Measurement Invariance of Foundational Learning Skills in Kindergarten Boys With and Without Autism: A Secondary Data Analysis

Nicole Sparapani, Ph.D
University of California, Davis

Natalie Koziol, Ph.D.
University of Nebraska-Lincoln

Bonnie Mackintosh, Ph.D.
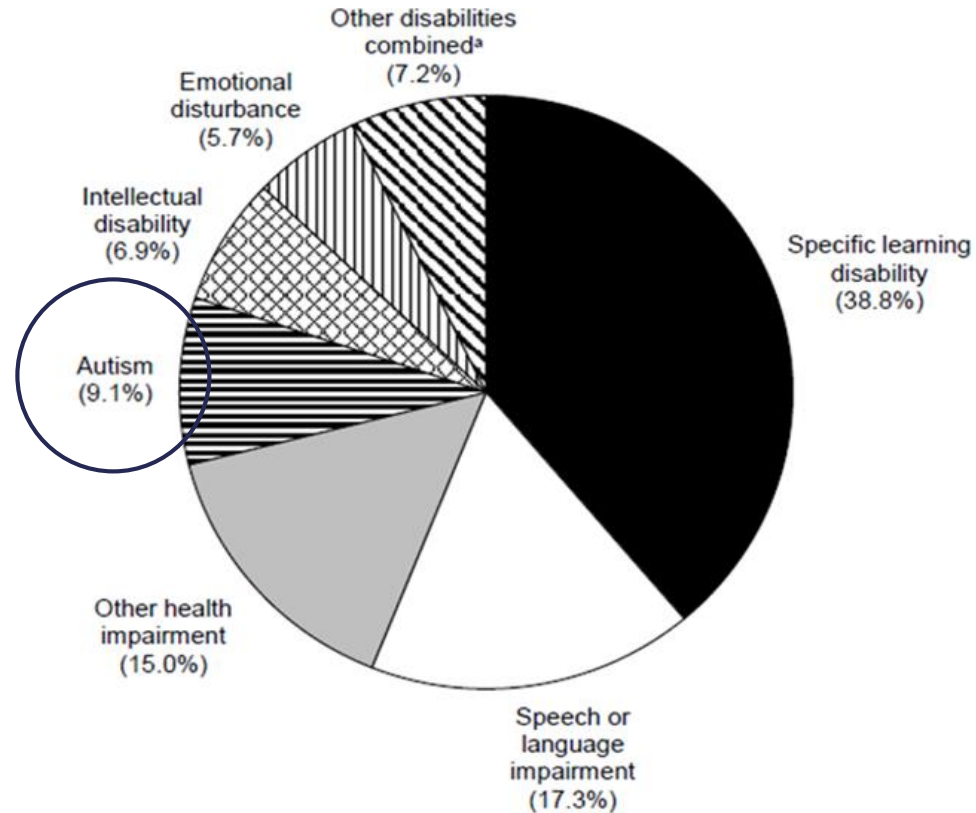OSSE, Government of the District of Columbia

Autism Spectrum Disorder (ASD)

- Neurodevelopmental disorder (4:1)
  - 1 in 59 in the U.S. (rise in prevalence)

- Core & associated features of ASD
  - Social communication
  - Repetitive behaviors/fixated interests

- General education classrooms
  - 68% (IQ >70), 70% co-morbidity

- Spectrum of impairment
  - Mild impairment to profound disability

(American Psychiatric Association [APA], 2013; Baio, 2018; Centers for Disease Control and Prevention [CDC], 2014; Charman et al., 2005; Estes et al., 2011)

ASD is the 4th largest category of students served under IDEA

Exhibit 21. Percentage of students ages 6 through 21 served under IDEA, Part B, by disability category: Fall 2015

- Other disabilities combined[a] (7.2%)
- Emotional disturbance (5.7%)
- Intellectual disability (6.9%)
- Autism (9.1%)
- Other health impairment (15.0%)
- Speech or language impairment (17.3%)
- Specific learning disability (38.8%)

Kena et al., 2016

ASD Features Interfere with Learning

- Joint attention
  - Attend to relevant instruction
  - Fixated attention

- Sensory differences
  - Hyper- or hypo-reactive to sensory input
  - Easily distracted

- Communication
  - Participate in interactions
  - Follow rules and classroom expectations

(Randi et al., 2010; Iovannone, Dunlap, Huber, & Kincaid, 2003; Kasari & Smith, 2013)

Many Students with ASD are Receiving Services in General Education Classrooms

- Heterogeneity in social, language cognitive, academic skills
  - Complicates programming
  - Teachers report feeling underprepared

- Limited educational research
  - Few studies have examined constructs related to classroom participation and learning skills in children with ASD

(Fleury et al., 2014; Nation, Clarke, & Wright et al., 2006; Whalon, Al Otaiba, & Delano et al., 2009)

Comparing Students With and Without ASD Requires Evidence of Measurement Invariance

- Measurement invariance (MI) suggests that, conditional on the underlying construct (i.e., assuming equal "ability" level), items function similarly for different groups

- Metric invariance suggests that the items measure the same underlying construct

- Scalar invariance suggests that the items are on the same scale across groups

This Study Aimed to

1) Evaluate the factor structure of of a set of foundational learning skills items for kindergarten boys with and without ASD

2) Examine whether the items function differently for kindergarten boys with and without ASD

Participants

- Nationally representative sample of children participating in the Early Childhood Longitudinal Study
  - Kindergarten class of 2010 – 2011
  - 5,660 boys with spring kindergarten teacher–report data who met sub-population criteria

ECLS-K:2011; NCES,n.d.

Sub-Population Criteria

ASD Group

▶ The ASD group (~1.6%) included boys with a primary disability of Autism as identified by their IEP

    ▶ Indicated during any of the 1st seven waves (through 3rd grade) of data collection

Non-ASD Group

▶ The non-ASD group included boys who did not have an IEP or parent-reported Autism diagnosis

15 items from the CBQ-SF and ECLS-K Approaches to Learning subscale were combined to measure 3 hypothesized foundational learning constructs

- **Strong Concentration**
  - Shows strong concentration
 - Becomes very involved
  - Sometimes becomes absorbed

- **Easily Distracted**
  - Has a hard time keeping mind on an activity
  - Moves from one task to another without completion
  - Is easily distracted
  - Has trouble sitting still

- **Foundations for Learning**
  - Persists in completing tasks
  - Pays attention well
  - Plans for new activities
  - Works independently
  - Keeps belongings organized
  - Shows eagerness to learn
  - Easily adapts to changes
  - Is good at following directions

Putnam & Rothbart, 200
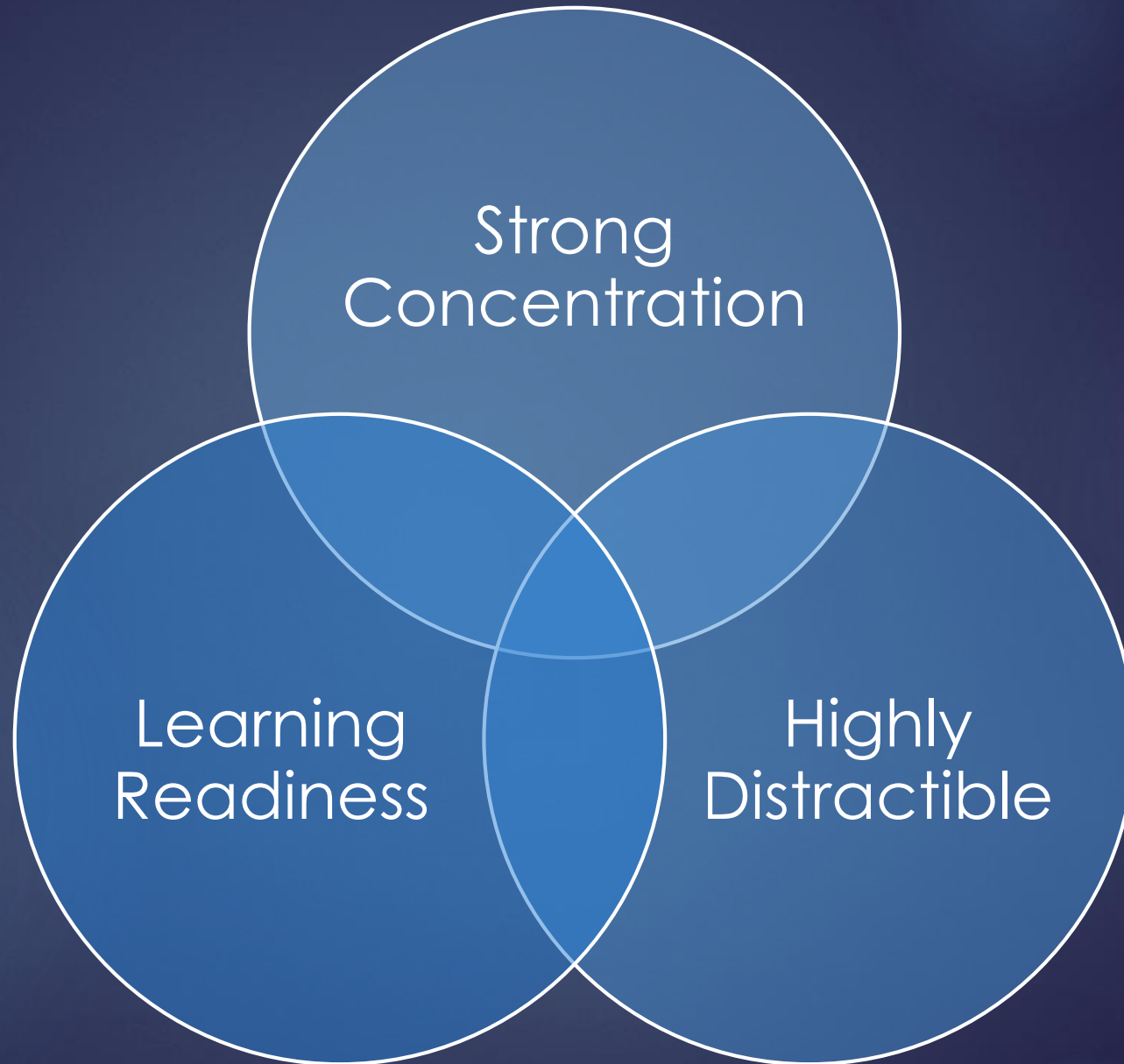
Analytic Methods

▶ Multiple-group categorical confirmatory factor analysis was used to evaluate evidence of configural (pattern) metric (loadings), and scalar (intercepts/thresholds) invariance

▶ Sampling weights and linearization variance estimation were used to account for the complex sampling design

Results supported the hypothesized structure for both groups and indicated partial measurement invariance

Table 1

Global Model Fit Information

Model	WLSMV $\chi^2(df)$	p	WLSMV $\Delta\chi^2(df)$	p	RMSEA (90% CI)	CFI
0a. Baseline (ASD)	116.21 (87)	.020	---	---	.063 (.026, .091)	.941
0b. Baseline (Non-ASD)	1242.75 (87)	< .001	---	---	.049 (.046, .051)	.945
1. Configural	894.76 (174)	< .001	---	---	.038 (.036, .041)	.969
2a. Metric	466.01 (186)	< .001	25.55 (12)[a]	.012	.023 (.020, .026)	.988
2b. Partial Metric	484.02 (185)	< .001	10.56 (11)[a]	.481	.024 (.021, .027)	.987
3a. Scalar	494.92 (206)	< .001	46.33 (21)[b]	.001	.022 (.020, .025)	.988
3b. Partial Scalar	482.46 (201)	< .001	20.78 (16)[b]	.187	.022 (.020, .025)	.988

Note. WLSMV difference tests calculated via the M*plus* DIFFTEST command. [a]Comparison = Model 1. [b]Comparison = Model 2b.

Results Continued…

Adapts (AL21)

Becomes absorbed (CBQ6)

Works independently (AL15)

Follows instructions (CBQ10)

Exhibited non-invariance

This indicates that teachers interpreted these skills differently for boys with and without ASD

After accounting for the non-invariance, there were also factor mean differences, with the ASD group exhibiting less Foundational Learning Skills than the non-ASD group on average

Conclusions

- Importance of considering symptomology when evaluating children's participation and learning
- Investigate psychometric evidence
- Advantages of secondary data
  - Large, representative samples (helpful when working with small subpopulations)
  - Item-level data typically available
- Challenges of secondary data
  - Item-level data not always available
  - Item wording not always available

Thank You

njsparapani@ucdavis.edu   nkoziol@unl.edu