

Effects of Procedural Variations on Implicit Sequence Learning in Preschool-Aged Children: Role of Task Pace and Accuracy Feedback

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Introduction

Studies using serial-reaction time (SRT) tasks have suggested that in adults, measurements of implicit learning are robust across variations in task procedures. However, disparate results exist regarding the developmental invariance of implicit learning, possibly due to children's increased sensitivity to SRT task demands.

Most SRT tasks have used response-contingent pacing in which the participant's own reaction time determines the duration of each trial. In contrast, recent paradigms with adults and children have used fixed trial pacing. While this method can control for total stimulus exposure and task duration across participants, it is accompanied by changes in response demands and accuracy feedback.

The purpose of this project was to investigate whether procedural variations in SRT tasks (task pacing and accuracy feedback) impact implicit learning in preschool-aged children.

Questions

- 1) Do children show increased learning on tasks with self-paced trials compared to fixed-paced trials?
- 2) When children are able to control their pace, does accuracy feedback impact implicit learning?

Participants

All participants were screened for serious medical conditions, learning disabilities, and family history of learning and/or psychological disorders.

Experiment 1:

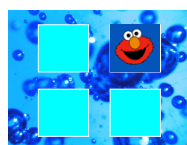
Task	N	Mean Age (sd)	Gender
Fixed	30	4.80 (.24)	15 female
Self NC	30	4.69 (.24)	15 female

Experiment 2:

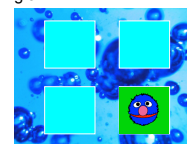
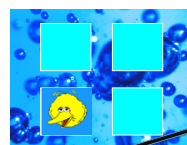
Task	N	Mean Age (sd)	Gender
Self NC	30	4.69 (.24)	15 female
Self	30	4.85 (.17)	15 female

Excluded Participants: Children who were explicitly aware of the sequence (5), children who failed to complete the task (15), and children who had poor accuracy ($< .70$ acc, (37)).

Methods



Task Instructions: Tag the character as quickly as possible by pressing a spatially corresponding button.



Awareness: Following the task, participants were asked a series of questions to assess for explicit awareness of the sequence.

Sequence Structure: Presented with interleaved blocks of sequence and pseudorandom trials.



Learning Measure: Assessed using z-normalized reaction time. Successful learning was indicated by faster responses during the sequence trials in comparison to the pseudorandom trials.

Fixed

- Fixed trial duration. (1500 ms).
- No accuracy feedback.

Self NC

- Variable trial duration. Pace is dependent on the time it takes to make any response.
- No accuracy feedback.

Self

- Variable trial duration. Pace is dependent on the time it takes to make a correct response.

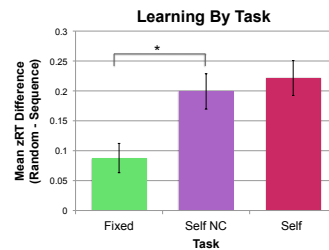
Experiment 1:
Task pace effect

Experiment 2:
Accuracy feedback effect

Results

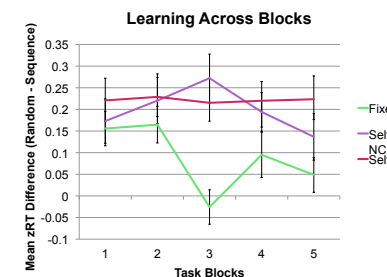
- Preschoolers showed equivalent accuracy across tasks.
- Preschoolers showed significant learning on all tasks (p 's $< .01$).

Experiment 1: Children showed significantly greater learning on the self-paced task vs. the fixed-paced task ($p < .05$).



Experiment 2: Children showed equivalent learning on the two self-paced tasks ($p = .59$).

Results



•Preschoolers completing the fixed-pace task showed differential learning across time compared to children completing the self-paced tasks.

Discussion

•**Effects of Task Pace:** Preschoolers showed reduced learning on a task using fixed-pace stimuli, suggesting that self-paced stimulus presentation improves learning in this age group.

•**Effects of Accuracy Feedback:** Preschoolers showed equivalent learning on self-paced tasks that varied in accuracy feedback, suggesting that feedback does not impact learning in this context.

•**Developmental Differences:** Learning by preschoolers on all three task variants was reduced in magnitude in comparison to previous studies with adults (Hodel et al. 2009), suggesting a general immaturity of implicit learning skills in this age group.

Future Directions

•**Developmental Change in Task Sensitivity:** Given that adults do not show learning differences on these tasks (Hodel et al. 2009), at what point in time does learning become equivalent in fixed- and self-paced conditions?

•**Effects of Motivation or Reward:** Because children's learning was improved in self-paced conditions (which may be more intrinsically motivating), could tasks that manipulate motivation and/or reward impact implicit learning in this age group?

•**Task Design:** Given the high exclusion rate for task completion, can more appealing and ecologically valid implicit learning tasks be developed for younger children?

Acknowledgments

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