to respond immediately, resulting in faster, but less accurate, responses with the shorter display" (Chignell & Krueger, 1984, p. 264). If the backward mask interrupts processing, it ought to be an even more compelling cue to respond immediately, and thus it too ought to reduce RT. However, with a backward lateral or ring mask (metaccontrast), the RT of a simple automatic judgment, such as detection, typically is not affected by the presence of the mask (Fehrer & Raab, 1962; Proctor, Nunn, & Pallos, 1983), whereas that of a more demanding judgment, such as identification, is increased (C. W. Eriksen & B. A. Eriksen, 1972; Proctor et al., 1983). The latter results are more consistent with an integration model of backward masking than the interruption model.

Furthermore, C. W. Eriksen and B. A. Eriksen found that as the SOA decreased, not only did RT increase, but so too did the standard deviation (SD) of RT. They concluded from the latter finding that masking is a graded rather than an all-or-none phenomenon. According to an integration model based on a psychological moment, RT ought to increase as the SOA decreases, because the probability that the target and mask enter the same psychological moment increases. If so, then the SD of RT ought to vary nonmonotonically with SOA, being higher at an

intermediate SOA (equal mixture of fast and slow RTs), than at either a short SOA (slow RTs predominate) or a long RT (fast RTs predominate), assuming, of course, that the variability contributed by a long RT per se is relatively small (Townsend & Ashby, 1983, Proposition 7.7). The present study provided a further test of this nonmonotonic prediction.

EXPERIMENT 1

Method

Subjects. Twenty Ohio State University undergraduates participated in order to receive credit in an introductory psychology course. Data from two additional subjects were discarded because of failure to follow instructions. All subjects had at least 20/30 vision (corrected) as tested with a Snellen chart.

Apparatus. Uppercase letters were presented at a 60-Hz refresh rate and at a 32-cd/m² intensity on a greenish-tint, fast-decay P31 phosphor (decay to 1% intensity at .25 msec after display offset) by an Imlac PDS-4 graphics computer, which measured RT to an accuracy of 1 msec. The letters, presented as thin, illuminated lines on a dark screen, were software generated, using short line vectors, so as to resemble normal English uppercase letters. Each subject sat alone in a dark room, with his or her head held fast in a chinrest located 70 cm from the display screen.

Stimulus materials. Each letter was .29 cm wide and .43 cm high, and .19 cm separated the two letters. The pair thus was .77 cm (.63°) wide. It was centered 0.3 mm above a small (1.6 × 1.6 mm) plus sign, which was the fixation mark at the center of the screen. The two letters were presented simultaneously for 50, 67, 83, 100, 117, 133, 167, or 200 msec, and were followed immediately by two noise characters, which appeared in the same two positions. Each noise character consisted of H, S, T, X superimposed on one another. The target filled the entire SOA in order to provide a smoother transition between target and mask. Although it thus was confounded with SOA, target duration per se was expected to have only a small effect. Chignell and Krueger (1984) found that doubling the target duration from 100 to 200 msec lengthened RT by 5 msec and decreased errors by 0.89%.

Each of the eight sets of 72 trials (one for each level of SOA) contained 36 *same* pairs (six each of DD, HH, MM, OO, VV, YY) and 36 *different* pairs (three each of the similar pairs: DO, OD, HM, MH, VY, YV; three each of the dissimilar pairs: DY, YD, HV, VH, MO, OM). Each set was split into two blocks of 36 trials each, which were not presented contiguously. Four practice trials preceded each block, and there was an initial practice block with an SOA of 167 msec, for a total of 680 trials. Four different random orderings of blocks (two were the reverse of the other two) and trials within sets were used.

Procedure. On each trial, the fixation mark appeared alone for 500 msec. The letter pair then appeared for its assigned duration, followed immediately by two mask characters in the same letter positions for 100 msec, and then the fixation mark appeared alone until a response was made. No feedback was given on the accuracy of the response during the .5-sec interval between trials. During the 15-sec interval between blocks, the next series of trials was read in from the host computer.

The subjects were told to keep their eyes focused at all times just above the fixation mark, between where the two letters would appear, and to respond as rapidly as possible, but not at the expense of accuracy. For half of the subjects, the "same" response was assigned to the right-hand button and the "different" response to the left-hand button; the other half had the reverse hand assignment. The subjects were told that some trials would be quite difficult, but that they should always attempt to judge which type of pair was

present, relying if necessary on their own intuitions, and not abandon the task, say, by just mechanically pressing one button on five trials in a row. Trials with an RT greater than 3 sec or less than 200 msec were discarded prior to data analysis. Mean RT was computed for correct trials only, and was measured from the onset of the target pair.

Results

As shown in Figure 1, mean errors increased as SOA decreased [$F(7,133) = 61.95, p < .001$], as did mean RT [$F(7,133) = 9.30, p < .001$] and mean SD of RT [$F(7,133) = 14.56, p < .001$]. Errors were higher on *same* (vs. *different*) pairs, 24.25% versus 15.68% [$F(1,19) = 22.31, p < .001$], whereas RT was lower, 706 versus 734 msec [$F(1,19) = 10.75, p < .01$], and SD of RT did not differ ($F < 1$). The *same-different* variable did not interact significantly with SOA [errors, $F < 1$; RT, $F(7,133) = 1.82, p < .10$; SD of RT, $F < 1$]. Separate analyses indicated that the preponderance of false-*different* errors was significant at each SOA ($p < .025$ or better), except for the shortest (50-msec) SOA ($F < 1$), whereas the fast-*same* effect was significant only at the shortest SOA (81 msec; $p < .05$) and

the longest SOA (56 msec; $p < .025$). The error disparity peaked at 12% to 13% at the 67- and 83-msec SOAs, then markedly declined to about 4% at the 50-msec SOA as all trials converged toward the 50% (pure guessing) accuracy level.

Discussion

Experiment 1 failed in one of its goals, which was to find an alternative method, one not involving speed stress, to restrict processing to the first 300 msec. With backward masking, false-*different*, not false-*same*, errors predominated. This indicates that the backward mask interfered with, but did not terminate, processing. In fact, the nearly 9% preponderance of false-*different* errors found here is far larger than the 1% to 2% preponderance typically found without masking (e.g., Chignell & Krueger, 1984). Under high speed stress, by contrast, Krueger and Chignell, employing the same set of letter pairs as that used here, found a preponderance of false-*same* errors. The fact that the opposite error pattern was found here indicates that subjects responded to a masked target pair as they would to a normal pair in late processing, where the internal-noise principle predominates, rather than early processing, where the missing-feature principle predominates.

The RT data also indicate that the arrival of the mask did not terminate processing. Mean RT increased, rather than decreased, as the SOA decreased. If the backward mask had interrupted processing, and had served as a cue to respond immediately, it ought to have reduced RT, forcing a faster response in a manner similar to that of high speed stress. The error and RT data thus support the integration model of backward masking over the interruption model.

Masking here was a graded, rather than an all-or-none, phenomenon. The SD of RT steadily increased as the SOA decreased (Figure 1), showing no tendency to decrease at the shorter SOAs, as would be predicted by an integration model based on the psychological moment. C. W. Eriksen and B. A. Eriksen (1972) likewise found a monotonic increase in the SD of RT as SOA decreased.

EXPERIMENT 2

In Experiment 1, the preponderance of false-*different* errors generally persisted as SOA decreased, but markedly declined to about 4% at the 50-msec SOA, as accuracy approached the chance level. In Experiment 2, the SOA was decreased even further in order to determine more precisely what near-chance performance would be like. Some longer, less informative, SOAs were omitted.

Under difficult or noisy conditions, both the fast-*same* effect and the preponderance of false-*different* responses typically increase (e.g., Krueger & Allen, 1987; Krueger & Gott, 1985), consistent with the internal-noise principle. However, in Experiment 1, the error and RT effects remained remarkably stable across SOA, rather than progressively increasing as SOA decreased, and thus the

Figure 1. Experiment 1, superimposed masking: Mean response time, standard deviation (SD) of response time, and percentage of error rate by trial type (*same*, *similar*, *different*, *dissimilar*) and stimulus-onset asynchrony between letter pair and superimposed mask.

level of difficulty increased. This is particularly puzzling on the errors, which showed an outsized (9%) *same-different* disparity. It may be that the tendency to perceive spurious mismatches increased as SOA decreased (internal-noise principle), but that this effect was concealed by proper adjustment of the criterion for responding versus rechecking. Trials were blocked by level of difficulty (i.e., SOA) in Experiment 1, so subjects could readily have adjusted the criterion upward at short SOAs, with the result that even moderate to large perceived differences produced immediate "same" responses.

Krueger (1985) found that when trials were intermixed, rather than blocked by level of difficulty (i.e., foveal vs. parafoveal presentation), subjects relied on a common, compromise criterion. The subjects rechecked moderate perceived differences for both easy and difficult trials, instead of adopting the separate, more appropriate criteria for easy trials (recheck small differences) and difficult trials (recheck large differences) used on pure blocks. Intermixing trials decreased the fast-*same* effect, but increased the preponderance of false-*different* errors on difficult trials, and did the reverse on easy trials.

Experiment 2 varied whether trials were intermixed or blocked on SOA. On each pure block, all trials had the same SOA, just as in Experiment 1. On each mixed block, all six levels of SOA were used. Intermixing SOAs in Experiment 2, by preventing proper criterion adjustment, ought to decrease the fast-*same* effect but increase the preponderance of false-*different* responses at short SOAs, and do the reverse at long SOAs. Relative to the common, compromise criterion used, the perceived differences on *same* pairs would be large at short SOAs, producing many false-*different* errors, and small at long SOAs, producing few false-*different* errors.

In Experiment 2, the letter pair was presented for a fixed, 33-msec duration, rather than for the entire SOA as in Experiment 1. This eliminated the confounding between stimulus duration and SOA, although it may have introduced some additional disruption due to the definite gap between letter pair and mask at the longer SOAs.

In Experiment 2, trial blocks involving superimposed masking were interleaved with lateral masking (metacontrast) blocks. In previous work, brief parafoveal presentation and lateral masking produced a large, nearly 70-msec speed advantage for *same* letter pairs, along with a large, nearly 10% preponderance of false-*different* errors (Krueger & Gott, 1985), whereas brief parafoveal presentation without lateral masking produced much weaker effects (14 msec, 2.03%; Krueger, 1985, pure-blocks condition). If, as these results suggest, lateral masking, not parafoveal presentation, was primarily responsible for the outsized effects Krueger and Gott obtained, then nearly the same large effects ought to be found here with lateral masking.

Method

There were 20 undergraduate subjects. The method was the same as in Experiment 1, except for the following changes. With lateral

masking, the two noise characters bracketed the two target letters, with one appearing .19 cm to the left of the target pair and the other .19 cm to the right. Thus, the four characters were evenly spaced apart, and were 1.73 cm (1.42°) wide as a set.

The two target letters were presented simultaneously for 33 msec, followed, after an interstimulus interval (ISI) of 0, 17, 33, 50, 67, or 100 msec, by the mask, which appeared for 100 msec. Thus, the SOA was 33, 50, 67, 83, 100, or 133 msec. Each block of 24 trials consisted of two each of the 6 *same* pairs and one each of the 12 *different* pairs (6 similar, 6 dissimilar) used in Experiment 1. There were six pure-SOA superimposed masking blocks and six pure-SOA lateral masking blocks, one for each SOA. All six SOAs were used with equal frequency (four times each) in each of the six mixed-SOA superimposed masking blocks and six mixed-SOA lateral masking blocks. In each set of six mixed blocks, each of the 24 letter pairs appeared once at each of the six SOAs. Four practice trials preceded each block, and there was an initial practice block (which intermixed superimposed and lateral masking trials, as well as SOAs), for a total of 700 trials. Four different random orderings of blocks (two were the reverse of the other two) and trials within blocks were used. The random ordering of blocks was modified so that superimposed and lateral masking blocks were interleaved. For half of the subjects, the odd blocks (1 to 23) involved superimposed masking, and the even blocks (2 to 24) involved lateral masking, whereas for the other half, it was the reverse.

Results

The results will be presented first for superimposed masking, followed by those for lateral masking and then by those for the two types of masking analyzed jointly.

Superimposed masking. As shown in Figure 2, errors increased as SOA decreased [$F(5,95) = 72.29$, $p < .001$], as did RT [$F(5,95) = 16.03$, $p < .001$] and SD of RT [$F(5,95) = 12.27$, $p < .001$]. Errors were higher on *same* (vs. *different*) pairs, 29.57% versus 20.52%, but only to a marginally significant extent [$F(1,19) = 4.27$, $p < .10$], whereas RT was significantly lower, 800 versus 837 msec [$F(1,19) = 9.76$, $p < .01$], and SD of RT did not differ ($F < 1$).

As would be expected if subjects relied on a common, compromise criterion, the fast-*same* effect decreased, whereas the preponderance of false-*different* errors increased, as SOA decreased. The SOA $\times$ *same* versus *different* interaction was significant on errors [$F(5,95) = 4.51$, $p < .01$], but not on RT ($F < 1$). The error interaction tended to be greater, as expected, on mixed-SOA blocks (see Table 1), and it was significant for mixed blocks analyzed separately [$F(5,95) = 5.52$, $p < .001$] but not for pure blocks [$F(5,95) = 1.42$]. However, the error interaction on pure blocks was sufficiently strong to stifle the three-way error interaction of SOA $\times$ *same* versus *different* $\times$ pure versus mixed [$F(5,95) = 1.35$]. As shown in Table 1, on pure blocks as well as mixed blocks, errors were much higher on *same* pairs than similar *different* pairs at the 33- and 50-msec SOAs, about equal at the 67-msec SOA, and somewhat lower at the 83-, 100-, and 133-msec SOAs. The latter reversal, along with the large positive disparity at the 33- and 50-msec SOAs, indicates that the subjects tended to use a common, compromise criterion that was properly adjusted for approximately the 67-msec SOA.

Figure 2. Experiment 2, superimposed masking: Mean response time, standard deviation (SD) of response time, and percentage of error rate by trial type (*same*, *similar*, *dissimilar*) and stimulus-onset asynchrony between letter pair and superimposed mask.

Unexpectedly, RT was 36 msec higher on pure than on mixed blocks [$F(1,19) = 5.88, p < .05$] and errors were about 5% higher [$F(1,19) = 14.82, p < .01$]. As shown in Table 1, the improved performance with mixed blocks was consistent across SOA and trial type.

Lateral masking. As shown in Figure 3, errors increased as SOA decreased [$F(5,95) = 4.95, p < .001$], as did RT as well, but only to a marginally significant extent [$F(5,95) = 2.18, p < .10$], and SD of RT did not change significantly ($F < 1$). Errors were higher on *same* (vs. *different*) pairs, 15.33% versus 8.21% [$F(1,19) = 11.50, p < .01$], whereas RT was lower, 679 versus 729 msec [$F(1,19) = 10.75, p < .01$], and SD of RT did not differ ($F < 1$). Mean RT was significantly higher on pure (vs. mixed) blocks [$F(1,19) = 5.27, p < .05$], but errors were not ($F < 1$).

Superimposed and lateral masking. Errors were higher on superimposed than on lateral masking blocks [$F(1,19) = 44.92, p < .001$], as was RT [$F(1,19) = 21.16, p < .001$] and SD of RT [$F(1,19) = 8.99, p < .01$]. Mask type did not interact with *same* versus

different [errors, $F < 1$; RT, $F(1,19) = 1.59$; SD of RT, $F < 1$], but did with SOA [errors, $F(5,95) = 31.01, p < .001$; RT, $F(5,95) = 6.38, p < .001$; SD of RT, $F(5,95) = 6.03, p < .001$]. The effect of SOA was much greater with superimposed masking (Figure 2) than with lateral masking (Figure 3), especially for *same* (vs. *different*) pairs on errors [$F(5,95) = 3.47, p < .01$]. Errors were higher on pure (vs. mixed) blocks, primarily with superimposed masking [$F(1,19) = 7.97, p < .025$].

The SOA $\times$ *same* versus *different* interaction was significant on errors [$F(5,95) = 3.15, p < .025$], especially, but not quite significantly so, on mixed (vs. pure) blocks [$F(5,95) = 2.07, p < .10$]. The interaction was significant for mixed blocks tested separately [$F(5,95) = 5.34, p < .001$] but not for pure blocks ($F < 1$).

Discussion

Superimposed masking. In Experiment 2, as in Experiment 1, the superimposed backward mask interfered with, but did not terminate, processing. Mean RT, mean SD of RT, and the preponderance of false-*different* errors, all increased steadily as SOA decreased. These

Table 1
Experiment 2: Mean Response Time (RT; in Milliseconds) and Percentage of Error Rate (PE) by Trial Type, Block Type, Mask Type, and Stimulus-Onset Asynchrony (SOA; in Milliseconds)

SOA, Mask Type, and Block Type	Trial Type					
	Same		Similar Different		Dissimilar Different	
	RT	PE	RT	PE	RT	PE
Superimposed; Pure						
33	985	50.58	1064	46.33	988	37.50
50	897	49.18	886	38.33	947	22.50
67	821	34.72	938	35.42	814	9.17
83	781	26.66	860	28.17	806	5.00
100	730	16.70	795	21.67	694	7.50
133	684	12.92	801	19.17	682	4.17
Superimposed; Mixed						
33	918	52.64	954	35.83	889	22.50
50	824	47.16	949	33.50	789	18.33
67	804	27.99	827	29.08	761	15.00
83	740	18.75	825	25.83	767	2.50
100	720	9.17	826	15.00	732	6.67
133	690	8.41	743	11.67	735	1.67
Lateral; Pure						
33	700	15.98	766	18.33	720	7.50
50	760	19.58	907	18.33	764	10.00
67	677	15.42	751	14.17	648	1.67
83	676	17.08	798	9.33	700	5.17
100	669	15.95	739	7.50	675	0.83
133	642	10.00	752	6.67	661	3.33
Lateral; Mixed						
33	673	18.60	817	14.17	692	6.67
50	680	17.65	728	14.17	666	5.00
67	684	15.42	785	8.34	703	5.00
83	635	12.69	811	10.83	653	5.00
100	680	13.45	750	16.67	660	2.50
133	668	12.17	697	4.17	656	1.67

Figure 3. Experiment 2, lateral masking: Mean response time, standard deviation (SD) of response time, and percentage of error rate by trial type (*same*, *similar*, *different*, *dissimilar*) and stimulus-onset asynchrony between letter pair and lateral mask.

results best fit an integration model, and indicate that masking is a graded, rather than an all-or-none, phenomenon (C. W. Eriksen & B. A. Eriksen, 1972).

The inclusion of the easier, lateral-masking blocks and the use of intermixed blocks, which generally facilitated performance, would seem to have led subjects to rely generally on a common, compromise criterion. This revealed more clearly what actually was perceived under superimposed masking, that is, many more spurious mismatches than matches. Thus, the internal-noise principle, not the missing-feature principle, predominates with superimposed backward masking. With masking, subjects apparently took seriously even the featural mismatches that involved missing or unresolved features, instead of regarding those as temporary aberrations of incomplete processing (missing-feature principle). It is not clear why strong evidence for the use of a common, compromise criterion was obtained only on errors, and not on RT. A reliable decrease in the fast-*same* effect ought to have accompanied the increased preponderance of false-*different* errors at the short SOAs (Krueger, 1985).

The mixed-SOA blocks unexpectedly helped performance, and their aid may explain in part why superimposed masking produced generally smoother functions and lower errors at short SOAs in Experiment 2 (Figure 2) than it did in Experiment 1 (Figure 1). When questioned afterwards, the subjects said they had had to concentrate harder on mixed blocks, since they never knew when a difficult, short-SOA trial would occur. This would explain why performance improved on mixed blocks for the easier, long-SOA trials. The subjects also said that the easier, long-SOA trials provided a welcome break on

mixed blocks and reduced their feeling of frustration from the more difficult trials. This would explain why performance improved on mixed blocks for the more difficult, short-SOA trials.

Performance also may have been improved in Experiment 2 because the common, compromise criterion relied upon was more natural, and therefore required less effort to maintain, than the more proper, but more extreme, criteria used on the pure-SOA blocks in Experiment 1. Under difficult or noisy conditions, proper adjustment would require responding "same" immediately to moderate-to-large perceived differences, which might oppose the more natural and perhaps more automatic tendency to respond "same" only to fairly small perceived differences on the basis, perhaps, of the output from a fast identity reporter (Bamber, 1969).

Lateral masking. In Experiment 2, mean RT and errors were significantly lower with lateral (vs. superimposed) masking, indicating that processing was less difficult, yet the *same-different* disparity on RT and errors remained just about as large (50 msec, 7.12% for lateral masking; 37 msec, 9.05% for superimposed masking). Most subjects said afterwards that lateral masking was easier, but some also said it was more distracting, because it pulled the attention to the sides. The outward apparent motion at the SOAs used here was very impressive to the casual observer (also see Kahneman, 1968), and 18 of the 20 subjects reported seeing it. The large *same-different* disparities on RT and errors found here with lateral masking (50 msec, 7.12%) indicate that the outsized effects Krueger and Gott found with brief, laterally masked parafoveal presentation (67 msec, 9.60%) were due mainly to their use of lateral masking.

Response competition. According to C. W. Eriksen et al.'s (1982) response-competition model, the presence of matching features makes *different* judgments slower than *same* judgments. Their model predicts that dissimilar *different* pairs, which contain few matching features, ought to be as fast as *same* pairs. This prediction was strikingly confirmed by the present data (see Figures 1, 2, and 3). The Eriksen et al. model also is consistent with the greater number of false-*same* responses found on similar than on dissimilar *different* pairs, but it does not explain the preponderance of false-*different* responses, which exceeded false-*same* responses even on similar *different* pairs in most cases.

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