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:

$$V_i = E_i + e_i.$$  \hfill (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

$$e_i = \sum_{j=1}^{n} S_j \times E_j,$$ \hfill (2)

where $E_j$ is the associative strength of a configural unit of another stimulus $j$ that is activated because of the similarity $S_j$ 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

\[ S_j = \frac{N_c}{N_i} + \frac{N_c}{N_j}, \]  

(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 \((1/1) \times (1/2) = 0.5\) according to Equation 3 and the similarity between the compounds AB and BC would be \((1/2) \times (1/2) = 0.25\).

**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 \( A S_{AB} = B S_{AB} = 0.5 \) this yields:

\[ V_A = V_B = E_A + 0.5E_{AB} = E_B + 0.5E_{AB} = 100 \]  

\[ \therefore E_A = E_B = 100 - 0.5E_{AB}. \]  

Inserting this term for \( E_A \) and for \( E_B \) in the equation for AB leads to:

\[ V_{AB} = E_{AB} + 0.5(100 - 0.5E_{AB}) + 0.5(100 - 0.5E_{AB}) = 0 \]  

\[ \therefore E_{AB} + 100 - 0.5E_{AB} = 0 \]  

\[ \therefore E_{AB} = -200 \]  

\[ \therefore E_A = E_B = 100 - [0.5 \times (-200)] = 200. \]
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 $S_j$ 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 $E_{CD}$:

\[ E_{AB} + 0.5(-0.5E_{AB}) = 100 \]  \hspace{1cm} (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 $E_{DA}$:

\[ E_{BC} = E_{DA} = -0.5E_{AB} = -66.7. \]  \hspace{1cm} (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
