PROCEDURAL LEARNING IN THE SERIAL REACTION TIME TASK: A LONG WAY TO STABILITY

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INTRODUCTION

The Procedural Deficit Hypothesis proposes an underlying impairment in the procedural memory system in Dyslexia and Language Impairments (Ullman et al., 2020).

The Serial Reaction Time task has been used to test this hypothesis; however, findings have been inconsistent, and the reliability of this task has been questioned (West et al., 2018; 2020).

AIMS

1. Investigate which factors affect the amount and stability of procedural learning in the Serial Reaction Time task in neurotypical adults;
   - Similarity of input (Exp 1);
   - Number of sessions (Exp 2) (pre-reg osf.io/yb3sv);
   - Presence/Absence of an interstimulus interval (ISI) (Exp 3) (pre-reg osf.io/e6r8c);
   - Participants' age (Exp 3) (pre-reg osf.io/e6r8c);
2. Explore the relationship between procedural learning and language, literacy and attention skills;

METHODS

Serial Reaction Time task

- Response time task with an underlying pattern unknown to the participants, 90% of the trials follow sequence A (probable trials) and 10% follow sequence B (improbable trials) (figure 2)
- Procedural learning = Improbable trials – Probable trials

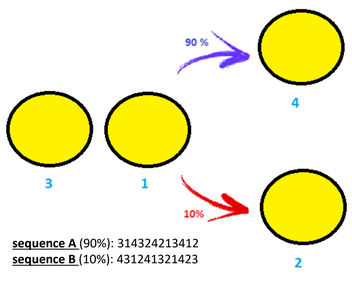

Figure 1.

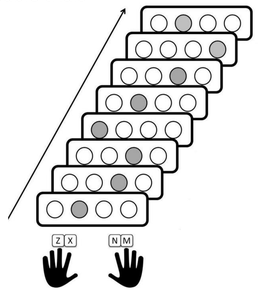

Figure 2.

Experiments

We conducted three separate experiments as described in table 1.

All experiments had a 1-week interval between sessions.

Table 1. Characteristics of the experiments

Exp	Age	N	Sessions	Setting	SRT sequences	ISI (ms)
1	19.17 [18-25]	102	2	In-lab	Diff seqs; varying similarity	0
2	20.09 [17-34]	47	3	In-lab	Diff seqs; highly similar	0
3	29.74 [18-60]	134	2	Online	Diff seqs; highly similar	0; noISI (N = 66); 250; ISI (N = 68)

THE STABILITY OF THE SERIAL REACTION TIME TASK INCREASES WITH THE NUMBER OF SESSIONS, BUT IS STILL BELOW PSYCHOMETRIC STANDARDS

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REFERENCES

Ullman, M. T., Earle, F. S., Walenski, M., & Janacsek, K. (2020). The Neurocognition of Developmental Disorders of Language. *Annual Review of Psychology*, *71*(1), 389–417.

West, G., Shanks, D. R., & Hulme, C. (2020). Sustained Attention, Not Procedural Learning, is a Predictor of Reading, Language and Arithmetic Skills in Children. Scientific Studies of Reading, 00(00), 1–17.

RESULTS

Across Experiments

- Participants show evidence of sequence learning on all sessions of the three experiments(Improbable RTs > Probable RTs) (Figure 4, 5, 6);
- Within session reliability is good and higher than across session reliability;
- Stability of the SRT task is suboptimal in all experiments (r < .70)

Experiment		Split-half	Test-retest
Exp. 1		.68 - .70	.16
Exp. 2		.55 - .91;	.28 - .60
Exp. 3	250-ISI	.61	.08 - .21
	noISI	.82 - .92	.42

Experiment 1

- Sequence learning was larger for more similar sequences (*Fig*. 6);
- Sequence similarity was not related to test-retest reliability (low/high similarity: r =< .30);

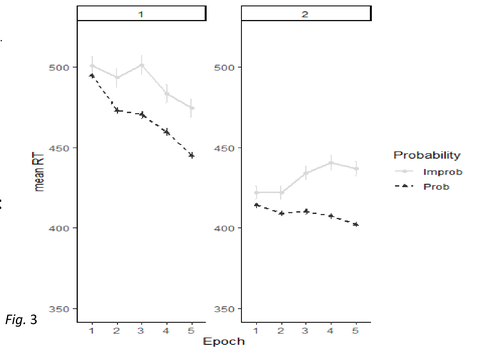

Fig. 3

Experiment 2

- Higher stability for later sessions (S1-2: r = 43; S2-3: r = 60);
- Sequence learning correlates with spelling (S1: r = .30), vocabulary (S3: r = .39), attention (S1: r = .44; S2: r = .49);

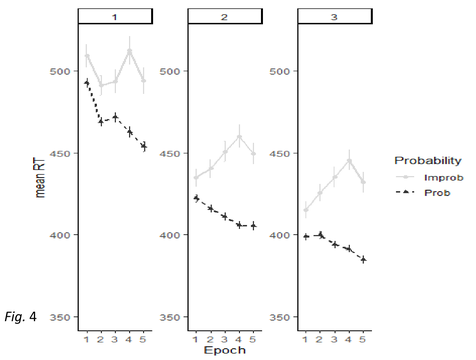

Fig. 4

Experiment 3

- No effect of age on sequence learning;
- Test-retest reliability higher for no-ISI group than 250-ISI group;
- Sequence learning correlates with attention but only for ISI group (S1: r = .44);

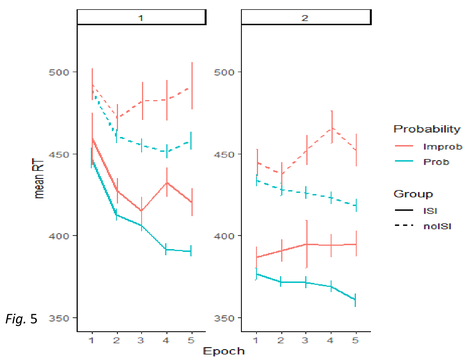

Fig. 5

DISCUSSION

- Sequence learning, but not stability, increases with the similarity of the input;
- Stability of sequence learning increases with practice, and is most evident when using regression slopes;
- Group with no-ISI shows higher stability than the 250-ISI group, but this is still suboptimal.
- Only partial support for the Procedural Deficit Hypothesis (Ullman et al., 2020) as no, or small, correlations with language/literacy measures were observed (and these were not consistent across sessions);
- Participants with better attention showed more evidence of procedural learning: Does poor attention represent an additional risk factor for procedural learning deficits?