Examining Mediators of the Effect of a Child Care Intervention on Adult Outcomes

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Results from a few influential early care and education (ECE) intervention projects show that these programs have positive outcomes into adulthood such as higher incomes, greater educational attainment, and improved health (Conti, Heckman & Pinto, 2016; Cuhna & Heckman, 2007). However, there is still a gap in understanding *why* certain program have long-lasting impacts. This has become a particularly relevant question with the treatment effects of many programs fading as early as elementary school (Duncan & Magnuson, 2013). Previous studies have identified cognitive and behavioral skills (Heckman, Pinto, & Savelyev, 2013) as the mechanisms through which ECE interventions are successful in improving outcomes. Learning more about the mechanisms through which interventions impact child outcomes is beneficial for at least two reasons (Reynolds, Ou, & Topitzes, 2004). Identification of likely mechanisms through which the early childhood education programs had long-term impacts could be used to adapt existing programs or develop new ones. Second, the comparison of identified mechanisms across studies asks whether early childhood programs with different curricular models appear to have long-term impacts through similar or different mechanisms. Finding similar mediators across studies increases confidence in findings. Finding different mediators suggests there may be multiple pathways through which different types of early childhood programs have long-term impacts.

Purpose of Study

The present research asks whether early cognitive and behavior skills appear to mediate the effects of a child care intervention on 30-year-old education and income levels. The intervention focused on providing high quality child care to children who were academically at-risk through nurturing positive attachment relationships with caregivers and providing high-quality language interactions in the classroom. Because of this intervention design, the present study focuses on cognitive (executive function & verbal skills) and behavior skills (independence & behavior problems) as mediators. Sex differences in the pathways were also examined based on previous research suggesting differential effects for males and females.

Participants and Procedures

Four cohorts of 28 infants who were deemed academically at-risk due to conditions of poverty were randomly assigned to treatment and control groups between 1972 and 1977. The treatment group received full-time, high quality care and education from approximately 4 months of age until entry to formal schooling. The control group received nutritional supplements, diapers, and medical referrals. The analysis sample includes 105 participants who completed assessments during at least one assessment period. Descriptive statistics are included in Table 1. Cognitive measures were collected at the end of the program and behavioral measures were reported by the kindergarten teacher.

Measures and Analysis

Executive Function (EF) was measured with the Wechsler Preschool and Primary Scale of Intelligence (WPPSI; Wechsler, 1967) Block Design subtest, which requires both cognitive

flexibility and working memory components of EF. The WPPSI was also used to capture verbal skills at age 5 using the verbal intelligence composite score, a sum of subtest scores measuring skills such as vocabulary and general knowledge. The participants' kindergarten teachers completed the Classroom Behavior Inventory (CBI; Schaefer, Edgerton & Aaronson, 1978). The original measure has 10 subscales, but an exploratory factor analysis with a varimax rotation was conducted for data reduction. Four subscales emerged, however only the independence and behavior problems subscales were deemed most relevant to the present models. Education was examined as a continuous variable ranging from 1 (less than 9th grade) to 12 (Doctorate Degree). The distribution for income was skewed, so income was dummy coded to capture whether the household income was at or below the federal poverty line. The models also include a treatment-by-sex interaction as past studies have suggested gender differences in the treatment effect of ECE interventions on skills.

Due to reduced power because of the small sample size, separate path analyses were conducted for each mediator and outcome (for a total of 8 path models) in MPLUS. For the continuous education outcome, a maximum likelihood estimator was used, but for models with the binary income outcome the weighted least square mean and variance adjusted (WLSMV) estimator was used. The treatment-by-sex interaction was dropped from the individual models if not significant, but a dichotomous variable for sex (male = 1) remained in all models as a covariate. All models controlled for the effect of maternal IQ on the outcomes of interest. Indirect effects of the treatment through each mediator was tested via bootstrapping 1000 datasets.

Results

Results can be found in Figure 1. At the end of treatment, the ECE treatment group was significantly higher than the control group on the Verbal IQ and Block Design tests and teacher ratings of independence, but also showed higher levels of behavior problems. The treatment x sex interaction indicated the treatment boys, but not girls, had a higher level of independence. None of the potential mediators were significant predictors of income level. Mediation analyses estimated indirect paths from treatment through these 5-year skills to 30-year education and income level. The only significant indirect effect was the paths from the treatment to education and income through verbal skills ($\beta = 0.09$, SE = 0.04, $p = 0.06$).

Conclusion

The intervention had significant effects on several early childhood skills, but verbal skills appear to be the mechanism through which this ECE intervention had effects on outcomes into adulthood. This was not surprising given the intervention's focus on verbal skills, and the importance of language for growth in a variety of developmental domains (Pace et al., 2019). In contrast, strong evidence did not emerge suggesting that behavioral mechanisms identified in careful analyses from previous studies (Cuhna & Heckman, 2007). Thus, findings across the two studies suggest different mechanisms potentially related to differences in the focus of the two programs. Although these analyses were limited by the small sample size, and we cannot make causal inferences from the results, these results suggest that similar ECE interventions designed

to improve the verbal skills of children may have similar positive effects on educational attainment in adulthood.

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Table 1. Descriptive statistics

	Control			Treatment			
	N	Mean	Std	N	Mean	Std	Effect Size
Sex (1=M, 0=F)	53	0.43	0.50	57	0.51	0.50	0.16
Child Age at program entry (weeks)	53	5.09	4.45	54	8.83	4.63	0.82***
Race (1 = African American, 0 = Other)	53	1.00	0.00	57	0.89	0.31	-
Mother highest grade completed	53	10.08	1.83	53	10.62	1.71	0.30+
60-Month Mediators							
WPPSI verbal IQ score	46	94.46	13.58	49	102.67	11.39	0.66**
WPPSI Block Design	46	9.65	2.58	49	10.45	2.23	0.33+
CBI Behavior Problems	43	2.57	0.18	45	2.75	0.21	0.92***
CBI Independence	43	2.52	0.10	45	2.52	0.11	0
30-Year Outcomes							
Education Level	49	4.94	2.09	52	6.04	2.56	0.47*
Income (1 = Above Poverty Line)	53	0.68	0.47	57	0.74	0.44	0.13

Note. *** p < .001, ** p < .01, * p < .05, + p < .1

Table 2. Indirect effects

	Education	Income
	β (SE)	β (SE)
EF	0.06 (0.04)	0.02 (0.03)
Verbal Skills	0.09+ (0.05)	0.05 (0.05)
Behavior Problems	0.07 (0.06)	0.03 (0.06)
Independence		
Treatment	0.07 (0.07)	0.02 (0.04)
Treat x Male	-0.11 (0.09)	-0.03 (0.06)

Note. +*0.1 > p* > 0.05; * *p* < 0.05

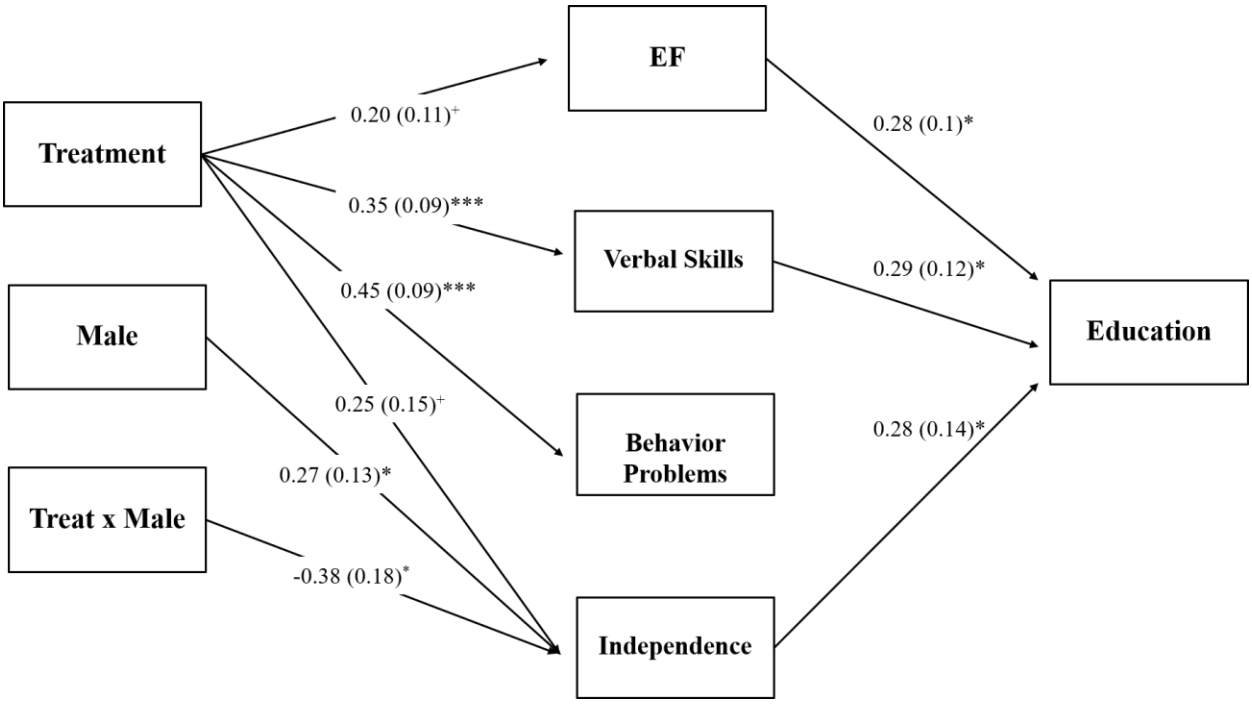

Figure 1. Significant standardized paths. Each mediator tested in separate models. All models control for path from maternal IQ to the outcome.