# Fitting associate learning models to data

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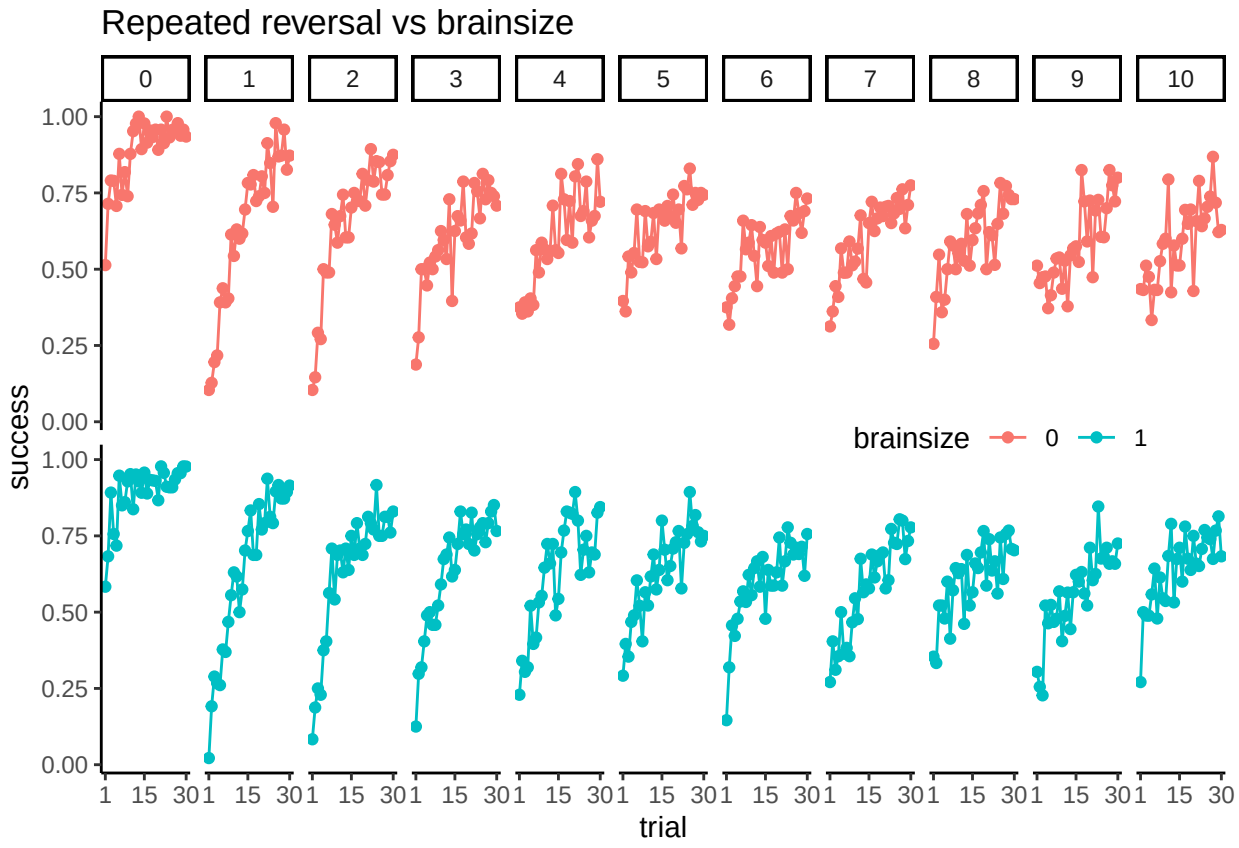
## The Boussard *et al* data set

In here I present the statistical model used to estimate reinforcement learning parameters from a data from a reversal learning task. In the experimental set up, individuals from two experimental treatments are trained to pick one of two stimuli. Where one of those two options provides reward in the form of food pellets. The experiments is composed of 11 reversal blocks, each of these blocks is composed of 30 trial. In other words, every 30 trials the stimulus that provides reward is switch. Thus, individuals must reverse their estimate of reward in order to make adaptive decisions and choose the rewarding stimulus. In **??**, I show the proportion of correct choices for both treatment groups along the trials, and reversal blocks.




In order to evaluate the performance of the model in estimating the parameter values. I first fit the model parameters to a data-set obtained by simulation the model with a set of preset parameter values. I then evaluate whether the algorithm correctly estimates these parameters. The model is based of the Rescorla-Wagner model of associative learning. Each individual has an estimate of reward for each stimulus. When

two stimuli are presented together, the individual chooses one of the two with a probability given by the soft-max distribution. We assume all individuals use the same temperature parameter ($\tau$). This parameter is estimated. Once the individual chooses one of the two stimuli, it updates its estimates of reward associated with the chosen stimulus. The update is performed every trial and is given by the product of the *prediction error* ($\delta$) and the *speed of learning* ($\alpha$). The *prediction error* is calcuted as the difference between the reward triggered by choosing a particular stimulus and the estimation of that reward prior to the choice. We assume each individual expresses a different *speed of learning*, and it's given by fixed and random effects. The treatment group of each individual is the fixed effect. Thus, we estimate a contribution of the treatment group to the *speed of learning* of each individual. As for the random effect, we assume the individual specific contributions to the speed of learning are distributed as a random variable with a normal distribution. We estimate the mean and standard deviation of the distribution. The model uses thus a hierarchical bayesian approach to estimating the parameters of the Rescorla-Wagner model.

## The simple fake data set

We first use the model to estimate a simple associative learning task without any reward reversal. In table **??**, I show the values of the model parameters to simulate the first data-set.In figure **??**, I show the average frequency of success for the two treatment groups.

### Parameters

- Temperature : 1
- Mean speed of learning : 0.2
- Treatment effects : c(-5, 5)
- St. dev. of speed of learning : 0.5

```
##           used (Mb) gc trigger  (Mb) max used  (Mb)
## Ncells 1247909 66.7    2103370 112.4  2103370 112.4
## Vcells 2531613 19.4    8388608  64.0  8381933  64.0
```

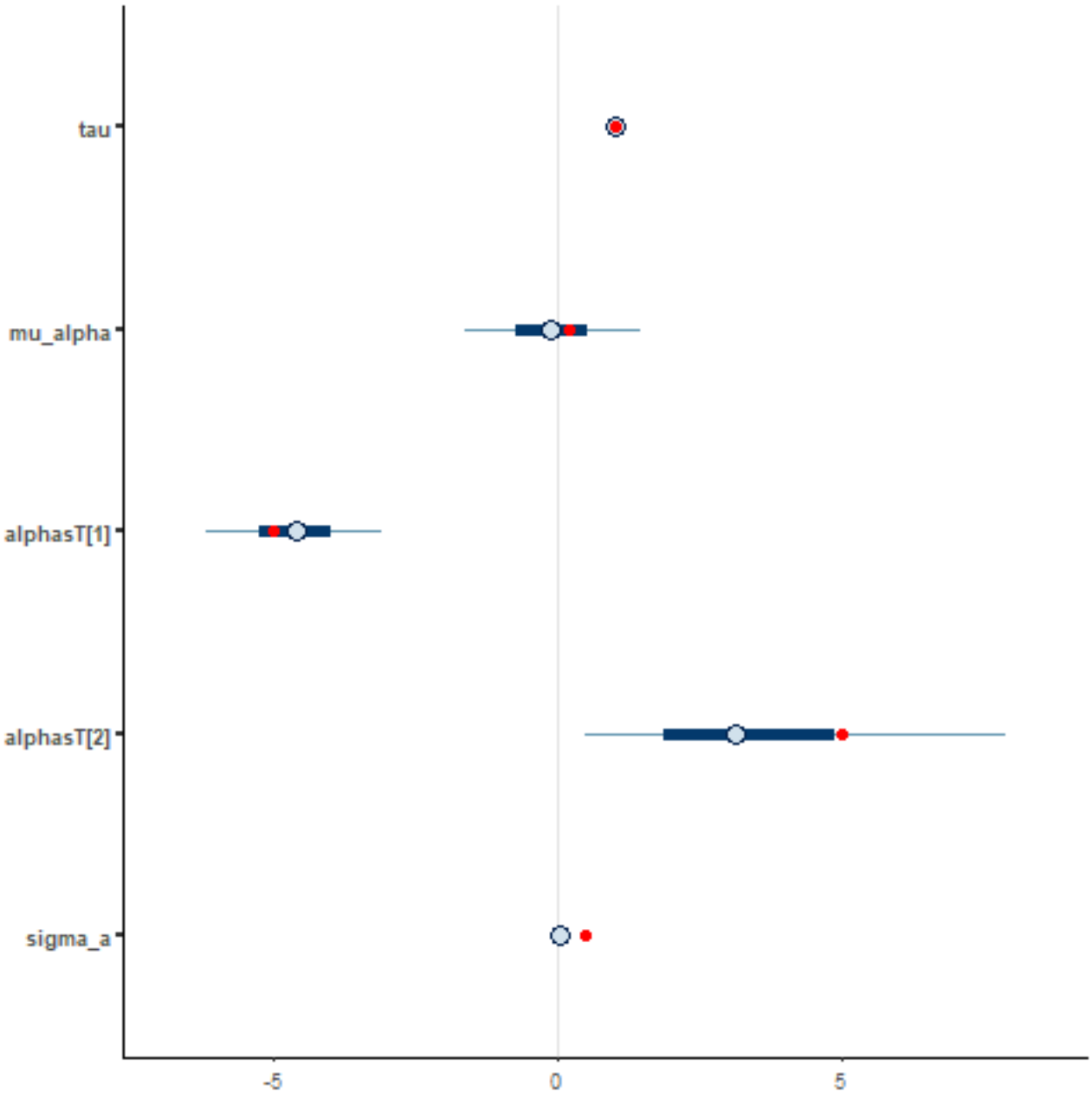
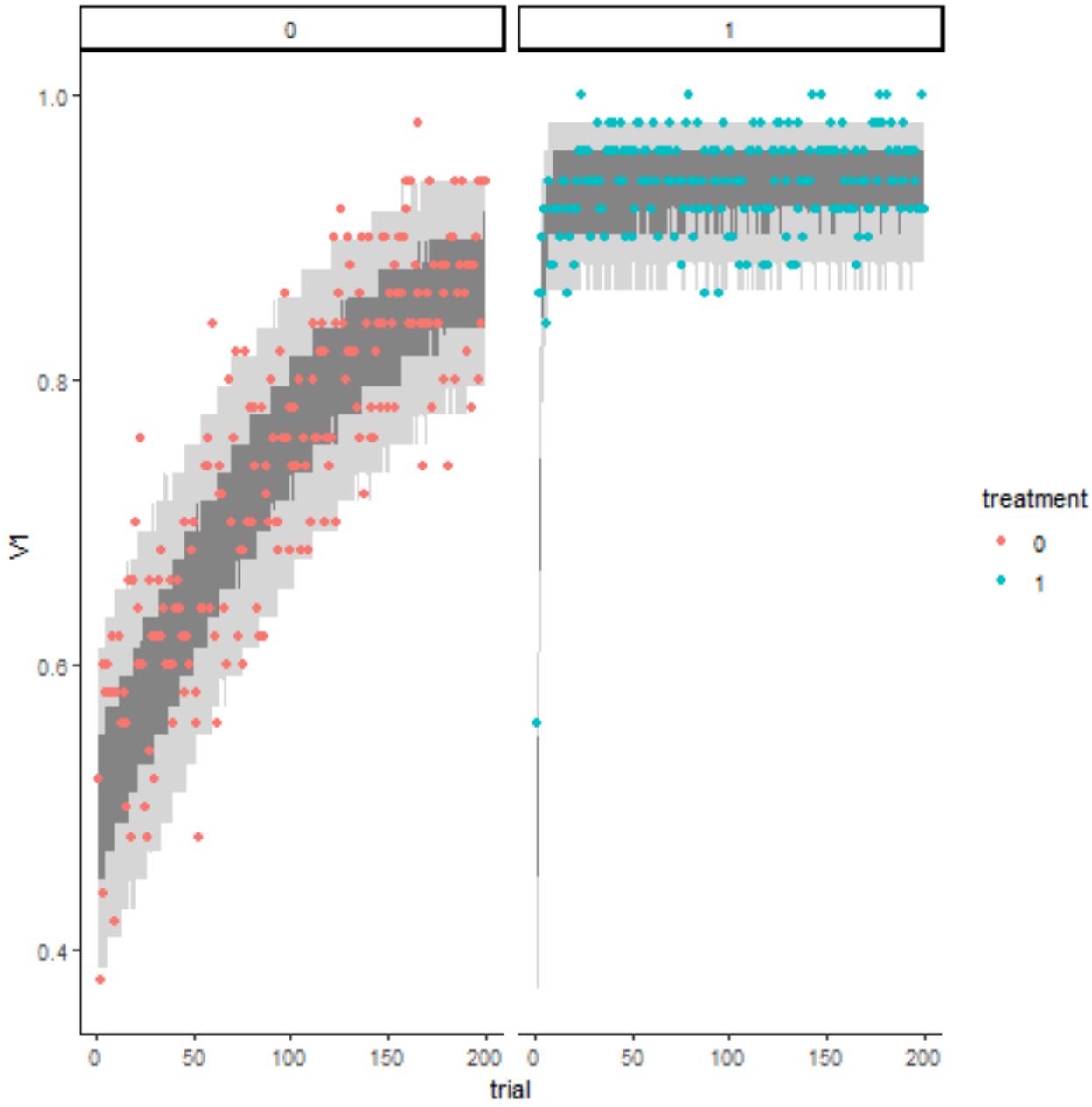



Figure 1: Estimatation of the paramerers used to generate the simulated data. Red points correspond to the real values of the parameteres.




## The reversal fake data set

### Parameters

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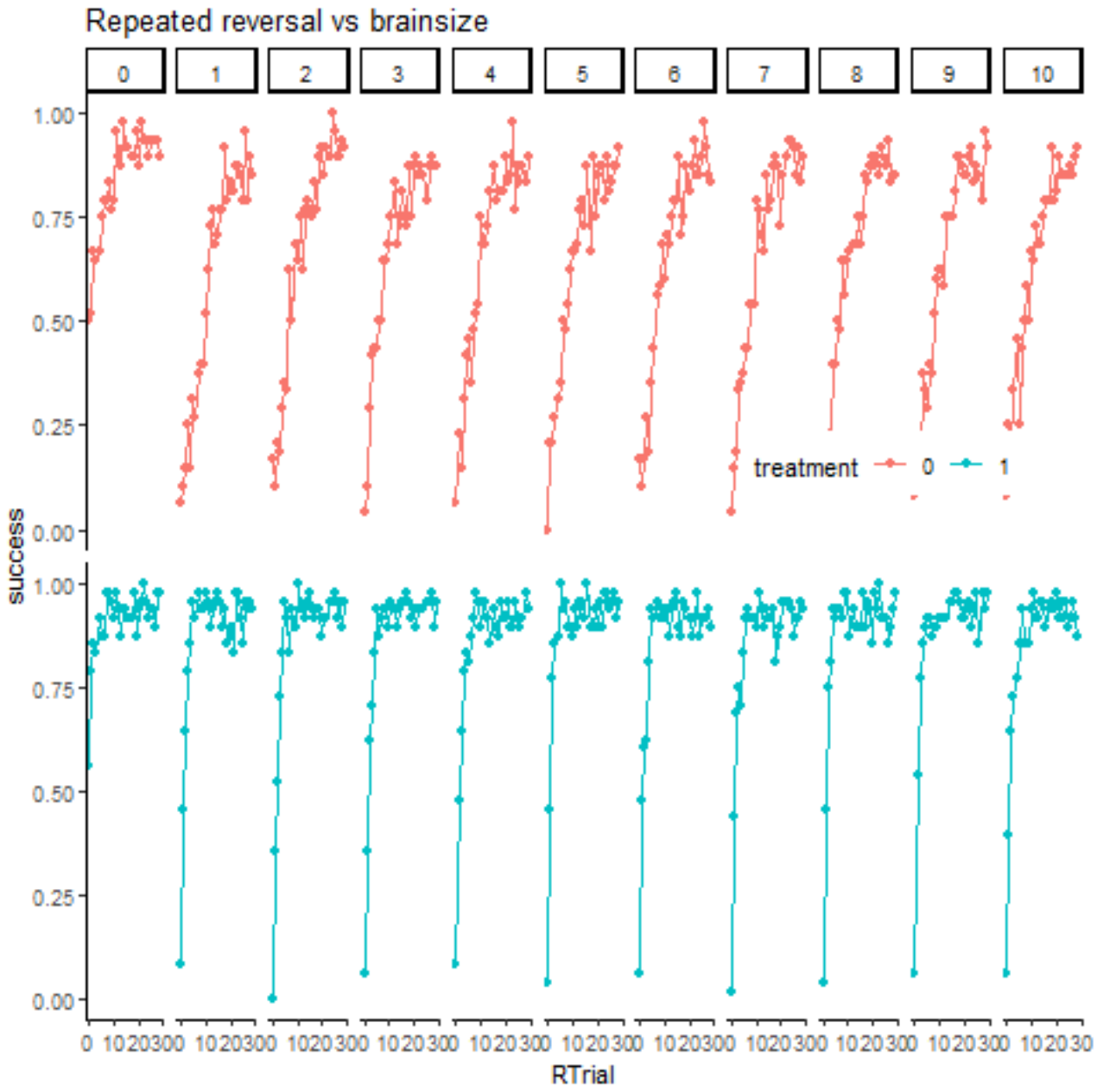
used (Mb) gc trigger  (Mb) max used  (Mb)
```

Ncells 1248237 66.7 2103370 112.4 2103370 112.4 Vcells 2532788 19.4 8388608 64.0 8381933 64.0 * Temperature : 1 * Mean speed of learning : 0.2 * Treatment effects : c(-2, 2) * St. dev. of speed of learning : 0.5


Repeated reversal vs brainsize
0
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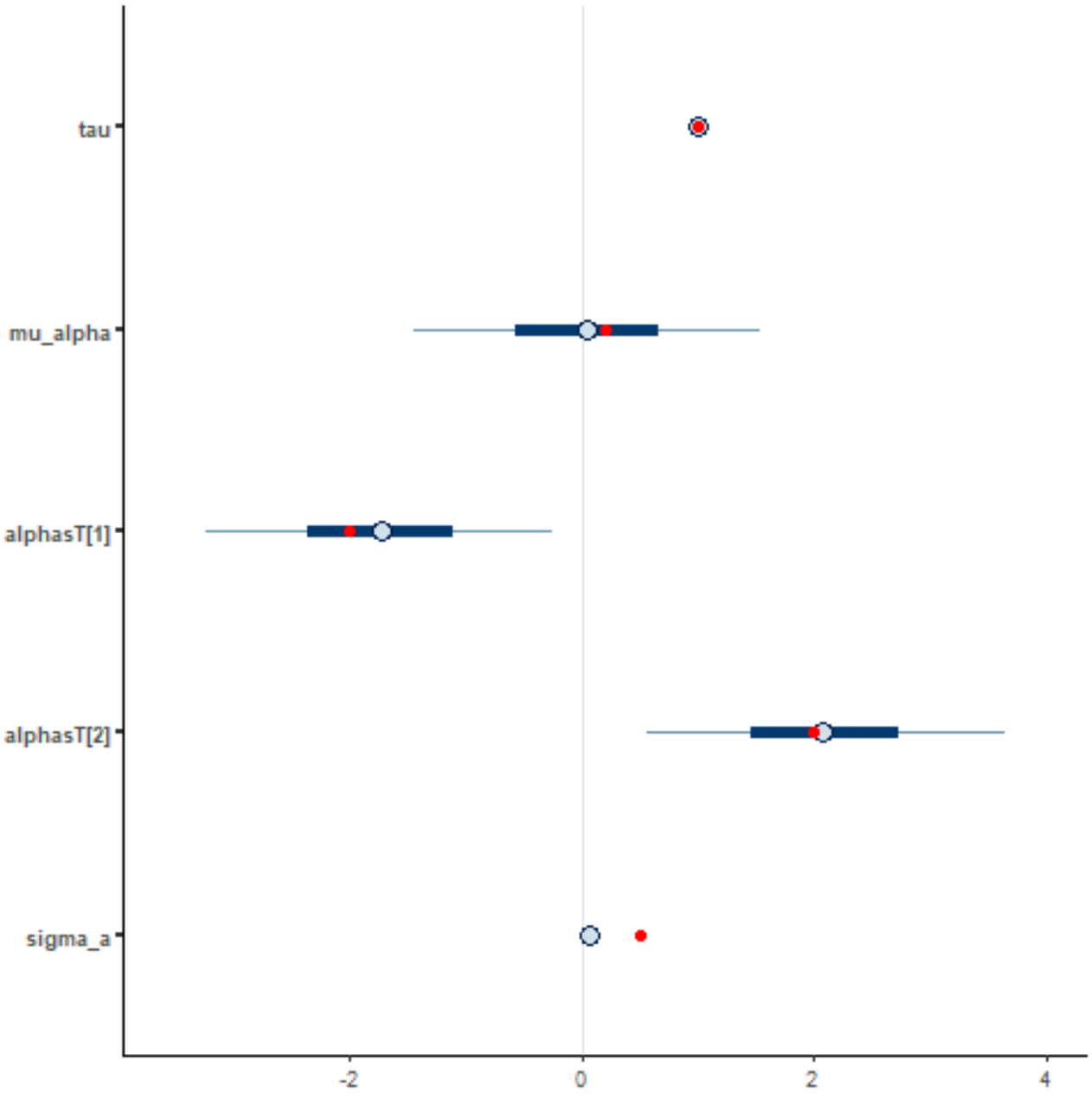
tau
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alphasT[2]
sigma_a
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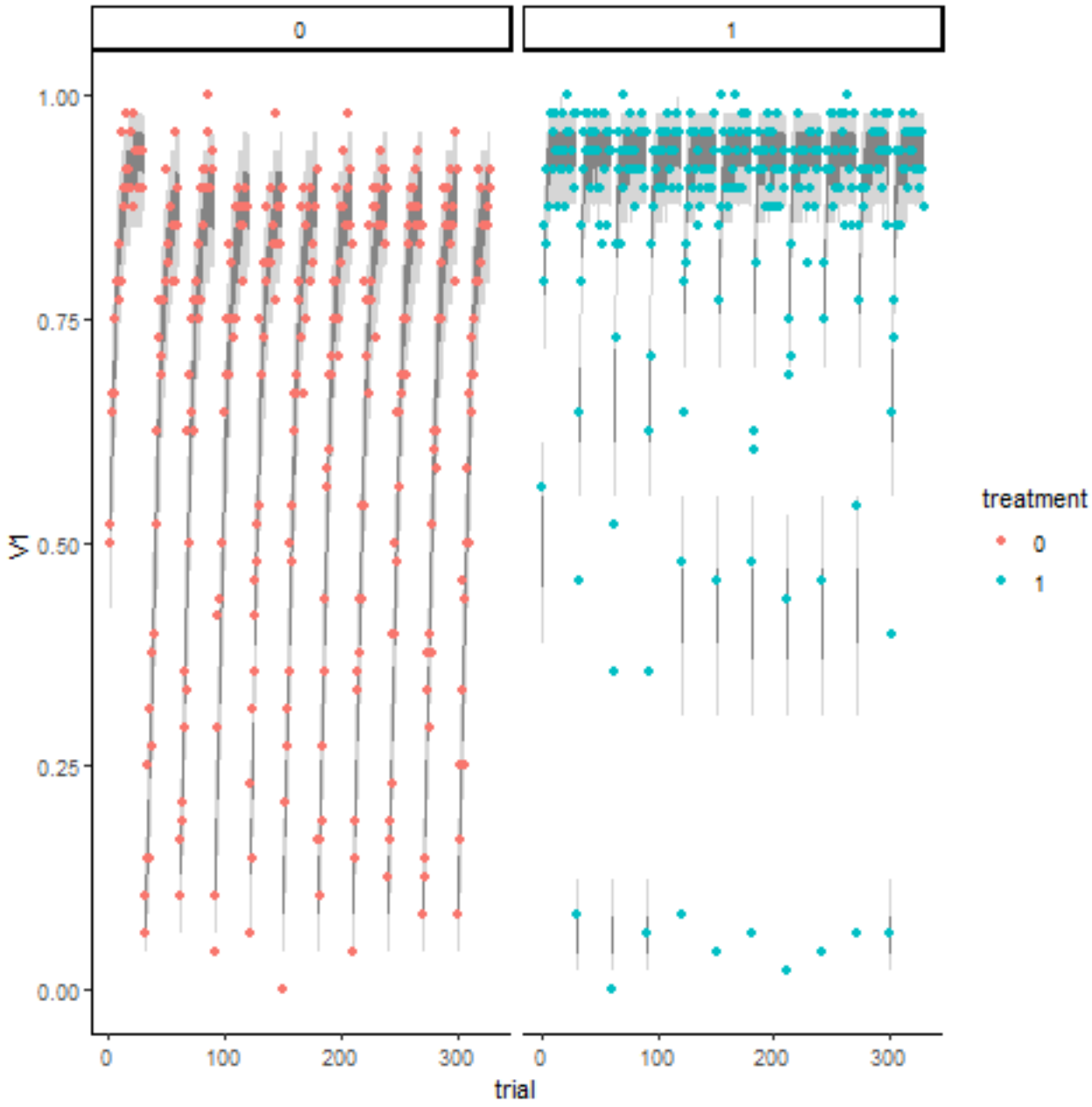
2
4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trial
treatment
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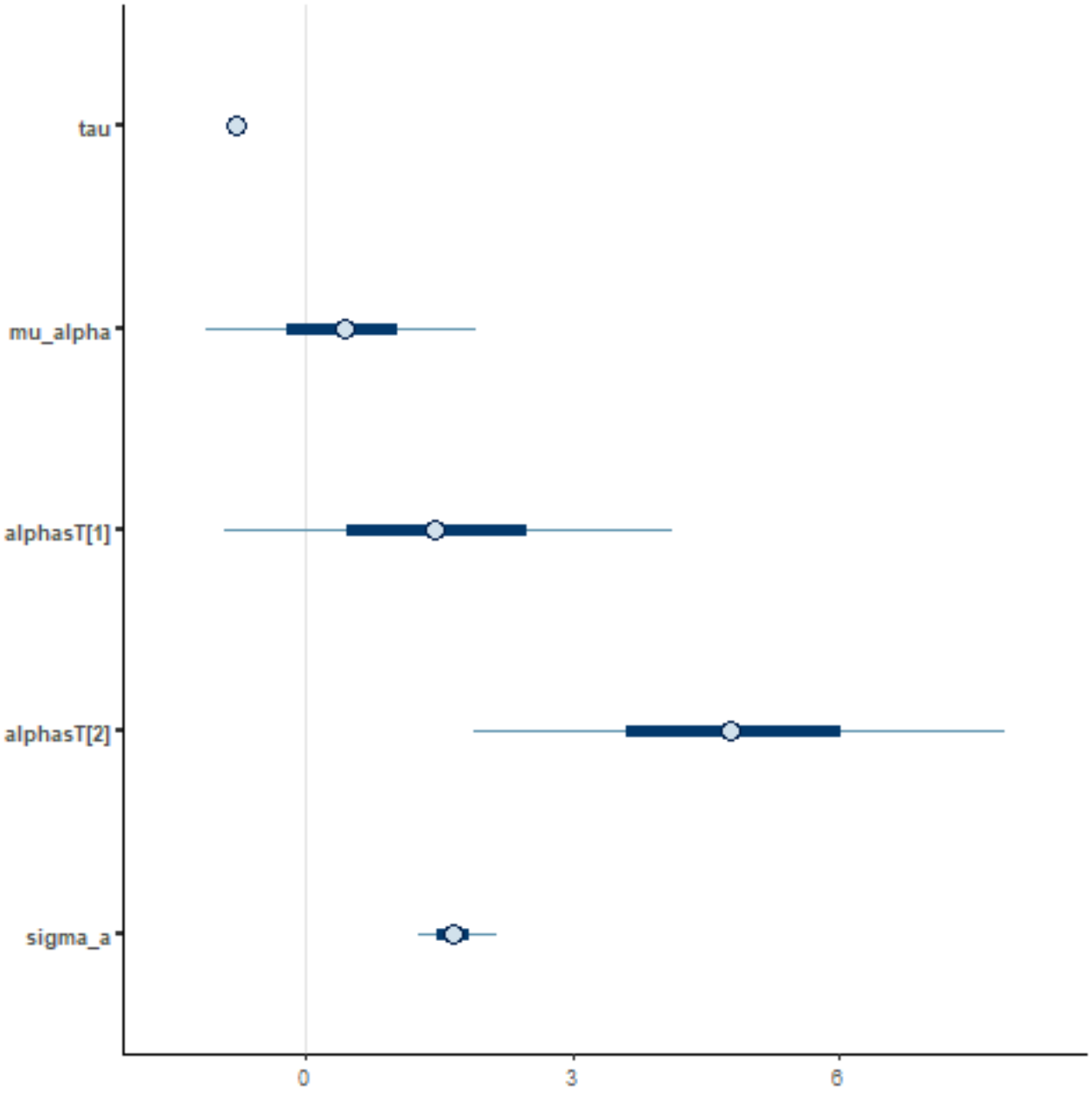
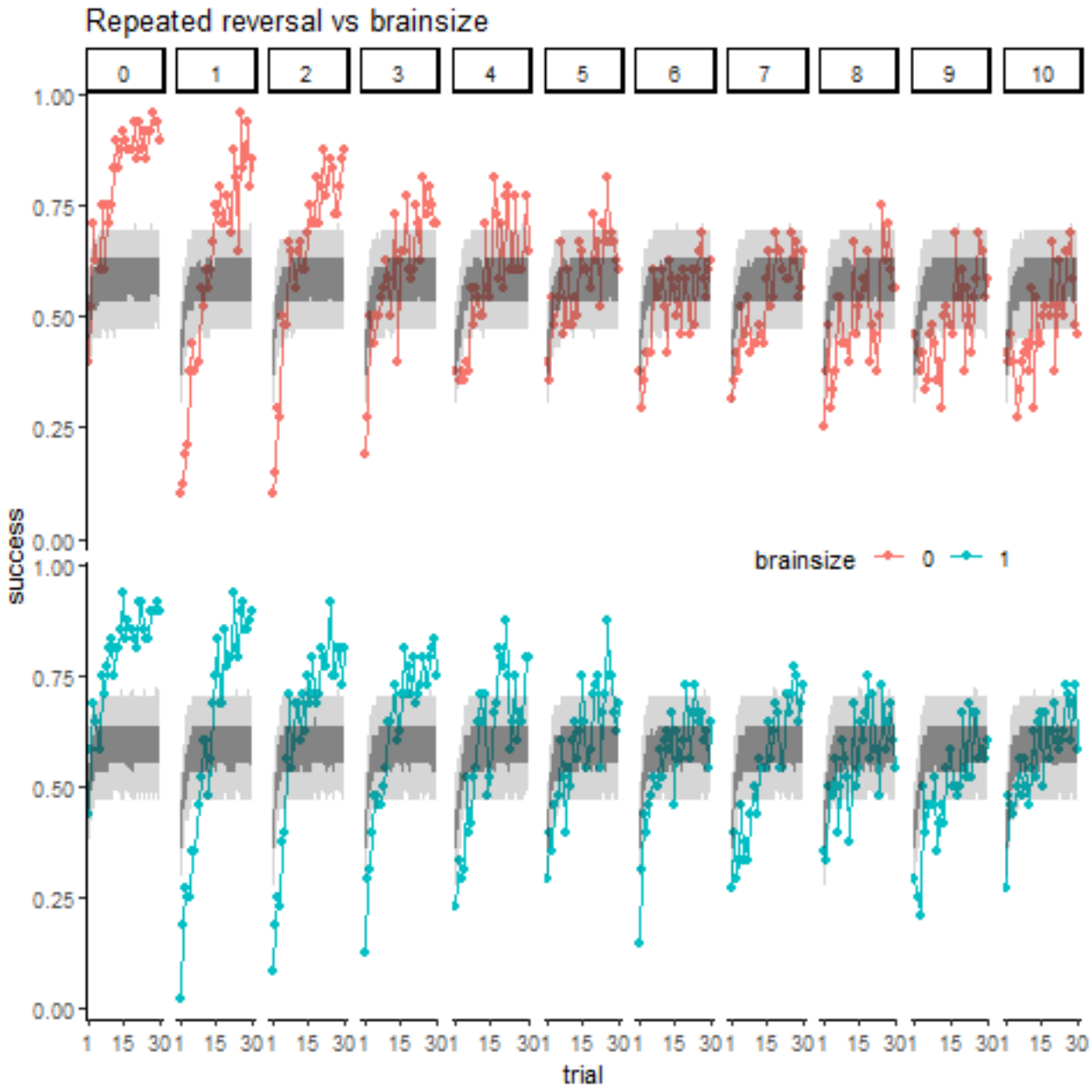
**Fitting the model to the Boussard *et al* data set**




Repeated reversal vs brainsize
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0.00
success
brainsize
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trial