This is the most complete version of the poster that I have on file (the images are missing due to Macintosh Word issues).

Secondary Generalization, Categorization and Single-feature Reversal

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Generalizing from a partial reversal

Suppose you have learned through experience that the clientele of "Club Palm" are predominately (at least two of) female, young and university educated, whilst at "Club Beach"

the clientele are predominately male, old and without degrees. Later, everyone you now meet at Club Beach turns out to have a university degree, and be an old female or a young male. At Club Palm, the clientele are now old females and young males without degrees. How surprised would you be to meet a young female (with or without a degree) at Club Palm? There are three answers:

1) Not surprised. Young women always used to go to Club Palm and nothing I've seen directly contradicts that.
2) Very surprised. Recent events suggest that the two clubs have reversed clientele.
3) Indifferent. Once Club Palm was full of young university-educated women, but now the only thing that seems to matter is that you left the education system before university. Sex or age no longer matter.

Partial reversal and secondary generalization

Hull (1943) makes a distinction between primary and secondary generalization. Generalization between two stimuli is primary if it occurs as a result of their perceptual similarity. Secondary generalization occurs as a result of a common reinforcement history. If we broaden this definition from "common reinforcement history" to "common category", answer 2 is a case of secondary generalization.

Partial reversal and pigeons

von Fersen & Lea (1990) trained pigeons to discriminate between two sets of 16 slides of naturalistic scenes. The slides had 5 programmed features: One set was predominately (at least 3 of) an office block, far away, shot at an oblique angle, shot from the ground, shot in bright

sunlight. The other set was predominately a pub, close up, horizontal angle, aerial perspective and cloudy.

Once this discrimination had been learned to criterion, one feature-pair (e.g. sunlight-cloudy) was reversed whilst the other four-pairs became indeterminate - each stimulus in this stage contained two positive features and two negative features, plus the reversed feature. 12 of the original 32 slides fitted these conditions

After the single-feature reversal had been learned to criterion, the remainder of the slides (20) were tested in extinction. By comparing the mean response rate for all stimuli containing, say, the pub, with the mean response rate for all stimuli containing the office block, the control this, or any other, non-reversed pair had over responding could be assessed. von Fersen & Lea found that their pigeons did not generalize the reversal of one feature-pair to the other four pairs.

The current experiment attempted to replicate von Fersen & Lea's results in undergraduates.

METHOD

Subjects /Apparatus

25 Cambridge undergraduates were tested on a Risc PC in a quiet cubicle.

Stimuli

Each stimulus was composed of 5 discrete components in a row. Fig. 1 gives an example. Each position in the row contained one of two symbols. From left to right, these were: Question

mark / Exclamation mark, Plus sign / Multiply sign, Up arrow / Down arrow, Triangle / Square, Pound sign / Dollar sign. One symbol in each pair was arbitrarily designated as the “category A” symbol, the other as the “category B” symbol. There are 32 different ways this can be done, and a different, randomly selected, combination was used for each subject. A stimulus containing three or more category A symbols was designated as a category A stimulus, otherwise it was designated as a category B stimulus. Hence, of the 32 different stimuli, 16 were category A and 16 were category B.

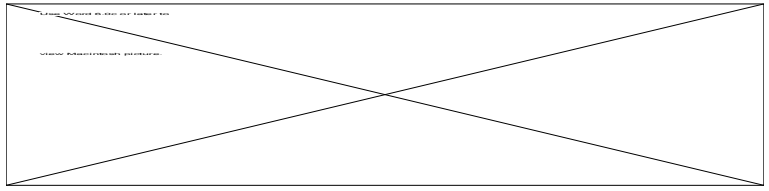


Figure 1: An example stimulus (not to scale - stimuli approximately 8.5 by 1.8cm).

Procedure

Subjects were told that the experiment might take up to four 1-hr sessions, each on a different day. They were also informed that the experiment might only take a single session, and that the number of sessions required depended entirely on their performance.

Stimuli were presented one at a time, and subjects responded by pressing one of two keys. Subjects were given an unlimited amount of time to respond, but after 15 seconds the stimulus was replaced by the message "Please respond now". They were given feedback after each response, and summary feedback (% correct) at the end of each block.

Acquisition phase: In each acquisition block, the 32 different stimuli were each presented once in a random order. The criterion was actually 27 out of 32 (84%) correct. If the subject completed 16 blocks without reaching criterion, the session was terminated and the subject was

asked to return the following day. The acquisition phase continued until the subject had either reached criterion.

Single-feature Reversal phase: For each subject, one feature-pair was designated as the reversed pair such that an equal number of subjects were reversed on each feature-pair. In this phase, only 12 of the 32 stimuli were presented. The 12 stimuli were those that a) contained 2 or 3 category A symbols, and b) whose reversed feature-pair was critical in determining category membership (see Fig. 2 for an example).

		AAAAA		
AAAAb	AAAbA	AAbAA	AbAAA	bAAAA
AAAbb	AAbAb	AbAAb	bAAAb	AAbbA
AbAbA	bAAbA	AbbAA	bAbAA	bbAAA
bbbAA	bbAbA	bAbbA	AbbbA	bbAAb
bAbAb	AbbAb	bAAbb	AbAbb	Aabbb
bbbbA	bbbAb	bbAbb	bAbbb	Abbbb
		bbbbb		

Figure 2: The 32 different stimuli, using "A" to represent a category A symbols and "b" to represent a category B symbols. Stimuli above the line are in one category, below the line they are in the other. The red items are those used in a single-feature reversal of the *leftmost* feature.

A block now consisted of 36 trials - 3 presentations of each of the 12 stimuli in a random order. Feedback was as in the acquisition phase, but reversed. Subjects were trained to criterion, which

was 31 out of 36 correct (86%) in this phase. The change from acquisition to reversal was not explicitly signalled to the subjects.

Generalization phase: The generalization phase was signalled by the statement “From now on, you will not be told whether your responses are right or wrong”. There were two blocks of generalization. In each block, the remainder of the stimulus set (20 stimuli - the full set of 32 minus the 12 reversal stimuli) were presented sequentially and in a random order.

RESULTS

All subjects reached criterion in both the acquisition and reversal phases. Subjects took a mean of 1.4 sessions to complete the experiment, 12.5 blocks to reach criterion in acquisition and 3.2 blocks to reach criterion in the reversal phase.

Dependent measure

The critical issue is whether subjects generalized the single-feature reversal to other feature-pairs. In order to assess this, we devised an index of feature control. The index is based on whether responses to a generalization stimulus are reversed or non-reversed with respect to the original (acquisition phase) category membership. It is calculated separately for each feature-pair on the basis of whether *that feature* was originally a category A symbol or a category B symbol. For example, if the triangle was originally category A and the square category B, then each "category A" response to stimuli containing squares would count as a reversed response for the square-triangle feature pair. Formally, $x_n = (UR_n - R_n) / 20$, where x_n is the index of feature control for feature-pair n, UR_n is the number of non-reversed responses on the above criterion, and R_n the number of reversed responses on the same criterion. The index ranges from +0.6 to -0.6, negative values indicating reversal. The mean of the four scores for the four non-reversed features was the dependent measure of this experiment. The index for the reversed

feature is not presented because the generalization phase specifically excludes stimuli where the reversed feature is critical. This means that the index for the reversed feature-pair would be artifactually deflated with respect to the non-reversed feature-pairs.

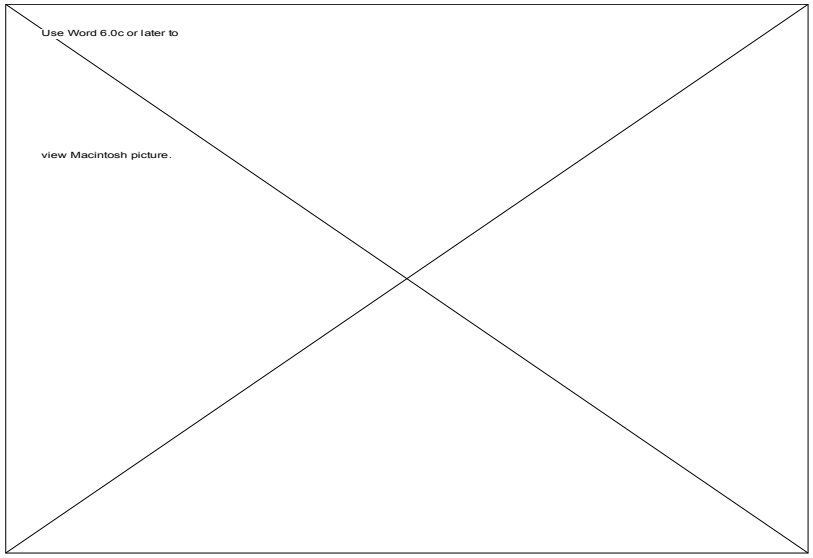
The mean index for the non-reversed features was -0.l8 in block 1 and -0.15 in block 2. The block 1 score was significantly different from zero, , t(24) = 2.3, p < 0.05. The block 2 score was only marginally significantly different from zero, t(24) = 1.8, p = 0.08.

There was no significant effect of block on the index, F(1,20) < 1, and no significant effect of which feature-pair was reversed, F(4,20)=2.1, or any significant interaction between reversed feature-pair and block, F(4,20) = 1.3.

DISCUSSION

Our subjects generalized the reversal of a single-feature pair to other, non-reversed feature-pairs. This result seems difficult to explain solely in terms of selective attention. Subjects must distribute their attention across the five feature-pairs to perform well in the acquisition phase. Perfect performance could be achieved in the reversal phase by attending to just the reversed feature, but this should lead to positive or zero feature control scores for the non-reversed features.

In contrast, the results could be explained by postulating a two-layer associative system where pre-existing stimulus->category associations are hard to change, but pre-existing category->response associations are easy to change. Although the



terminology is different, the idea basically corresponds to Hull's mechanism of secondary generalization.

References

Hull, C. L. (1943). *Principles of behavior*. New York: Appelton-Century-Crofts.

von Fersen, L., & Lea, S. E. G. (1990). Category discrimination by pigeons using five polymorphous features. *Journal of the Experimental Analysis of Behavior, 54*(2), 69-84.