Executive Function Skills and Academic Achievement in Pre-K: Contributions of Learning-Related Behaviors

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Study Rationale

- Established associations between young children's entering executive function skills and subsequent academic achievement (e.g., Blair & Razza, 2007; Bull, Espy, & Wiebe, 2008; Duncan et al., 2007; McClelland, Cameron, Connor, Farris, Jewkes, & Morrison, 2007)
Study Rationale

- Researchers have hypothesized that executive function facilitates children’s ability to successfully adapt to school context (e.g., Blair & Diamond, 2008; McClelland & Cameron, 2011; Eisenberg, Valiente, & Eggum, 2010)
Learning-Related Behaviors

- Children’s ability to successfully adapt to the demands of the classroom, includes
  - Focus and actively engage in learning opportunities
  - Complete tasks with multiple steps
  - Participate in learning interaction with peers and teachers
  - Avoid disengagement, isolation, and disruption
Learning-Related Behaviors & Executive Function Skills

- Teacher-reports of children's learning-related behaviors associated with direct assessments of executive function (Brock et al., 2009; Fuhs, Farran, Turner, under review)
- Observations of engagement related to direct assessments of executive function (Brock et al., 2009)
Learning-Related Behaviors & Academic Achievement

- Associations found between learning-related behaviors and concurrent and future achievement:
  - Teacher ratings (DiPerna, Lei, & Reid, 2007; Howse, Calkins, Anastopoulos, Kean, & Shelton, 2003, McClelland, Acock, & Morrison, 2006)
  - Behavioral observations (Brock, Rimm-Kaufman, Nathanson, & Grimm, 2009; Downer, Vitiello, Maier, & Williford, 2011)
Participants

- 702 native English speakers who participated in a large-scale evaluation of a pre-k curriculum
  - Completed at least one measure at both the beginning and end of pre-k and observed for at least 2 of the 3 in-class observations

- Children were from 80 pre-k classrooms, which were situated in 57 schools across 6 school districts
Procedures & Measures

- Direct Assessments
  - Executive Function
    - Copy Design, Corsi Blocks, Dimensional Change Card Sort, Head Toes Knees Shoulders, Peg Tapping
  - Academic Achievement
Procedures & Measures

• Classroom Observations / Learning-Related Behaviors
  – Child Observation in Preschool (COP; Farran & Son-Yarbrough, 2001; Bilbrey, Vorhaus, Farran, & Shufelt, 2010)
  – Variables:
    • Level of Involvement During Learning Opportunities
    • Sequential Behaviors
    • Social Learning Interactions (Associate or Cooperative)
    • Off-task and Disruptive Behaviors
      – Off task when academic activities were occurring
      – Disruption of class time or in time-out
Analytic Plan

• Test of Direct and Indirect Effects Path Analysis in Mplus 7.0
  – Independent and dependent variables centered at group mean
  – Standard errors adjusted to account for dependency among observations
Methodological Challenges

- Interested in examining if children's entering skills predict their use of learning-related behaviors and subsequent academic achievement
- Children’s skills and behaviors are influenced by the classroom context
Academic Achievement
Spring Pre-k
R² = .71

EF Skills
Fall Pre-k
R² = .11

Academic Achievement
Fall Pre-k
R² = .12

Learning-Related Behaviors
Level of Involvement
R² = .04

Sequential Behaviors
R² = .08

Social Learning Interactions
R² = .03

Off-task/Disruptive
R² = .05

Direct Effects:
Overall Model
Direct Effects: EF Skills & Learning Related Behaviors

- EF Skills Fall Pre-k $R^2 = .11$
- Level of Involvement $R^2 = .04$
- Sequential Behaviors $R^2 = .08$
- Social Learning Interactions $R^2 = .03$
- Off-task/Disruptive $R^2 = .05$

Direct Effects: EF Skills & Learning Related Behaviors
Direct Effects: Achievement & Learning Related Behaviors

- **Level of Involvement**: $R^2 = .04$
- **Sequential Behaviors**: $R^2 = .08$
- **Social Learning Interactions**: $R^2 = .03$
- **Off-task/Disruptive**: $R^2 = .05$

Direct Effects:

- **Academic Achievement Fall Pre-k**: $R^2 = .12$

Arrows indicate the direction of influence between the variables.
Direct Effects: Predictors of End of Pre-K Achievement

Academic Achievement Fall Pre-k
$R^2 = .12$

EF Skills Fall Pre-k
$R^2 = .11$

Learning-Related Behaviors

Level of Involvement
$R^2 = .04$

Sequential Behaviors
$R^2 = .08$

Social Learning Interactions
$R^2 = .03$

Off-task/Disruptive
$R^2 = .05$

Academic Achievement Spring Pre-k
$R^2 = .71$
## Indirect Effects: Test of Mediation

<table>
<thead>
<tr>
<th>Path</th>
<th>Estimate (Standard Errors)</th>
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</thead>
<tbody>
<tr>
<td>EF T1 → AA T2, Cumulative Indirect Effect</td>
<td>0.012 (0.006)*</td>
</tr>
<tr>
<td>EF T1 → Level of Involvement → AA T2</td>
<td>0.001 (0.004)</td>
</tr>
<tr>
<td>EF T1 → Sequential Behaviors → AA T2</td>
<td>0.001 (0.002)</td>
</tr>
<tr>
<td>EF T1 → Social Learning → AA T2</td>
<td>-0.002 (0.003)</td>
</tr>
<tr>
<td>EF T1 → Off-task/ Disruptive → AA T2</td>
<td>0.013 (0.005)*</td>
</tr>
<tr>
<td>AA T1 → AA T2, Cumulative Indirect Effect</td>
<td>0.004 (0.006)</td>
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</tbody>
</table>

Notes: *p < .05.
Conclusions

• Greater executive function skills at beginning of pre-k were associated with:
  – Higher levels of involvement during learning opportunities
  – More participation in social-learning interactions
  – Less demonstrations of off-task and disruptive behaviors

• Children’s learning-related behaviors were a mechanism by which children’s executive function skills facilitated their pre-k academic gains
  – Driven by negative behaviors, which were infrequent in sample (5% of snapshots)
  – Exclusion of negative behaviors from model: Positive behaviors (involvement and sequential behaviors) facilitate gains
Conclusions

- Results highlight the importance of entering academic and cognitive regulations skills for understanding how children respond to learning opportunities and succeed academically.

- How children exert themselves in their environment is only half the picture.
  - Need to identify strategies and practices that enhance the richness of the learning opportunities for children with higher skills while also providing access to learning for those with lower skills.
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