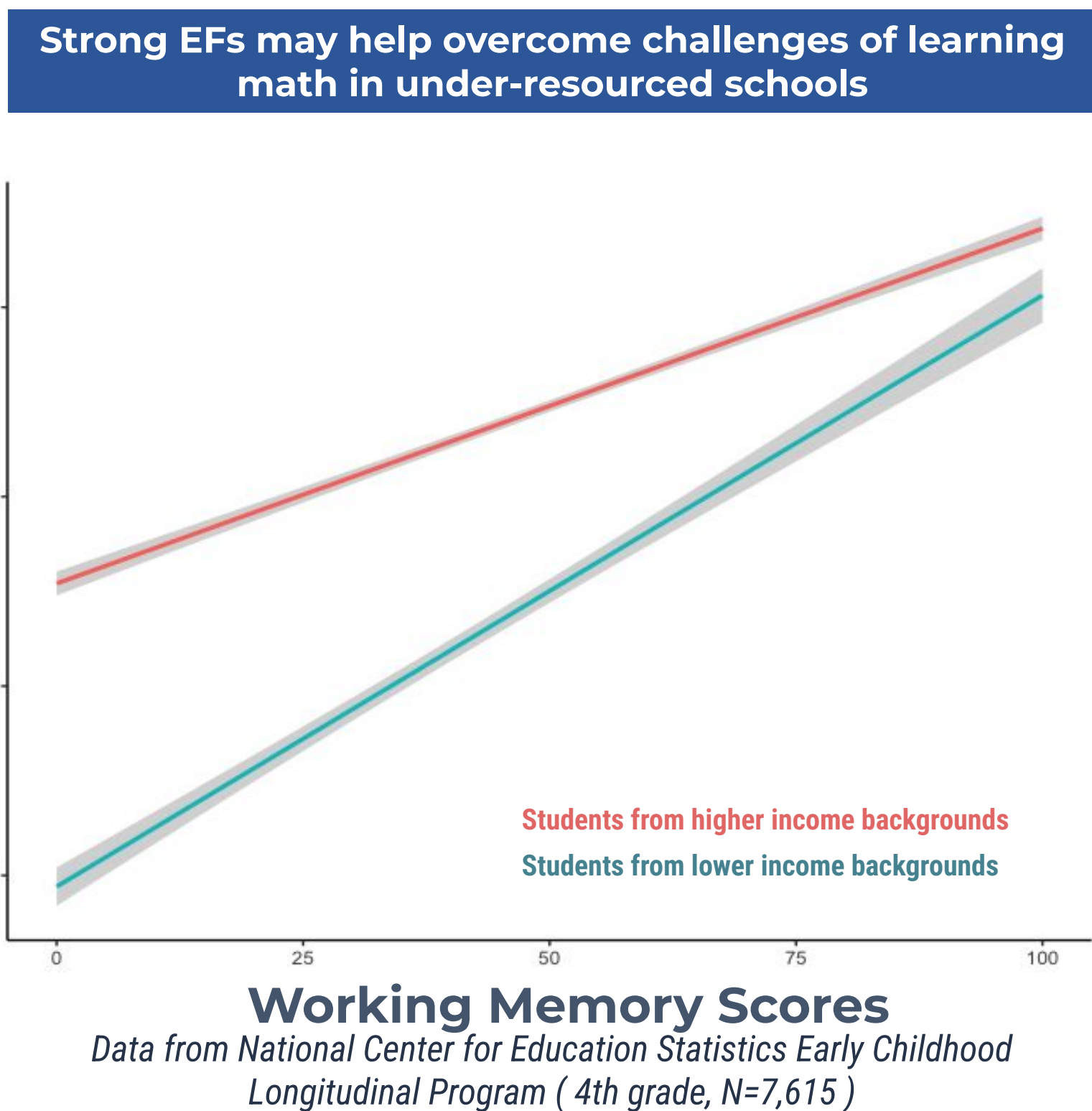


# Exploring a Portfolio Approach of Co-Designed Mathematics Interventions that Leverage Executive Functions

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## CHALLENGE

- Relations between executive functions (EFs) and math are stronger for American students from low-income homes than for students from higher income homes (Ribner et al., in prep; EF+Math, 2021).
- EF interventions do not often improve math, nor do they provide explanatory evidence for mechanisms driving change (Scerif et al., 2023)

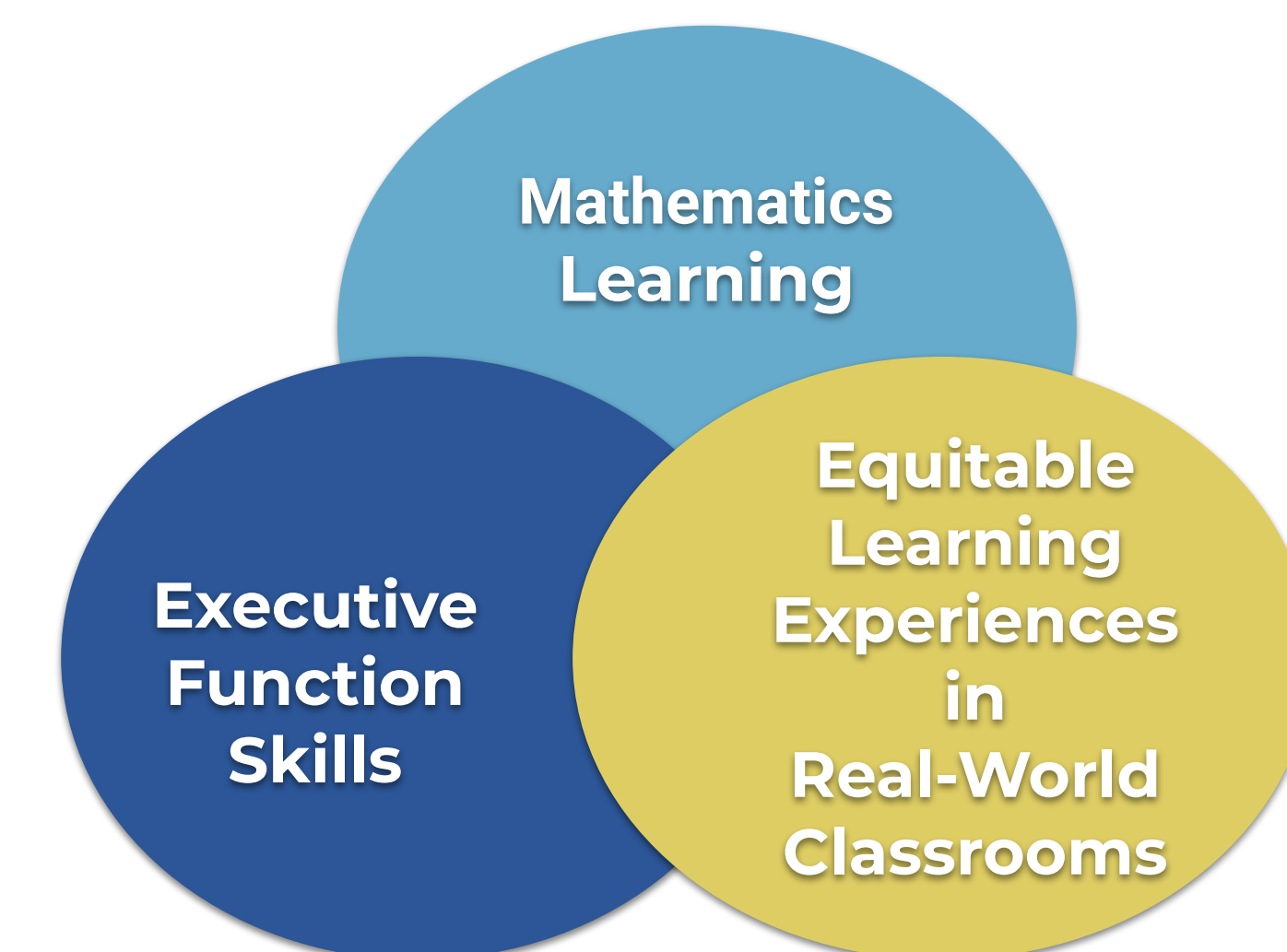


### Interventions leveraging EFs to improve math learning may be more effective if:

- Theories of change are clearly defined (Scerif et al., 2023)
- EFs are engaged in the math context (Niebaum & Munakata, 2023)
- Approaches to assessing EFs are strengths-based (Miller-Cotto et al., 2022)

## PORTFOLIO APPROACH

**Core Hypothesis:** The **integration of EF skill development** in math learning approaches that address **conceptual understanding and complex problem solving**, in ways which afford **equitable experiences in math learning**, can increase students' mathematics outcomes.



### Portfolio includes teams of researchers, educators, and developers which each:

- Defined individual theories of change for embedding EFs in math learning in partnership with school districts and teachers
- Developed and tested these approaches, iterating based on findings
- Leveraged different assessment tools aligned with their theories of change (Uncapher et al., Brunner et al., 2024)

## WHAT WE ARE LEARNING

### Math Learning Approaches with Integrated EF Interventions



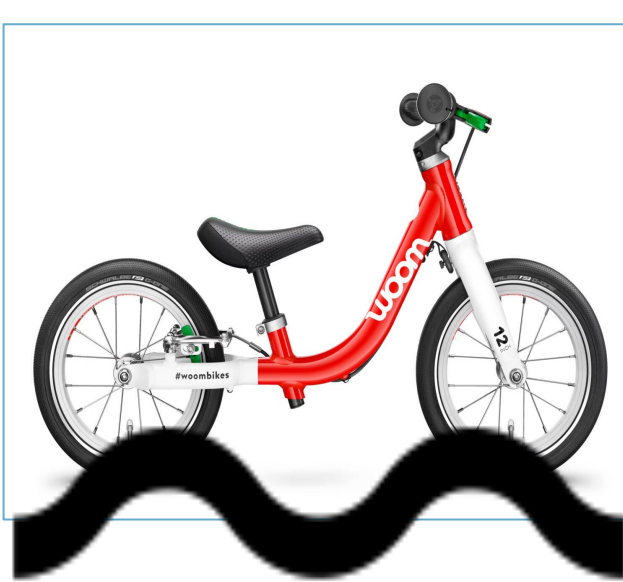
#### EF-related supports (3 teams)

Ex: **Problem solving** approach which **supports EF through embedded metacognitive scaffolds** throughout a digital platform



#### Explicit EF skill strengthening (2 teams)

Ex: Instructional approach which **directly strengthens EF skills in math games**, alongside discourse-centered, **problem-based learning** activities that link to math in the real world



#### Facilitating EF skill engagement (3 teams)

Ex: Collaborative **problem solving** which **engages students' EFs in practice** through turn-taking, strategy shifting, and discourse

### Integrated EF Intervention Example: Spark Math Equivacards (Spark Math, n.d.)

- Match cards from your hand to a card that was previously played
- Cards can be matched on color or number
- Designed to: reinforce math concepts, practice cognitive flexibility, promote sense of belonging in mathematics



### Strengths of this Approach

- Converging findings across portfolio on overarching constructs, such as:
  - stronger correlations with math-contextualized EF assessments compared to non-contextualized
  - Key role of working memory across different math content areas and grades
- Multiple tests of different potential mechanisms underlying core hypothesis (exemplified by the "bike metaphor" visual on the left)
- Variation in classroom contexts, content, and supplemental intervention design allows for unique explorations of combinations

### Challenges of this Approach

- Generalizing deeply contextualized results which are tied to the mechanism under study
- Study constraints (like assessment burden) can limit ability to explore both mechanisms and portfolio-level constructs
- Interdisciplinary teams must navigate R&D priorities for each involved party: *what are we studying, for whom, and how?*

### Ongoing Work

- Preliminary evidence of promise (EF+Math, 2023)
- Current studies are attending to mechanistic analyses in addition to exploring impact at scale

