Concurrent learning of explicit and implicit sequences

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INTRODUCTION

SEQUENCE LEARNING

Often assessed by

Serial Reaction Time (SRT) [1]

Explicit sequence learning

Clear series of steps to achieve a goal

- Preparing a coffee
- Car driving
- ...

Implicit sequence learning

Sensitivity to environnemental regularities

Simultaneously

Possible learning of distinct sequences in different dimensions (e.g. visual/temporal)[2,3]

Possible learning of 2 implicit sequences (as long as subjetcs were to attend the regularities)[4]

Subsequently
(1 sequence per block of trials)

Possible learning of two consecutive sequences but with a slight **interference** on the second sequence[5]

No research focused on the impact that can have the explicit learning of a sequence on an implicit learning presented in the same blocks.

QUESTION OF INTEREST:

Does the nature of learning for the secondary sequence (implicit vs. explicit) affect the implicit learning of the first sequence ?

Superficial bottom-up processing of explicit trials

Implicitly learning the secondary sequence involves the same processes

➔ We expected a reduced interference from the explicit sequence

METHODS

Task

Serial Reaction Time (SRT) with 2 distinct sequences in the same series of trials

Task : A choice reaction time task in which 4 possible stimulus locations are displayed horizontally (Fig.1).

Goal : quickly press the response button corresponding to the stimulus location.

Stimulus locations follow a predefined hidden sequence (First sequence - implicit sequence)

A second interfering sequence is included

EXPLICIT CONDITION

Explicit sequence – ES trials

Explicitly described to the participant (+training)

IMPLICIT CONDITION

Implicit sequence – IS trials

Hidden to the participant

+ random trials

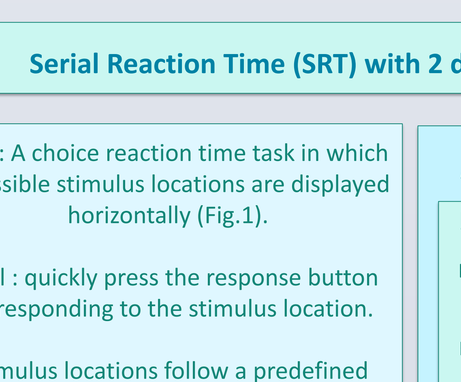
To distinguish implicit sequence learning from general improvement at the task

$$\bar{X}_{random} - \bar{X}_{implicit} = SSL^{*}$$ *(Sequence Specific Learning)*

*benefit of implicit learning

Example

Fig. 1



1 serie

[134231][RRRRRR][*423124*][RRRRRR]

- Stimuli locations of the 1st sequence - hidden
- Random trials
- Stimuli locations of the 2nd sequence – explicit or hidden
- Random trials

7 blocks of 10 series = 420 IS trials *(Sequence A)* + 420 ES/IS trials *(Sequence B)* + 840 random trials

Population

Conditions for the interfering sequence

N_{total} = 66	IMPLICIT	EXPLICIT
N	33	33
Mean age	28,24 (10,94)	26,54 (11,53)

3 SSL scores for each block
- SSL Sequence A
- SSL Sequence B
- Overall SSL

SSL scores computed for the implicit sequence in each block

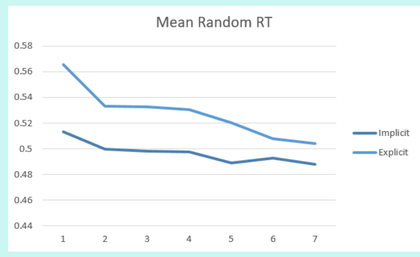
RESULTS

PRELIMINARY RESULTS

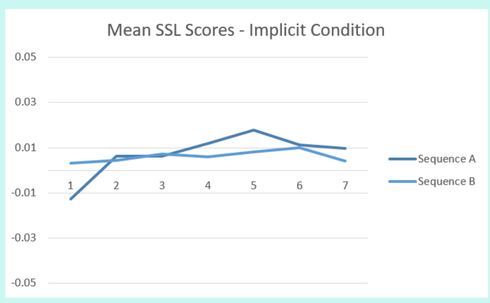
➔ Good accuracy in both conditions
Implicit : **96%** Explicit: **95%**

➔ Participants reported **no explicit knowledge** of hidden sequences

➔ General improvement at the task
Block effect: $F(6,52) = 2.33; p=0.045$ Block*Condition: $F(6,52)=1.16; p=0.342$



SSL ANALYSES (GLMM)



Block effect: $\chi^2(6) = 10.899, p=0.091$

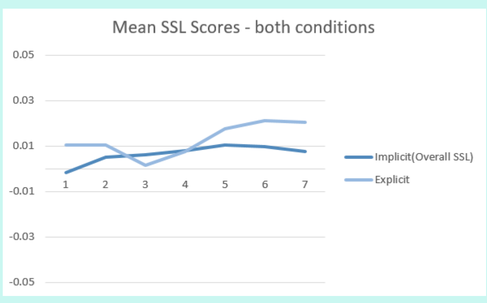
➔ Slight trend – Failed to reach significance

Sequence effect: $\chi^2(1) = 0.117$, p=0.731

➔ No difference between sequences

Block*Sequence Interaction: $\chi^2(6) = 5.818$, p=0.443

➔ No interaction



Block effect – **Explicit condition**: $\chi^2(6) = 14.934, p = 0.020$

➔ Implicit learning occured in the explicit condition

Condition effect: $\chi^2(1) = 0.824$, p=0.364

➔ No difference between conditions

Block*Condition interaction: $\chi^2(6) = 7.004$, p=0.3204

➔ No interaction

DISCUSSION

Implicit learning for the forst sequence is effective with an explicit interfering sequence

- We could not demonstrate implicit learning in the implicit condition, **but:**

χ^2 close to sig. + Effective learning in explicit condition + No condition effect

With more blocks/trials, we could expect implicit learning in both conditions

- No impact of the interfering sequence type:

Differential attentional requirements from the secondary sequences does not seem to play a role in the learning of the previous implicit sequence

2 possible explanations:

No actual effect of interfering sequences
→ More blocks would show implicit learning in both conditions

Both sequences interfere to the same extent
→ Removing interfering sequence would provide a greater learning

Limits
- No control group without interfering sequence
- Lack of blocks/trials to provide more robust results

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