Notes and Comment

On tactile and visual recognition

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Craig (1979) reported confusion matrix data for the uppercase English alphabet presented tactually via an Optacon transmitter applied to the index fingertip of the left hand. The letters were presented as the appropriate elements of a 6 by 18 array, energized simultaneously for a controlled interval. Correct recognition averaged .52. He invited exploration of the question of whether or not these data were explainable in terms of visual feature processing recognition models. One such model (Geyer & DeWald, 1973) demonstrated that a particular feature set proposed by Geyer (1970) and a feature processing model generally compatible with Selfridge's (1959) pandemonium model accounted for more than 91% of the total sum squares variance of each of the three visual confusion matrices for capital letters reported by Townsend (1971a, 1971b). The same model and feature set, when applied to the Craig (1979) data, performed very poorly, accounting for only 83% of total sum squares variance.

These results seem to cast doubt on Craig's (1979) suggestion that visual and tactile recognition may tap similar processes, but leave aside the puzzling fact, reported by Craig, that his main diagonal vector correlated .88 with the main diagonal vector reported by Gilmore, Herish, Caramazzo, and Griffin (1979) for recognition of block capital letters presented as the appropriate elements of a 5 by 7 dot matrix on a videoscreen. In fact, the Geyer and DeWald (1973) model is similarly poor at accounting for the Gilmore et al. (1979) data—80% of total sum squares. The contrast between the Craig (1979) and Gilmore et al.

(1979) data, on the one hand, and the Townsend (1971a, 1971b) data, on the other, is quite visible in Table 1, which shows the sum square error for each pairing of one matrix as a predictor of another. Table 1 does not illuminate the question as to why the Gilmore et al. (1979) visual data should be more similar to Craig's (1979) tactual data than to Townsend's (1971a, 1971b) visual data.

In a further effort to understand this question, Fisher, Monty, and Glucksberg's (1969) data were also analyzed. Since they used tachistoscopic presentations of capital letters, it seemed plausible that, if they could be compared on some common basis to Townsend's (1971a, 1971b), the results should be similar. The difficulty is that Townsend controlled his average correct recognition to .5, whereas it was .59 and .78 for Fisher et al.'s (1969) two matrices. As an approximation, these two matrices were normalized to .5 by multiplying all main diagonal elements by the appropriate factors (.85 and .64) and proportionally correcting all off-diagonal cells. These reconstructed matrices were then compared to Townsend's (1971a, 1971b), Craig's (1979), and Fisher et al.'s (1969) matrices. The results are summarized in Table 1.

While not totally clear-cut, it appears that the differences between either of the two Fisher et al. (1969) matrices and any one of Townsend's (1971a, 1971b) three matrices are only slightly larger than the differences within either subset, and substantially smaller than the differences between any one of these five and either the Craig (1979) or Gilmore et al. (1979) data.

Mewhort and Dow (1979) point out that Gilmore et al.'s main diagonal vector correlates -.873 with the number of dots used in the representation of each character. They suggest that differential brightness controlled performance, but Gilmore and Herish (1979) reply by pointing out that Mewhort and Dow's (1979) assumption of a slow dot-brightening algorithm is not correct. An alternative explanation,

Table 1
Total Sum Squares Differences Between Pairs of Confusion Matrices Reported in Studies Cited

	Townsend (1971a, 1971b)			Craig (1979)	Gilmore et al. (1979)	Fisher et al. No. 1 (1969)
	av s	MJ	VF			
Townsend's MJ	.667					
Townsend's VF	.911	.820				
Craig	1.969	2.350	2.665			
Gilmore et al.	2.246	2.985	3.052	1.065		
Fisher et al. No. 1	1.086	1.108	1.545	2.562	2.896	
Fisher et al. No. 2	1.393	1.195	1.973	2.526	2.872	.797

both plausible and theoretically intriguing, is that visual presentation of a dot matrix pattern, limited to a 5 by 7 array, does not trigger the neural feature detection networks involved in conventional stroke letter recognition. This does not seem a far-fetched conjecture, since feature detection research has been principally concerned with "edge detection" (cf. Hubel & Wiesel, 1959, 1962; Lettvin, Maturana, McCulloch, & Pitts, 1959). If this conjecture is correct, then visual dot patterns would need to be processed in some alternative fashion, possibly similar to the processing of dot pressure patterns from tactual presentations. While speculative, this idea gains modest support from the fact that Craig's (1979) main diagonal data also correlate highly with the number of pins actuated by his Optacon for each letter, $r = -.84$.¹

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NOTE

1. We are grateful to James C. Craig for providing the pin letter patterns used by him for Optacon presentation of capital letters.

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