

Judgment or Recall:

On the Problematic Procedure for Estimating Parameters of Exemplar Models in Experiments of Quantitative Judgment



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Introduction

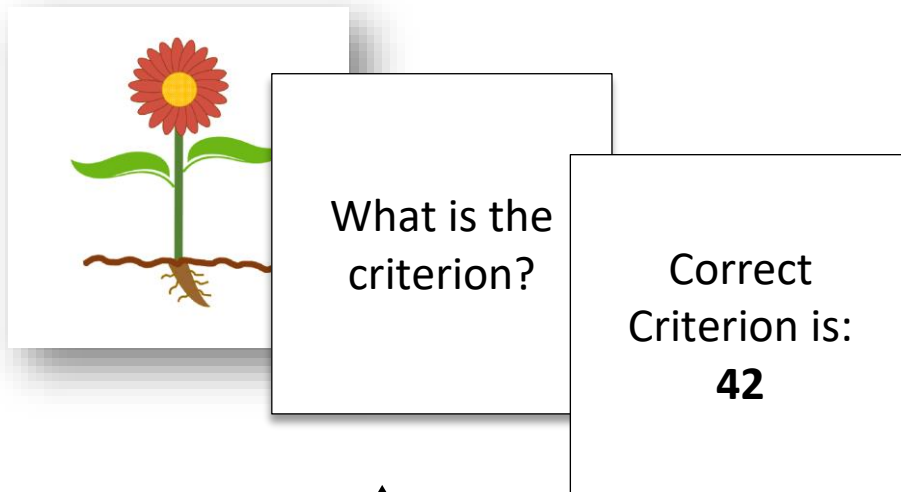
- Exemplar models original come from the areas of
 - Memory recall (Hintzman, 1984)
 - Associative learning (Jamieson, Crump, & Hannah, 2012)
 - Categorization and classification (Medin & Schaffer, 1978; Nosofsky, 1984)
- Are now also successfully used in research of
 - Decision making (Juslin & Persson, 2002, Platzer & Bröder, 2012)
 - Judgments (e.g., Bröder & Gräf, 2018; Hoffmann et al., 2013, Hoffmann et al., 2018; Juslin et al., 2003; von Helversen et al., 2010; Wirebring et al., 2018)
- These exemplar models assume that ...
 - ... people **store previously encountered objects** and their criterion value in memory (Juslin et al., 2003, 2008), these are called exemplars.
 - ... new objects are then judged based on the **similarity** to the exemplars stored in memory (Medin and Schaffer, 1978; Nosofsky, 1984, Juslin et al., 2003).



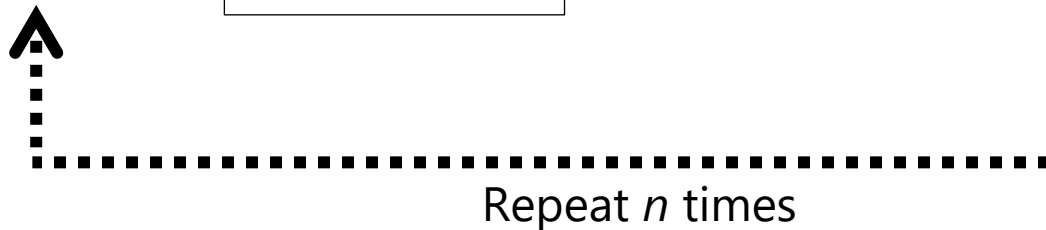
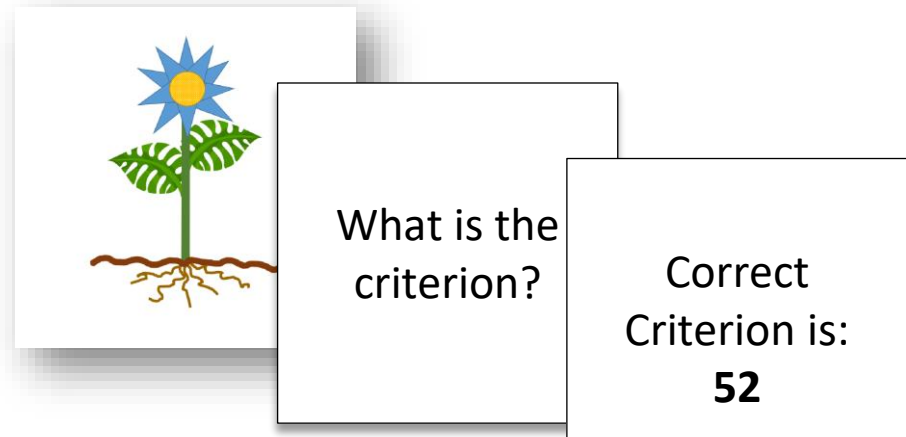
Experimental Paradigm: Multiple-Cue Judgments

- Typical experiment consists of two phases, a **training phase** and a **judgment phase**
- In the **training phase**, participants have to judge the criterion value of a distinct set exemplars multiple times and they get feedback about the correct criterion value

Exemplar 1



Exemplar k



Experimental Paradigm: Multiple-Cue Judgments

- Typical experiment consists of two phases, a **training phase** and a **testing phase**
- In the **testing phase**, participants have to judge the criterion value of already learned exemplars and new stimuli

Exemplar 1



What is the
criterion?

Exemplar 2



What is the
criterion?

New Stimulus



What is the
criterion?



The Problem

- Data is a **mixture** of two types of data generated by two qualitatively distinct cognitive processes: **Judgment and direct recall**
- Two possibilities when participants are confronted with an already presented exemplar:
 - They have **learned** the exemplar and its respective criterion value and are thus able to **recall the exact value**
 - They have **not learned** the exemplar and thus have **to judge** its criterion value, as it were a **new stimulus**
- Using the context model of Medin and Schaffer (1978) extended to account for the continuous criterion in multiple-cue judgments (Juslin et al., 2003) one can show that:

Not regarding the mixture nature of the data (i.e., the distinction between judgment and recall) should lead to biased estimation of the criterion towards 0.



Simulation

For different simulation parameters:

true s – parameter: .001, .01, .3, .8
memory probability: .1, .5, 1

Repeat 200 times

- 1) Generate stimulus matrix (5 cues, 32 stimuli, 12 exemplars)
- 2) Simulate judgment data for these 32 stimuli based on the 12 exemplars and the simulation parameters

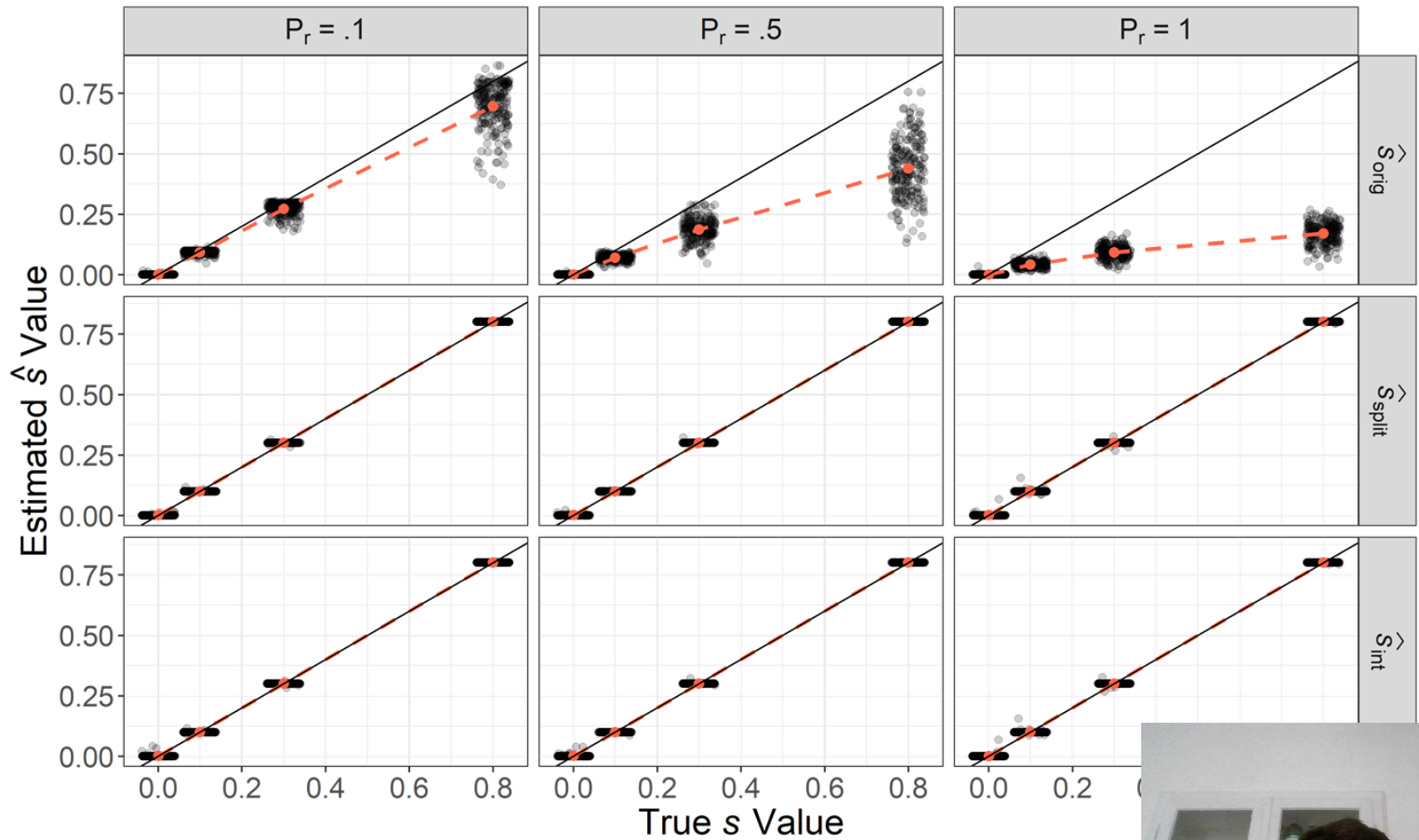
Model: Context model of Medin and Schaffer (1978) extended to account for the continuous criterion in multiple-cue judgments (Juslin et al., 2003):

- 3) estimate s -parameter in three different ways:

1. Using the original exemplar model based on all 32 judgments -> \hat{s}_{orig}
2. As proof-of-concept: Split data into correctly remembered exemplars and other.
Then estimate parameter based on the "other" data-subset -> \hat{s}_{split}
3. Use a latent-mixture extension of the original exemplar model, which integrates the assumption that trained exemplars can be directly recalled from memory with probability p



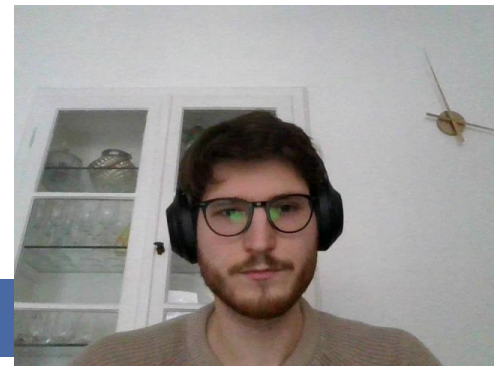
Results Simulation



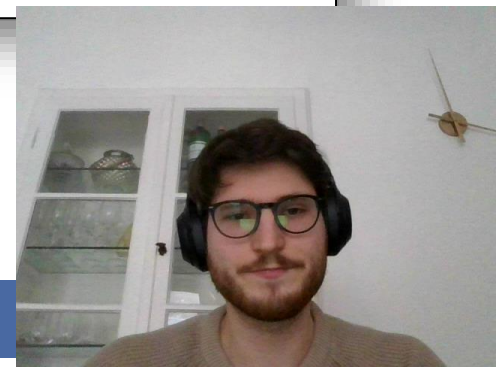
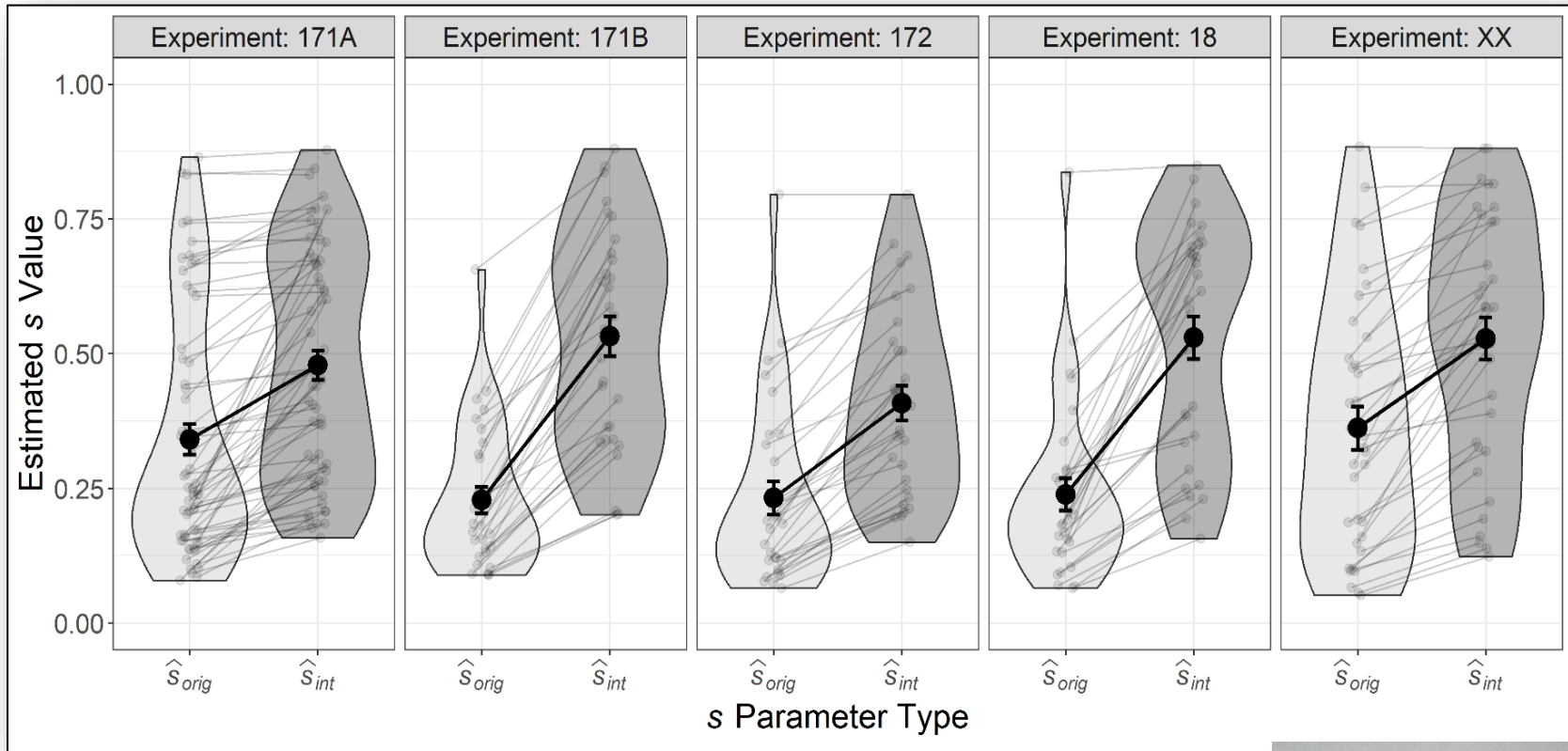
Reanalysis of 5 Experiments

Predictions based on simulation results:

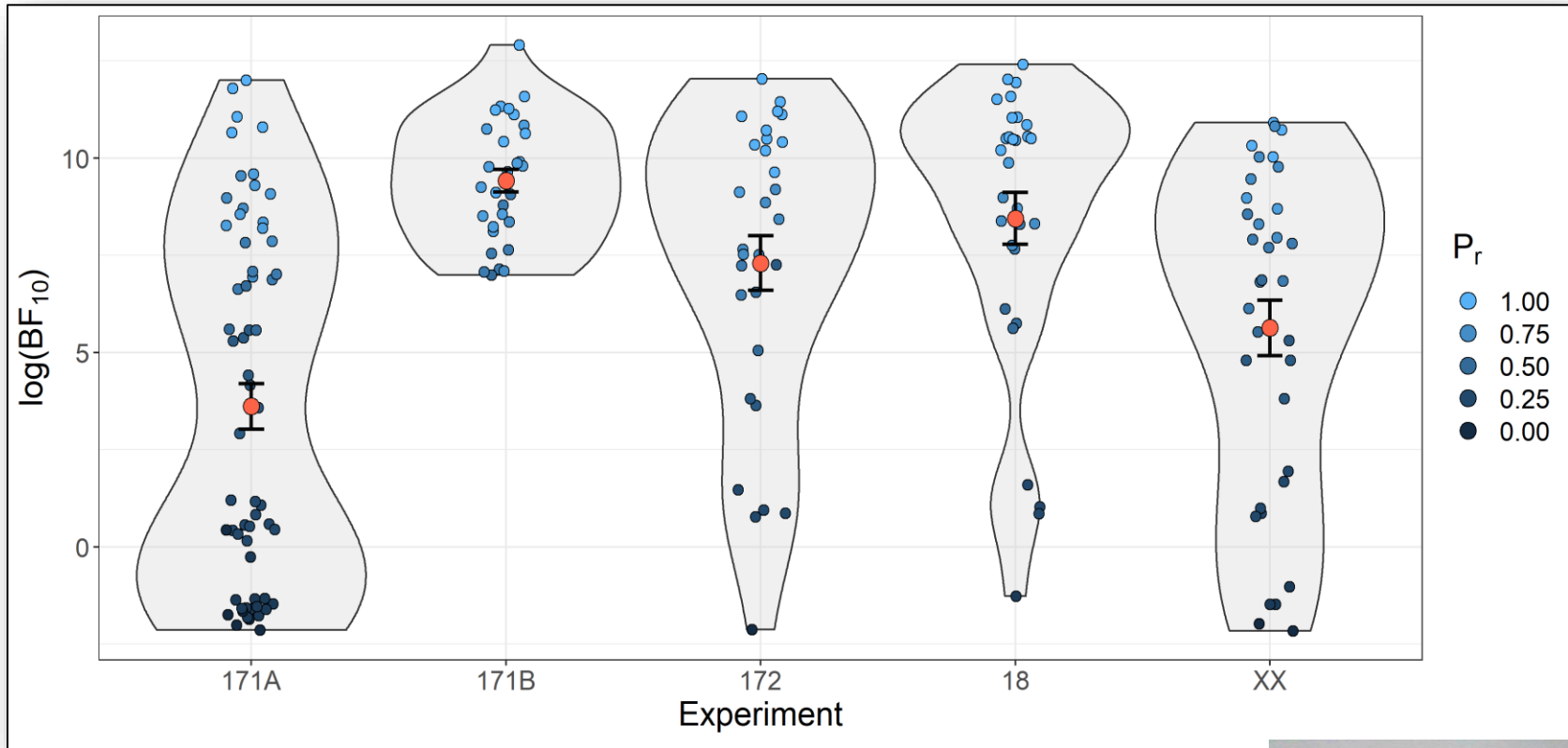
- \hat{s}_{int} higher than \hat{s}_{orig}
- Better model fit of the model with integrated recall



Results – Prediction 1



Results – Prediction 2



$\log(\text{BF}_{10}) > 0 \rightarrow$ more evidence for the model with integrated recall

$\log(\text{BF}_{10}) = 1 \rightarrow \text{BF}_{10} = 2.7$

$\log(\text{BF}_{10}) = 5 \rightarrow \text{BF}_{10} = 148.4$



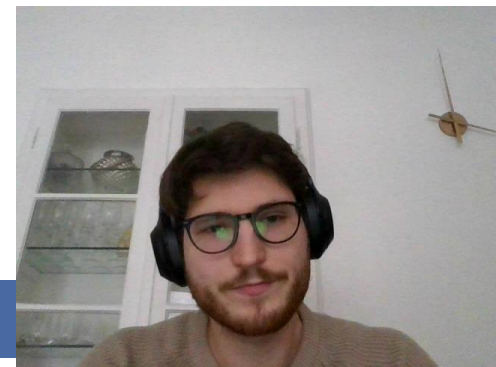
Summary

- Not regarding the two distinction between judgment and recall leads to biased estimation of the s parameter
- If the recall process is explicitly integrated into the model, the s parameter is unbiased again.



Discussion

- Not a problem with the model itself, but the rather the adaptation of the experimental design from categorization research which involves having few overlearned stimuli (e.g., Medin & Schaffer, 1978; Nosofsky & Palmeri, 1998), to multiple-cue judgment research
- The combination of very few well learned exemplars with their unique criterion values leads to the biased estimation of the s parameter
- Biased estimation should be less pronounced in other paradigms where there are more exemplars, participants get no feedback about true criterion value, or multiple exemplars share the same criterion (e.g., Pachur & Olsson, 2012, Nosofsky & Alfonso-Reese, 1999; Ratcliff & Rouder, 1998)
- However, on a psychological level, the mixture between different process still is a problem in these cases.



Thank you !

