# What is the impact of the sequence structure on implicit learning in children?

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## INTRODUCTION

It is generally admitted that implicit learning abilities are efficient early in childhood. **HOWEVER**, a question persists in the literature concerning the **age-invariance** and the **effects of sequence complexity** on learning.

**OBJECTIVE**

- To explore, with two Serial Reaction Time tasks adapted to the young child, whether **implicit learning abilities** are present to the same extent in 4-, 7-, and 10-year-old children
- To investigate the **impact of the structure** of the sequence **on** the children's performance
- To assess the **explicit awareness** developed by the children in this 2 SRT tasks

## SUBJECTS

**A TOTAL OF 107 CHILDREN**
- 32 4-year-old children
- 39 7-year-old children
- 36 10-year-old children

- Monolingual French speakers
- Normal or corrected vision
- No history of learning disabilities
- No neurological or behavioral diagnoses
- Right-handed

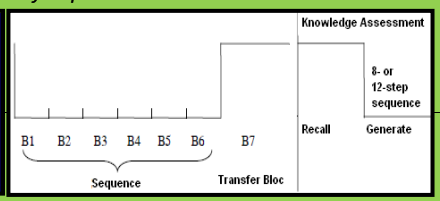
## MATERIAL & PROCEDURE

**Serial Reaction Time (SRT): The « Harry Potter task »**

Participants were randomly assigned to one of two adapted SRT tasks:

**Ambiguous sequence (8 items)** — **Second Order Conditional sequence (12 items)**

- **7 blocks** (one block consisted of 8 repetitions of the sequence).
  → the 7th block = transfer block
- The traditional SRT task was adapted in order to make the task more attractive for the children
  - → ***Touch screen*** *responding mode*
  - → *A sorcerer appears in four of the six windows of a castle*
  - → *The child has to touch the sorcerer with a magic wound* ***(pen stylus)*** *as fast and as accurately as possible*

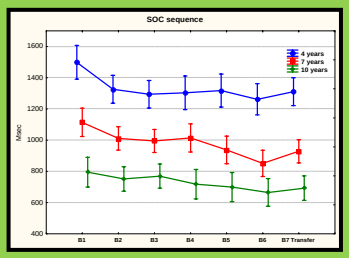


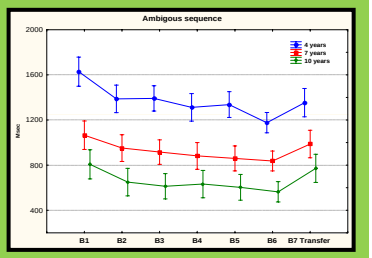

- **After the SRT task**, half of the children were asked a ***series of questions*** AND completed a ***free generate* task** to assess their subsequent explicit awareness of the sequence (8 or 12 trials – one repetition of the sequence)

## RESULTS

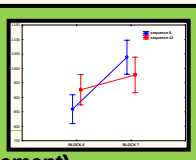
**I. ANOVA with Block (2 levels: 6 vs. 7) x Sequence (2 levels : SOC vs. Ambiguous) x Age group (3 levels: 4, 7, 10)**

Results showed **significant** but different **learning** effects for the two types of sequences
- Group effect: p<.001 → 10- children are faster than 4- and 7-year-old children
- Block effect : p<.001: block 6 is processed faster than the transfer block (B7)



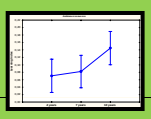




- Block x Sequence effect: p<.001
  → The difference between block 6 and block 7 is greater for the **Ambiguous sequence than for the SOC sequence**



**II. Learning Index measure (percent improvement)**
Stadler (1995) ([Bloctransfert – Bloc 6]/ [Bloc transfert + Bloc 6])

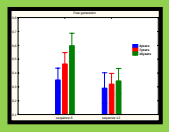
- **SOC sequence**: No Age group effect: p = .42 → the learning effect was similar in the different age groups
- **Ambiguous sequence**: Significant Age group effect : p=.047
  →the learning effect was different between age groups: the 10-year-old children showed better learning effects than the 4- and 7-year-old children.



**III. Explicit awareness measures**

→score=the longest correct sequence produced by each child /sequence's length

- Group effect : p<.001: **10-year-old** children are better than the other groups
- Sequence effect : p<.001: the generation score is better for the **ambiguous sequence** than for the SOC sequence
- No significant interaction: p =.153



## DISCUSSION

1) 4-, 7-, and 10-year-old children demonstrate significant learning effects with both the ambiguous and the SOC sequences with touch screen responding →**these results confirm that implicit learning abilities are present in early childhood**
2) **An age effect** appears only for the ambiguous sequence → the statistical structure of the sequence enables the child to use explicit strategies
3) This latter result confirms that explicit strategies might intervene in the children's SRT performance, which could explain the age effect observed for the ambiguous sequence

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