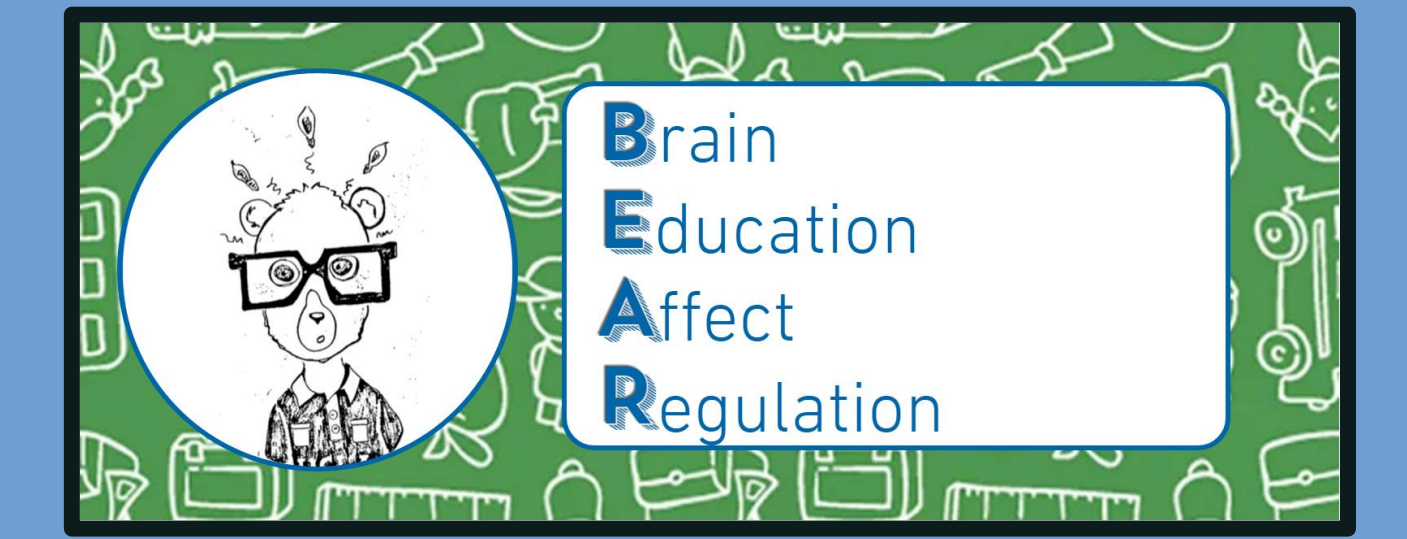




# None-the-less She Persisted: Gender Differences in Executive Function and Persistence in Early Elementary School

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## INTRODUCTION

### Persistence:

- Ability to continue effort despite a cognitive challenge (Berhenke, et al., 2011).
- Higher when a child's learning context promotes autonomy, competence, and social relatedness (Ryan & Deci, 2000).

### Child characteristics and the learning context:

- Children's self-imposed learning goals and expectations impact their level of persistence (Shunk, 1991).
- Differences in gender socialization (Deci & Ryan, 1980; Burnett, 2002) may influence student levels of autonomy, competency, and social relatedness.
  - Boys are socialized to value independence and achievement and are more likely to be praised for their ability (Kostner, 1989).
  - Girls are socialized to value interpersonal relationships and are more likely to be praised for their good behavior, hard work, and effort (Dweck, et al., 1978).

### Executive function (EF) skills:

- Basic cognitive skills that underly individual differences in a child's ability to regulate their thoughts, emotions, and behavior to meet the demands of their learning environment (Ll-Ginning, et al., 2010).
- Link to learning-related behaviors, such as persistence when measured via teacher report (Vitiello, et al., 2011).

### Relating brain and behavior:

- Neural correlates of EF can be interpreted from event-related potentials (ERP) evoked during cognitive control tasks (Gehring, et al., 2012).
- The ERN and Pe components, in particular, have been linked to math and literacy skills as well as perceived competence (Kim, et al., 2017).

## Study Aims

### RQ1: What student characteristics are related to persistent behavior?

Aside from teacher report, little work has investigated the relation among skills important for academic success as they are emerging in early elementary school.

### RQ2: How do aspects of students' EF and motivational beliefs interact to support persistent behavior?

Gender differences may impact effort on challenging tasks, particularly when in the presence of a social agent such as an experimenter. However, higher EF skills may boost children's engagement and persistence when completing a challenging cognitive task.

## RELATING DEVELOPMENT, EDUCATION, AND NEUROSCIENCE

### What are the complex, multiple forces shaping children's cognitive growth?

- A neurological perspective can enhance our understanding of the developmental trajectory and the relation between EF skills and skills related to academic success such as persistence and motivation that are difficult to measure in elementary school.

### How are instructional environments influencing the development of cognitive skills important for student learning?

- Changes in brain activity may emerge prior to behavioral indicators of learning. Examining schools' influence on the timing of development could provide insight into the mechanisms underlying the development of academic skills.

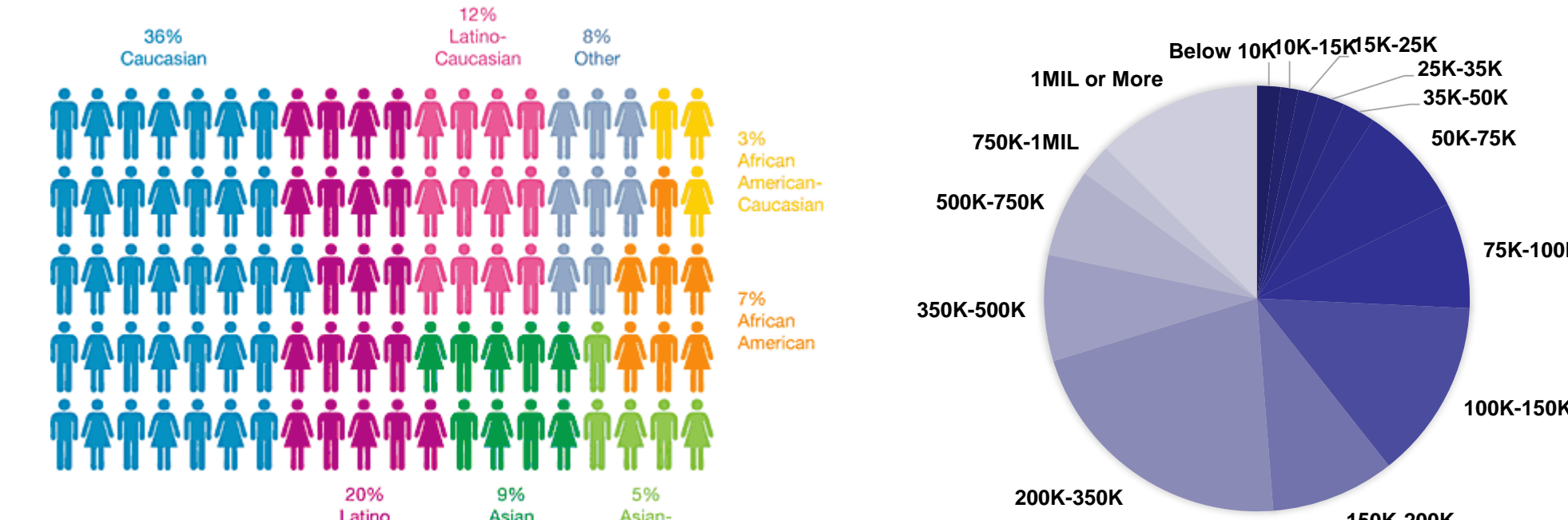
### What are the neurological sources for the individual differences observed in children's cognitive skills?

- Analyzing brain activity underlying cognitive skills, moves science closer to specifying neurological sources of individual differences among children who learn well and those who struggle to acquire EF skills or to demonstrate positive learning approaches such as persistent behavior.

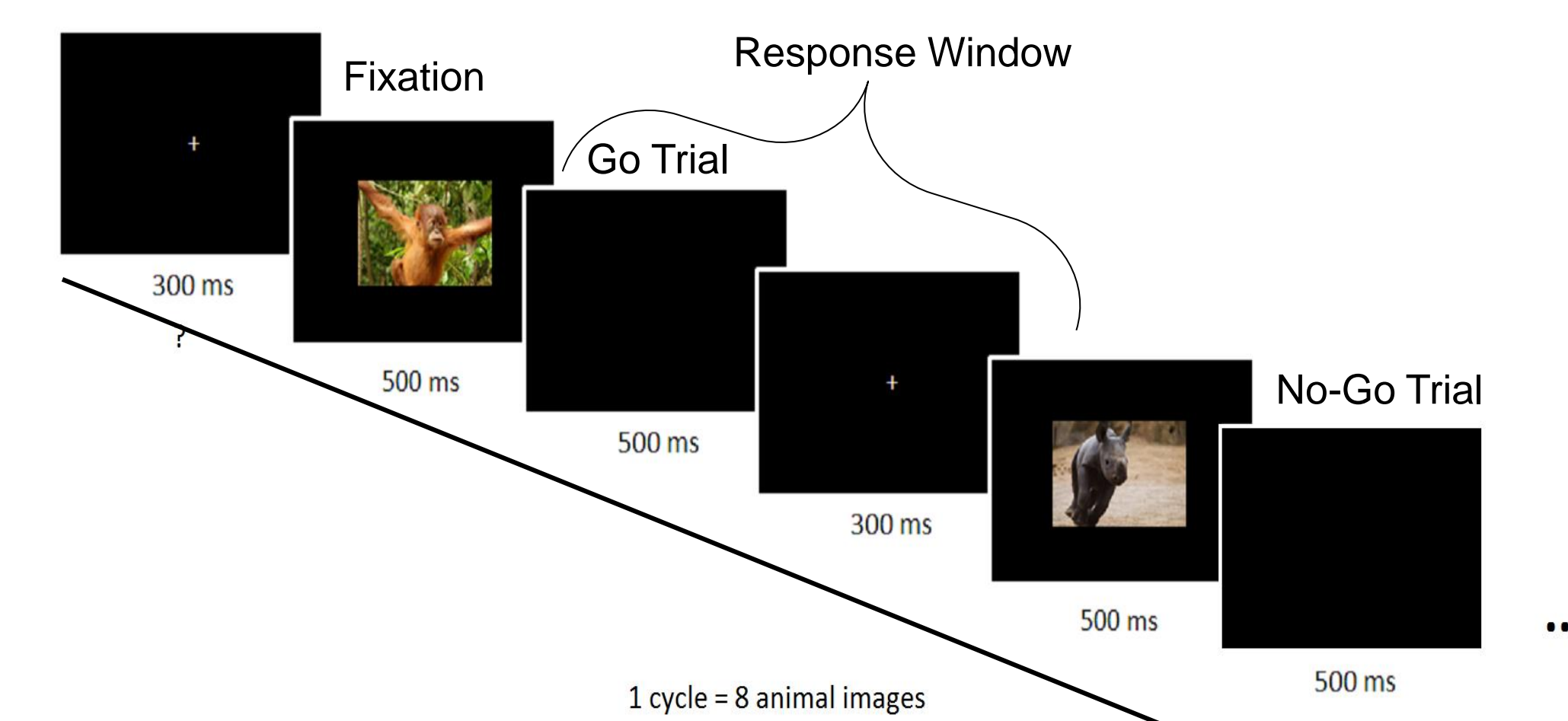
## METHOD

**Participants:** A total of 84 kindergarten (N=42), first (N=21), and second-grade (N=21) students were tested (Male=33; *M*age = 6.94 years).

### School Demographics:



**Executive Function:** Tested using a standardized task the Head, Toes, Knees, Shoulders (HTKS; Ponitz, et al., 2008). Cognitive control indices measured by child-friendly Go/No-Go task (Grammer et al., 2016).



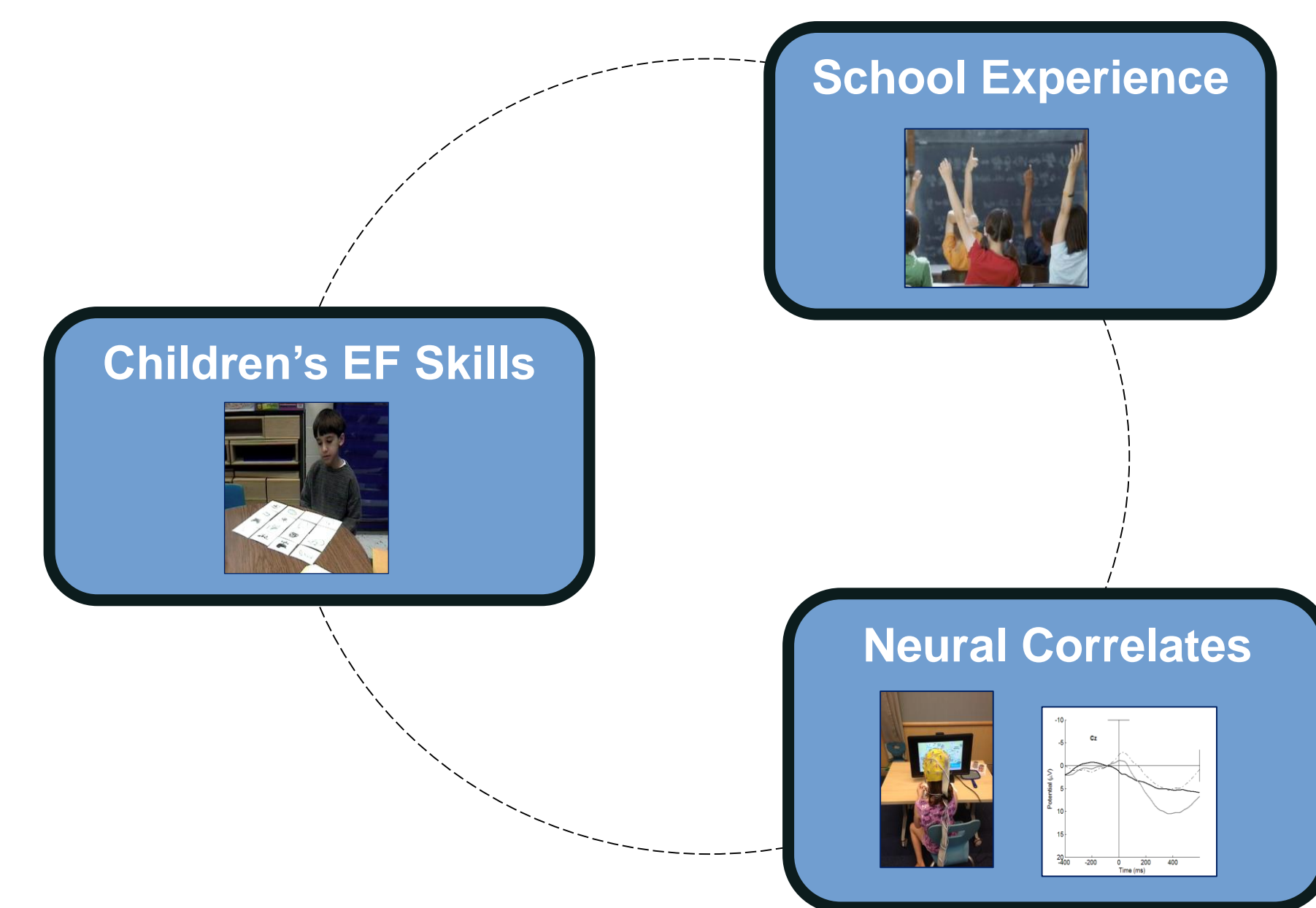
**Persistence:** Measured as time attempting a challenging puzzle.



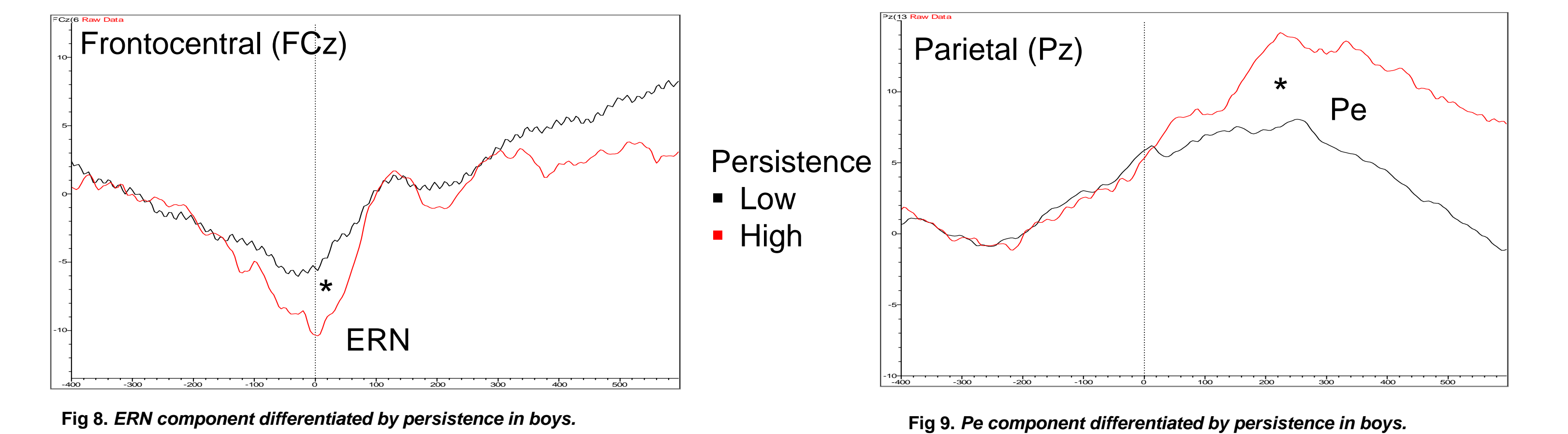
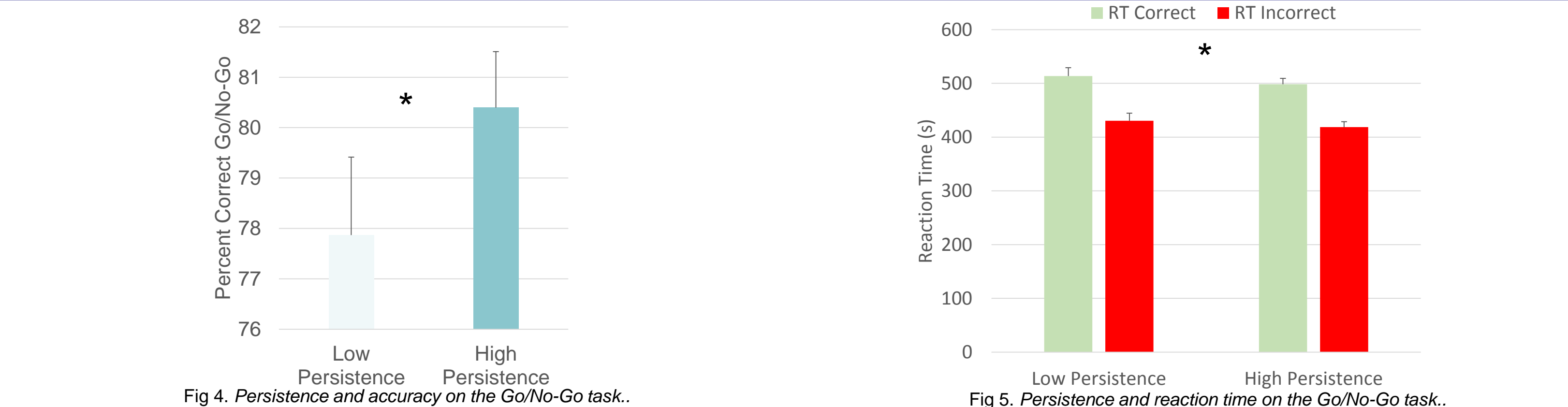
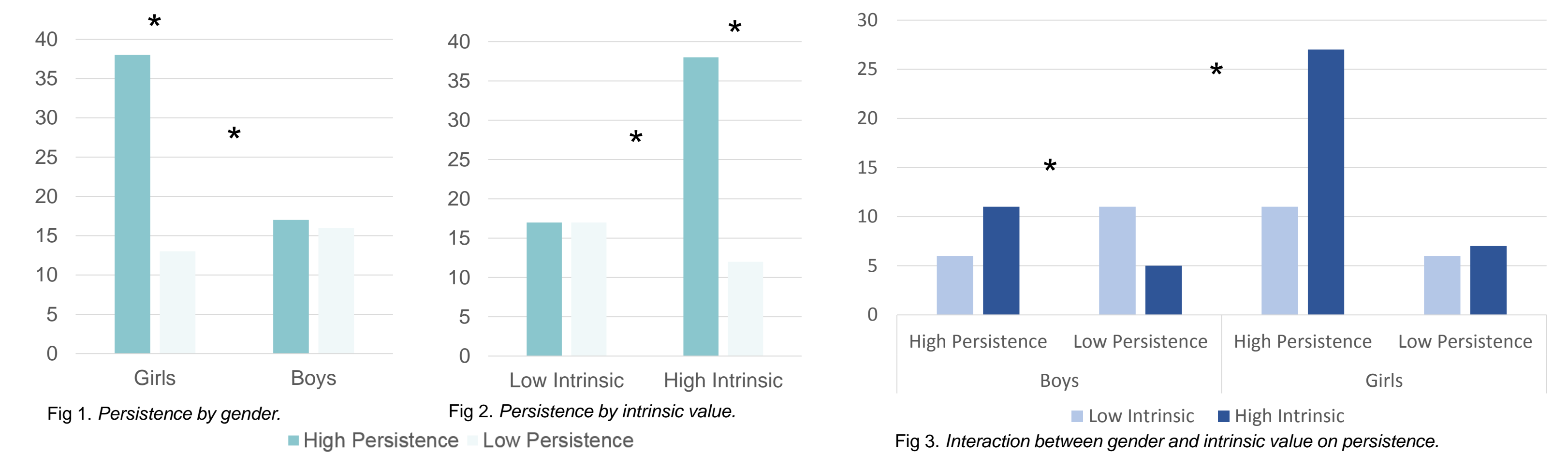
**Motivational Beliefs:** Following the puzzle task, self-reports of intrinsic value and perceived competence were collected utilizing a puppet interview and binary statements.

**Intrinsic:** *I have fun doing puzzles.* vs. *I don't have fun doing puzzles.*  
**Competence:** *I can do puzzles.* vs. *I can't do puzzles.*

## STUDYING COGNITION IN THE SCHOOL CONTEXT



## RESULTS



## DISCUSSION & IMPLICATIONS

**RQ1:** Overall, girls persisted more than boys ( $\chi^2(1,84)=4.687, p=.030$ ) and children that showed high persistence reported higher intrinsic value ( $\chi^2(1,84)=6.052, p=.014$ ). An interaction effect emerged, such that intrinsic value was only a significant influence on boys' level of persistence ( $\chi^2(1,33)=3.694, p=.05$ ). Children that persisted also showed higher levels of EF as measured by the Go/No-Go game both in terms of accuracy ( $F(1,69)=18.897, p=.025, \eta_p^2=.869$ ) and reaction time ( $F(1,59)=12.222, p=.004, \eta_p^2=.481$ ). These findings have implications for intervention work focused on increasing persistence and engagement in learning as much early intervention work focuses on improving children's EF skills, while intrinsic value is emphasized in later schooling.

**RQ2:** EF interacted with a child's level of competence ( $F(1,79)=4.548, p=.036, \eta_p^2=.054$ ) and intrinsic value ( $F(1,59)=3.984, p=.051, \eta_p^2=.063$ ) such that EF skills differentially related to persistence for children with low competence or high intrinsic value. Children with High EF skills but low persistence showed lower reports of competence. High EF and high persistence related to greater reports of intrinsic value. Additionally, boys showed differences in underlying neural activity related to cognitive control skills. Specifically, boys with high persistent behavior showed enhanced ERN ( $F(1,31)=4.068, p=.053, \eta_p^2=.123$ ) and Pe ( $F(1,31)=6.667, p=.015, \eta_p^2=.187$ ) components in response to making an error during the Go/No-Go game. This finding suggests that, for boys in particular, response monitoring skills may be a crucial factor in persistent behavior and that differences in the way children attend to performance can be observed at the physiological level.

Overall, these findings provide evidence that gender socialization may be influencing the development of skills related to academic success such as executive functions and persistence. Further work is needed to investigate whether these skills may be observed differentially depending on the context of the student and what underlying mechanisms support the relation between context and behavior.

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