

Hydrated halloysite was not found as far as the fifth layer (depth: 225–275 cm), and the sixth layer, the third former surface layer, was the uppermost one containing the mineral. Namely, the hydrated halloysite of this layer is youngest in the profile at Kanoya. However, this layer is beyond the limits of carbon-14 dating, that is, older than 30,000 years. The particles of the mineral are not so different in shape from those of Choyo, and show spherules, curled laths, and short tubes. The particles of Choyo are mostly composed of spherules, while tubes are dominant in the Kanoya mineral. This might explain the metamorphosis of spherules into tubes. Kuwano *et al.*³ considered that the layer belongs to the lower loam of the Pleistocene Epoch. This would mean that it is about 30,000 years old or more and is consistent with the radiocarbon measurements.

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¹ Aomine, S., and Wada, K., *Amer. Min.*, **47**, 1024 (1962).

² Shinagawa, A., *Bull. Fac. Agr. Kagoshima Univ.*, **11**, 155 (1962).

³ Kuwano, Y., Gohara, Y., and Matsui, T., *Misc. Rep. Res. Inst., Natural Resources*, **49**, 59 (1959).

PSYCHOLOGY

Ipsilateral Confusion in 2-Choice and 4-Choice Responses with the Hands and Feet

THE experiments to be described here suggest that confusion occurs between ipsilateral responses in certain choice-reaction tasks. This finding has apparently not been reported before.

In the first of the present 4-choice experiments, the subject responded to a positional display consisting of four neon indicator bulbs set in a black screen so as to form a square 4 in. × 4 in. The subject sat facing the screen, and responded by pressing morse keys with the hands and feet. Details of the apparatus will be given in a later communication. The required response to the top right signal was the right hand, to the bottom right signal the right foot, and similarly on the left side. 45 subjects each responded to 80 signals, 20 for each foot and each hand, presented in a random order. 513 errors were made, giving a total error rate of 14.25 per cent. The distribution of these errors is given in the matrix in Table 1. 98.1 per cent of the errors were ipsilateral (for example, right-hand responding to right foot signal, left foot responding to left-hand signal, etc.). There were no diagonally opposite errors (for example, left foot responding to right-hand signal, etc.).

Two further 4-choice experiments were afterwards carried out with slightly altered displays, one with the signals in the form of a square 1½ in. × 1½ in., and the other

Table 1. ERRORS MADE IN FOUR-CHOICE REACTION TASK WITH HANDS AND FEET

		Errors			
		RH	LH	RF	LF
Correct Response	RH	/	2 (2) 0.2%	105 (42) 11.7%	0
	LH	4 (4) 0.4%	/	0	139 (42) 15.4%
	RF	116 (38) 12.9%	0	/	2 (2) 0.2%
	LF	0	143 (42) 15.9%	2 (2) 0.2%	/

Down the side of the matrix is indicated the correct response. The columns across show the number of errors made to each signal by each of the other limbs. The figures in parentheses give the number of subjects contributing to the total ($N = 45$). Errors are also expressed as percentages of the total number of responses to each signal.

with them in the form of a rectangle, 4 in. (vertical dimension) × 1½ in. In each experiment 13 subjects each responded to 800 signals, 200 for each foot and each hand, presented in a random order. Results were obtained similar to those of the first experiment. With the small square display, in the first half of the experiment (that is, the first 400 responses for each subject), 97.9 per cent of the errors were ipsilateral (total error rate 11.0 per cent), and in the second half 97.1 per cent were ipsilateral (total error rate 11.3 per cent). With the rectangular display, in the first half 97.6 per cent of the errors were ipsilateral (total error rate 9.6 per cent), and in the second half 85.3 per cent were ipsilateral (total error rate 11.9 per cent).

The same predominance of ipsilateral errors occurred again in a further 4-choice experiment, this time with tactile stimuli. The response movements were the same as in the three previous experiments, and tactile stimulation was provided by screws attached by an adjustable extension to the plunger of a solenoid. 12 subjects each responded to 800 signals, as in the second and third experiments. In the first half of the experiment 98.7 per cent of the errors were ipsilateral (total error rate 8.3 per cent); in the second half 85.5 per cent were ipsilateral (total error rate 6.2 per cent).

Two 2-choice experiments were carried out with the original square display (4 in. × 4 in.). Each was in three parts, with the two responses being either ipsilateral, contralateral or diagonally opposite. In the first, one of the two responses was always the right hand, the alternative being the right foot, left hand, or left foot, respectively. In the second, one of the two responses was the left foot and the alternative was the left hand, right foot, or right hand, respectively.

In each part of each experiment six subjects each responded to 300 signals over three sessions. In each session the three parts were presented in a different order. The mean reaction times for both the right hand and the left foot were least when the alternative response was the contralateral limb, and greatest when it was the ipsilateral (Table 2). In both cases analysis of variance showed that the differences were significant ($D < 0.01$). The number of errors was also greatest when the alternative response was ipsilateral.

Table 2. VARIATION IN TWO-CHOICE REACTION TIMES ACCORDING TO ALTERNATIVE RESPONSE

	Alternative response		
	Contralateral (LH)	Diagonally opposite (LF)	Ipsilateral (RF)
Exp. 1			
Group mean right hand RT (ms)	281	290	316
Mean σ	38	42	51
Total errors	14	10	34
Exp. 2			
Group mean left foot RT (ms)	301	320	346
Mean σ	40	45	60
Total errors	18	22	56

These findings indicate confusion between ipsilateral hand and foot responses, leading either to errors between them, or to a lengthened reaction time when distinction between them is required. In the only previous experiment on reaction times that appears to be relevant, Davis¹ found no difference in the mean 2-choice reaction time between a situation in which the responses were made by the two hands, and one in which they were made by two fingers on one hand. This gives a warning against generalizing from the present findings to the conclusion that all ipsilateral responses are liable to be confused.

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¹ Davis, R., *Quart. J. Exp. Psychol.*, **8**, 24 (1956).