Selective Attention Development Affects Implicit Learning

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Abstract
The role that developing selective attention plays in implicit learning was examined in two experiments using the "contextual cuing" paradigm (Jiang & Chun, 2001). In experiment one, 6, 8, and 10 year olds as well as adult participants completed a visual search through stimuli presented in an attended (e.g. red) and unattended (e.g. green) color. When the spatial configuration of items was in the attended color, invariant, and consistently paired with the target location, adult reaction times improved, demonstrating learning. Of child participants, ten year olds showed this learning, but only when the stimuli in both the attended and the unattended colors remained invariant. In experiment two, ten year olds and adults completed the same task but the ratio of attended to unattended stimuli varied (e.g. 75:25, 50:50, and 25:75). Differences in learning as a function of the attended to unattended ratio.

Background
Across childhood, our ability to selectively attend to different aspects of the environment develops, potentially affecting implicit learning. While the development of both attention and learning are often studied, the interaction of the two is not as well understood, particularly in the context of development. Previous research suggests that:

- Selective attention improves across development (e.g. Enns & Girgus, 1985)
- Implicit learning is NOT thought to show differences across development (e.g. Macleman, Van der Linden, & Fornel, 1996), although recent studies indicate subtle changes (e.g. Thomas & Nelson, 2001).

Selective attention and implicit learning interact, with attention influencing implicit learning, and learning affecting selective attention (Jiang and Chun, 2001). However, little is known about the role of selective attention in implicit learning across development. Therefore, the purpose of the present research is to explore how selective attention may play in implicit learning in the course of development using a context cuing paradigm.

Experiment 1
The main goal of Experiment 1 was to explore the selectivity of children’s attention to relevant contextual information in implicit learning. Previous research has shown that children as young as six are capable of implicit learning in a standard contextual cuing paradigm (Vaidya et al., 2002). Therefore, this experiment builds from the Vaidya et al. study and explores the development of selective attention to the relevant context.

Participants
- 23 Six year olds (13 Female, 10 Male, mean age=6 years 7 months, SD=2.76)
- 20 Eight year olds (8 Female, 12 Male, mean age=8 years 8 months, SD=3.10)
- 20 Ten years olds (11 Female, 9 Male, mean age=10 years 8 months, SD=0.93)
- 20 Adults (13 Female, 7 Male, mean age=20 years 8 months, SD=33.42)

Participants were recruited from the University of Minnesota and Minneapolis Area. All participants were screened for color blindness and learning disorders (based on self and parent report). Additionally, all adult participants as well as parents of children gave informed consent and all eight and ten year old children gave informed assent.

Methods
Similar to the contextual cuing paradigm (Chun & Jiang, 1998), in this task participants were presented with a visual display containing a number of rotated "T" (distractors) and a single rotated "T" (target). Distractors appeared in two colors, red and green, and participants were asked to attend to only one of the colors (the same color as the target). The participants’ task was to find the rotated "T" as quickly as possible and indicate the direction its stem was facing (left or right). However, the structure of the visual search varied creating four conditions.

16 Red and Green Stimuli
- 7 Distractors in the Attended Color
- 8 Distractors in the Unattended Color
- 1 Target in the Attended Color

10 Year Olds
- 10 adults significant learning of the Both-Old and Attended-Old Conditions in 75:25 task (p<.01), trend in the Both-Old condition in 50:50 task (p=.074)

Discussion
Results from Experiment 2 combined with Experiment 1 suggest:

- Implicit learning improves across development and interacts with the development of selective attention
- Adults and 10 year olds selectively allocate attention to the attended color (as reflected in increasing reaction times with number of stimuli attended and in learning of the both-old and attended-old conditions)
- 10 year olds learned as a function of the ratio of attended to unattended stimuli suggesting immature filtering of distractor information

Future research should explore the development of filtering aspects of attention in relation to implicit learning.

References
Please see handout or contact the first author at jcouperus@hampshire.edu.

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