Assessment of Executive Functions Skills Among First Graders in Kenya

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Outline

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Research goal

(i) Determine the factor structure of *Childhood Executive Functioning Inventory* (CHEXI: Thorell, & Nyberg, 2008);

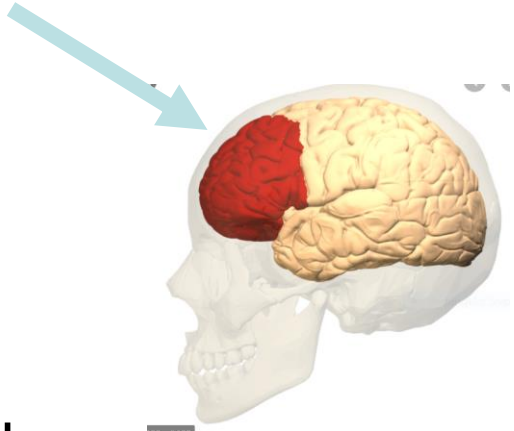
(ii) Determine measurement invariance of the CHEXI based on gender(boys vs girls)

(iii) Executive Function skills differences of the Kenyan First Graders

Executive Functions(EF)

Theoretical Background

- Cognitive abilities found in prefrontal cortex of the brain



- Composed of three components: working memory, inhibitory control and cognitive flexibility (Zelazo et al 2016)

- Working Memory and Inhibition most central (Miyake et al. 2000)

Significance of EF

- critical role in

  (i) School Readiness (Blair & Razza 2007; Morrison et al 2007)

  (ii) mental and physical health (Zelazo et al., 2016),

  (iii) socio-emotional competence (Rhoades et al., 2009),

  (iv) school success (Duncan 2007)

  (v) preschool to school transition (Barret et al 2018)

  (vi) Job success; marital harmony, public safety and Quality of life (Bailey 2007; Eakin 2004; Davis 2010)

Research Gap

- Contradiction in literature of EF components and academic achievement (e.g. Christopher et al., 2012; Vandenbroucke et al., 2017; Blair & Razza, 2007; Lee et al., 2012).
- Role of low and high SES in EF difficulties (e.g. Cook et al., 2020)
- Over 90% done in western world (Willooughby et al.,2019)
- Assessment of EF has mainly been laboratory based (Obradović & Willoughby, 2019) but not behavioural e.g.
  - 1. Childhood Executive Functioning Inventory(CHEXI),
  - 2. Behavioral Rating Inventory of Executive Functions (BRIEF)

Method

Sample and Procedures

- Stratified random sample of 526children in 27 schools (ITC, 2018) guidelines
- Strata - public schools(n=15) and private (n=12)
- 20 randomly selected in class counterbalancing gender
- Age-6 to 11years (M=7.8 years, SD=1.16, 273 boys/2461 girls).

Measures

1. Childhood Executive Functioning Inventory(CHEXI)

- Developed in Sweden (Thorell & Nyberg, 2008)
- Has 24 items tapping on **working memory**(8 items), **planning**(4 items), **inhibition**(6 items) and **regulation**(6 items) (Thorell & Nyberg, 2008)
- Ratings from *1- definitely not true to 5 definitely true.*
- High scores suggest high EF difficulties Camerota et al. 2018
- Validated in other cultures: Hungary (Józsa & Józsa, 2020); US (Camerota et al. 2018); Sweden (Thorell & Nyberg, 2008)

Results

- **Factor structure of the CHEXI**

(1) Exploratory Factor Analysis (EFA)

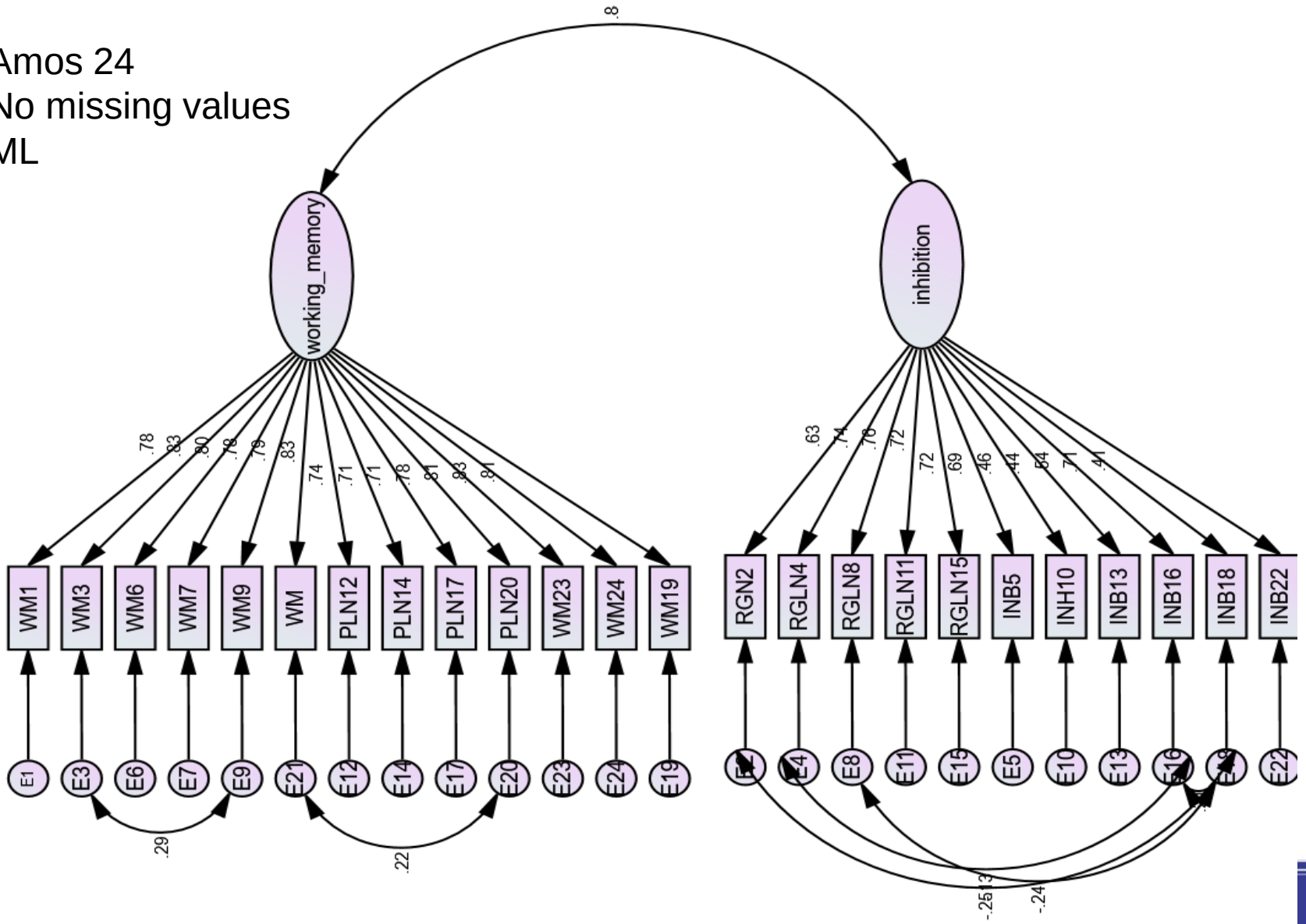
- Principal Component Analysis and Varimax rotation
  - KMO of 0.96 (Kaiser, 1970)
  - CHEXI
    - At first the factors (Working Memory + Planning); Regulation, Inhibition

- Observation of scree plot

(scree plot - 2 factors >1Eigen Value)

2. Confirmatory Factor Analysis (CFA)

Amos 24
No missing values
ML



Confirmatory Factor Analysis Results

- Model fit indices fit indices :

  RMSEA < 0.08, TLI ≥ 0.90, and CFI ≥ 0.90 (Schreiber et al., 2006; Schumacker & Lomax, 2010).

Table 1. Model fit indices for CHEXI factor structure

Model	Model description	CMIN/DF	SRMR	CFI	TLI	RMSEA
	CHEXI factors					
1	4 Factors (WM, PLAN, INH, REG)	3.227	0.042	0.938	0.930	0.065
2	2 Factors (WM, INH)	3.864	0.046	0.914	0.930	0.064
3	2 Factors (WM, INH) w/correlated errors	2.972	0.041	0.950	0.940	0.027

Note. CFI = comparative fit index; INH = inhibition; PLAN = planning; REG = regulation; RMSEA = root mean square error of approximation; SRMR = standardized root mean square residual; TLI = Tucker Lewis Index; WM = working memory

2. Factor loading

- All were above 0.40 but most 0.60 (Gliner et al 2017)

  Except item 10 = 0.437

  "*Gets overly excited when something special is going to happen (e.g. going on a field trip, going to a party)*

3. Average Variance Extracted(AVE) of 0.626 above 0.5

4. Construct reliability- working memory – 0.934 and inhibition of 0.897

Reliability

- working memory scale (α=0.954)
- inhibition α=0.862.
- The total EF reliability of the CHEXI was 0.952.
- Total variance explained was 62% above the threshold of 30% (Bollen, 1989)

Measurement Invariance

Measurement invariance of the CHEXI across Gender

Model	X^2 (*df*)	CFI	RMSEA (90%CI)	SRMR	Model comp	ΔX^2 Δdf	ΔCFI	ΔRMSEA	ΔSRMR
M1 Configural invariance	1309.5 (490)	0.903	0.056 (0.053-0.060)	0.058	-	-	-	-	-
M2 Metric Invariance	1328.5 512	0.903	0.055 (0.052-0.059)	0.069	M1	19.0 (22)	0	-0.001	0.011
M3 Residual Invariance	1350 (534)	0.903	0.054 (0.050-0.058)	0.067	M2	22.15 (22)	0	0.001	-0.002
Scalar invariance	1626 (558)	0.894	0.060 (0.057-0.064)	0.08	M3	76 (24)	0.009	0.006	0.020

a model demonstrates measurement invariance if the ΔCFI ≤ 0.01
Cheung and Rensvold (2002),

Differences in EF skills

a) Public vs Private schools

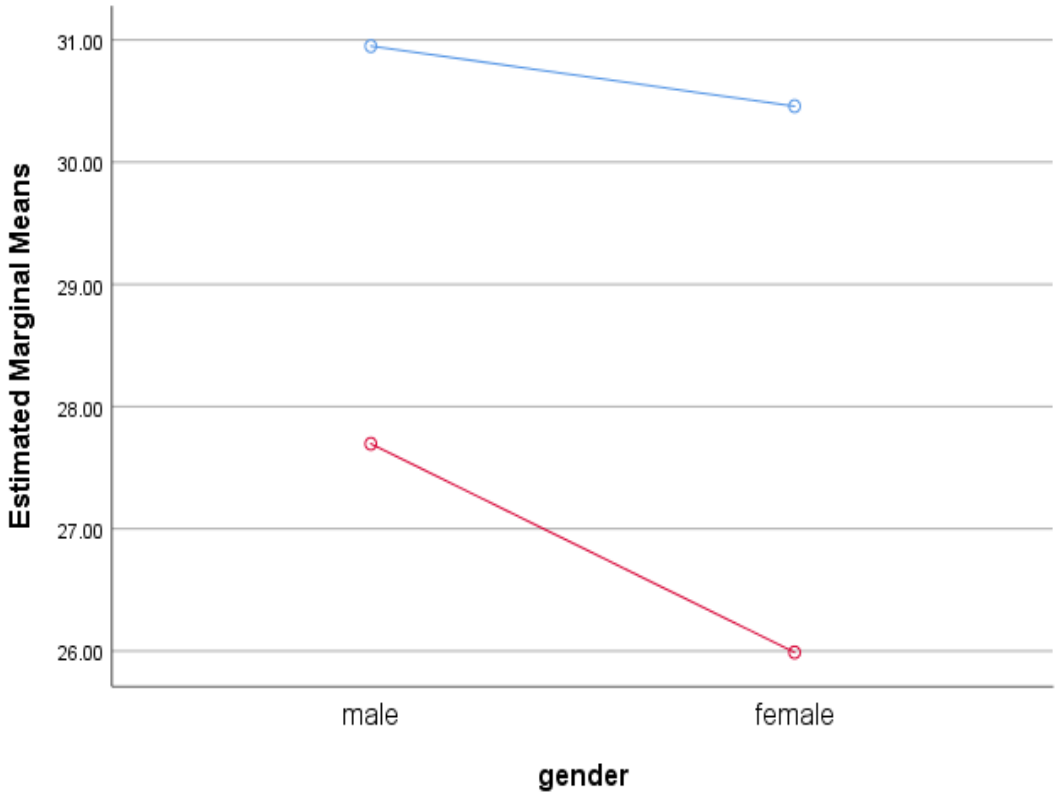
i) Working Memory difficulties

Public Schools

Private Schools

Covariates appearing in the model are evaluated at the following values: age of the child = 7.7833

(ii) Inhibition

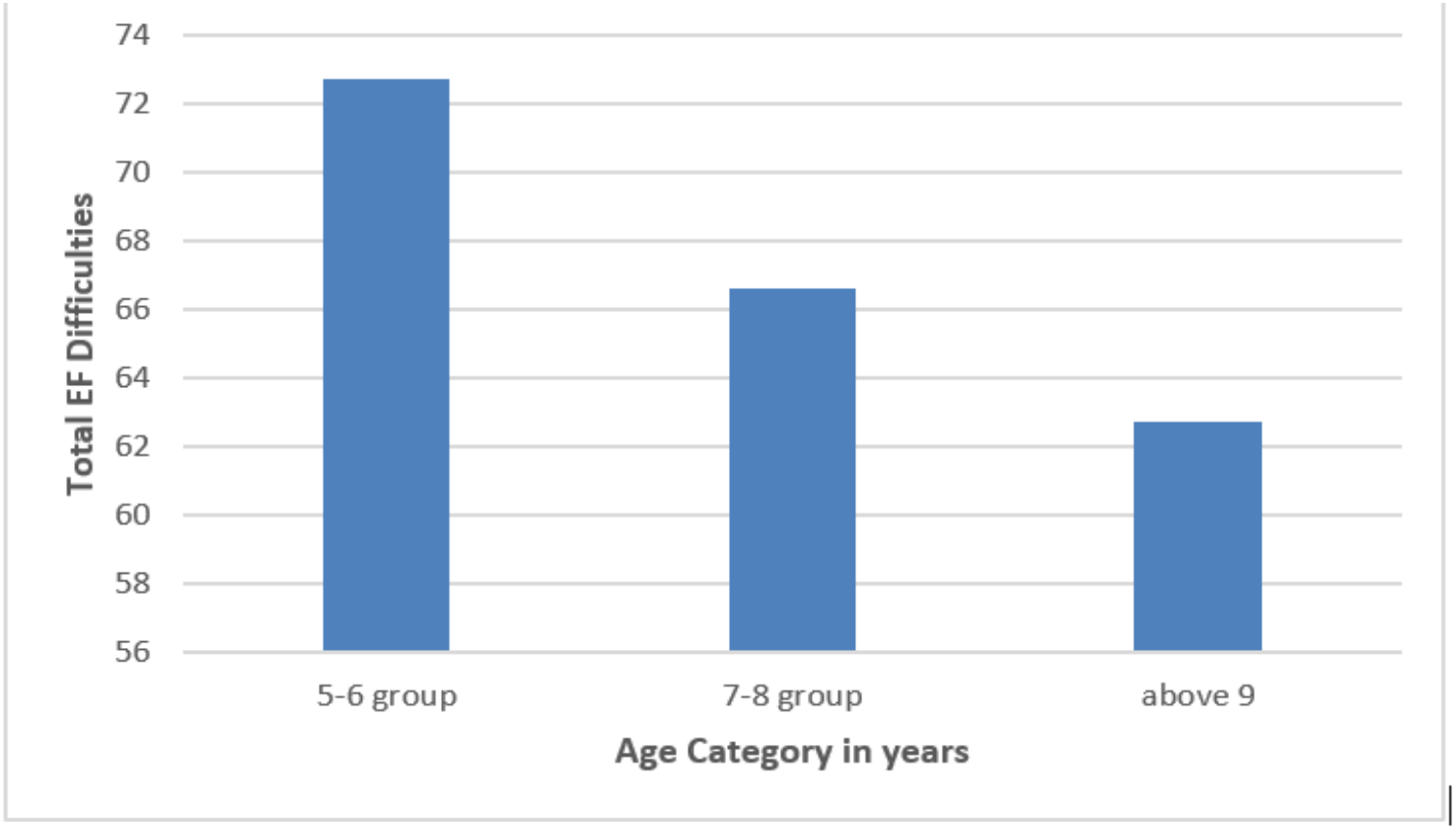


Public Schools

Private Schools

Covariates appearing in the model are evaluated at the following values: age of the child = 7.7833

(b) Total EF skills Differences by age



(c) No gender differences on the EF skills

Strategies to Improve EFs

Strategies to improve EF include

1) Cognitive training programs (Aksayli et al., 2019),

2) Classroom curricula that target EF (Solomon et al.,2018),

3) High quality instructional practices and classroom management procedures (Bierman et al., 2008;Raver et al., 2011).

4) martial arts, mindfulness and Montessori teaching (Diamond & Ling, 2016).

Conclusion

- Two model factor structure was retained similar to Thorell & Nyberg, 2008; Jozsa & Jozsa, 2020
- CHEXI reliable and valid in Kenyan context
- CHEXI demonstrated strong gender invariance
- Private schools have better EF skills than public schools in Kenya. The 5-6 age group in public schools is the most seriously affected category

- Thank you

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