Supplementary materials for *A computational evaluation of two models of retrieval processes in sentence processing in aphasia*

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Prior distributions

Figures 1 and 2 display the prior distributions of the main parameters of the activation-based and the direct-access model, respectively. We randomly generated 10000 data points using the values of the prior distributions specified for each one of the parameters and plotted them.

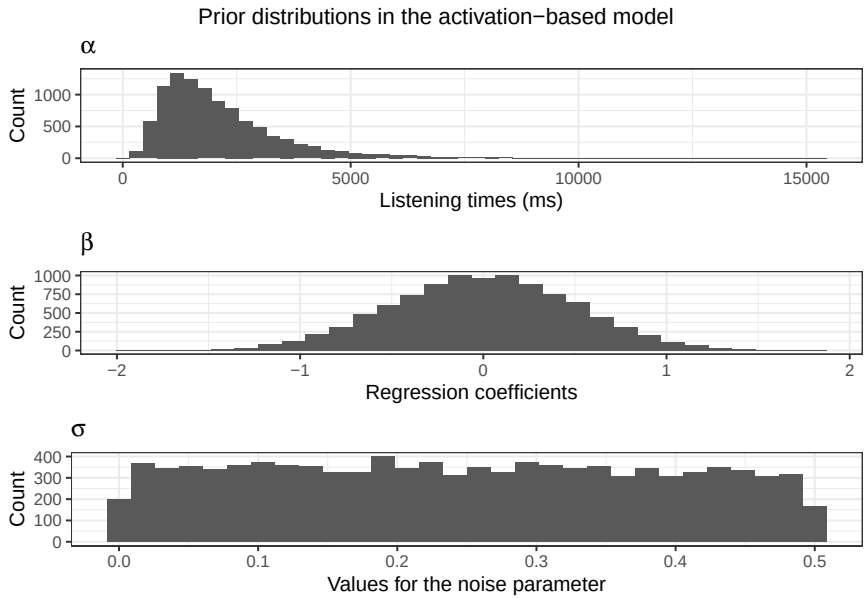

Figure 1. Histograms depicting the prior distribution of the main parameters of the activation-based model. The histograms show the distribution of 10000 data points that were randomly generated using the priors specified in the model for each parameter.

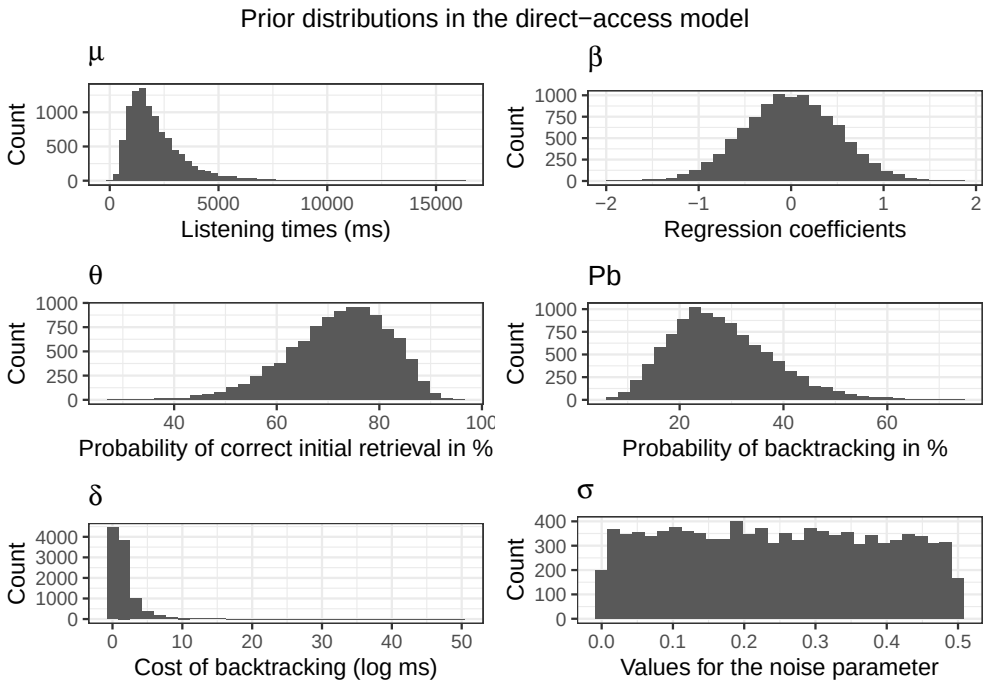

Figure 2. Histograms depicting the prior distribution of the main parameters of the direct-access model. The histograms show the distribution of 10000 data points that were randomly generated using the priors specified in the model for each parameter.

Aggregated total listening times

A reviewer pointed out that the results of the analysis and the modeling may be different when considering all the sentence regions. In the following plot we present the estimated effects of a Bayesian model that is identical to the one explained in the main text of the paper. However, whereas in the main text the dependent measure of the analysis was the listening times at the critical region, here the dependent measure is the aggregated listening times of all the sentence regions plus the reaction times of the picture-selection accuracy.

The estimates show that the effects have the same direction than the effects found in the model of the critical region. However, the magnitudes of the effects are larger in this model. Effect of condition: 989 ms CrI: [732, 1258], group: 3599 ms CrI: [2364, 4944], and

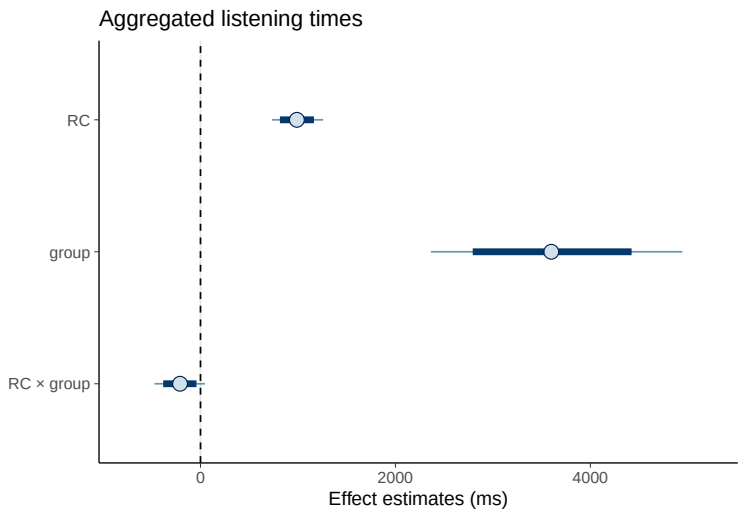

Figure 3. Posterior probability distributions of the different effect sizes for the effect of group (controls/IWA), condition (SR/OR), and their interaction. The dot corresponds to the mean of the distribution, the thick lines are 80% credible intervals, and the thin lines show 95% credible intervals. The dashed line stands for an effect size of zero.

their interaction: -210 ms CrI: [-472, 45]. Regarding model comparisons, the cross-validation results yielded an $\widehat{elpd}$ difference of 138.13 (SE = 67) in favor of the activation-based model. The results of this cross-validation confirm that the activation-based model outperforms the direct-access model, even when considering the listening times of the complete sentence plus the reaction times of the picture-selection task.

Recovery of the parameters

We present the recovery of the parameters of each model. First, we extract the parameter estimates of the model and use these values to generate a simulated dataset. Second, we fit the same model to its corresponding simulated data. Third, we assess graphically the scaled discrepancies between the posterior estimates of the two models: If 0 is within the 95% credible interval of the posteriors of the model fitted to the simulated data, the model is considered to be capable of recovering its parameter values. Figures 4, and 5 show the scaled discrepancies for the activation-based and the direct-access model,

respectively. Both models successfully recover their parameters, as the 95% posterior intervals of nearly all the parameters include 0.

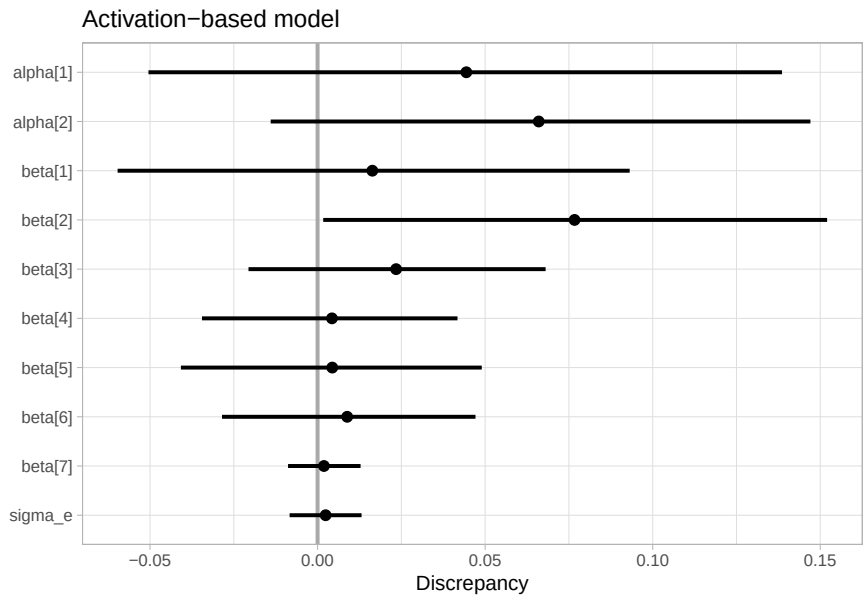

Figure 4. Scaled discrepancies between the estimated and the true values of the parameters of the direct-access model. The true value of a parameter is the value that has been used to generate the simulated data. The y-axis displays the model parameters, and the x-axis their scaled estimated value. Black points stand for the scaled difference between the posterior mean and its corresponding true value. The black lines are the 95% posterior intervals for this difference. If the black dot of a given parameter is at 0, or its corresponding 95% interval includes 0, the model can successfully recover that parameter.

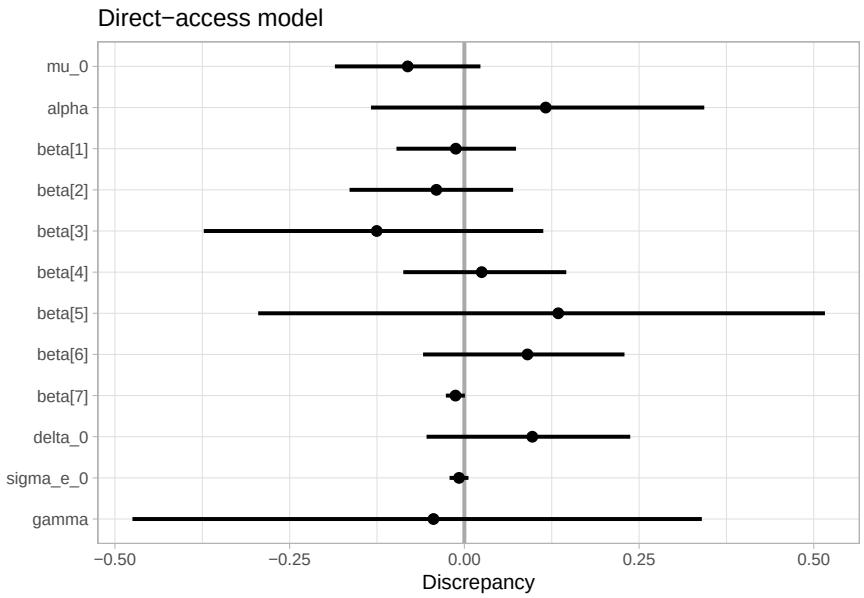

Figure 5. Scaled discrepancies between the estimated and the true values of the parameters of the direct-access model. The true value of a parameter is the value that has been used to generate the simulated data. The y-axis displays the model parameters, and the x-axis their scaled estimated value. Black points stand for the scaled difference between the posterior mean and its corresponding true value. The black lines are the 95% posterior intervals for this difference. If the black dot of a given parameter is at 0, or its corresponding 95% interval includes 0, the model can successfully recover that parameter.

Bayes factors

Table 1

BF for the μ parameter in the activation-based model. M0 assumes no effect of group and no interaction group $\times$ condition. M1 has a β for the group effect, and a β for the interaction. The first two columns indicate the priors used for these two β in M1, and the third column shows the corresponding BF_{10}.

Group prior sd	Interaction prior sd	BF_{10}
0.1	0.1	0.6
0.1	0.3	0.7
0.1	0.5	0.3
0.3	0.1	1
0.3	0.3	1.1
0.3	0.5	0.5
0.5	0.1	0.5
0.5	0.3	0.5
0.5	0.5	0.4

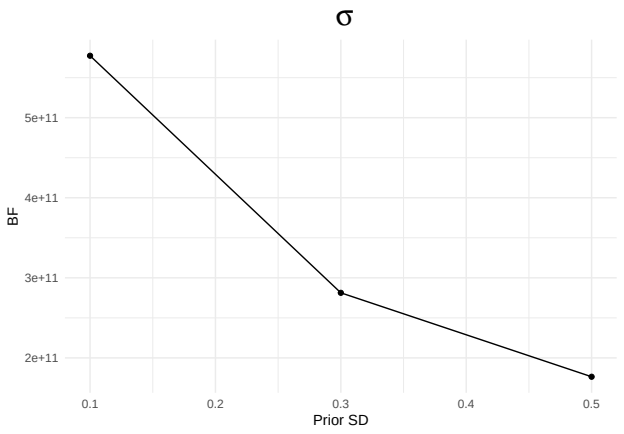

Figure 6. This figure shows the BF_{10} as a function of the prior SD of the group β for the σ parameter in the activation-based model. The BF are well above 100, meaning that there is extreme evidence in favor of M1.

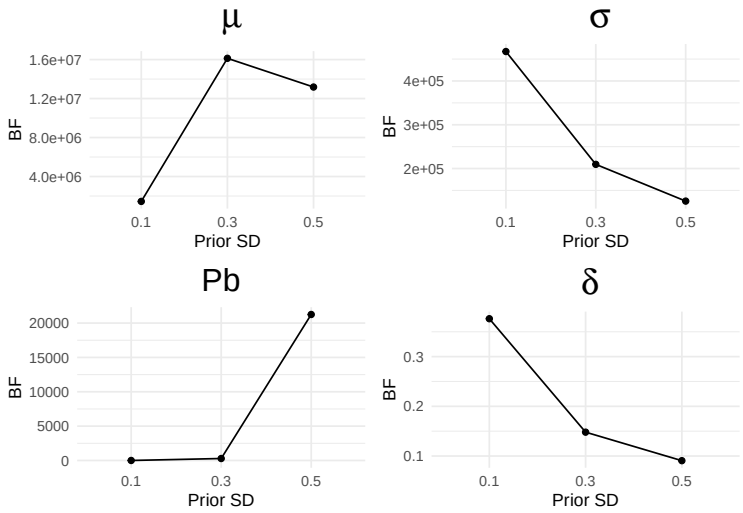

Figure 7. These plots show the BF_{10} for the parameters μ, Pb, δ, and σ as a function of the prior SD of the group β in the direct-access model. BF values under 1 yield evidence in favor of M0, whereas BF over 1 yield evidence in favor of M1.

Table 2

BF for the θ parameter in the direct-access model. M0 assumes no effect of group and no interaction group $\times$ condition. M1 has a β for the group effect, and a β for the interaction. The first two columns indicate the priors used for these two β in M1, and the third column shows the corresponding BF_{10}.

Group prior sd	Interaction prior sd	BF_{10}
0.1	0.1	171
0.1	0.3	171
0.1	0.5	971
0.3	0.1	240
0.3	0.3	446
0.3	0.5	787
0.5	0.1	221
0.5	0.3	690
0.5	0.5	584