The Trajectory of Change in Toddlers' Inhibitory Control

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Introduction

- High effortful control, or the purposeful regulation of one's attention and behavior, has been linked to lower negative emotionality, problem behaviors (both internalizing and externalizing), social competence, conscience, and prosocial responding among children (Eisenberg, Smith, Sadovsky, & Spinrad, 2003).
- Inhibitory control (IC) is a mechanism of effortful control that involves suppression of a preferred or predominant response in favor of a non-preferred or subordinate response (Kochanska, Murray, & Coy, 1997; Rueda, Posner, & Rothbart, 2005).
- IC parallels the development of attention among infants, emerging toward the end of their first year (Rothbart & Ahadi, 1994; Rothbart, Derryberry & Posner, 1994) and continuing to improve through the preschool years (Rothbart & Bates, 2006).
- Extant literature has examined IC through rating forms (e.g., Children's Behavior Questionnaire, Rothbart, Ahadi, & Hershey, 1994) as well as lab-based behavior tasks (e.g. Go/No Go tasks, Carlson & Moses, 2001).
- Behavior tasks assessing IC resembling the game Simon Says have demonstrated improvement in children's IC between 36 and 48 months of age (Jones, Rothbart, & Posner, 2003).
- One performance task assessing IC is the Bird/Alligator task (adapted from Reed et al, 1984), requiring children to inhibit behavior directives from one puppet and obey those from the other.
- Researchers have yet to compare the developmental trajectories produced from parental ratings of IC and the Bird/Alligator lab task.

Purpose of Study

To examine associations between parents' perspectives of children's IC (measured with the IC subscale from the CBQ), and behavioral assessment of IC that was conducted in a research lab (measured with the Bird/Alligator Game).

Methods

Participants

- Data for the present study included N=85 children whose IC was tested with the Bird/Alligator task repeatedly over three sessions at the age of 30, 36, and 42 months. All children were part of a longitudinal examination of developmental implications of early childhood sleep (Bates, Molfese, Rudasill, & Molfese, 2012), and had parental consent for participation. Prior to each assessment, parents also provided their ratings of children's IC using a checklist.

Methods

Measures

- Child Inhibitory Control (IC) was assessed in two ways: A lab-based performance task named the *Bird/Alligator Game* (B/A; Reed et al, 1984), and parent report on the *Children's Behavior Questionnaire* (CBQ; Rothbart, Ahadi, & Hershey, 1994).
  - *Lab-Based IC* used the B/A task to assess behavioral self-regulation and *IC*.
    - In this task, the experimenter asked the child to play a game involving a bird and an alligator. The child is instructed to listen to the "nice" bird puppet and perform its simple commands (e.g. "touch your nose") ("GO TRIAL"), but ignore the "naughty" alligator puppet and its commands ("NO GO" TRIAL). The 36-month assessments included a rule shift where if, after completing the task the child has a score of 100% correct, the go and no-go trials were reversed (i.e., alligator became "go"; bird, "no-go"). The 42-month assessments included the rule shift regardless of performance on the first trial.
    - Each no-go trial was scored on a 0 (full movement) to 3 (no movement) scale. The final B/A score was the child's average score on all the no-go trials (0–3).
  - *Parent-reported IC* was obtained from the Inhibitory Control subscale from the CBQ.
    - Parents were asked to rate their child on each item, using a 7-point Likert scale ranging from "extremely untrue" to "extremely true."
    - The Inhibitory Control subscale measured a child's ability to respond to parent's instructions, e.g., "Can easily stop an activity when s/he is told 'no.'" Items were averaged, and higher scores indicate greater capacity to suppress inappropriate responses under instructions.

Data Analyses

- Individual differences in participants' change in IC (as measured by the lab and parent report) across three occasions (30, 36, and 42 months) were examined within SAS PROC MIXED in which occasions were modeled as nested within persons. Linear model for time provided the best fit for each outcome, indicating significant linear growth in children's IC from 30 to 42 months (see Table 1). Further, in order to compare the slopes between the two models for IC, the data were standardized (see Table 2). The differences in two slopes were calculated using the formula by Clogg, Petkova, & Haritou (1995): $Z= (\beta 1- \beta 2)/SQRT((SE\beta 1)^2+(SE\beta 2)^2)$.

Results

Figure 1. CBQ (Parent Report) Score Trajectory

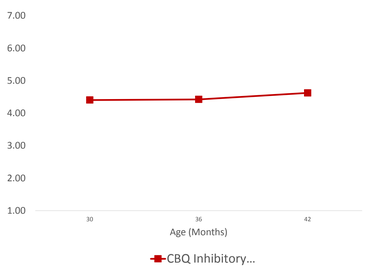
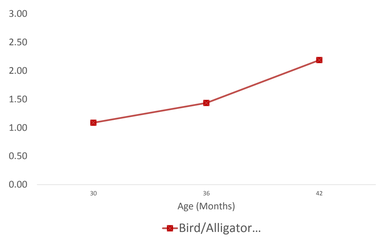


Figure 2. B/A (Lab Report) Score Trajectory



- The trajectories of scores across time points are presented in Figure 1 (CBQ) and Figure 2 (B/A).
- The linear model indicated significant linear growth in IC from 30 to 42 months for both parent and lab reports of IC (Table 1).
- Standardized linear model results (Table 2) indicate that the lab data show significantly faster growth in children's IC (β =0.47, SE(β)=0.06) compared to the parents' reports (β =0.10, SE(β)=0.05) (z=4.61).

Results

Table 1. Unstandardized Results For Inhibitory Control

	Parent report			Lab report		
Model for the Means	B	SE(B)	p-value	B	SE(B)	p-value
Intercept	4.31	0.09	<.0001	0.51	0.15	0.0012
time	0.08	0.04	0.0354	0.53	0.07	<.001
Model for the Variance						
Residual	0.25	0.04		0.84	0.09	

Table 2. Standardized Results For Inhibitory Control

	Parent report			Lab report		
Model for the Means	B	SE(B)	p-value	B	SE(B)	p-value
Intercept	-0.20	0.11	0.085	-0.92	0.14	<.001
time	0.10	0.05	0.0354	0.47	0.06	<.001
Model for the Variance						
Residual	0.39	0.04		0.66	0.07	

Discussion

Key Take-away points

1. Children show significant increases in IC from ages 30 months to 42 months.
2. A lab-based measure of IC appears to detect faster growth in IC than parental reports of temperamental regulation.

Practice and Policy Implications

1. Early childhood educators should be mindful of differences in IC when working with and setting expectations for individual children.
2. Efforts to detect changes in IC among children may be more efficient when using behavioral measures of IC which detect faster growth than using parental report.

Future Directions

1. Research is needed that examines changes across the time points to better understand individual differences in growth of IC and variables that influence growth.
2. Use of additional measures of IC (e.g. additional performance tasks and ratings scales) may add to our understanding of developmental changes in IC domain.
3. Administration of performance measures in early education settings may add to our understanding of children's IC in real world (non-laboratory) settings.
4. Studies of trajectories of IC are needed to predict later academic success.

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