Title: Analyzing the mediating role of academic and thriving-related skills in the effect of City Connects on middle school academic achievement outcomes.

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Analyzing the mediating role of academic and thriving-related skills in the effect of City Connects on middle school academic achievement outcomes.

Introduction. City Connects is a theory-guided and evidence-based student support intervention that addresses in- and out-of-school factors that may seriously impede students' ability to benefit from instruction (Walsh & Braebeck, 2006).

At the core of the City Connects intervention is a full-time coordinator in each school, a Masters'-level licensed counseling psychologist or social worker. Key elements of the intervention include: (1) working with teachers to identify the strengths and needs of every student in four developmental domains (academic, social/emotional/behavioral, health, and family); (2) developing a tailored plan for each student that identifies services and supports that could promote student strengths and meet needs in the four domains; (3) connecting students to a set of prevention, intervention, and enrichment services in the school and the community, working closely with families to ensure service delivery; (4) implementing school-wide prevention programs; (5) helping teachers to manage student crises; and (6) developing and maintaining relationships with community partners. Beginning in 2001 in one school, City Connects is now implemented in 83 high-poverty urban schools across five states.

Objective. While previous research has shown evidence of positive effects on academic achievement outcomes (An, 2015; Dearing et al., 2016; Lee-St. John, 2013; Shields, Walsh, & Lee-St. John, 2016; Walsh et al., 2014), little empirical research has focused on understanding the mechanisms through which the intervention enhances student achievement. Thus, the present study is focused on exploring mediation mechanisms that intervene in the direct or indirect effect of the intervention on middle school academic outcomes.

Methods. This study aims to determine the direct and indirect effect of the intervention dosage (i.e., the number of years the student has taken part in City Connects) on students' scores on the Massachusetts Comprehensive Assessment System examination (MCAS; Massachusetts Department of Elementary & Secondary Education, 2014) in 6th grade, taking into account the mediation effects of academic and thriving-related indicators at the 5th grade. The hypothesized mediators include report card scores in the academic domains of mathematics, reading, and writing, and in the thriving domains of effort, work habits, and behavior.

The analyses are based on data from Boston Public Schools (BPS), where some schools have implemented City Connects since 2001. The analyses are focused on 2,619 students from 18 schools taking part in City Connects, and who started elementary school between the school years 2001-02 and 2007-08, such that 6th grade MCAS scores would be available before or during the school year of 2013-14.

Table 1 summarizes sociodemographic information for the students in the sample, which were included as additional student-level covariates in the mediation models. The amount of time students were in the intervention ranged from less than one year to seven years, with a mean dosage of 3.37 years (s.d. = 1.86).

The hypothesized mediators and MCAS outcomes were drawn from different years and so z-scores were calculated by grade and school year. Table 2 summarizes the descriptive statistics for each hypothesized mediator and the MCAS English language arts (ELA) and mathematics outcomes. Overall, students in the sample had slightly higher report card and MCAS scores compared to the average in their school district.

Because of the nested structure of the data having students within schools taking part of the intervention, multilevel structural equation models (MSEM; Muthén & Asparouhov, 2009, 2011; Preacher, 2015; Preacher, Zhang, & Zyphur, 2011; Preacher, Zyphur, & Zhang, 2010) were used to empirically test hypotheses about the direct and indirect effect of the City Connects student-level dosage indicator on the student-level MCAS scores through the mediation effect of student-level academic and thriving indicators in fifth grade. The MSEM analyses were performed using M-Plus software (Muthén & Muthén, 2012).

Figure 1 represents the MSEM approach used to test the mediation model. The triangulation among dosage, hypothesized academic and thriving mediators, and the MCAS score outcomes were defined both within schools and between schools, following the guidelines set out by Preacher et al. (2010, 2011). The mediators were defined as representing either academic-related skills (mathematics, reading, and writing) or thriving-related skills (effort, work habits, behavior), so correlations between mediators of the same skill type were included in the model. The additional sociodemographic covariates described in Table 1 were added as within-cluster predictors of the MCAS outcome.

Results. Tables 3 and 4 show the results of the mediation models for the 6th grade MCAS ELA and mathematics outcomes, respectively. Results for ELA show significant within-cluster indirect effects through the 5th grade academic mediators (i.e., mathematics, reading, and writing), but no significant within-cluster direct effects between the levels of dosage and the academic achievement in ELA. The academic mediators also show significant within-cluster direct effects on the MCAS ELA outcome, and they are significantly predicted by the dosage variable. The thriving mediators (i.e., effort, work habits, and behavior) were not statistically significant predictors of the outcome nor showed a significant indirect effect of dosage on the outcome.

The MCAS mathematics results show a pattern of significant effects similar to the one obtained for MCAS ELA, but the within-cluster direct effect of dosage on the outcome is statistically significant in this case. Additionally, Tables 3 and 4 show significant within-cluster and between-cluster correlations among the mediators.

Finally, Table 5 presents the intraclass correlations (ICC) for the variables in the model. The dosage variable presents the highest ICC, which is expected since some schools have implemented the intervention for a longer period of time. On average, the thriving mediators tended to show higher ICC values compared to the academic mediators and the MCAS outcomes, which may indicate there is a trend in the manner students are graded in their report cards within each school.

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Tables in manuscript

Table 1. Sociodemographic characteristics of the sample

Characteristic		Percentage
Gender	% Female	51.2
Race-Ethnicity	% Black	27.7
	% White	11.3
	% Asian	27.3
	% Hispanic	31.9
	% Native American	0.3
	% Mixed or other race	1.4
Special education status	% Special education. Level 2	8.5
	% Special education. Level 3	7.6
Lunch benefit	% Free lunch	60.6
	% Reduced-price lunch	3.1
English language status	% English Language Learner	29.8
	% Foreign born	21.2

Table 2. Descriptive statistics for mediators and outcomes

		Mean	SD	Min	Max
Academic mediators	Mathematics	.184	.998	-2.057	1.670
	Reading	.110	..952	-2.449	1.595
	Writing	.136	.958	-2.492	1.874
Thriving mediators	Effort	.160	.921	-2.569	1.510
	Work habits	.052	.920	-3.418	1.424
	Behavior	.111	.871	-2.805	1.100
MCAS outcomes	English Language Arts	.091	.982	-2.969	2.084
	Mathematics	.189	.992	-2.613	1.765

Note: 'SD' refers to the standard deviation, 'Min' to the minimum value, and 'Max' to the maximum value.

Table 3. MSEM mediation model for the MCAS English Language Arts

Path coefficients

Mediators		**a$_W$ (S.E.)**	**b$_W$ (S.E.)**	**c$_W$ (S.E.)**	**Ind$_W$ (S.E.)**
Academic	Math Report Card	0.044*** (*0.011*)	0.180*** (*0.020*)		0.008*** (*0.002*)
	Reading Report Card	0.046*** (*0.014*)	0.351*** (*0.024*)		0.016*** (*0.005*)
	Writing Report Card	0.053*** (*0.012*)	0.216*** (*0.049*)	- 0.007 (*0.008*)	0.011*** (*0.003*)
Thriving	Effort Report Card	0.020 (*0.012*)	-0.105 (*0.067*)		-0.002 (*0.002*)
	Work Habits Report Card	0.022 (*0.012*)	0.000 (*0.037*)		0.000 (*0.001*)
	Behavior Report Card	0.014 (*0.014*)	-0.003 (*0.037*)		0.000 (*0.001*)
		a$_B$ (S.E.)	**b$_B$ (S.E.)**	**c$_B$ (S.E.)**	**Ind$_B$ (S.E.)**
Academic	Math Report Card	0.117* (*0.060*)	-0.114 (*0.323*)		-0.013 (*0.036*)
	Reading Report Card	0.133* (*0.060*)	0.390 (*0.503*)		0.052 (*0.072*)
	Writing Report Card	0.114 (*0.073*)	0.283 (*0.395*)	-0.006 (*0.047*)	0.032 (*0.039*)
Thriving	Effort Report Card	0.141* (*0.061*)	0.344 (*0.325*)		0.049 (*0.059*)
	Work Habits Report Card	0.143 (*0.079*)	-0.487 (*0.501*)		-0.069 (*0.083*)
	Behavior Report Card	0.108 (*0.075*)	0.465 (*0.303*)		0.050 (*0.050*)

Correlations among mediators

		Cor$_W$ (S.E.)	**Cor$_B$ (S.E.)**
Academic	Math – Reading	0.558*** (*0.058*)	0.117* (*0.060*)
	Math – Writing	0.551*** (*0.058*)	0.133* (0.060)
	Reading – Writing	0.670*** (*0.058*)	0.114 (*0.073*)
Thriving	Effort – Work Habits	0.616*** (*0.056*)	0.141* (*0.061*)
	Effort – Behavior	0.438*** (*0.060*)	0.143 (*0.079*)
	Work Habits – Behavior	0.530*** (*0.071*)	0.108 (*0.075*)

Note: 'S.E.' refers to the standard error, 'Ind' to the indirect effect through the mediator, 'Cor' to the correlation between mediators. The subscript W refers to the within-cluster estimates and B to the between-cluster estimates. Significance level. * ≤ .05, ** ≤ .01, *** ≤ .001

Table 4. MSEM mediation model for the MCAS Mathematics

Path coefficients

Mediators		a_W (S.E.)	b_W (S.E.)	c_W (S.E.)	Ind_W (S.E.)
Academic	Math Report Card	0.044*** (0.011)	0.471*** (0.030)		0.021*** (0.005)
	Reading Report Card	0.046*** (0.013)	0.136*** (0.031)		0.006* (0.003)
	Writing Report Card	0.053*** (0.012)	0.138* (0.058)	-0.032* (0.015)	0.007** (0.003)
Thriving	Effort Report Card	0.020 (0.012)	-0.074 (0.052)		-0.002 (0.002)
	Work Habits Report Card	0.022 (0.012)	-0.024 (0.063)		-0.001 (0.001)
	Behavior Report Card	0.014 (0.014)	0.022 (0.032)		0.000 (0.001)
		a_B (S.E.)	b_B (S.E.)	c_B (S.E.)	Ind_B (S.E.)
Academic	Math Report Card	0.097 (0.060)	0.311 (0.260)		0.030 (0.032)
	Reading Report Card	0.113 (0.061)	0.810* (0.358)		0.091 (0.071)
	Writing Report Card	0.092 (0.075)	-0.564 (0.337)	-0.032 (0.041)	-0.052 (0.063)
Thriving	Effort Report Card	0.142* (0.060)	0.417 (0.311)		0.059 (0.061)
	Work Habits Report Card	0.143 (0.078)	-0.474 (0.428)		-0.068 (0.078)
	Behavior Report Card	0.108 (0.074)	0.320 (0.333)		0.035 (0.047)

Correlations among mediators

		Cor_W (S.E.)	Cor_B (S.E.)
Academic	Math – Reading	0.558*** (0.057)	0.086* (0.036)
	Math – Writing	0.550*** (0.058)	0.098* (0.039)
	Reading – Writing	0.671*** (0.058)	0.104* (0.042)
Thriving	Effort – Work Habits	0.617*** (0.056)	0.088* (0.035)
	Effort – Behavior	0.438*** (0.060)	0.070* (0.034)
	Work Habits – Behavior	0.530*** (0.071)	0.093* (0.039)

Note: 'S.E.' refers to the standard error, 'Ind' to the indirect effect through the mediator, 'Cor' to the correlation between mediators. The subscript W refers to the within-cluster estimates and B to the between-cluster estimates. Significance level. $* \leq .05, ** \leq .01, *** \leq .001$

Table 5. Intraclass correlations for the variables in the model

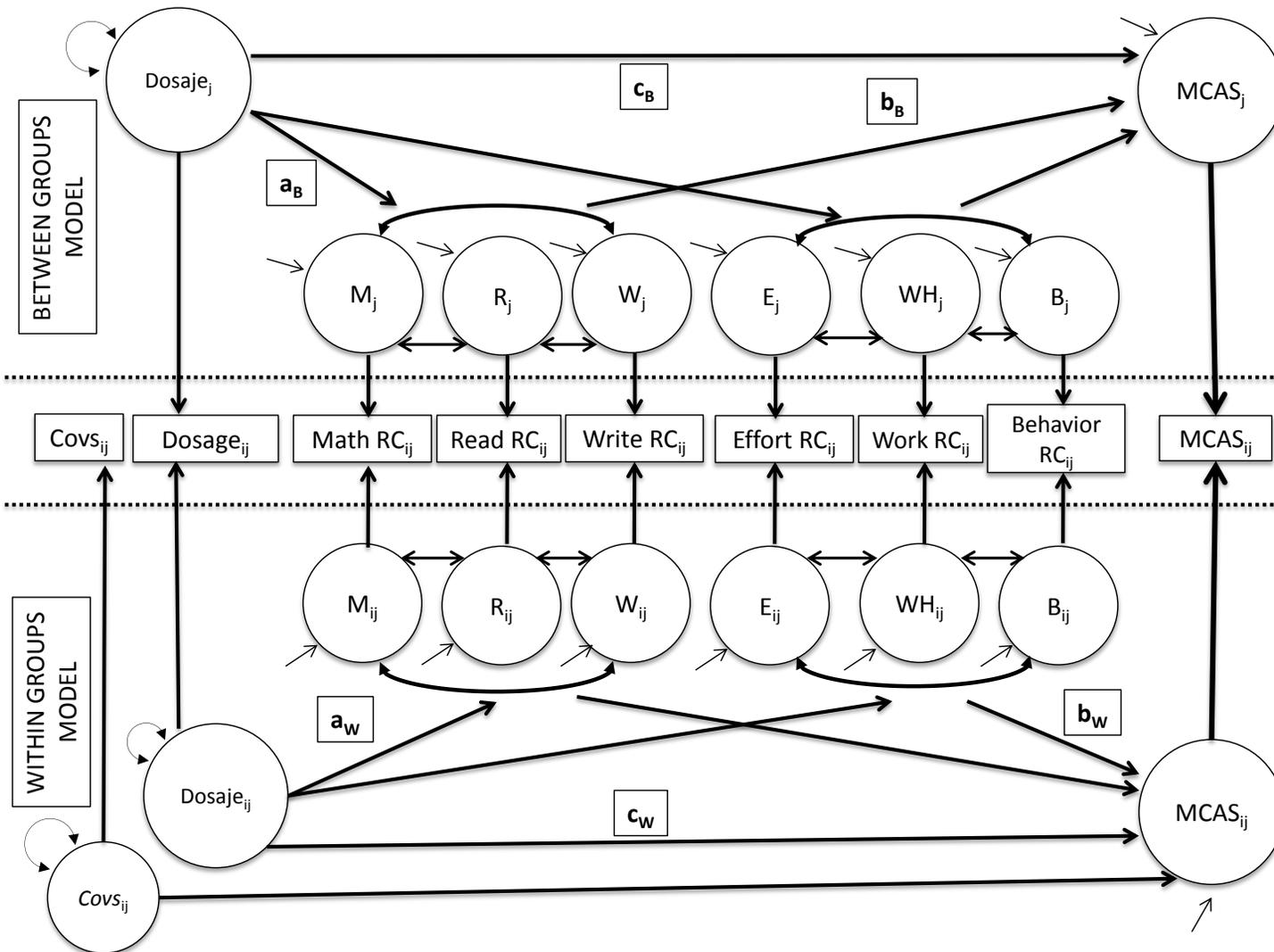|	ICC
Dosage	0.288
Math Report Card	0.067
Reading Report Card	0.082
Writing Report Card	0.097
Effort Report Card	0.098
Work Habits Report Card	0.119
Behavior Report Card	0.112
MCAS ELA	0.051
MCAS Mathematics	0.036

Figures

Figure 1. MSEM representation of the model