Comparing sequential effects across paradigms – Using a modelling approach

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1. Introduction

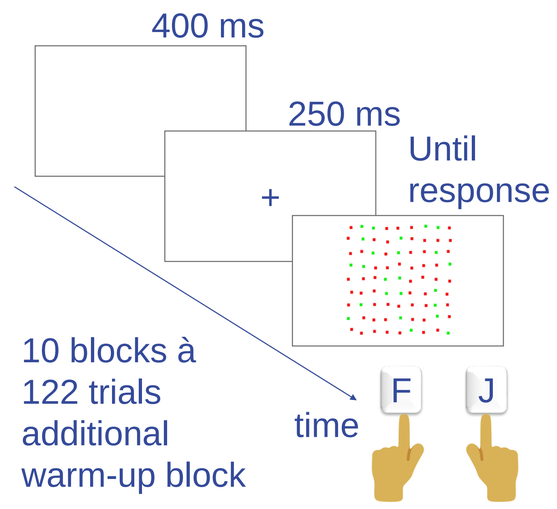
- *Sequential effects*: Performance gains in case of a repetition between trial *n*-1 and trial *n* compared to an alternation
- Observed in many paradigms; e.g.,
  - Two-choice RT → response category
  - Visual search → target dimension
  - Task-switching → task-sets
  - Interference → congruency

- Sequential effects have been investigated – so far – mostly in their respective sub-disciplines (but see Frings et al., 2020)
- Questionable whether common mechanisms are involved

➢ **Do sequential effects show more similarities than only on the level of mean RTs and accuracy; for example also in their RT distributions?**
➢ **Can stochastic RT models account for the different types of sequential effects with similar mechanisms?**

2. Method

Between-subject:
- Two-choice RT paradigm (2CRT)
  (17 m, 37 f, 2 d; *M* = 29.1 y)
- Visual Search paradigm (VS)
  (24 m, 30 f, 2 d; *M* = 29.0 y)
- Task-switching paradigm (TS)
  (17 m, 37 f, 2 d; *M* = 27.8 y)
- Interference paradigm (Int)
  (23 m, 33 f, 1 d; *M* = 29.8 y)



Analyses:
- Parameter estimation for four different models via maximum likelihood estimation separately per participant and stimulus-type
- Comparison of parameter estimates via *t*-tests with trial sequence as within-subject factor

3. Percentile rank pooling

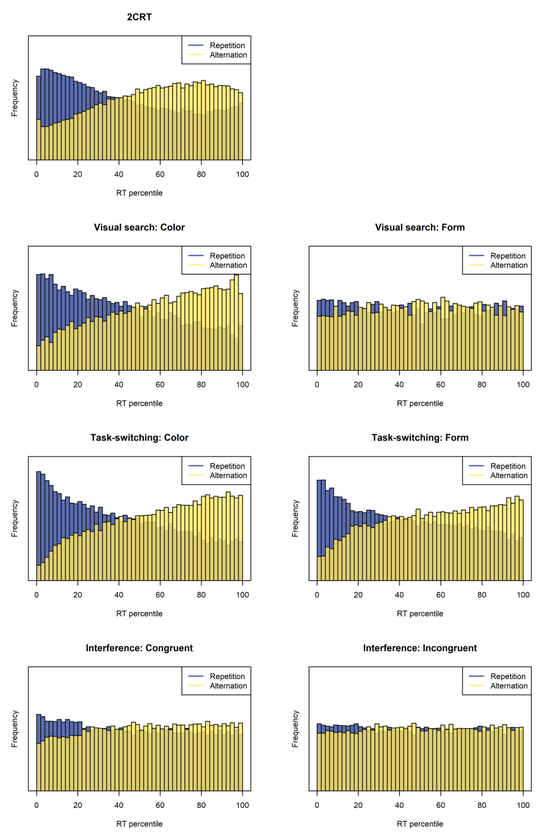
Procedure: (Miller, 2021)

1. Computation of percentile ranks (PR) for RTs within participants but across conditions

$$PR(t) = \frac{L+0.5\times E}{N}$$

L= number of trial lower t
E = number of trials equal to t
N = total number of trials

2. Pooling across participants of the computed ranks, separately for each condition of interest

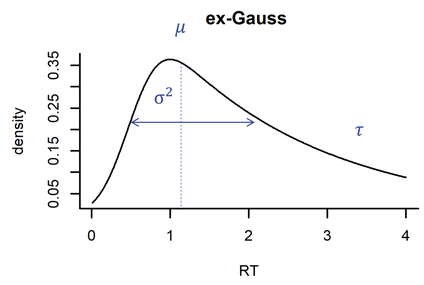


Results:
- Within- and between-paradigm differences in sequential effects on shapes of RT distributions

4. Ex-Gaussian distribution

Convolution of two independent random variables:
1. Normal (μ und σ^2)
2. Exponential ($\tau = 1/\lambda$)

Results:
- For all paradigms repetition and alternation trials differ in the location of the lower-tail of the distribution (μ)
- Depending on paradigm and stimulus type additional parameters differ significantly



Parameters with significant differences between repetition and alternation trials per paradigm

2CRT	μ, σ^2		
VS color	μ, τ	VS form	μ
TS color	μ, τ	TS form	μ, τ
Int con	μ	Int inc	μ

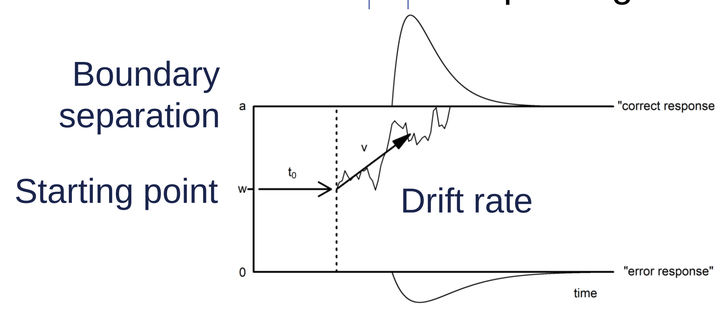
5. Seven-parameter diffusion model

- Psychological interpretation of processes that contribute to decision making in binary decision tasks (Ratcliff, 1978)

Results:
- For most paradigms repetition and alternation trials differ in their drift rate (*v*)
- Parameters that capture the sequential effect depend on the paradigm and stimulus type

Parameters with significant differences between repetition and alternation trials per paradigm

2CRT	a, w		
VS color	$v, t_0, \sigma_v, \sigma_{t_0}$	VS form	
TS color	a, v, t_0, w, σ_w	TS form	v, t_0
Int con		Int inc	v, σ_v



6. EZ-diffusion model

- Closed form expression of the most important parameters of the diffusion model (Wagenmakers et al., 2007; Grasman et al., 2009)
- Advantage: more robust with fewer trials and low error rates

Results:
- For all paradigms repetition and alternation trials differ in their drift rate (*v*)
- Parameters that capture the sequential effect depend on the paradigm and stimulus type

Parameters with significant differences between repetition and alternation trials per paradigm

2CRT	a, v, t_0, w		
VS color	a, v, t_0, w	VS form	v
TS color	a, v, t_0, w	TS form	v, t_0
Int con		Int inc	v

7. Conclusion

- **Clusters of paradigms that show more similarities in the changes of response time distributions for sequential effects than other paradigms or stimulus types (e.g., VS color and TS vs. 2CRT)**
- In some paradigms, the sequential effects on specific diffusion model parameters are not plausible
- Future research: Investigate individual differences in sequential effects that are common across paradigms to assess commonalities of underlying mechanisms

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References and Funding:
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