Supplement to "Evidence for Discrete-State Processing in Perceptual Word Identification"

August 7, 2013

1 Specification of Models for the Two-Alternative Confidence Ratings Task

For the purposes of analysis, continuous confidence ratings were binned into 8 discrete bins. The following is for the 2A-CR task. Let p_{ijk} be the probability that the confidence rating is in the kth bin ($k = 1, \dots, 8$) for the ith strength condition ($i = 1, \dots, 4$) when the target is on the jth side (1 = target on left, 2 = target on right).

The discrete-state model is

$$p_{ijk} = d_{ij} a_{jk} + (1 - d_{ij}) g_k, \qquad (1)$$

where d_{ij} is the probability of detection for the ith target level presented on the jth side, and g_k is the probability of endorsing a rating in the kth bin conditional on guessing.

Let $i = 1$ denote the 0 ms guessing condition and note that $d_{11} = d_{12} = 0$, that is, there is no detection when the stimulus was not flashed. We do not allow wrong-side confidence ratings, and this is achieved by setting $a_{15} = \dots = a_{18} = 0$ and $a_{21} = \dots = a_{24} = 0$. In the data, there is a fair amount of symmetry, and we allow $d_{i1} = d_{i2}$. Additional symmetry is imposed by setting $a_{11} = a_{28}$, $a_{12} = a_{27}$, $a_{13} = a_{26}$, and $a_{14} = a_{25}$. Finally symmetry in guessing up to one bias parameter was imposed by setting $g_1 = \beta g_8$, $g_2 = \beta g_7$, $g_3 = \beta g_6$ and $g_4 = \beta g_5$. There are natural sums-to-zero constraints in the model such that only three a parameters and three g parameters are needed. Added to these six are the three detection parameters (d_2, d_3, d_4) and the bias parameter β for a grand total of 10 parameters. The discrete-state model is depicted in Figure **??**.

A comparable 10-parameter equal-variance signal detection model is constructed by assuming seven criteria to produce the 8 categories. There are three additional d' parameters, one for each strength condition ($d' = 0$ in the 0 ms guessing condition). The same symmetry assumptions on confidence ratings were implemented in the latent-strength model.

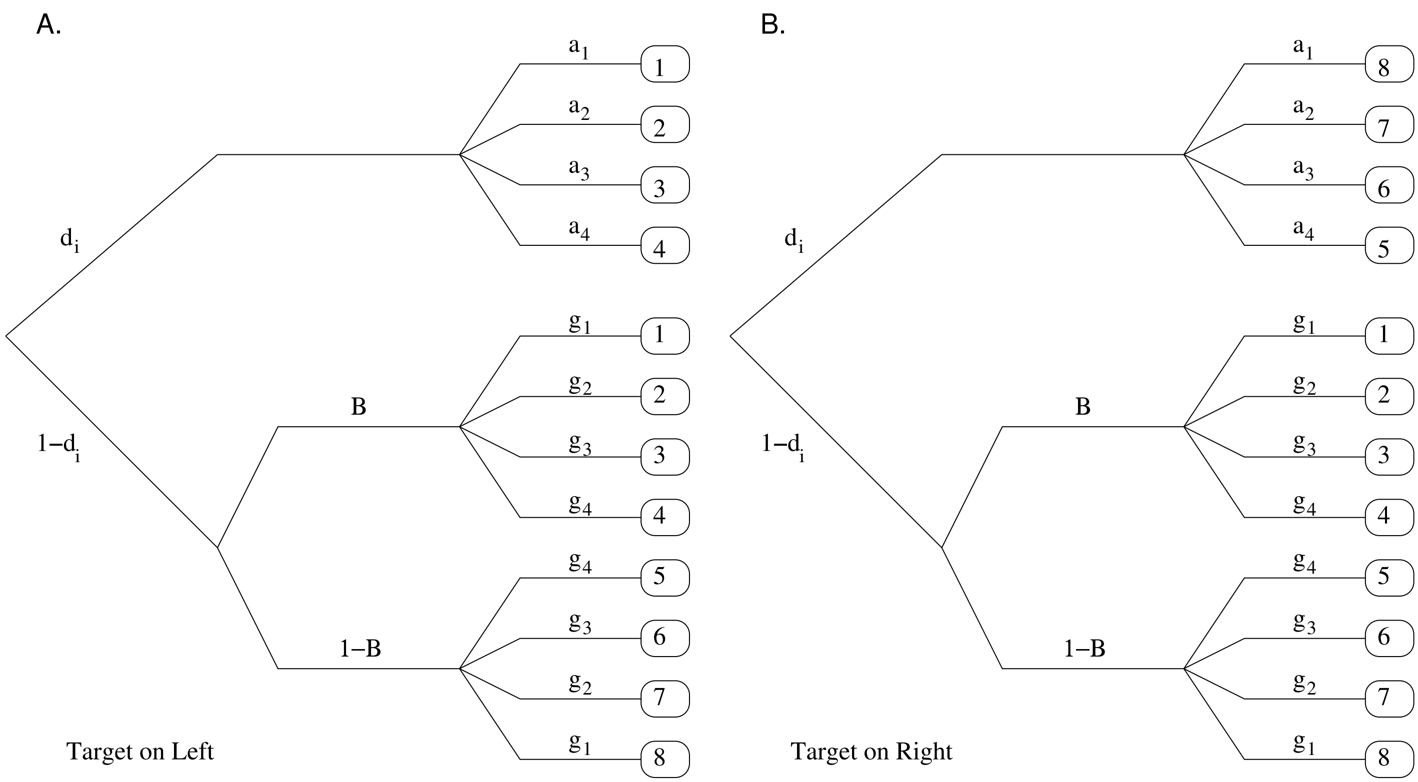

Figure 1: Ten-parameter discrete-state model for the 2A-CR task. The numbers 1 to 8 represent confidence ratings from sure left to sure right, respectively. **A.** Model given target was presented on left. **B.** Model given target was presented on right.

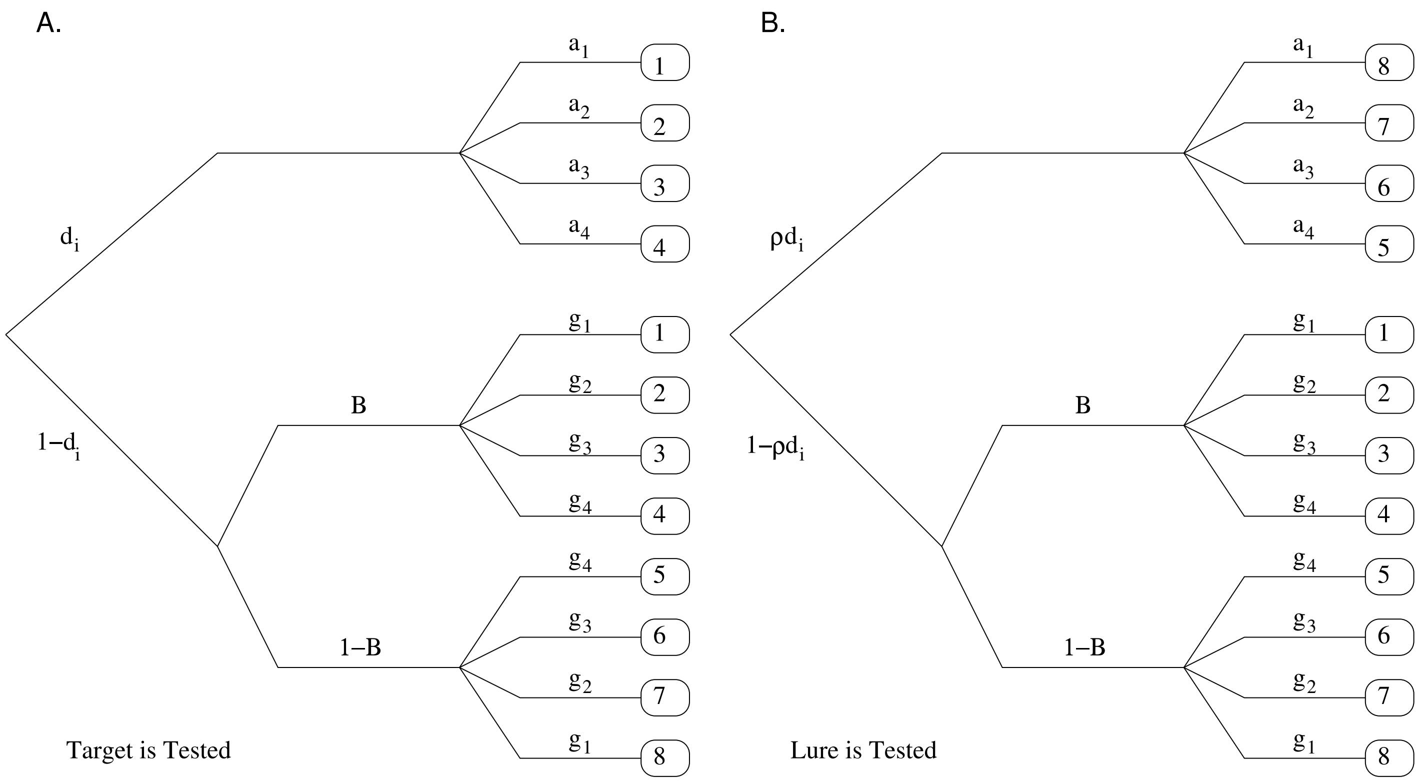

Figure 2: Eleven-parameter discrete-state model for the YN-CR task. The numbers 1 to 8 represent confidence ratings from sure target to sure lure, respectively. **A.** Model given the target was presented (same as previous ten-parameter model). **B.** Model given lure was presented.

2 Specification of Models for the Yes/No Confidence Ratings Task

Although it would seem desirable to model YN-CR data with the same models as 2A-CR, the data from these tasks differ substantially. In particular, while data in 2A-CR look symmetric for targets on the left and right, data from YN-CR do not display a comparable symmetry for target and lure items. We found participants were systematically less likely to respond with high confidence for lures than for targets. We responded to this asymmetry by multiplying the probability of detection on lure trials by a new parameter, ρ, constrained by $0 < \rho < 1$. When the target is tested, $\rho = 1$. For example, the probability a participant detected a target as old in the easiest condition is d_4, but the probability the participant detected a lure as new in the same easy condition is $\rho\ d_4$. The 11-parameter discrete-state model is pictured in Figure **??**.

Again a comparable 11-parameter equal-variance signal detection model was constructed by assuming the same seven criteria, three d' parameters, and the additional ρ parameter which was multiplied by d' for responses to lure trials.