

# ***The Development of Self Regulation: Implications for Understanding Disparities in Health and Development***

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## ***What is self regulation?***

- *“Primarily volitional cognitive and behavioral processes through which an individual maintains levels of emotional, motivational, and cognitive arousal that are conducive to positive adjustment and adaptation, as reflected in positive social relationships, productivity, achievement, and a positive sense of self.”*

Blair, C. B., & Diamond, A. (2008). Biological processes in prevention and intervention: The promotion of self-regulation as a means of preventing school failure. *Development and Psychopathology*, 20, 899-911.



# ***How is self regulation related to health and development?***

- Children with lower self regulation skills are:
  - at greater risk of obesity (Bonato & Boland, 1983; Bourget & White, 1984; Francis & Susman, 2009; Seeyave et al., 2009; Tan & Holub, 2011; Tsukayama et al. 2010)
  - more likely to experience early school failure (Blair & Diamond, 2008; Evans & Rosenbaum, 2008; Li-Grining et al., 2010; Matthews et al., 2009, 2010; McClelland et al., 2007; Raver, 2002)
  - at greater risk for behavior problems (Barkley, 1997; Brewis et al., 2003; Dennis et al., 2007; Eisenberg et al., 2001; Hill et al., 2006; Martel & Nigg, 2006)



## ***How is self regulation related to health and development?***

- Youth with lower self regulation skills are:
  - more likely to engage in risky behavior (See Romer 2010 for a review)
  - less well adjusted in adolescence (Mischel et al., 1998)
  - more likely to engage in and persist with antisocial behavior during adolescence (Monahan et al., 2009)
  - may be less able to effectively self-manage **chronic illness** (Berg & Wiebe, *A self-regulation approach to diabetes adherence into emerging adulthood*, 1-R01-DK092939-01)



**Table 2. Percentage of Teachers (Means and Standard Errors) Who Said that *About Half of the Class or More* Enter Kindergarten with Specific Problems ( $N = 3,595$ )**

Type of Problem	Percentage of Teachers ( <i>SE</i> )
Difficulty following directions	46.16 (1.07)
Lack of academic skills	36.26 (0.98)
Disorganized home environment	34.54 (1.00)
Difficulty working independently	34.39 (1.02)
Lack of any formal preschool experience	30.79 (0.99)
Difficulty working as part of a group	30.45 (0.99)
Problems with social skills	20.39 (0.88)
Immaturity	19.87 (0.87)
Difficulty communicating/language problems	13.50 (0.72)

Rimm-Kaufman, S. E., Pianta, R. C., & Cox, M. J. (2000). Teachers' judgments of problems in the transition to kindergarten. *Early Childhood Research Quarterly, 15*, 147-166.



# *Self regulation and school readiness*

McClelland, M. M., Cameron, C. E., Connor, C. M., Farris, C. L., Jewkes, A. M., & Morrison, F. J. (2007). Links between behavioral regulation and preschoolers' literacy, vocabulary, and math skills. *Developmental Psychology*, 43, 947-959.

Table 3  
*Correlations for Behavioral Regulation and Background Variables*

Variable	1	2
1. Fall behavioral regulation	—	—
2. Spring behavioral regulation	.48***	—
3. Fall child age (in years)	.28***	.12*
4. Gender (Girl = 0, Boy = 1)	-.05	-.14*
5. Fall prior child care experience (in months)	.12 <sup>†</sup>	.14*
6. Fall hours per week in prekindergarten	.03	.05
7. Parent education level (in years)	.14*	.20**
8. Minority (0 = White or Asian, 1 = other minority)	-.16**	-.22***
9. Spanish behavioral regulation task (0 = English version, 1 = Spanish version)	-.14*	-.16**
10. Fall literacy ( <i>W</i> -scores)	.25***	.18**
11. Fall vocabulary ( <i>W</i> -scores)	.35***	.27***
12. Fall math ( <i>W</i> -scores)	.47***	.41***
13. Spring literacy ( <i>W</i> -scores)	.23***	.22***
14. Spring vocabulary ( <i>W</i> -scores)	.32***	.30***
15. Spring math ( <i>W</i> -scores)	.39***	.37***

<sup>†</sup>  $p < .10$ . \*  $p < .05$ . \*\*  $p < .01$ . \*\*\*  $p < .001$ .



**Table 2. Overweight at Age 11 Years in Relation to ATDG at Age 4 Years in Unadjusted and Adjusted Analyses**

Characteristic	Relative Risk (95% Confidence Interval)				
	Unadjusted (n=818)	Base Model (n=805)	Base Model Adjusted for Child's BMI z Score at 4 Years (n=797)	Base Model Adjusted for ME-ATDG (n=792)	Base Model Adjusted for Maternal Weight (n=801)
Inability to delay gratification <sup>a</sup>	1.44 (1.18-1.75)	1.29 (1.06-1.58)	1.30 (1.08-1.57)	1.28 (1.04-1.56)	1.16 (0.95-1.42)
Income to needs ratio <sup>b</sup>		0.92 (0.88-0.97)	0.95 (0.91-0.99)	0.92 (0.87-0.96)	0.96 (0.92-1.01)
BMI z score at 4 y			1.90 (1.73-2.10)		
No ME-ATDG for food				1.21 (0.99-1.47)	
Mean maternal weight status at 15, 24, and 36 mo <sup>c</sup>					1.32 (1.24-1.40)

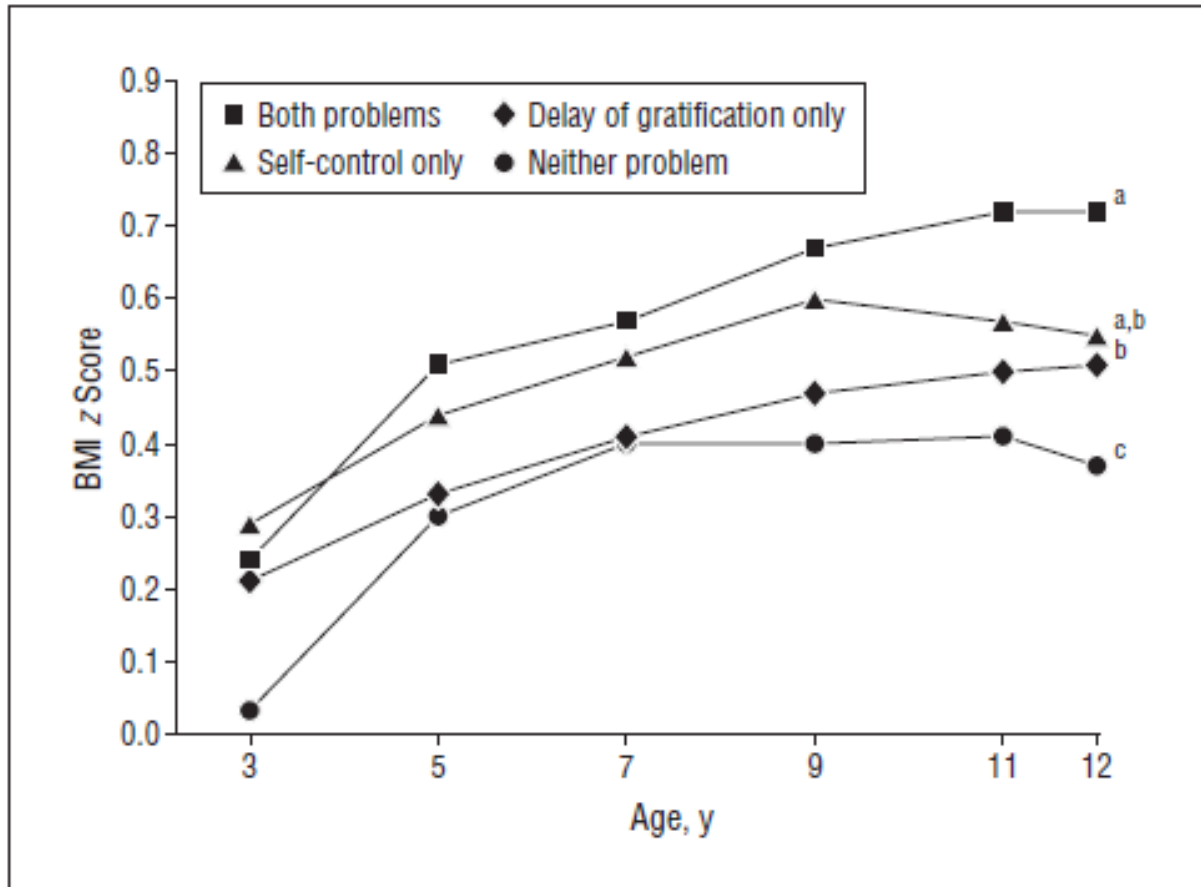
Abbreviations: ATDG, ability to delay gratification; BMI, body mass index; ME-ATDG, maternal expectation of child ATDG.

<sup>a</sup>Failed ATDG task.

<sup>b</sup>Reflects ratio of family income to poverty line; family living at poverty line has an income to needs ratio of 1.0, evaluated continuously with each 1-unit increase reflecting increase in income relative to the poverty line.

<sup>c</sup>Range 1 to 9, with obesity (BMI [calculated as weight in kilograms divided by height in meters squared]  $\geq 30$ ) at about 6; each 1-unit increase reflects increasing BMI.

Seeyave, D. M., Coleman, S., Appugliese, D., Corwyn, R. F., Bradley, R. H., Davidson, N. S. (2009). Ability to delay gratification at age 4 years and risk of overweight at age 11 years. *Archives of Pediatric and Adolescent Medicine*, 163, 303-308.



**Figure 1.** Child body mass index (BMI) z score from age 3 to 12 years by self-regulation group. The BMI z scores are standardized for age and sex and represent deviations from the group median at each point. Age 3 years, n=1090; age 5 years, n=1031; age 7 years, n=991; age 9 years, n=938; age 11 years, n=929; and age 12 years, n=917. Different superscript letters indicate significant differences between groups in the rate of change over time at  $P < .05$ .

Francis, L. A., & Susman, E. J. (2009). Self-regulation and rapid weight gain in children from age 3 to 12 years. *Archives of Pediatric and Adolescent Medicine*, 163, 297-302.





## ***Another definition of self regulation***

“Emotion regulation and executive function are both control processes that are linked in fundamental ways to more basic physiological and attentional processes and have consequences for later-developing and more sophisticated social and cognitive skills”

Calkins, S. D., & Marcovitch, S. (2010). Emotion regulation and executive functioning in early development: Integrated mechanisms of control supporting adaptive functioning. In S. D. Calkins & M. A. Bell (Eds.), *Child development at the intersection of emotion and cognition*. Washington, D.C.: American Psychological Association.



## ***Another definition of self regulation (cont.)***

“We ... embed these processes within the larger construct of self regulation. So, one way to conceptualize the self-regulatory system is to describe it as adaptive control that may be observed at the level of physiological, attentional, emotional, behavioral, cognitive, and interpersonal or social processes.”

Calkins, S. D., & Marcovitch, S. (2010). Emotion regulation and executive functioning in early development: Integrated mechanisms of control supporting adaptive functioning. In S. D. Calkins & M. A. Bell (Eds.), *Child development at the intersection of emotion and cognition*. Washington, D.C.: American Psychological Association.



## ***What is executive function?***

- Goal-directed behavior (Zelazo & Frye, 1998)
- Flexible behavior/thought (Munakata, 2001)
- The ability to use a representation to guide behavior despite pull of previous experience (Diamond, 2006b)
- General purpose control mechanism that modulates cognition (Miyake et al. 2000)

Garon, N., Bryson, S. E., & Smith, I. M. (2008). Executive function in preschoolers: A review using an integrative framework. *Psychological Bulletin*, 134, 32-60.



Inhibition

*The ability to ignore distraction and stay focused, and to resist making one response and instead make another*

*The ability to hold information in mind and manipulate it*

||



*The ability to flexibly switch perspectives or focus of attention*

||

Working memory

Cognitive flexibility



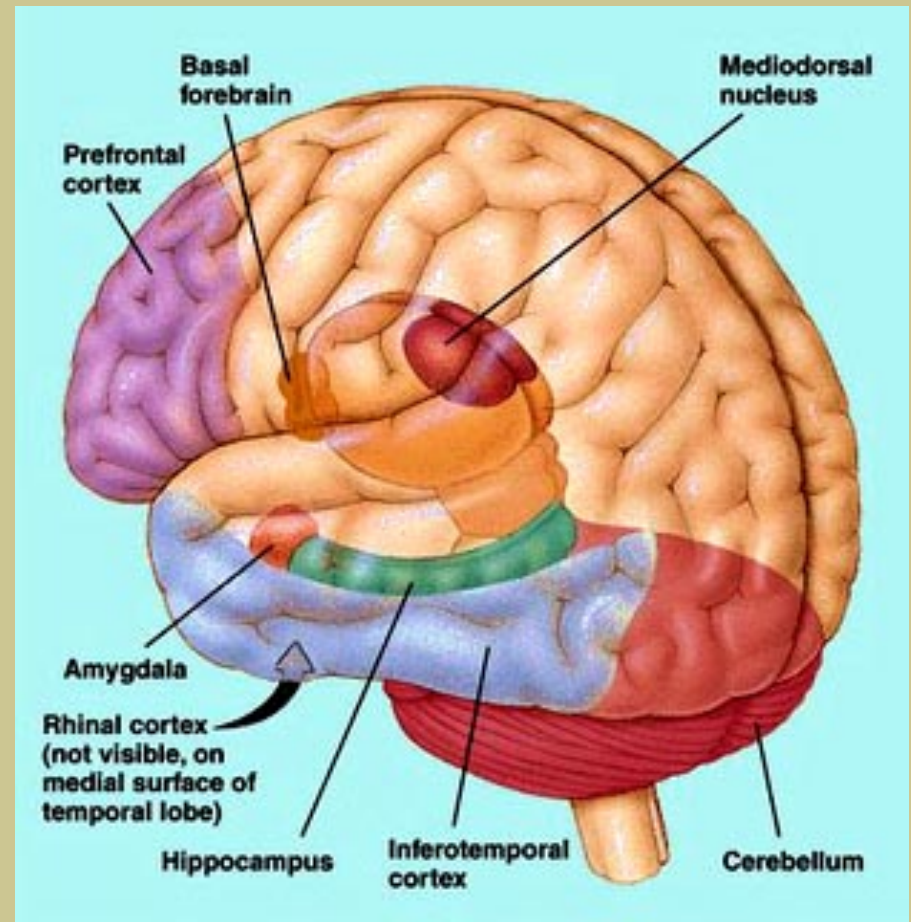
## ***Developmental course of self regulation***

- Shared neural pathways control both affective and cognitive processes
- Prefrontal cortex (PFC)
  - Central in executive function processes
  - Guided by the anterior attention system of the anterior cingulate cortex (ACC)
    - One part of ACC governs cognitive/attentional processes (connections to PFC)
    - Another part of ACC governs emotion (connections to limbic system)



## *Developmental course of self regulation*

- PFC and ACC – control higher order processes including planning, monitoring and goal setting; effortful
- Amygdala, hypothalamus – responsive to emotional cues; more automatic
- Connected in a feedback loop





## ***Developmental course of self regulation***

- Birth to age 1:
  - Emergence of voluntary control of attention
  - Enables child to regulate emotional reactivity
  - Control of emotions enables child to engage in broader array of cognitive tasks
- Age 1-3
  - Further development of voluntary attention; planful control of attention



## ***Developmental course of self regulation***

- Preschool (age 3-5) – marked improvements in inhibition and cognitive flexibility (ability to change perspectives)
- Through adolescence – continued development of the PFC (linear decrease in impulsivity across childhood/adolescence); increase in reward-seeking behavior



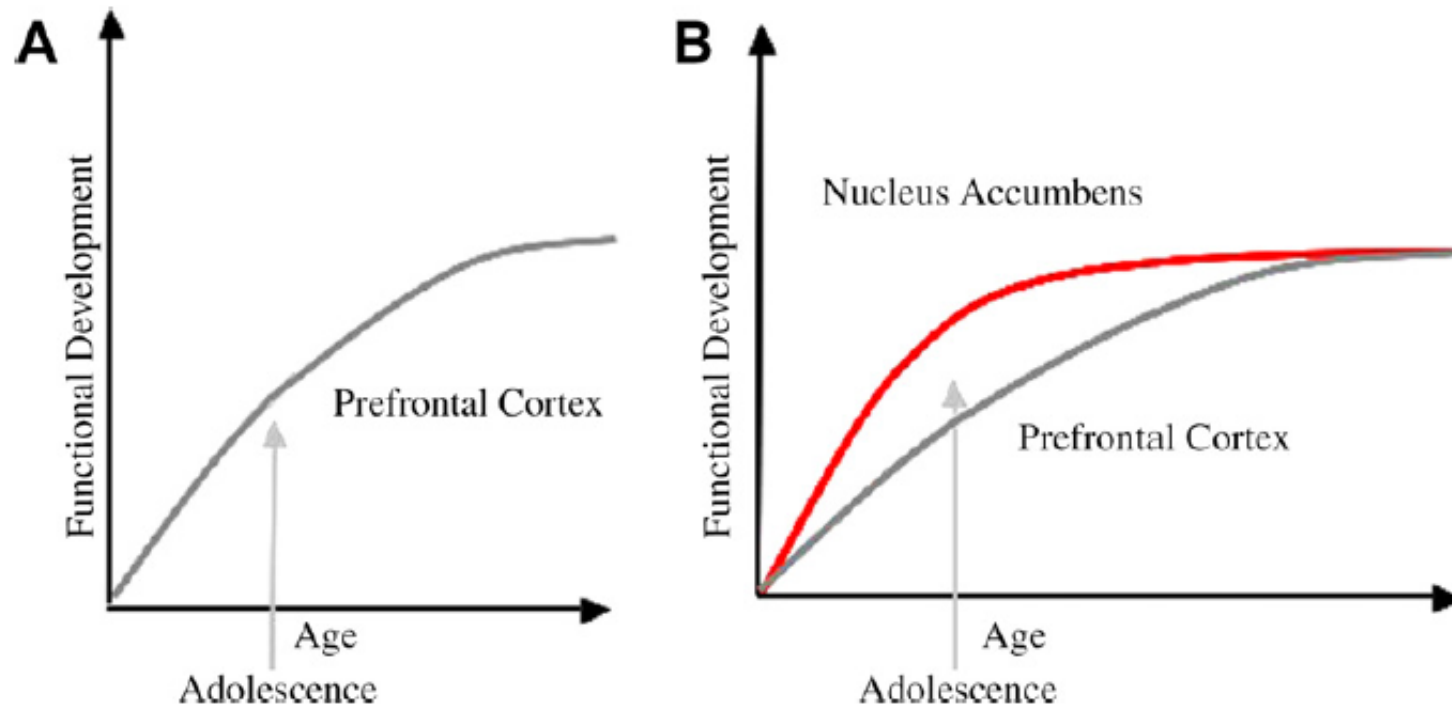


Fig. 1. The traditional explanation of adolescent behavior has been suggested to be due to the protracted development of the prefrontal cortex (A). Our model takes into consideration the development of the prefrontal cortex together with subcortical limbic regions (e.g., nucleus accumbens) that have been implicated in risky choices and actions (B).

Casey, B. J., Getz, S., & Galvan, A. (2008). The adolescent brain. *Developmental Review*, 28, 62-77.

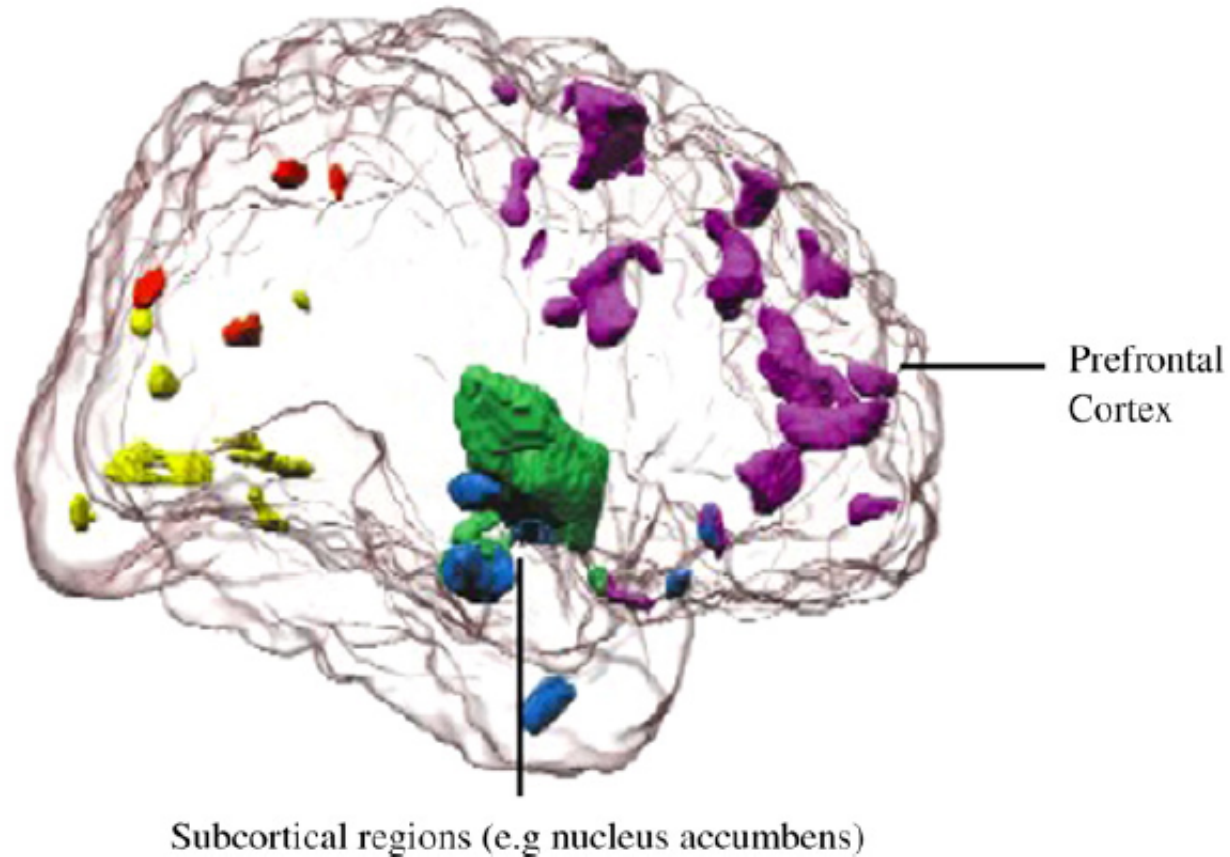


Fig. 3. Illustration of the brain regions showing the greatest structural changes over early and late adolescence (from Sowell et al., 1999).

Casey, B. J., Getz, S., & Galvan, A. (2008). The adolescent brain. *Developmental Review*, 28, 62-77.



# ***How do we assess self regulation skills?***

- Inhibitory control (simple)
  - Delay of gratification
    - Very young children: snack delay, forbidden toy, wrapped gift
    - School age children: take a smaller reward now or a larger reward if you wait



# ***How do we assess self regulation skills?***

- Working memory
  - Forward/backward digit span
  - Keeping track
  - Memory chocolates





# *How do we assess self regulation skills?*

- Inhibitory control (complex)
  - Adolescents/adults
    - Stroop test

**BLUE**

**GREEN**

**YELLOW**

**PINK**

**RED**

**ORANGE**

**GREY**

**BLACK**

**PURPLE**

**TAN**

**WHITE**

**BROWN**

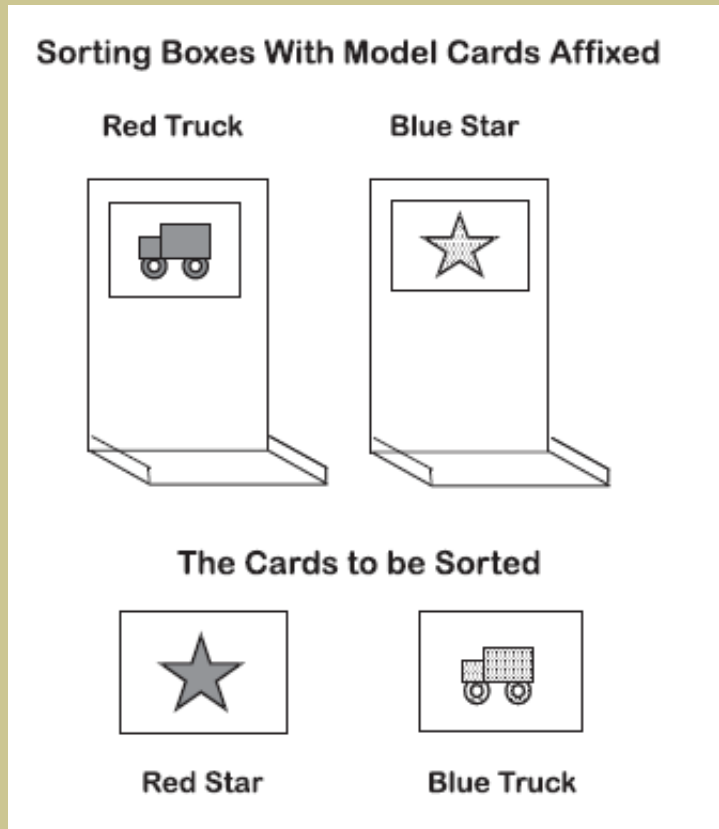


# ***How do we assess self regulation skills?***

- Inhibitory control (complex)
  - Adolescents/adults
    - Go/No-Go tasks
    - Tower of London/Tower of Hanoi
    - Flanker task
  - School-age children (kindergarten and up)
    - Advanced Dimensional card change sort
    - Go/No-Go Tasks



# ***Dimensional Card Change Sort***



Diamond, A., Carlson, S. M., & Beck, D. M. (2005). Task switching on the dimensional change card sort task: Separating the dimensions aids the ability to switch. *Developmental Neuropsychology*, 28, 689-729.



# ***How do we assess self regulation skills?***

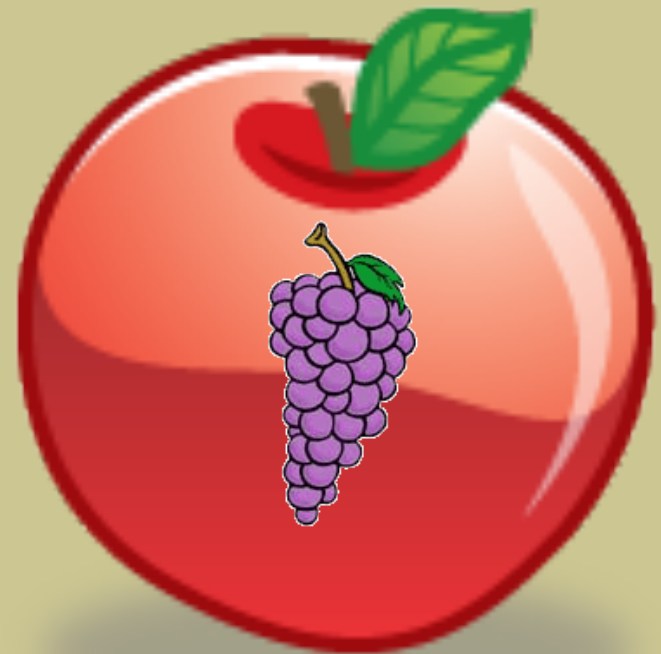
- Inhibitory control (complex)
  - Preschoolers
    - Bear/Dragon, Day/Night, Grass/Snow
    - Fruit Stroop (aka “shape stroop”)
    - Regular Dimensional Card Sort
    - Heads-Toes-Knees-Shoulders
    - Mommy & Me





# ***Complex response inhibition: Fruit Stroop***

***"Show me the baby grapes"***





# ***Complex response inhibition: Mommy & Me***

## **Mommy & Me**



**Dallas Preschool  
Readiness Project**

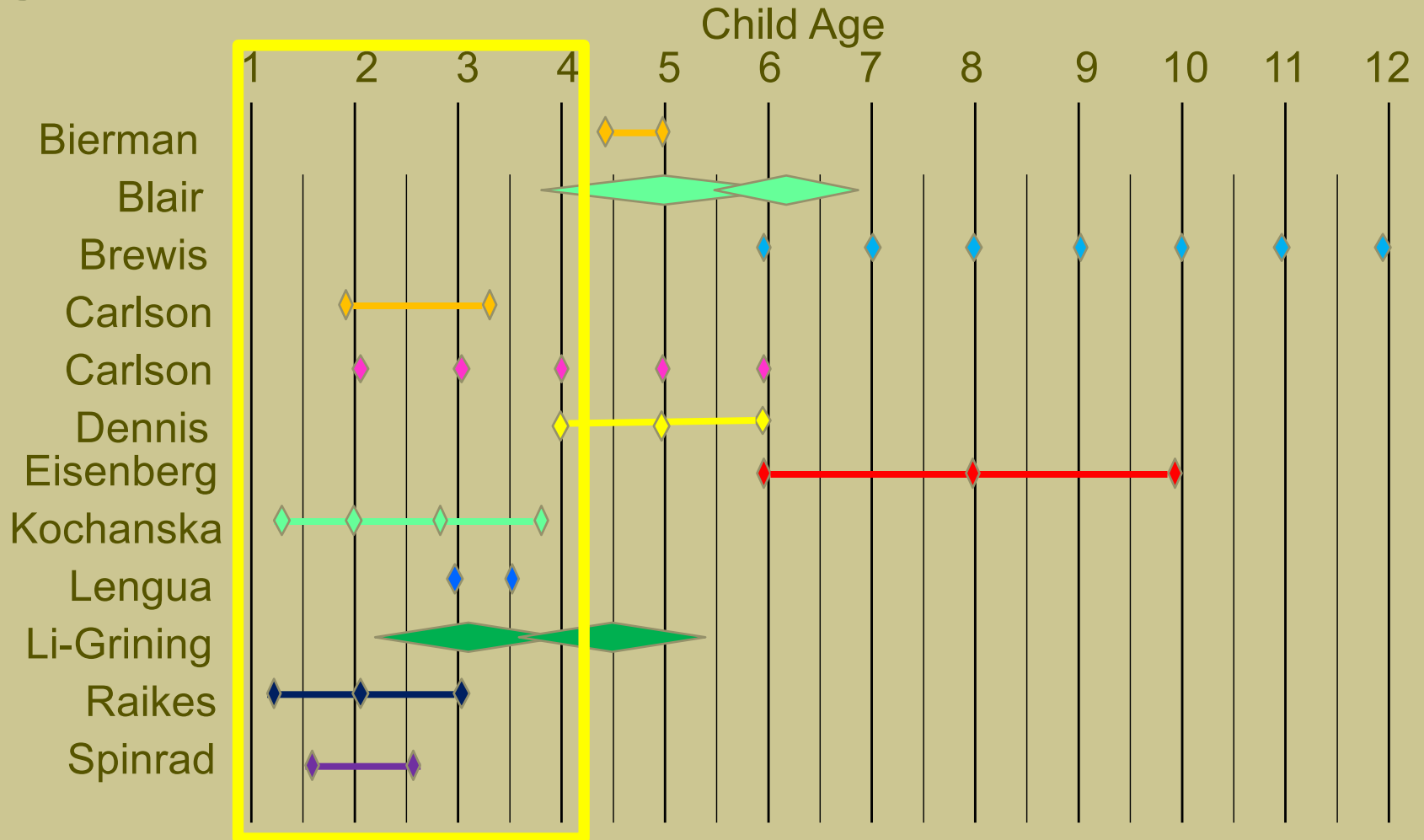


## ***What do we know about disparities in self regulation development?***

- Risk factors associated with poverty are associated with poorer self regulation development
  - Maternal depression
  - Coercive depression
  - Household mobility

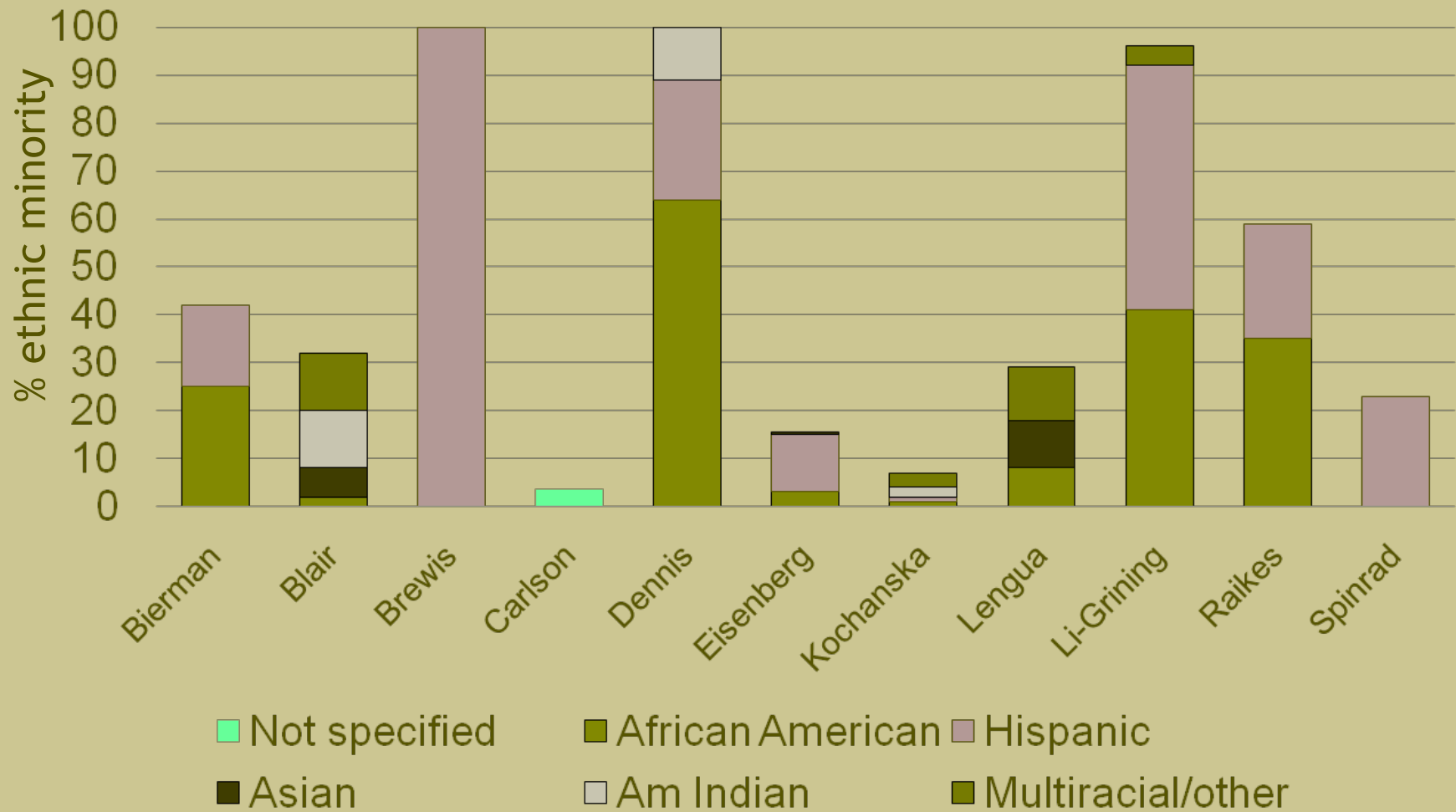


# *What do we know about developmental trajectories for EF?*





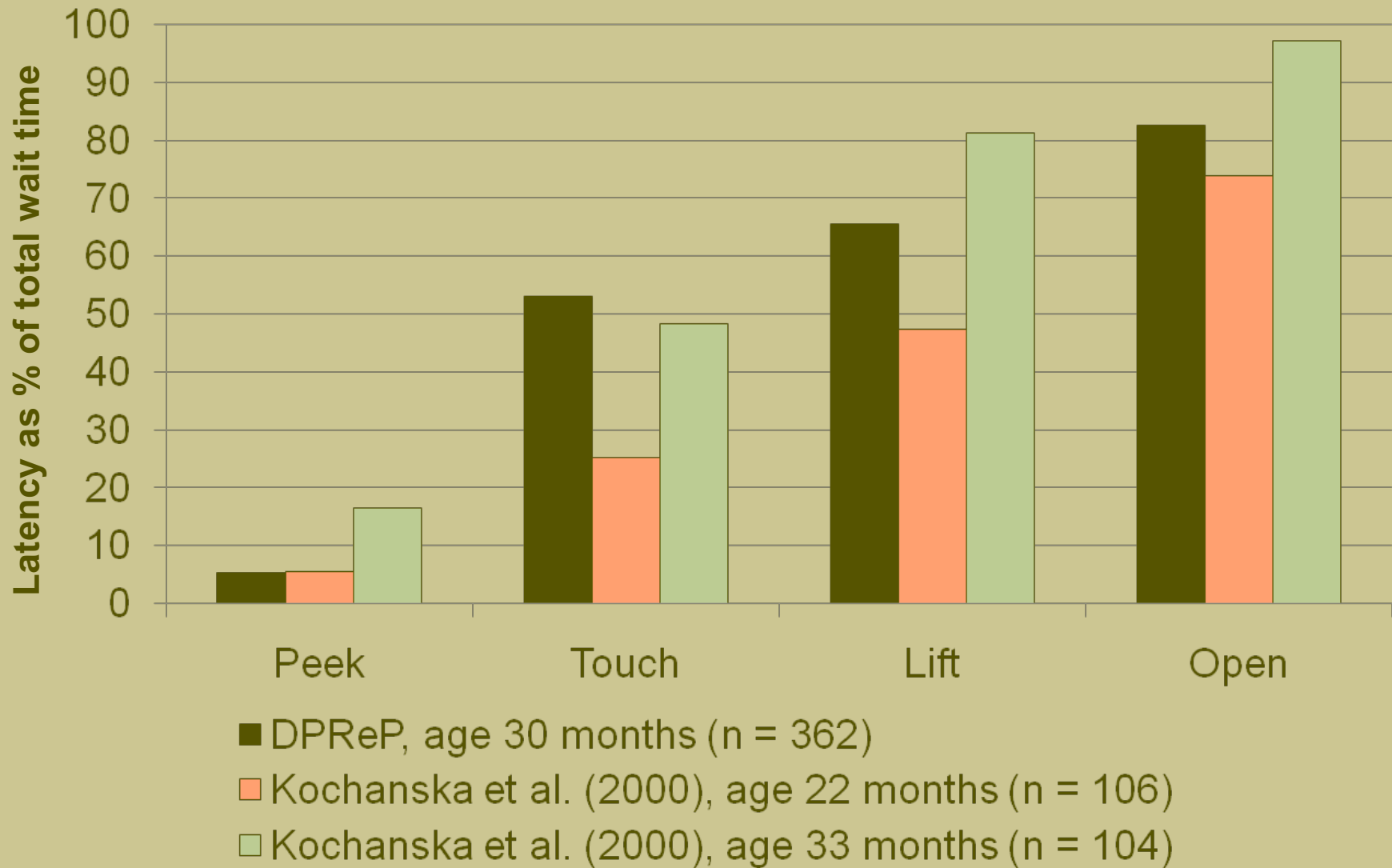
# ***Ethnic composition of longitudinal studies of executive functioning***





# ***Dallas Preschool Readiness Project: Sample characteristics***

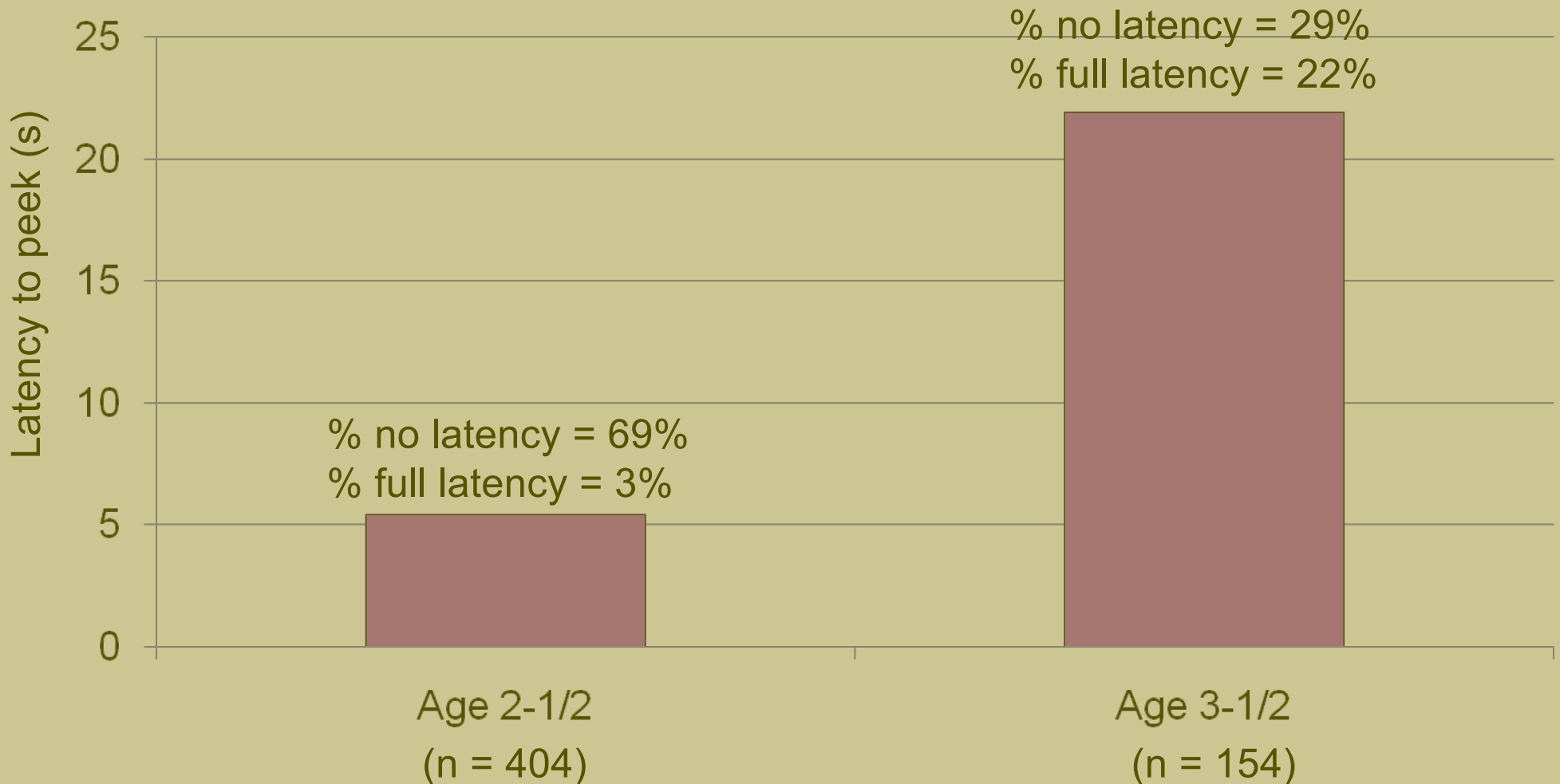
	<b>African American (N = 182)</b>	<b>Latino (N = 222)</b>
<b>Father/father-figure in home</b>		
No	44.0%	11.7%
Yes	56.0%	88.3%
<b>Family income</b>		
Less than 50% poverty	61.8%	19.3%
50-99% poverty	16.6%	42.0%
100-200% poverty	18.5%	28.2%
>200% poverty	3.2%	1.4%
Foreign born	---	73.4%
Country of origin = Mexico	---	95.7%
Spanish speaking (child)	---	80.5%
Spanish speaking (parent)	---	74.8%
Average child age at Time 1: 29.8 months (range: 28-31 months)		



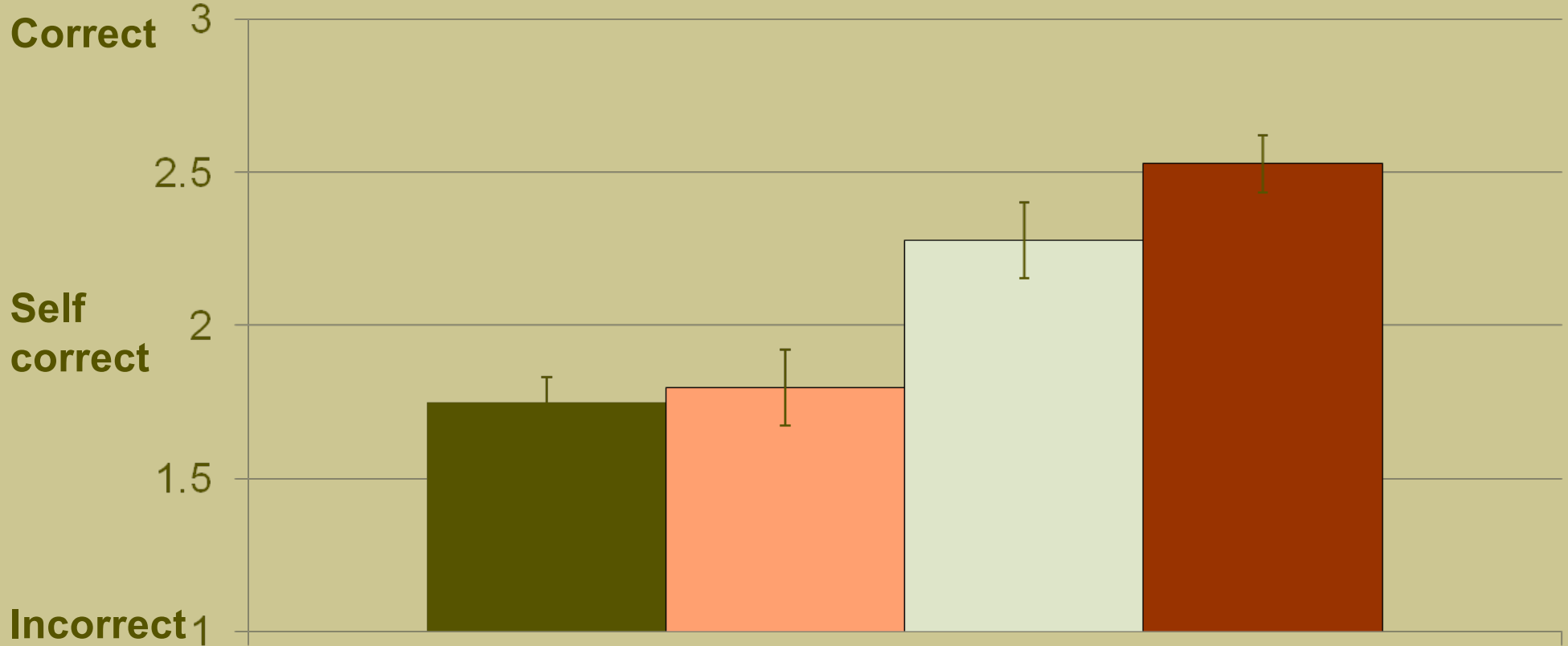
**Wrapped gift performance in two samples of preschoolers**



## ***Growth in simple inhibition from 2½ to 3½ years of age***

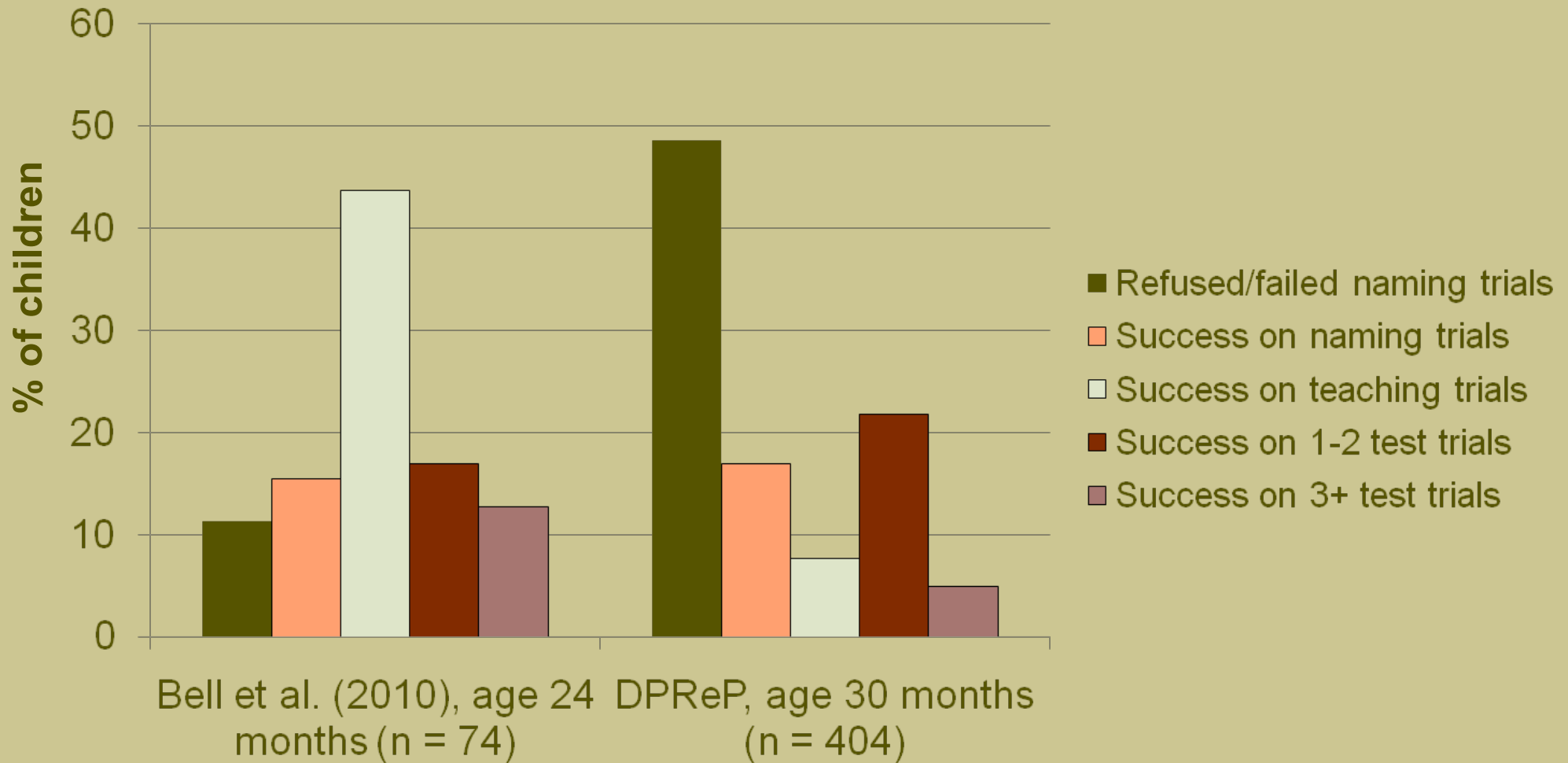






- DPRReP, age 30 months (n = 125)
- Kochanska et al. (2000), age 22 months (n = 106)
- Kochanska et al. (2000), age 33 months (n = 104)
- Carlson et al. (2004), age 24 months (n = 74)

**Average Shape Stroop scores in three samples of preschoolers**

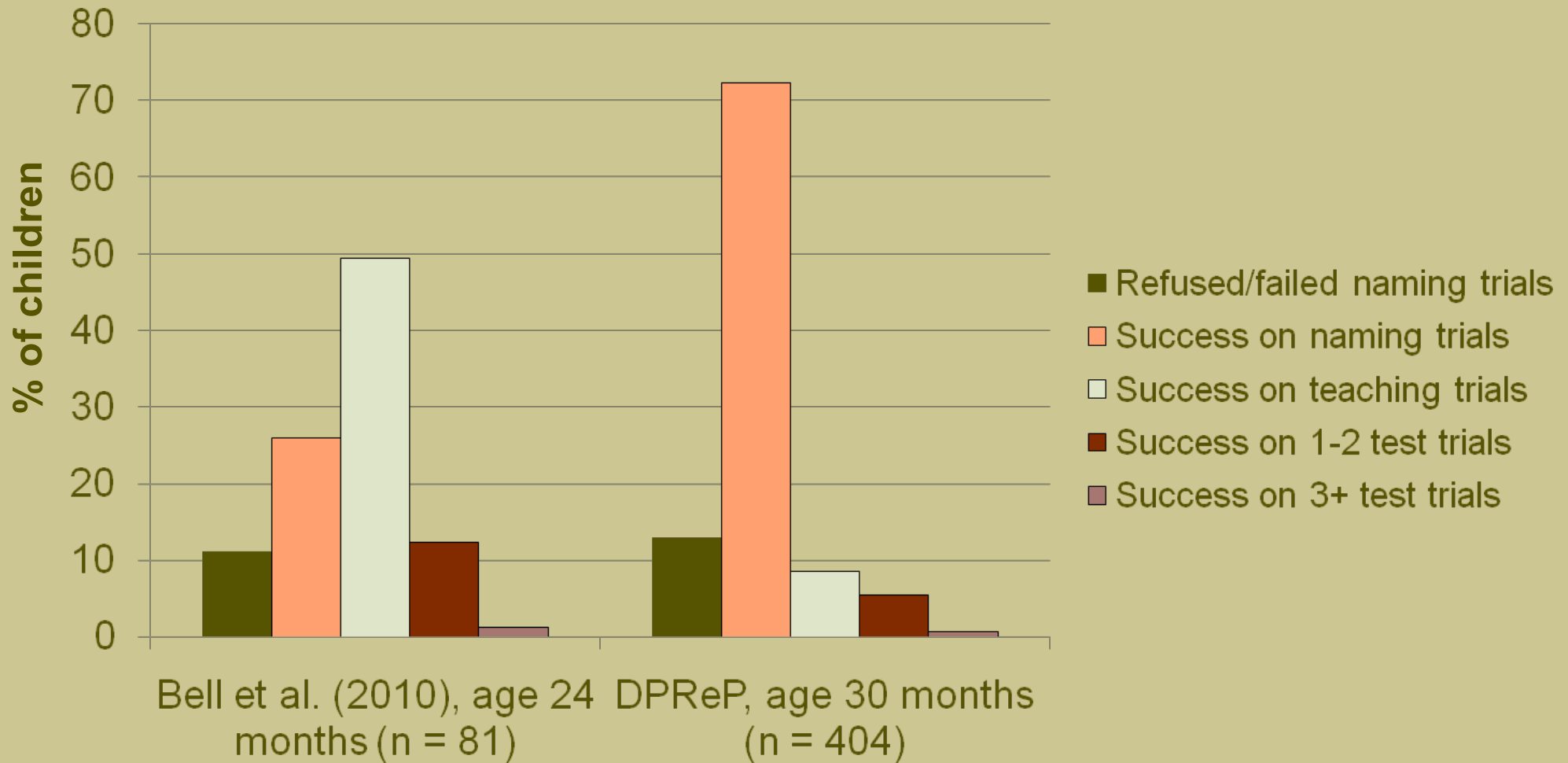


## Shape Stroop performance in two samples of preschoolers



# Stimuli used in Shape Stroop task

(Courtesy of Martha Ann Bell)



## Mommy & Me performance in two samples of preschoolers

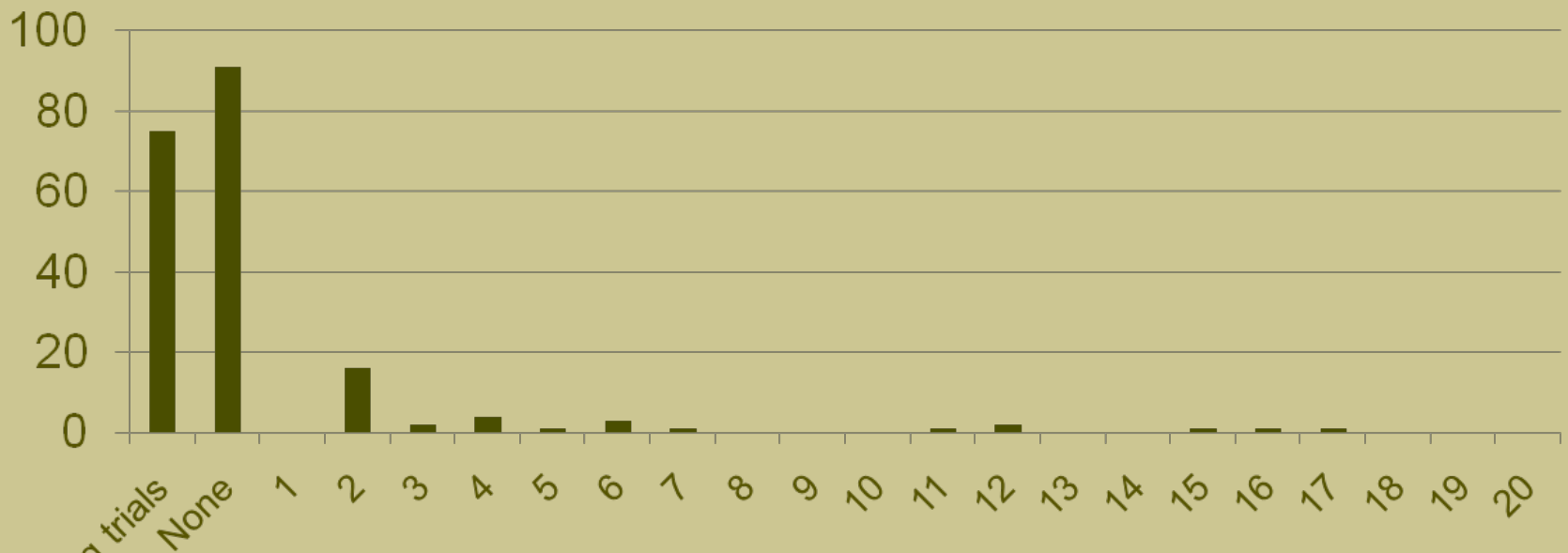


## ***Challenges in measuring executive function in very young, ethnically diverse children***

- Are the stimuli familiar?
- Is the assessment engaging?
- Does the child understand the instructions?
- How do you differentiate lack of ability from lack of cooperation?
- How can you best capture the full range of performance?



# ***Heads & Toes Performance, Age 3½ years (n = 199)***



Mean = .46

SD = 2.78

83.4% refused/failed teaching trials or scored 0

Refused/Failed teaching trials



# ***Self regulation and school readiness***

Partial correlations between self regulation at age 30m  
with three measures of school readiness

	<u>Response Inhibition (30m)</u>	
	<u>Simple</u>	<u>Complex</u>
<u>Whole sample</u>		
CBCL Total Score (30m)	-.026	-.170**
Bracken (42m)	.162*	.231**
<u>African Americans</u>		
CBCL Total Score (30m)	.020	-.110
Bracken (42m)	.289+	.346*
<u>Latinos</u>		
CBCL Total Score (30m)	-.070	-.220**
Bracken (42m)	.111	.158+

Adjusted for family income-to-needs ratio



# ***Promoting self regulation development***

- Preschool curriculums
  - Tools of the Mind (Bodrova & Leong, 2008; Diamond et al. 2007); Preschool PATHS
    - Self regulatory talk, dramatic play, tangible aids for memory and attention, tools for emotion regulation
- “Kindergartners learn self-regulation best through activities in which children—and not adults—set, negotiate, and follow the rules.”  
(Bodrova & Leong, 2008)





## ***Fostering self regulation before preschool: The importance of parenting***

- Sensitive and responsive parenting is associated with better self regulation development
- Recent evidence suggests responsive parenting affects executive function development through modulation of stress physiology (Blair et al., 2008; Blair, Granger, & Razza, 2005; Blair et al., 2011)

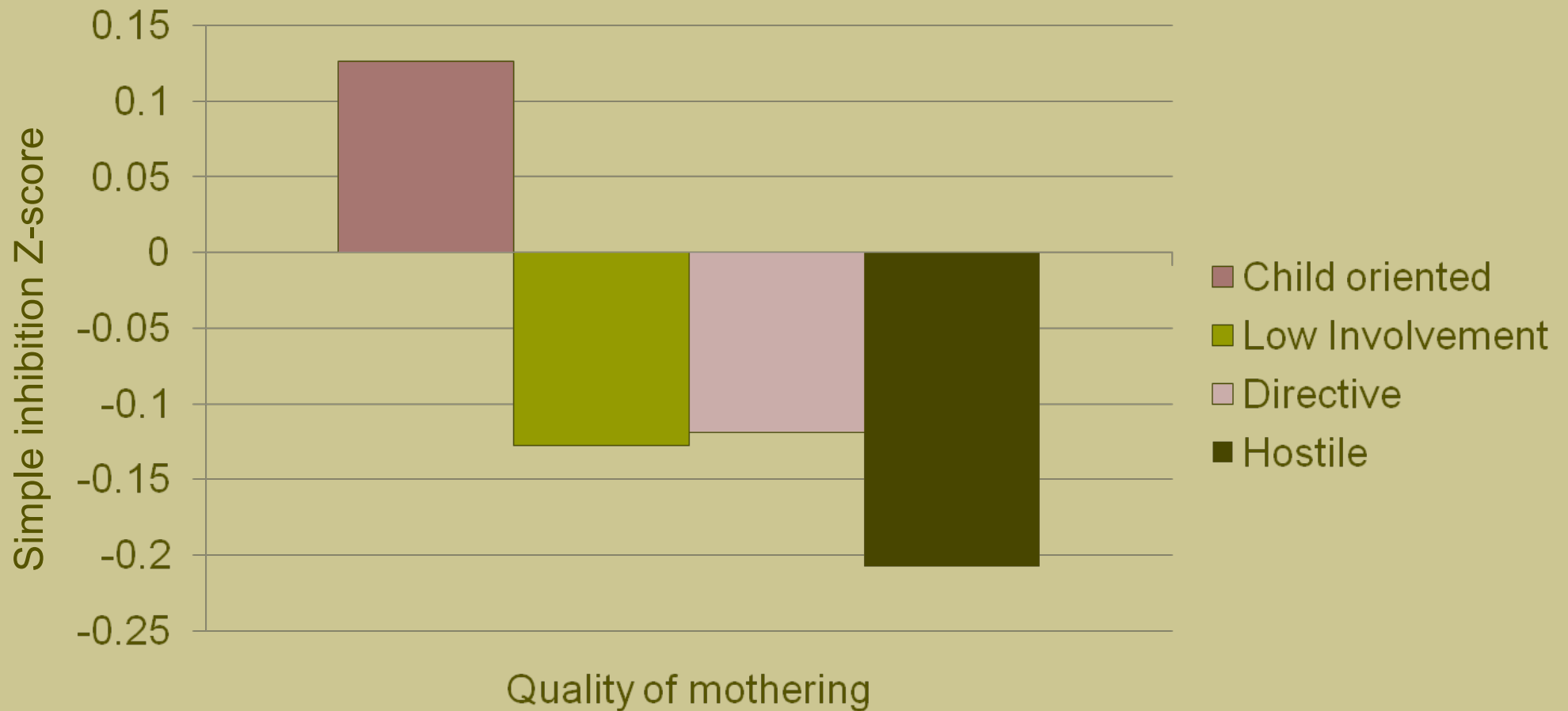


## ***Coding quality of parent-child interaction***

- Sensitivity
- Intrusiveness
- Detachment
- Positive regard
- Negative regard
- Cognitive stimulation
- Quality of relationship
- Child positive/negative affect

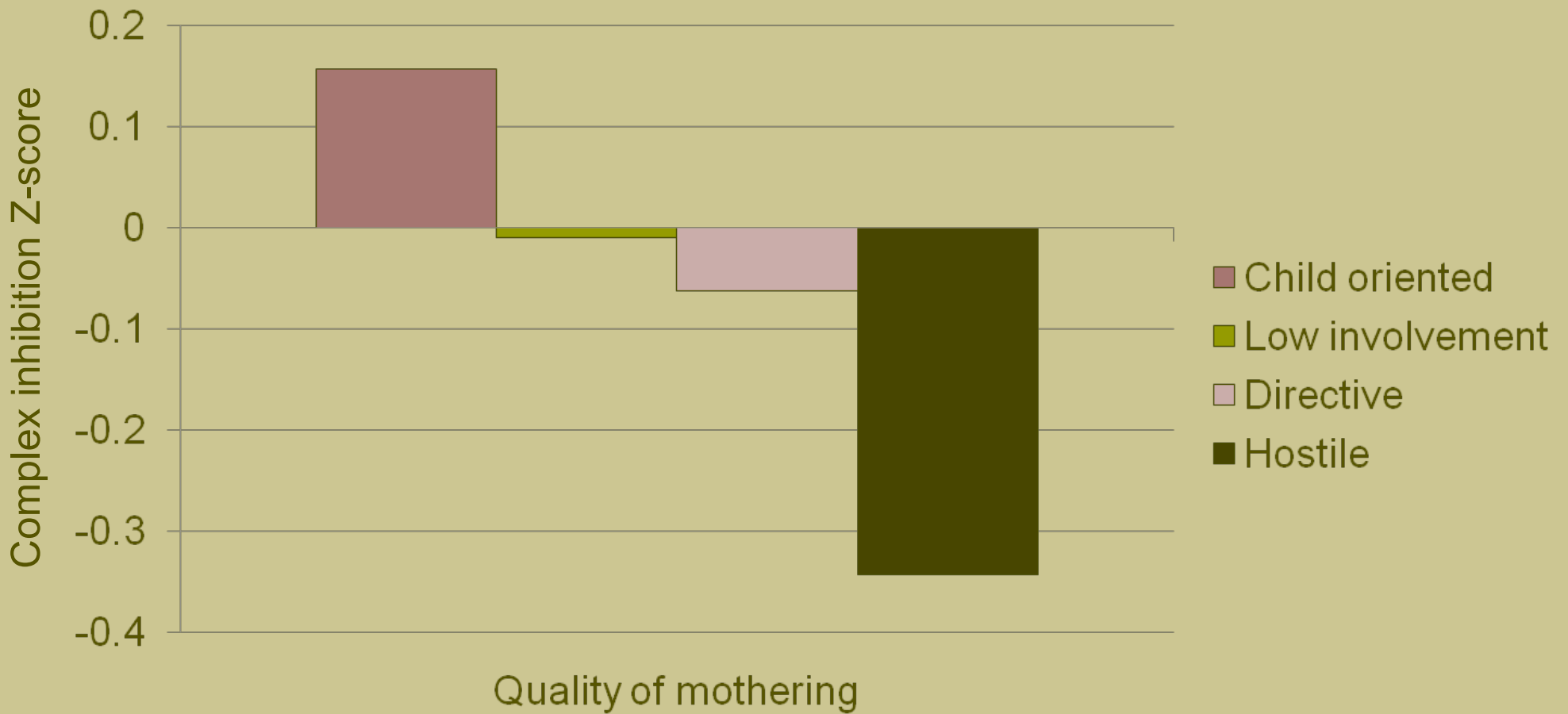


# *Quality of mothering and simple inhibition*



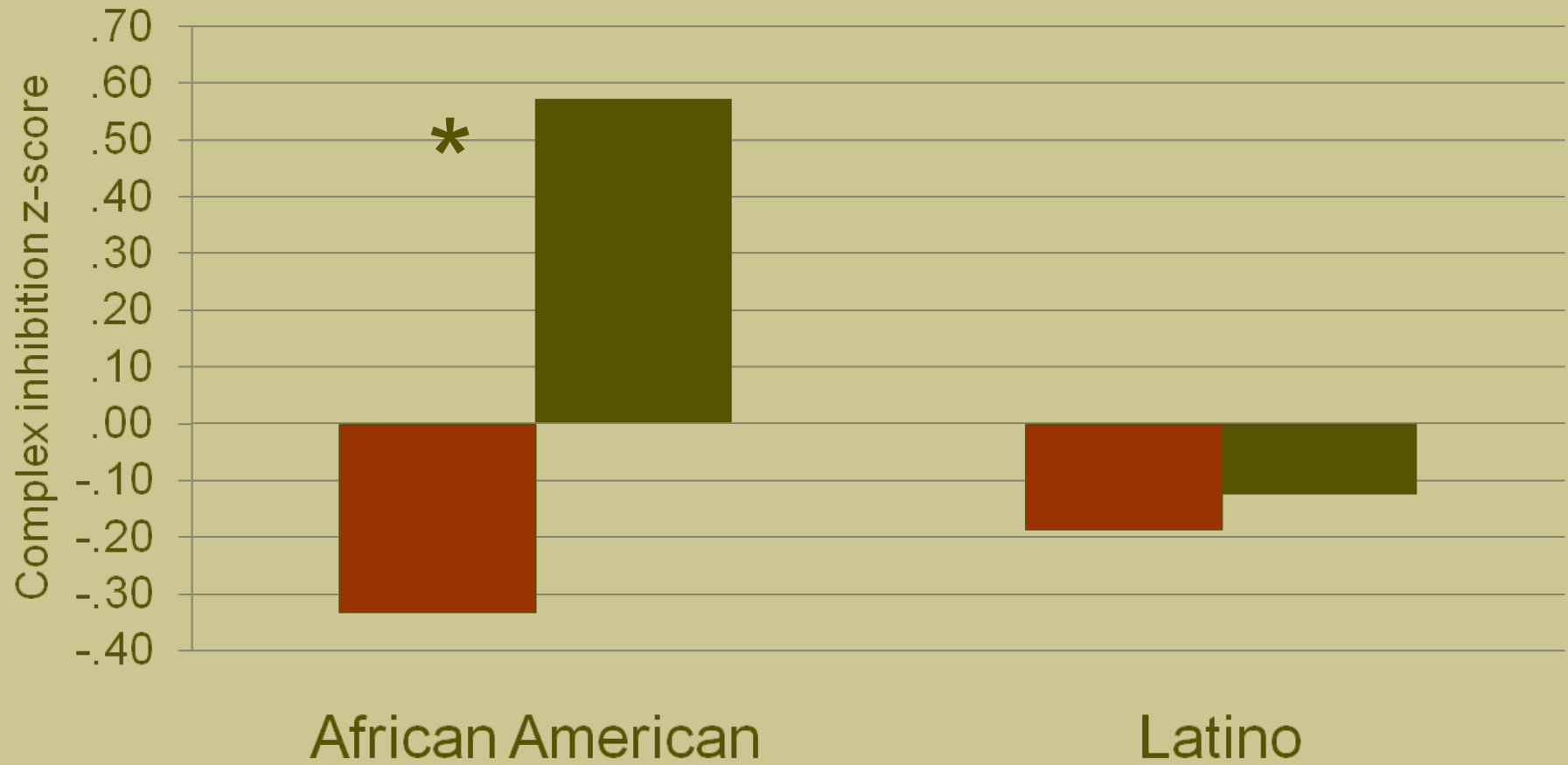


# *Quality of mothering and complex inhibition*





# ***Complex response inhibition by child oriented fathering and child ethnicity***



*\*p < .05*

■ Other fathering profiles

■ Child-oriented fathering



## ***Self regulation in ethnic minority preschoolers: Implications for policy & prevention***

- Being ready for school is more than ABCs/123s
- Improving self regulation skills would reduce disparities in educational achievement
- Reaching families and children before preschool requires collaboration between public health and early childhood education professionals



## ***Self regulation in ethnic minority preschoolers: Implications for policy & prevention***

- All domains of development are interrelated
  - An intervention focused on one domain often affects another
    - Ex.: physical activity
    - Ex.: parenting interventions
- A comprehensive approach to improving child health and reducing disparities requires coordination across multiple disciplines



# Dallas Preschool Readiness Project

Funded by the *Eunice Kennedy Shriver* National Institute of Child Health and Development



## Principal Investigators

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