reserpine, Smith, Kline and French for chlorpromazine, and Wyeth for meprobamate.

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Intermodality Transfer of Specific Discriminations in the Monkey

WE wish to report evidence that monkeys trained to discriminate between two forms using only tactual cues are affected by such experience when the same forms are presented visually with tactual cues excluded.

Six rhesus monkeys were used in two experiments. All testing was done in a Wisconsin general testing apparatus, with food reward for the correct choice of two objects presented simultaneously. Forty (non-correction) trials were given daily. All objects to be discriminated (cross, square, *S*, etc.) were cut from $\frac{3}{4}$ in. plywood, painted black, and attached to food-well covers. For visual discriminations, transparent plastic cylinders covered the objects; tactual discriminations were performed in the dark with the objects uncovered.

In the first experiment, all monkeys learned to discriminate between 11 pairs of objects, both visually and tactually. Each problem was learned to a criterion of 27 correct responses out of 30. The first pair of objects given to an animal (and the third, fifth, etc., pairs) was learned first visually and then tactually; the even-numbered pairs were learned first tactually and then visually.

Comparisons were made of average performance on tactual problems presented after visual learning of the same objects (transfer problems) with performance on those problems for which tactual learning was the initial experience with the object pair. Neither trials to criterion nor errors in the first 30 trials of each problem disclosed a significant transfer effect. Furthermore, similar analyses of visual-problem performance provided no evidence for tactual-visual transfer.

During the tactual problems animals were observed (with a snooperscope) and it was noted that only rarely did they palpate the full surface of the stimuli before making a choice. Usually some aspect of the near edge of the stimulus, or the distance of some part of it from an exposed edge of the testing board, appeared to be the effective cue; and it is well known that not all aspects of a stimulus object presented visually enter equally into the discrimination which is learned. It is possible that our subjects (and those of other experiments) did not always 'see' the same part or aspect of the object as the part that they 'felt'. Stimulus objects for the second experiment were designed so that there would be more certainty as to the nature of the discrimination being formed.

Pieces of $\frac{3}{4}$ in. plywood, $\frac{3}{8}$ in. in width, and either 1 in. or 2 in. in length, were used. The wooden strips were attached to food-well covers, and were so oriented that they differed in length in the near–far dimension of the animal. Three short stimuli were made, with the near edge of the wooden strip $\frac{1}{4}$ in., $1\frac{1}{4}$ in., or $2\frac{1}{4}$ in. from the near edge of the food-well cover; two long stimuli were made, with the near edge of the strip $\frac{1}{4}$ in. or $1\frac{1}{4}$ in. from the near edge of the cover. On each trial one short and one long stimulus were presented, with balanced series determining the combination to be used and the right–left placement of the positive stimulus.

The subjects were divided randomly into two groups of three monkeys each, which received the sequences of problems shown in Table 1. The first two discriminations were run to a criterion of 38 correct out of 40 trials, plus six consecutive correct trials on each of the six combinations of stimuli. On the day after an animal reached criterion on a problem, 10 additional trials were given on that problem followed immediately by 30 trials on the next problem.

Table 1. SEQUENCE OF LENGTH DISCRIMINATIONS, AND PERFORMANCE ON TRANSFER TESTS

Group	Tactual (1) Positive stimulus	Visual Positive stimulus	Visual Errors in first 30 trials	Tactual (2) Positive stimulus	Tactual (2) Errors in first 30 trials
I	Short	Short	9	Long	28
	Short	Short	13	Long	24
	Short	Short	14	Long	16
II	Long	Short	16	Short	16
	Long	Short	18	Short	20
	Long	Short	21	Short	27
		$P < 0{\cdot}05$		$P > 0{\cdot}05$	

Evidence for intermodality transfer is shown on the first 30 trials of the visual discrimination (Table 1). All animals that had previously learned the same discrimination tactually (Group I) made fewer errors than all animals that had had the opposite tactual discrimination ($t = 3{\cdot}01$, $P < 0{\cdot}05$). Furthermore, the two groups of scores are placed appropriately on either side of the chance value of 15. (The effect is apparently weak in comparison to other influences, for the groups did not differ in trials-to-criterion on the visual task nor on performance on the second tactual task, where the strong intramodal effect of the first tactual task apparently overwhelms any possible intermodal effect.)

We conclude, then, that a specific intermodality transfer effect can be demonstrated if we require that the 'same' discrimination be made in the two modalities. It can be suggested that in our first experiment there were some problems on which individual animals happened to make use of the same cues in the two modalities: each animal met criterion immediately (in the first 30 trials) more frequently on transfer problems than on non-transfer problems—for visual and tactual problems combined, or for tactual problems alone. Perhaps the one monkey of Ettlinger[1] which showed what may have been tactual-visual transfer happened to attend to the same cue in the two modalities.

In this experiment we have studied transfer between touch and vision when the same objects are presented to the two modalities. This must be distinguished from transfer between analogous auditory and visual discriminations[2], evidence for which has come primarily from an experiment[3] the results of which might possibly be explained as due to an even more general effect, the intermodality facilitation of learning sets[4]. These may prove to be three different kinds of transfer in discrimination problems, which must be studied separately.

In any event, a method for demonstrating specific intersensory transfer opens the way to investigations of the role of early sensory experience and of various neural structures in the normal development of such transfer.

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