

# Implicit rhythmic abilities in children

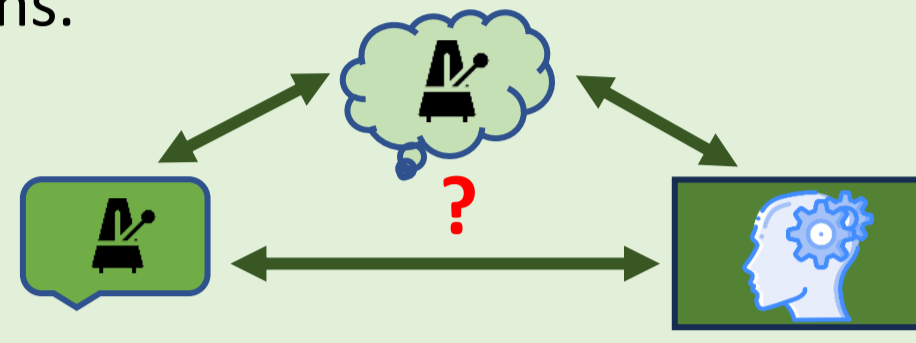
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## Introduction

- Rhythmic abilities are linked to cognitive development in childhood, and rhythmic deficits are found in many neurodevelopmental disorders. [1,2]
- The rhythm of auditory events can be processed:
  - Implicitly** = when temporal information is processed incidentally while performing a non-rhythmic task. [3, 4, 5]
  - Explicitly** = when we judge the temporal properties of an auditory sequence, such as its regularity
- Little is known about implicit rhythmic skills in children relative to explicit skills and attention/executive functions.



**Aim: to investigate implicit rhythmic abilities in children and their relationships with explicit rhythmic abilities and with attention and executive functions**

## Method

N= 101 children aged 7-13 (mean = 10.1 years ; SD = 1.7)

**RHYTHM: IMPLICIT TASK**

Instructions/goal NOT linked to rhythm  
 focus on pitch = press the button if the last sound has a higher pitch than the previous ones

2 conditions: temporally regular vs irregular

6 blocks of 30 trials (50% regular, 33% catch trials, 1block ~4min)

Expected: if children process the rhythm implicitly, they would anticipate the onset of the auditory events and improve their performance in the temporally regular condition:

Reaction Time (RT) and/or Accuracy (d')

Gamified task to maintain motivation and attention in children

Hits (star's color as a function of RT)      False Alarm      Block score

**RHYTHM: EXPLICIT TASKS** Instructions / goal linked to rhythm

Tablet version of the Battery for the Assessment of Auditory and Sensorimotor Timing Abilities (BAASTA) [7]

Beat Alignment Test (BAT) judge whether the sounds arrive on the musical beat

tapping in sync with music

Beat Tracking Index (BTI) [7,8]

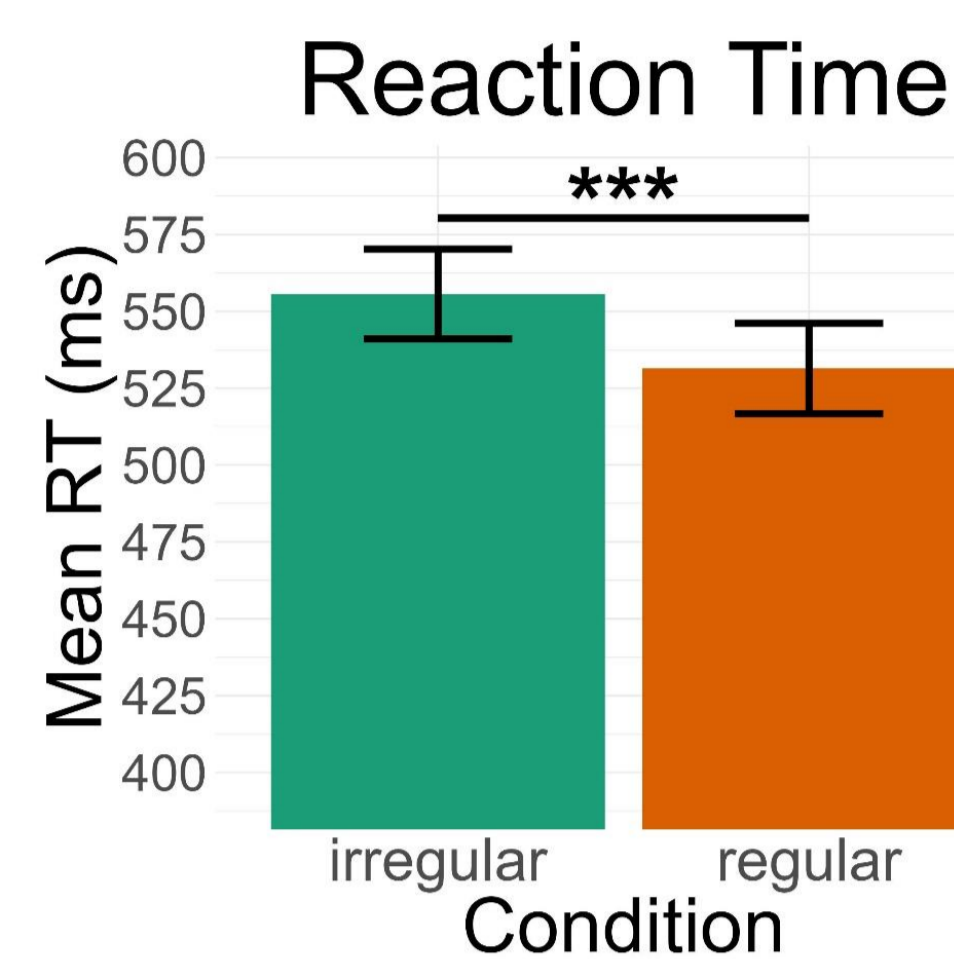
## COGNITIVE TESTS

- Auditory Sustained Attention (TEA-ch)
- Auditory Working Memory (WISC V)
- Inhibition (FEE)
- Flexibility (TEA-ch)
  - accuracy score
  - time score (the lower, the better)



## Results

- Children implicitly process temporal regularity to improve their reaction time



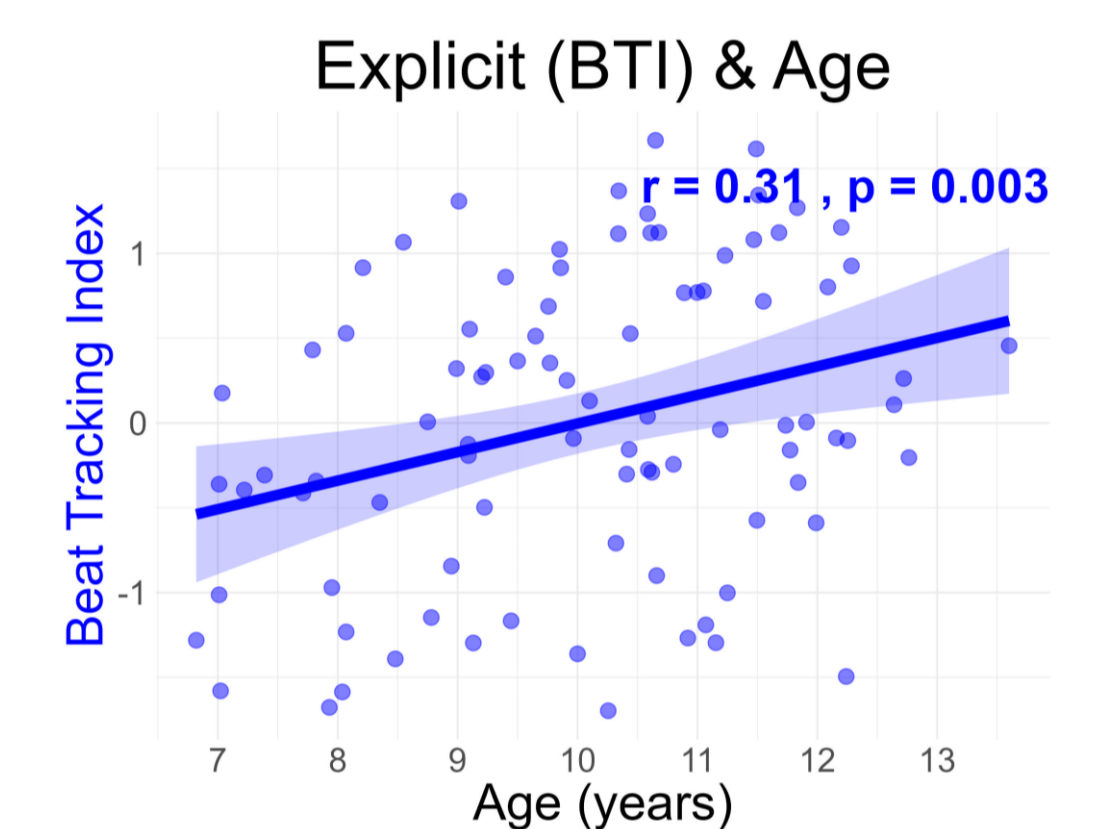
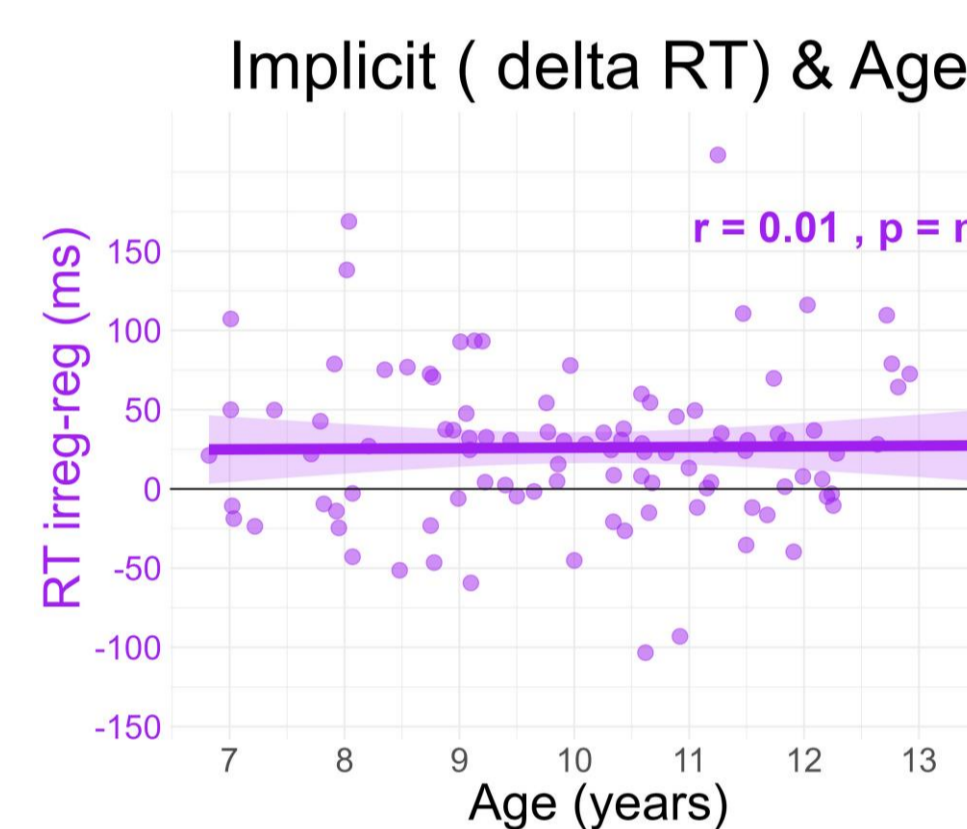
- Children responded faster when the sequence of sounds preceding the target was regular than when the sequence was irregular. ( $V = 1096, p < .001$ )
- Children were also less accurate in the regular condition ( $t = -3.39, p < .001$ ). The difference of accuracy between conditions was not a significant predictor of RT in a mixed-effects analysis.



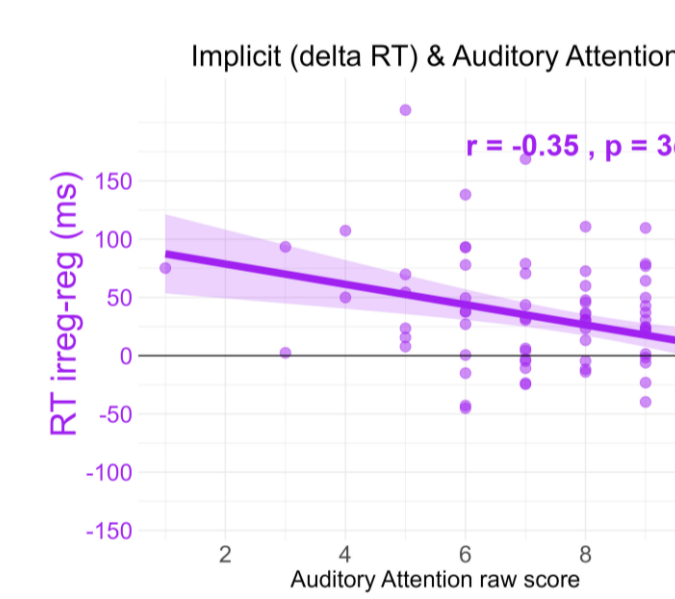
- Implicit abilities are independent of explicit rhythmic abilities

No correlations were found between the RT improvement in the implicit timing task and the performance in the explicit tasks.

- Implicit abilities are independent of age, whereas explicit abilities improve with age

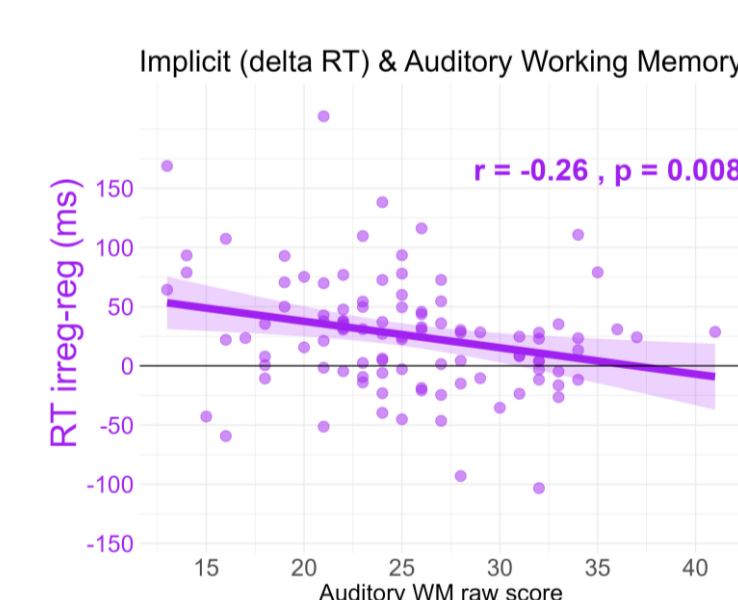


- Relations between implicit/explicit abilities and cognitive functioning:

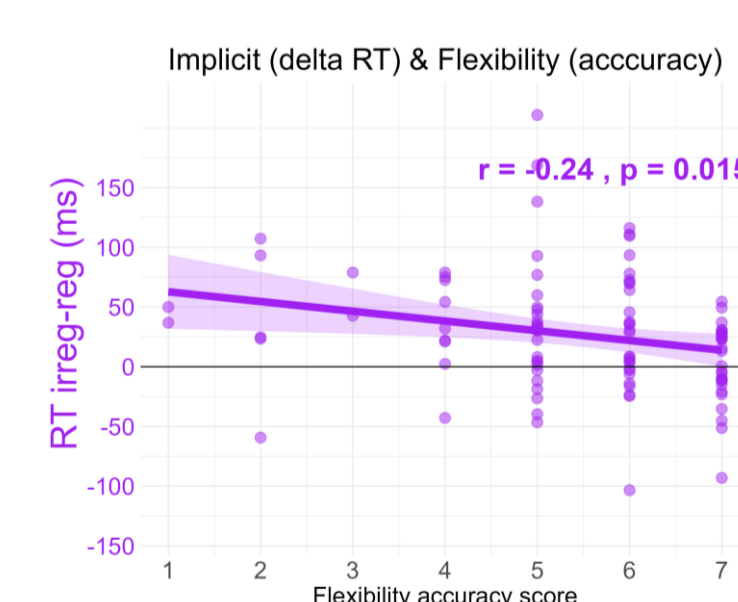
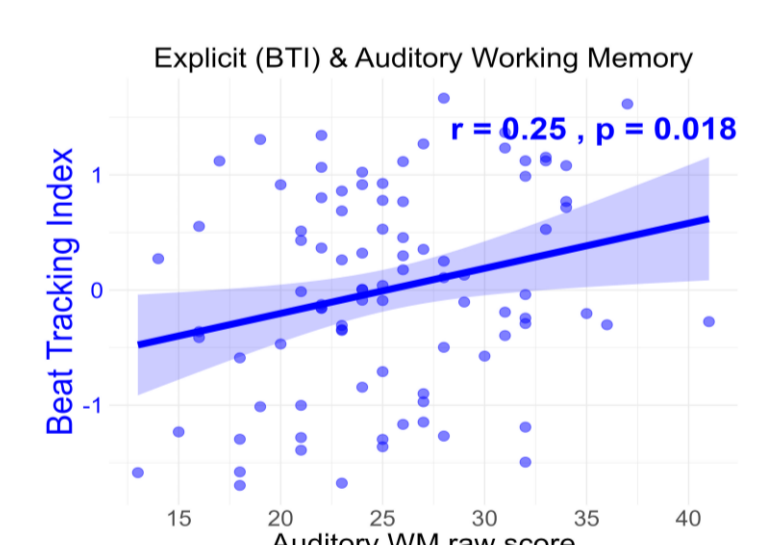


Auditory Attention

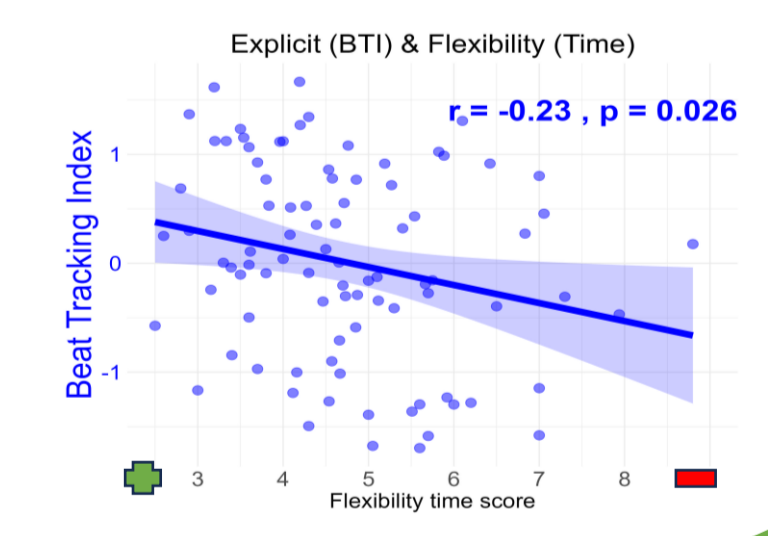
No significant relation between the BTI (explicit) and sustained Auditory Attention abilities



Working Memory



Flexibility



## Discussion

- Implicit and explicit rhythmic processing were not related in this developmental population.
- Implicit timing performance was independent of age, whereas explicit timing performance improved with age.
- Variability in implicit and explicit rhythmic performance in this population could be explained by different executive functions:
  - negatively linked to Attention, Working Memory and Flexibility (accuracy score)
  - positively linked to Working Memory and Flexibility (time score)
- Our results are in line with the hypothesis of different developmental trajectories for implicit vs explicit timing [9] and could pave the way for the development of new diagnostic or intervention tools using rhythm in neurodevelopmental populations.

## Acknowledgements



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