Asymptotic Predictions of the Pearce-Model for Negative Patterning and for a Biconditional Discrimination

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According to Pearce's (1987; 1994) configural theory, presentation of a stimulus *i* activates both its specific configural unit as well as the configural units of similar stimuli. The overall activation V_i of the US representation in a trial is then determined by the aggregate associative strength of all the configural units that are activated:

$$V_i = E_i + e_i. \tag{1}$$

In Equation 1, E_i is the associative strength of the configural unit that corresponds to stimulus *i* and e_i is the summed associative strength that generalizes to *i* from similar stimuli. e_i is given by

$$e_i = \sum_{j=1}^{n} {}_iS_j \times E_j \,, \tag{2}$$

where E_j is the associative strength of a configural unit of another stimulus *j* that is activated because of the similarity ${}_iS_j$ between stimuli *i* and *j*. This similarity in turn depends on the number of identical components shared between *i* and *j* (at least as long as these

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components have the same salience). In his applications of the model, Pearce (1987, 1994) assumes that this similarity is given by

$$ {}_{i}S_{j} = \frac{N_c}{N_i} + \frac{N_c}{N_j}, \qquad (3) $$

where N_c is the number of common elements between stimuli i and j, N_i is the number of elements in stimulus i, and N_j the number of elements in stimulus j. The similarity between A and AB would, for example, be (1/1) × (1/2) = 0.5 according to Equation 3 and the similarity between the compounds AB and BC would be (1/2) × (1/2) = 0.25.

Asymptotic Predictions for a Negative Patterning Task

In a negative patterning task, an A+, B+, AB- discrimination has to be learned. At asymptote, A and B should both activate the US representation with values of 100 for V_{A} and V_{B} and the compound AB should not activate the US representation at all, so that V_{AB} should be 0. Together with ${}_{\mathrm{A}}S_{\mathrm{AB}} = {}_{\mathrm{B}}S_{\mathrm{AB}} = 0.5$ this yields:

$$ V_{\mathrm{A}} = V_{\mathrm{B}} = E_{\mathrm{A}} + 0.5E_{\mathrm{AB}} = E_{\mathrm{B}} + 0.5E_{\mathrm{AB}} = 100 \qquad (4) $$

$$ \therefore\ E_{\mathrm{A}} = E_{\mathrm{B}} = 100 - 0.5E_{\mathrm{AB}}. $$

Inserting this term for E_{A} and for E_{B} in the equation for AB leads to:

$$ V_{\mathrm{AB}} = E_{\mathrm{AB}} + 0.5(100 - 0.5E_{\mathrm{AB}}) + 0.5(100 - 0.5E_{\mathrm{AB}}) = 0 \qquad (5) $$

$$ \therefore\ E_{\mathrm{AB}} + 100 - 0.5E_{\mathrm{AB}} = 0 $$

$$ \therefore\ E_{\mathrm{AB}} = -200 $$

$$ \therefore\ E_{\mathrm{A}} = E_{\mathrm{B}} = 100 - [0.5 \times (-200)] = 200. $$

When one compares the asymptotic associative strengths E_{AB} for the reinforced compound and E_A and E_B for the nonreinforced elements, then their difference is 400.

Asymptotic Predictions for a Biconditional Discrimination

In a biconditional discrimination, an AB+, BC-, CD+, DA- discrimination has to be learned. At asymptote, the compounds AB and CD should both activate the US representation with values of 100 for V_{AB} and V_{CD} and the compounds BC and DA should not activate the US representation at all, so that V_{BC} and V_{DA} should both be 0. As the similarity ${}_iS_j$ is 0.25 for each pair of compounds that share one component it follows that

$$V_{AB} = V_{CD} = E_{AB} + 0.25E_{BC} + 0.25E_{DA} = 100 \quad (6)$$

and

$$V_{BC} = V_{DA} = E_{BC} + 0.25E_{AB} + 0.25E_{CD} = 0. \quad (7)$$

Since $E_{BC} = E_{DA}$, Equation 6 becomes

$$E_{AB} + 0.5E_{BC} = 100. \quad (8)$$

Similarly, as $E_{AB} = E_{CD}$ rearrangement of Equation 7 leads to

$$E_{BC} = -0.5E_{AB}. \quad (9)$$

Insertion of E_{BC} in Equation 8 then yields the asymptotic associative strengths of E_{AB} and E_{CD}:

$$E_{AB} + 0.5(-0.5E_{AB}) = 100 \quad (10)$$

$$\therefore E_{AB} - 0.25E_{AB} = 100$$

$$\therefore E_{AB} = 133.3$$

$$\therefore E_{CD} = 133.3.$$

Insertion of E_{AB} and E_{CD} in Equation 9 then leads to the asymptotic associative strengths of E_{BC} and E_{DA}:

$$E_{BC} = E_{DA} = -0.5E_{AB} = -66.7. \quad (11)$$

When one compares the asymptotic associative strengths E_{AB} and E_{CD} of the reinforced compounds with those of the nonreinforced compounds, E_{BC} and E_{DA}, then their difference is 200, only half of the difference that resulted for negative patterning.

References

Pearce, J. M. (1987). A model for stimulus generalization in Pavlovian conditioning. *Psychological Review, 94*, 61-73.

Pearce, J. M. (1994). Similarity and discrimination: A selective review and a connectionist model. *Psychological Review, 101*, 587-607.