How executive function impacts the growth of reading achievement: A stepwise approach

Background/Context

Executive function is important for early literacy learning and has been associated with reading comprehension and fluency (Blair & Razza, 2007; Cartwright, Marshall, Huemer, & Payne, 2019). Unfortunately, there is a great amount of variability in elementary students' executive function and few longitudinal studies have examined the impact of specific executive function skills on the growth of reading ability (Jerman, Reynolds, & Swanson, 2012). Fewer studies have investigated the relationship disability status (reading disability & no disability) has on the impact of executive function on the growth of reading.

Previous research has found that certain executive function skills impact the development of reading over time (Jerman, Reynolds, & Swanson, 2012). After following around 70 students over three years, it was found that working memory span did not impact the growth of reading ability, but inhibition did. They also found that poor readers had a similar reading growth as their peers. More investigation, with a larger sample size, needs to be conducted to replicate these findings with improved generalizability. Additionally, given the fact that socioeconomic status (SES) impacts students' executive function (Little, 2017), more work needs to be done to understand the relationship that SES has within the context of executive function and reading growth. By understanding the role of early executive function and SES on reading growth, this could lead to a variety of considerations when identifying and intervening with students with reading difficulties.

Purpose/Objective/Research Question

The overall purpose of this research project is to understand how executive function and SES impact the growth of reading achievement from second until fifth grade between students with and without an identified reading disability. Specifically, the proposed research study will determine how the growth of reading over time is impacted by working memory, while also determining if SES is a predictor/mediator in this area. Additionally, how does the reading disability status impact these relationships?

The objective of the overall research plan is to work to build a full model that includes reading disability status, working memory, cognitive flexibility, inhibition, and SES. We are using a stepwise approach, and for this In the Pipeline Poster Session proposal, we are only building a model looking at the impact of working memory and SES on the growth of reading achievement. Once completed, additional executive function skills will be added to the model.

Population/Participants/Subjects/Setting

This study will be using data from the Early Childhood Longitudinal Study, Kindergarten Class of 2010-2011 (ECLS-K: 2011). The data contains a nationally normed sample of students followed from kindergarten until the fifth grade. The total sample size is 18,174 and includes public and private school students.

Proposed Method of Analysis

The longitudinal data from the ECLS-K: 2011 data set will be analyzed using linear mixed modeling with maximum likelihood (ML) estimation (Raudenbush & Bryk, 2002). We will examine individual change over time, shape of reading growth curves, systematic differences in change, and the effects of potential predictors/mediators (i.e., working memory and SES) on group differences (reading disability v. no reading disability) in the initial status and the rate of reading growth over a four year timespan (i.e., second through fifth grade).

Following the strategy suggested by Singer and Willet (2003), several models will be tested. These include: (1) an unconditional model that will examine any mean differences in reading growth across individuals; (2) an unconditional growth model that will serve as a baseline model to explore whether the growth curves are linear or curvilinear; (3) a higher-order polynomial model that will determine if the rate of change accelerated or decelerated across time; and (4) a conditional model that will investigate whether certain predictor/mediator variables are related to the growth parameters (i.e., initial status, linear growth, and quadratic growth). The intercept and linear slope will be allowed to vary across individuals. Missing data will be handled through listwise deletion or imputation.

In terms of model evaluation, the $\chi 2$ (chi-square) statistic and a group of descriptive goodness-of-fit indices will be used. The chi-square fit index is highly sensitive to sample size and the hypothesized model is likely to be rejected when the sample size is large, even though the discrepancy between the sample and model covariance matrices may be small (Fan, Thompson, & Wang, 1999; Fan & Wang, 1998). For this reason, several widely used descriptive goodness-of-fit indices will also be used to assess model fit. These will include the normed chi-square ($\chi 2/df$) and the root mean square error of approximation (RMSEA), which are relatively independent of sample size. -2 log likelihood (i.e., likelihood ratio test/deviance test), Akaike Information Criterion (AIC), and Bayesian Information Criterion (BIC) may also be used as goodness-of-fit indices.

Analyses will be performed using the Statistical Package for the Social Sciences (SPSS) 24.0. Although the restricted maximum likelihood method (REML) is the default option for model estimation in SPSS, we will use ML for model estimation in order to compare nested models (Singer & Willett, 2003). Taking a model building perspective, this is the first of many planned models that will be built and analyzed. Additional models will be completed to incorporate cognitive flexibility and inhibition.

References

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