#3003

Episodic retrieval in task switching: Repeating the response induces retrieval of the task.

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poster https://github.com/ele-ben/Posters

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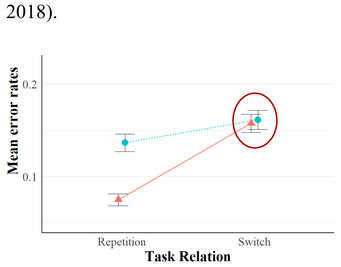
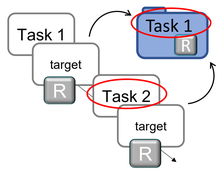
The Response Repetition (RR) Effect in Task Switching

Task switching (see Kiesel et al., 2010 for a review) used to study cognitive control in multitasking settings, but performance is also affected by features binding and episodic retrieval processes (e.g., Koch & Allport 2006).

For example, we often observe response repetition benefits in task repetitions that *disappear* or become *costs* in task switches. Different accounts exist that can explain this effect, one of them is **task-response binding and retrieval account** (Altmann, 2011; Koch, Frings & Schuch, 2018).



Note. Vertical bars indicate 95% confidence intervals.



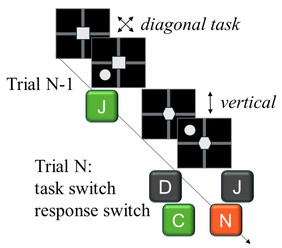
The task and the response are bound in each trial. When **the response repeats, it retrieves the n-1 task, which is wrong in task switches**, hence causing costs..

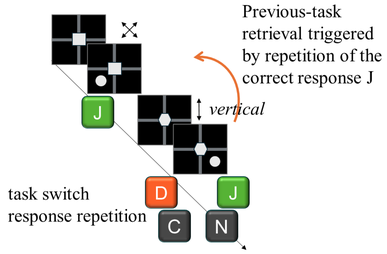
Research Question: Does repeating the correct response induce retrieval of the previous task?

Classifying Errors in Task Switching

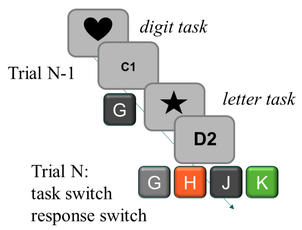
The study includes four datasets, two published (Grange, 2023; Mayr, 2002) and two novel experiments.

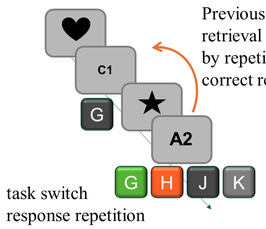
Paradigms of Mayr 2002 and Grange, 2023. Participants switched between three tasks (mentally move the dot in the correct quadrant) with four responses (D, C, J, or N) mapped on the spatially compatible responses.





Paradigms of Experiment 2. Participants switched between three tasks (categorize the letter, the digit or the string size) with four responses mapped from left to right from 1 to 4, A to D or small to large.

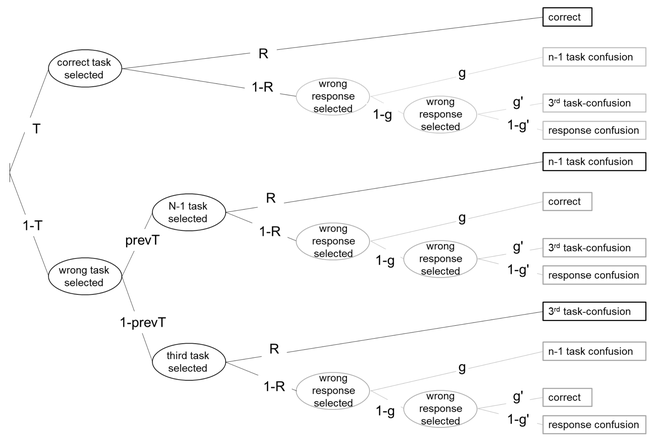




This setting with 3 tasks and 4 responses allows to **identify different response types** (see Moretti et al., 2023): Green = correct, Orange = **N-1 task confusion**, black = third task confusion, grey =response confusion error.

The MPT Model

We designed the Multinomial Processing Tree Model (MPT, Batchelder & Riefer, 1999) below, with 8 categories, 6 free categories and 6 free parameters (0 df). The *T* parameter indicates selection of the correct task, ***prevT* selection of the N-1 task**, and *R* selection of the correct response for the selected task. g and g' were constant and equal to .33 and .5, respectively. We predicted $prevT_{response\ repetition} > prevT_{response\ switch}$. We tested this prediction with Bayesian paired-sample *t*-tests on the participants' parameter estimates.



Hypothesis 1: In response repetitions, higher percentage of N-1 task confusion errors than in response switches.

Hypothesis 2: In response repetitions, larger parameter of MPT model indicating task retrieval than in response switches.

Results: Mean % Errors

Hypothesis 1 only confirmed in Grange 2023 data, where N-1 task confusions significantly more frequent in response repetitions than switches.

		Mean % of Errors by Error Type			
Response	**Category**	**Mayr, 2002**	**Grange, 2023**	**Exp. 1**	**Exp. 2**
Response Repetition	N-1 task confusion	**46.52**	**43.35**	**39.25**	**45.81**
	Response confusion	11.51	5.95	25.82	17.57
	Third task confusion	39.41	44.81	34.93	36.61
Response Switch	N-1 task confusion	**42.09**	**34.85**	**39.09**	**46.73**
	Response confusion	11.32	5.71	27.26	19.24
	Third task confusion	46.59	58.66	33.65	34.03
t-test on N-1 task confusions in response repetitions vs switches		$t(38) = 0.90$, $p = .375$, d = 0.83	$t(254) = 3.77$, $\mathbf{p < .001}$, d = 0.61	$t(95) = 0.06$, $p = .952$, d = −0.11	$t(95) = -0.63$, $p = .529$, d = −0.06

The table reports the mean % of each error type over the total number of errors per participant per cell. The last row reports paired-sample *t*-tests on the mean % of N-1 task confusions in response repetitions vs. switches.

Results: prevT parameters of MPT model

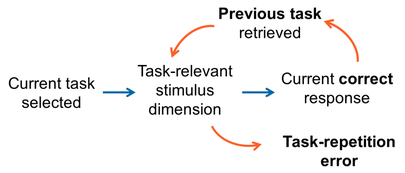
Bayesian latent-trait hierarchical MPT models fir with TreeBUGS R package (Heck et al., 2018) on the 4 datasets with n.iter = 50000, n.burnin = 10000, n.adapt = 10000, n.thin = 3, and selecting more stringent priors only for T, Ts, R, Rs (different depending on the dataset, either dnorm(1,0.5) or dnorm(0.8,1)). The model is saturated (df = 0).

Hypothesis 2 confirmed in all datasets, with $prevT_{response\ repetition} > prevT_{response\ switch}$.

	Mayr 2002		Grange 2023		Experiment 1		Experiment 2	
Parameter	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
prevT	0.51	0.06	0.49	0.02	0.22	0.15	0.6	0.03
prevTs	0.13	0.04	0.36	0.01	0.11	0.07	0.19	0.03
R	0.99	<0.01	0.99	<0.01	0.89	0.01	0.9	0.01
Rs	0.99	<0.01	0.99	<0.01	0.89	0.01	0.9	0.01
T	0.99	<0.01	0.96	<0.01	0.98	0.01	0.89	0.01
Ts	0.99	<0.01	0.98	<0.01	0.98	<0.01	0.93	<0.01
prevT > prevTs?	$t(38) = 79.47$, $BF_{10} = 1.28^{40}$, d = 12.72		$t(254) = 160.07$, $BF_{10} = 37.75^{251}$, d = 10.02		$t(95) = 30.05$, $BF_{10} = 37.47^{251}$, d = 3.07		$t(95) = 41.9$, $BF_{10} = 2.46^{59}$, d = 4.28	

Summary & Discussion

- Retrieval of N-1 task seems more likely upon repetition of the N-1 response (i.e., the correct, but eventually not executed keypress).
- **This pattern is predicted by feature binding and episodic retrieval accounts of the RR effect**, but not by other accounts. Hence these results support this account over the others.
- The "**contingent encoding assumption**", which posits that the cue and the target must be encoded before response selection can start, underlies most verbal and computational models of task switching (Schneider & Logan, 2014).
- This assumption implies a feedforward-only model (blue arrows), from task selection to response selection.
- However, **task and response selection may proceed more in parallel than thought and include feedback loops** (orange arrows).
- During response selection, task selection can still be diverted so that a different task is selected.
- **Episodic retrieval might underlie the re-selection**. Retrieval happens because the task and the response are bound in trial N-1, and repeating the response retrieves the task.



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