Supplementary Materials for

A Cognitive Model of the Response Omissions in Distraction Paradigms

Detection Task

Priors

Priors for all parameters were normal distributions (or all mean rate parameters and contaminant probability estimated on a probit scale) or truncated normal distributions for start-point variability, threshold and rate standard deviation parameters (truncated below by zero) and for non-decision time parameters (truncated below by 0.1s and above by 1s).

Prior means and standard deviation for start-point variability and threshold parameters were 1 and 2. Prior means matching accumulator rate means were 2 and for mismatching accumulators 1, with prior standard deviations of 2. Prior rate standard deviations had a prior mean of 1 and a standard deviation of 2. Prior means for non-decision time were 0.3s with a standard deviation of 2s. Contaminant probability had a mean of zero and a standard deviation of 1 on the probit scale (and so was uniform on the probability scale).

Supplementary Detection Plots

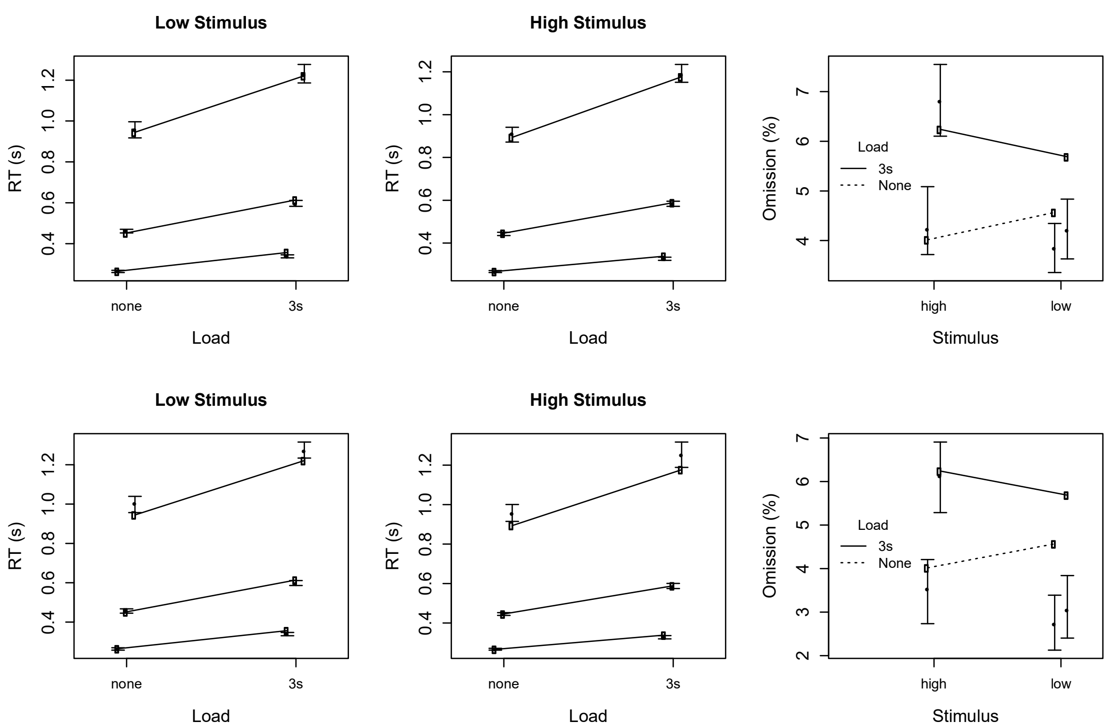

Figure S1. Fits of the LBAO model with a positive rate distribution (upper row) and with no contaminant omissions (lower row). The left and middle columns show the RT distributions, where the lower, middle, and upper points and lines show the 10th, 50th, and 90th percentiles, respectively. The right column shows the omission percentages. Data are shown with open symbols and model fits as posterior predictive medians with solid points and 95% credible intervals (i.e., from the 2.5th to the 97.5th percentiles of the posterior predictive distribution). Load conditions: none and 3s (i.e., count backwards by 3s).

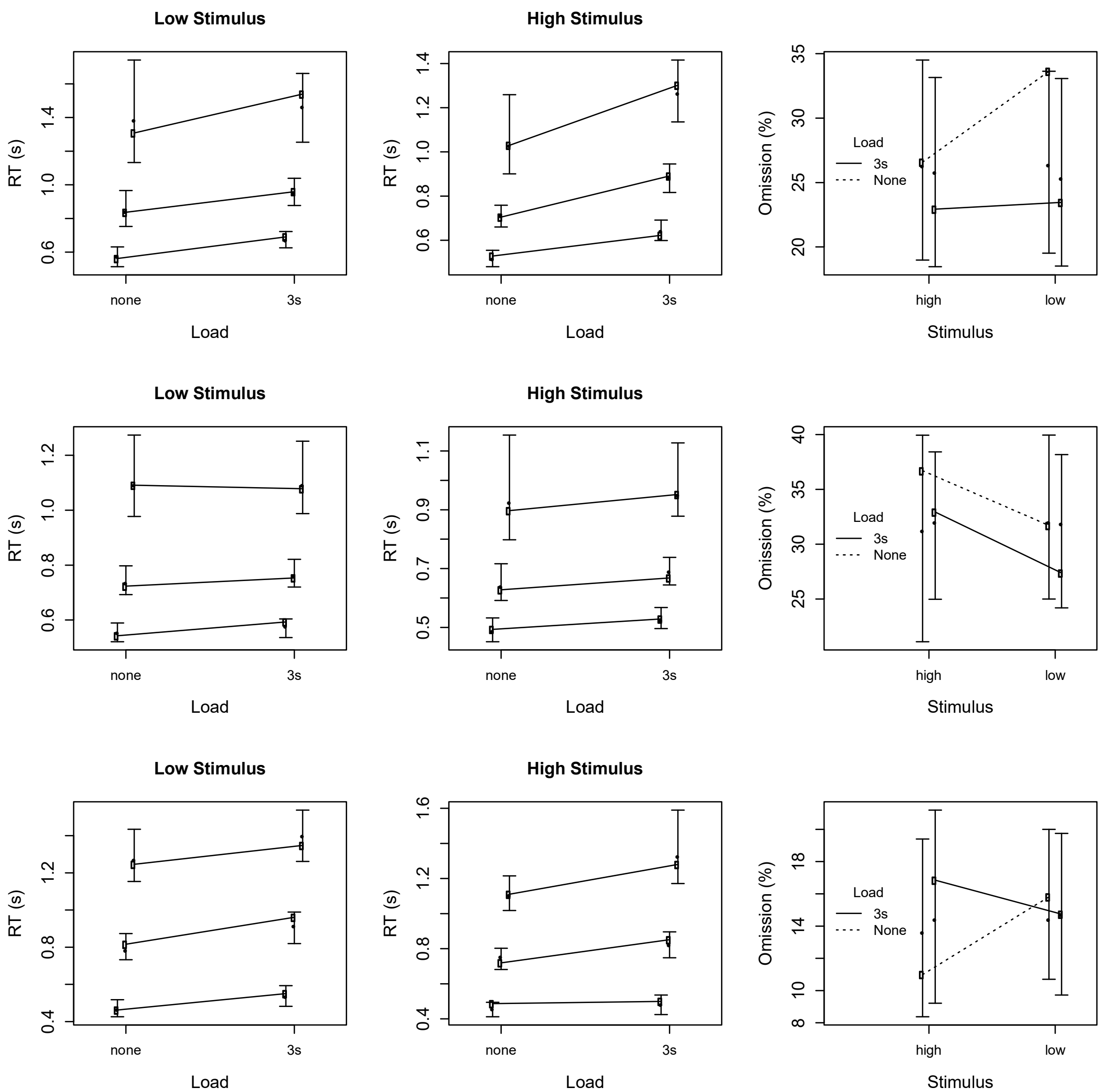

Figure S2. Fits of the model selected in Table 1 to three participants with high omission rates. See Figure S1 for definitions of figure components. The left and middle columns show the RT distributions, where the lower, middle, and upper points and lines show the 10th, 50th, and 90th percentiles, respectively. The right column shows the omission percentages. Data are shown with open symbols and model fits as posterior predictive medians with solid points and 95% credible intervals (i.e., from the 2.5th to the 97.5th percentiles of the posterior predictive distribution). Load conditions: none and 3s (i.e., count backwards by 3s).

Choice Task

Priors

Priors for all parameters were normal distributions (or all mean rate parameters and contaminant probability estimated on a probit scale) or truncated normal distributions for start-point variability, threshold and rate standard deviation parameters (truncated below by zero) and for non-decision time parameters (truncated below by 0.1s and above by 1s).

Prior means and standard deviation for start-point variability and threshold parameters were 1 and 3. Prior means matching accumulator rate means were 2 and for mismatching accumulators 1, with prior standard deviations of 3. Prior rate standard deviations had a prior mean of 1 and a standard deviation of 3. Prior means for non-decision time were 0.3s with a standard deviation of 0.25s. Contaminant probability had a mean of zero and a standard deviation of 1 on the probit scale (and so was uniform on the probability scale).

Supplementary Choice Plots

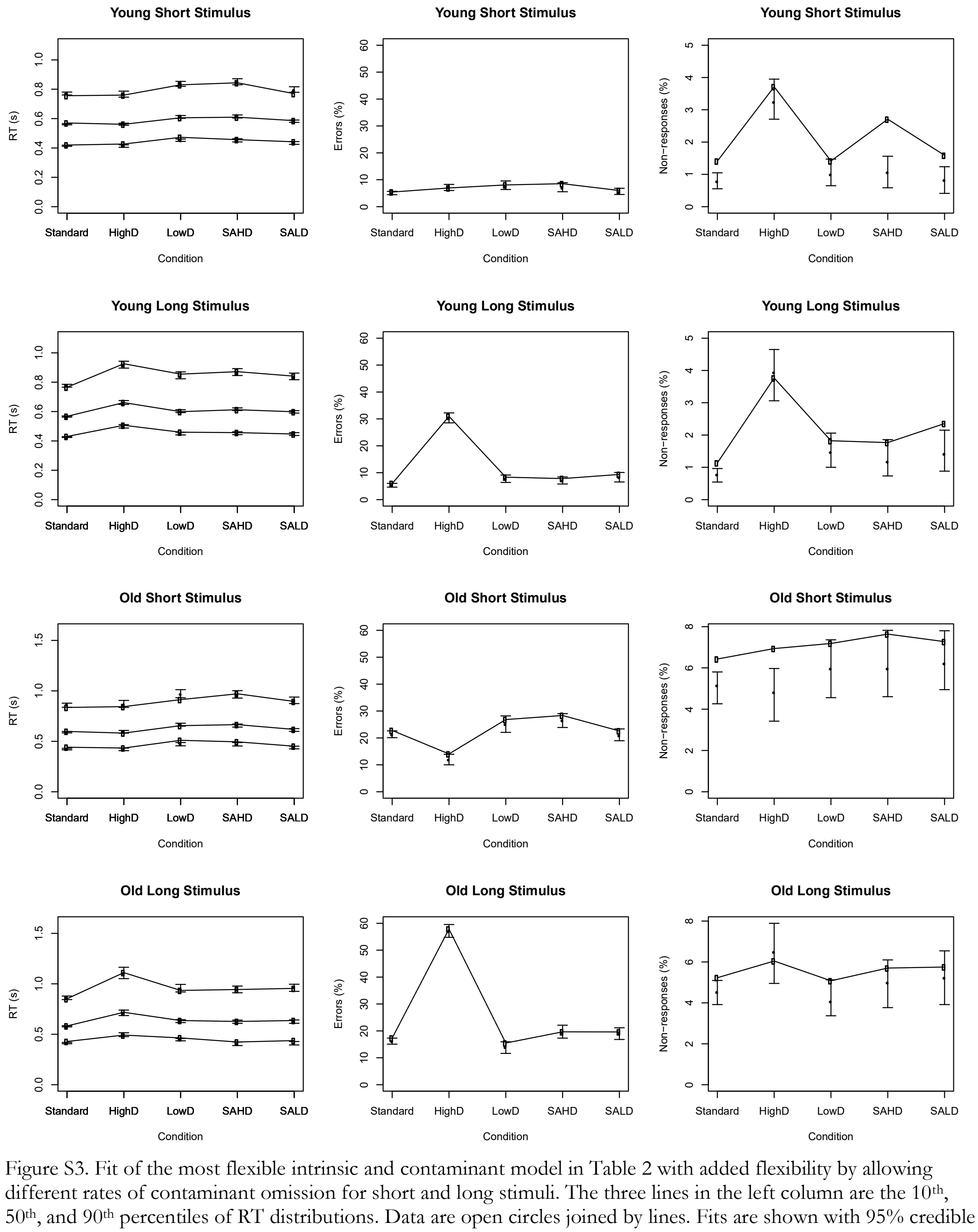

Figure S3. Fit of the most flexible intrinsic and contaminant model in Table 2 with added flexibility by allowing different rates of contaminant omission for short and long stimuli. The three lines in the left column are the 10th, 50th, and 90th percentiles of RT distributions. Data are open circles joined by lines. Fits are shown with 95% credible intervals. HighD = High Deviant, LowD = Low Deviant, SAHD = Standard After High Deviant, SALD = standard after low deviant.

Parameter Estimates

Older participants had greater start-point noise (posterior median = 1.59, 95% credible interval [1.51,1.68]) than younger participants (1.0 [0.95,1.06]). Younger participants had a slightly greater non-decision time (0.147s [0.142,0.153]) than younger participants (0.128s [0.124,0.133]).

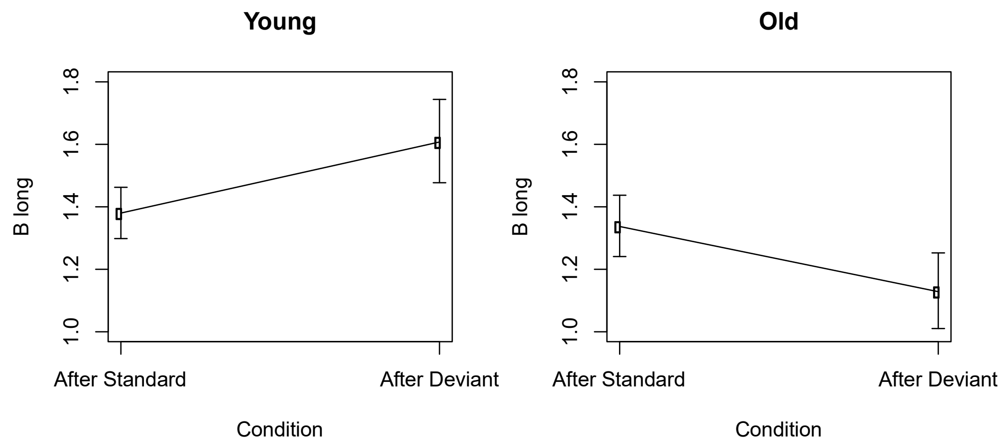

Figure S4. The difference between thresholds (*b*) and the range of start point noise (*A*, i.e., $B = b\text{-}A$) with 95% credible intervals for the long-response accumulator on trials after a standard and after a deviant. Note that $B = 1$ for the short-response accumulator.

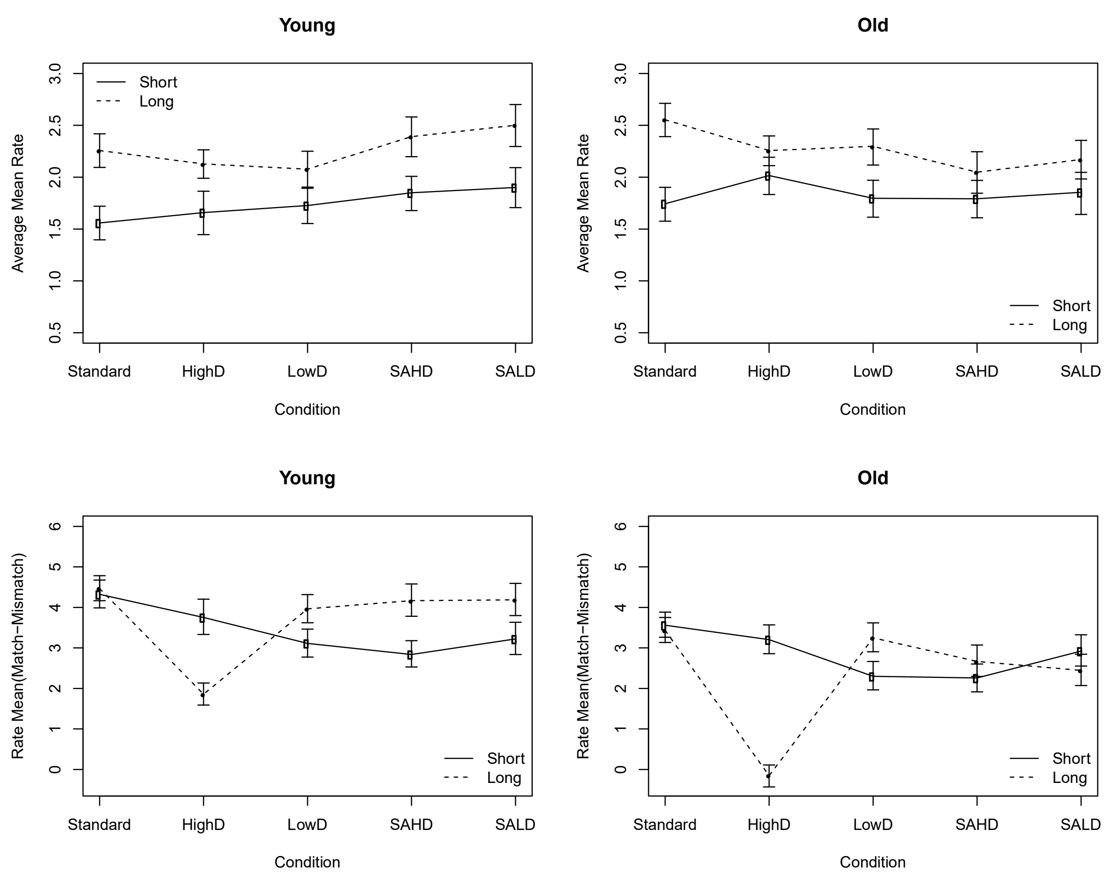

Figure S5. Mean rate estimates with 95% credible intervals for the most flexible intrinsic and contaminant model in Table 2. The first row shows the average over matching and mismatching accumulators and the second the difference. HighD = High Deviant, LowD = Low Deviant, SAHD = Standard After High Deviant, SALD = standard after low deviant.

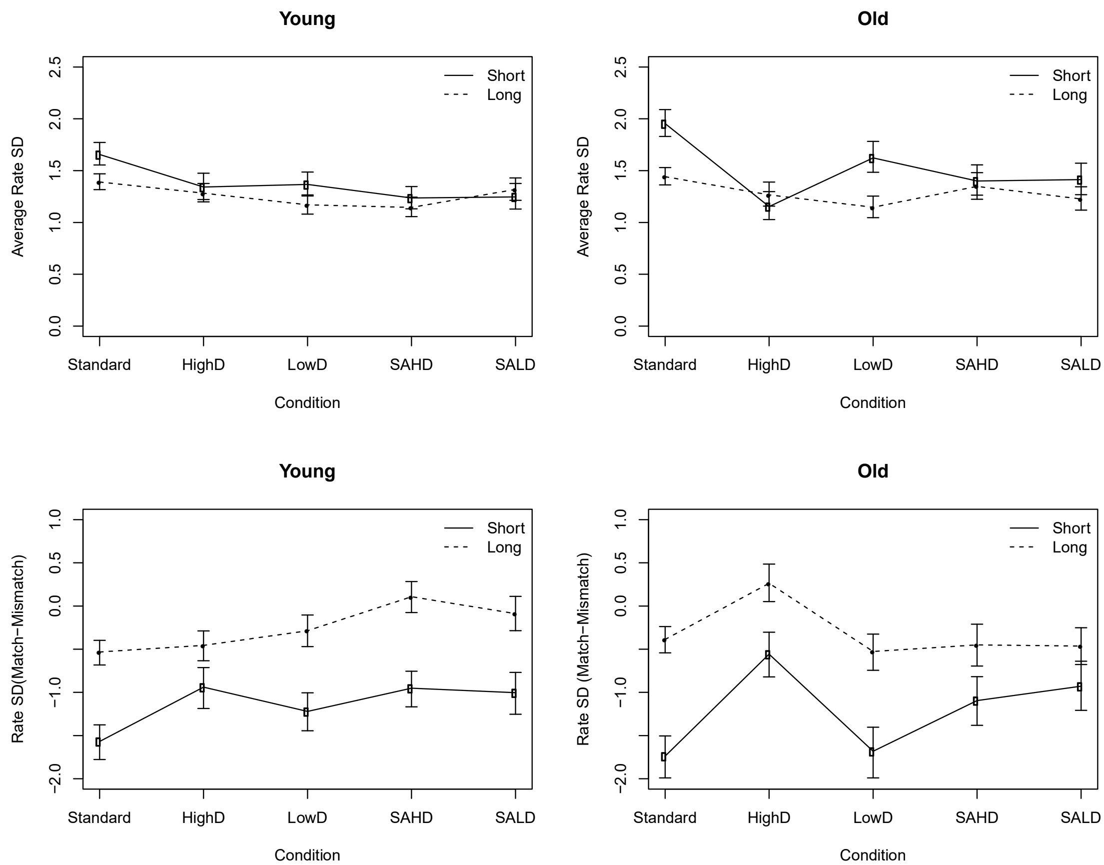

Figure S6. Rate standard deviation estimates with 95% credible intervals for the most flexible intrinsic and contaminant model in Table 2. The first row shows the average over matching and mismatching accumulators and the second the difference. HighD = High Deviant, LowD = Low Deviant, SAHD = Standard After High Deviant, SALD = standard after low deviant.

Parameter-Recovery Studies

Methods

For each participant in each task, we generated 100 replicated data sets using the same experimental design (including the number of trials per cell of the design) as reported in the main text and the median of the posterior distribution of the participant-level parameters from the selected model (v, sv, t_{er}) detection model, and the full omission model for the choice data (with only on contaminant omission) as true data-generating values. We then fit each replicated data set with the selected model using the same procedures and prior distributions we used for the main analyses (see LBAO.R file at https://osf.io/hb4dw/).

For each parameter set in each task we then compared the standard LBA parameter estimates and estimates of the various omission parameters to the data-generating values. The posterior distribution of contaminant omissions was directly estimated (see Castro et al., 2019; Matzke et al., 2019). The posterior distribution of the design and intrinsic omission parameters was computed using samples from the posterior distribution of the standard LBA parameters using the equations presented in the main text, where the number of posterior samples equalled 20 x the number of MCMC chains x number of model parameters. For the distraction paradigm, the probability of design and intrinsic omissions was averaged over correct and error responses weighted by the probability of each type of response.

Results

The results of the parameter-recovery studies are shown in the following files at https://osf.io/hb4dw/:

detectionResponseTask.LBAparameters.pdf (standard LBA parameters) and detectionResponseTask.omissions.pdf (omission parameters on probability scale) for the detection response task and in distractionParadigm.LBAparameters.pdf and distractionParadigm.omissions.pdf for the distraction paradigm (see parameterRecoveries.zip).

The figures show scatterplots between the data-generating values (x-axis) and the corresponding estimates (y-axis). The estimates for each parameter set were obtained by averaging the mean of the posterior distributions across the 100 replications. The parameter names are shown in the captions, along with the Pearson product-moment correlation between the true values and the estimates (r) and the coverage of the posterior distributions (i.e., the proportion of replications that the true value was withing the 95% credible interval of the posterior). The coverage values are averaged across the parameter sets.

For the detection response task, we used the following notations to index the various parameters and parameter-condition-accumulator combinations:

- A = upper bound of the uniform distribution of start points,
- B = b-A, where b is the response threshold,
- mean_v = mean of the normal distribution of the rate of evidence accumulation,
- sd_v = standard deviation of the normal distribution of the rate of evidence accumulation,
- t0 = non-decision time t_{er},
- gf = probability of contaminant omissions on the probit scale,
- high = high stimulus,
- low = low stimulus,
- none = no load condition,
- 3s = 3s load condition (i.e., count backwards by 3s),
- true = matching accumulator (note that there is no mismatching accumulator in this simple RT task),
- contaminant = probability of contaminant omissions on the probability scale (Note that this parameter corresponds to the gf parameter but it was transformed to the probability scale and -similar to the other omission parameters- its posterior distribution is based on only a subset of the available posterior samples.),
- design = probability of design omissions on the probability scale,
- intrinsic = probability of intrinsic omissions on the probability scale,
- allOmissions = overall probability of omissions on the probability scale computed as P(contaminant)+(1-P(contaminant) x P(design) + P(intrinsic)).

For the distraction paradigm, we used the following notations to index the various parameters and parameter-condition-accumulator combinations:

- A = upper bound of the uniform distribution of start points,
- B = b-A, where b is the response threshold,

- mean_v = mean of the normal distribution of the rate of evidence accumulation,
- sd_v = standard deviation of the normal distribution of the rate of evidence accumulation,
- t0 = non-decision time t_{er},
- gf = probability of contaminant omissions on the probit scale,
- Standard = standard,
- AfterS = after standard,
- AfterD = after deviant,
- HighD = high deviant,
- LowD = low deviant,
- SAHD = standard after high deviant,
- SALD = standard after low deviant,
- Long/LONG = long stimulus/long response,
- short = short stimulus,
- true = matching accumulator
- false = mismatching accumulator,
- contaminant = probability of contaminant omissions on the probability scale (Note that this parameter corresponds to the gf parameter but it was transformed to the probability scale and -similar to the other omission parameters- its posterior distribution is based on only a subset of the available posterior samples.),
- design = probability of design omissions on the probability scale,
- intrinsic = probability of intrinsic omissions on the probability scale,
- allOmissions = overall probability of omissions on the probability scale computed as P(contaminant)+(1-P(contaminant) x P(design) + P(intrinsic)).

In the detection response task, both the standard LBA parameters and the three types of omission parameters were recovered well, with all correlations between estimates and data-generating values ≥ 0.919 and coverage values in an acceptable range between 0.834 – 0.95. Note that these results include the contaminant omission parameters on the probit scale (i.e., "gf" in detectionResponseTask.LBAparameters.pdf) and not the contaminant omission parameters on the probability scale (i.e., "contaminant" in detectionResponseTask.omissions.pdf).

In the distraction paradigm, the standard LBA parameters were recovered relatively poorly. Although the correlations between the estimates and data-generating values were reasonable (all correlations ≥ 0.832), the coverage of the posteriors was substantially lower than nominal, ranging between 0.34 and 0.896. This result is not surprising as the selected model was severely overparametrized. The three types of omission parameters were recovered substantially better than the standard LBA parameters. With the exception of two of the intrinsic omission parameters (intrinsic.LowD.long and intrinsic.SADH.long), the correlations between estimates and data-generating values were generally strong, with all correlations ≥ 0.788. The coverage of the posteriors was slightly less than nominal, with values ranging between 0.787 – 0.855. Note that these results include the contaminant omission parameters on the probit scale (i.e., "gf" in distractionParadigm.LBAparameters.pdf) and not the contaminant omission parameters on the probability scale (i.e., "contaminant" in distractionParadigm.omissions.pdf).