Abstract Title Page
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Title: Process Dimensions of Child Care Quality and Academic Achievement: An Instrumental Variables Analysis

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Abstract Body
Limit 4 pages single-spaced.

Background / Context:

The use of center-based childcare increased greatly in the 1970's as many mothers returned to the workforce while their children were still at preschool ages (e.g., Clarke-Stewart & Allhusen, 2005; Vandell & Shumow, 1999; Waldfogel, 2010). Prior to the 1970's, home-based care was the norm, with the majority of mothers staying home to provide care (Clarke-Stewart & Allhusen, 2005; Vandell & Shumow, 1999). However, with the rising cost of living in the United States and the stagnant income levels over the past thirty years, more mothers were forced to re-enter the workforce than ever before (Waldfogel, 2010).

Because of the influx of children entering center-based child care, the quality of the care became an area of interest among early childhood researchers (Burchinal, 1999; Burchinal, Roberts, Nabors, & Bryant, 1996; NICHD ECCRN, 2000; Phillipsen, Burchinal, Howes, & Cryer, 1997; Vandell & Wolfe, 2000; Vandell, Belsky, Burchinal, Steinberg, & Vandergrift, 2010). Although it is a much studied topic, little is known about the mechanisms through which quality of center-based care affects academic outcomes. Prior research points to a positive, but modest, relationship between child care quality and concurrent and longitudinal academic outcomes, with children from low-income families benefitting more from high-quality care (Burchinal, Kainz, Cai, 2011; Dearing, McCartney & Taylor, 2009; Vandell 2010). Because the income-based achievement gap already exists at kindergarten entry, it is important to find ways to boost children's achievement during the preschool years so they enter school with the same skills as their more affluent peers (Haskins & Rouse, 2005; Ramey & Ramey, 2004).

Child care quality is usually measured along two dimensions–structural and process. In this paper we focus on process quality–the quality of child care center instructional practices and teacher interactions with students. We use an instrumental variables technique to estimate the effect of child care center process quality on academic achievement for children.

Purpose / Objective / Research Question / Focus of Study:

We use a national data set, focusing on low-income children, to examine the effects of high process quality child care on math, reading and vocabulary outcomes for preschool children. The goal is to discover the causal effect of process quality on children's academic outcomes in the preschool years.

Setting:

The present study is an analysis of secondary data collected at different sites around the country, which is described in detail below. Data from the Preschool Curriculum Evaluation Research Initiative Study are used in the study.

Population / Participants / Subjects:
Data Sets and Participants

Twelve research teams around the United States were awarded grants to systematically study the effect of a preschool curriculum on child academic outcomes into kindergarten. The 12 teams choose the curriculum to be examined, with some sites testing the effect of more than one curriculum. A total of 14 different curricula were tested. At each grantee site, curriculum condition was randomly assigned to classrooms within a preschool center. Because of feasibility and cross contamination across classrooms, most research sites were only able to assign one curriculum to each center; very few were actually able to randomly assign treatment and control classrooms within a center. Site in the analyses refers to the level of random assignment. Children included in the study were predominately low-income and from diverse backgrounds. Approximately 40% of children were Black and 15% were Hispanic.

Quality Measures
Several process quality measures were combined to create a child care process quality composite. Each quality measure in the composite is described in detail below. All quality measures used in the study were collected at the end of the preschool year. The composite was used in all analyses.

Early Childhood Environment Rating Scale -Revised (ECERS-R). The ECERS-R is composed of 43 items (Harms, Clifford, & Cryer, 1998). Each item was rated by observers on a seven point scale. Two factors were derived from the scale items and were used in the study. These factors have been used in previous research and represent two components of child care quality: Teacher Interactions and Provisions for Learning (Pianta et al., 2005). Teacher Interactions consists of items related to the interactions that occur between children and the teachers, how they communicate with each other and the type of discipline that occurs in the classroom. Provisions for learning focuses on the learning environment and physical features that are provided to the children in the classroom. For more information on the specific items in each factor see Pianta et al., 2005.

Arnett Caregiver Interaction Scale. Interactions between children and teachers were also measured using the Arnett Caregiver Interaction Scale (Arnett, 1989). There are 26 items on the scale that are rated on a four-point scale, with one being not true at all to four being very much true. The total score was used in the child care quality composite.

Teacher Behavior Rating Scale (TBRS). In order to understand the effect of a more specific measure of quality, such as quality of instruction in math or reading, the TBRS was used (Landry, Crawford, Gunnewig, & Swank, 2002). This measure captures both the frequency and quality of certain literacy and math activities conducted in the classroom. Multiple literacy activities are captured in the instrument including phonological awareness, book reading, and oral language use. A composite of all literacy quality and quantity ratings was used in the composite. For math, only one rating of both quality and quantity was available, so they were entered individually into the composite.

Child Outcomes
Three academic outcomes were examined in the study. The first outcome is vocabulary and is measured by the Peabody Picture Vocabulary Test (PPVT) (Dunn & Dunn, 1981). The second and third assessments are Applied Problems (math) and Letter Word Recognition (reading),

which both come from the Woodcock-Johnson Psycho-Educational Battery-Revised (Woodcock, 1977). Children were administered these assessments at the beginning and end of their pre-school year.

Control Variables
Child and parent level controls were included in the analyses. Prior adjustment for the academic variable, gender of child, race of child, mother or primary caregiver educational level, mother or primary caregiver age, income, whether receiving welfare aid, whether employed and marital status were included in all analyses. Table 1 displays the demographic characteristics of the children and their families along with descriptive statistics of the child care quality measures and academic outcomes.

(please insert Table 1 here)

Research Design:

Analyses on previously collected data were conducted. The data set was chosen because of its random assignment design and availability of quality and academic measures.

Data Collection and Analysis:

In order to estimate the effect of child care quality on academic outcomes, instrumental variables (IV) was used. IV is a method commonly used to control for omitted variable bias and can be used in studies containing a randomized design (Angrist & Krueger, 2001; Duncan, Morris, & Rodrigues, 2011; Ludwig & Kling, 2006). The method consists of conducting a Two-Stage Least Squares regression to estimate the endogenous variable's impact on the outcome variable. In the first stage of the regression, site and treatment dummy variables, as well as their interaction are used, along with control variables, to predict the process quality measure of the child care setting. The second stage uses the predicted value of quality from the first stage, site, treatment and the control variables to predict the academic outcome. The treatment and the interaction of site and treatment are left out of the second stage regression since they act as the exogenous variables that estimate a portion of the variation in the quality variables, which is then used to estimate the effect of child care quality on academic outcomes. We also compared Ordinary Least Squares (OLS) regression results with the IV estimates. The same controls variables used in the IV models and site were included in the OLS models.

Findings / Results:

Table 2 presents the results from the OLS and IV analyses. Results for the OLS regressions indicate that the process quality composite has a consistently positive and significant effect on vocabulary and reading achievement in the preschool years. No significant effect is found for math achievement. The first stage of the IV analyses is strong as indicated by the large F-statistic (22). The large F-statistic indicates the instrument, in this case site interacted with treatment, was an appropriate instrument that should provide sufficient power to estimate child care quality effects. The results from the IV analyses show a significant effect of process child care quality

on preschool children's vocabulary and math achievement; however, contrary to the OLS results there is no significant effect of process quality on children's reading achievement.

(please insert Table 2 here)

Conclusions:

Overall, our composite measure of child care process quality was found to significantly affect preschool children's vocabulary and math achievement. The effects are significant, but small according to Cohen (1992), and are similar to the associations found when using OLS. Given the quasi-experimental method used, it was expected that larger effects of process quality would have been found. Our IV estimates are similar to the results found from a meta-analysis conducted by Burchinal and colleagues (2011), which show a small to modest association between child outcomes and child care quality. There has been speculation surrounding the ability of current instruments to provide sufficiently valid measures of child care process quality (Burchinal et al., 2011), which is one possible explanation for our findings. Child care quality as presently measured may need to be modified or strengthened to ensure quality is being measured in a valid way. Also, previous research has typically relied on non quasi-experimental methods to estimate the effect of child care quality. This may have led to overestimates of the effect of quality on achievement, particularly children's reading ability. The findings of the study are important because they demonstrate the need to improve the quality measures currently used in early childhood settings, and also suggest the need for more rigorous methods in evaluating the effect of child care quality on youth outcomes.

Appendices

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Appendix A. References

References are to be in APA version 6 format.

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Appendix B. Tables and Figures

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Table 1.

Preschool Curriculum Evaluation Research (PCER) Study Participant Demographic and Background Characteristics, and Center Quality Measures.

	Treatment					Control				
	N	Mean/ % of Sample	SD	Min	Max	N	Mean/ % of Sample	SD	Min	Max
Child Characteristics										
Gender - Female	1550	48%				1150	49%			
Race	1400					1100				
White		35%					33%			
Black		42%					44%			
Asian		1%					1%			
Hispanic		16%					15%			
Other		6%					7%			
Age (months)	1500	54.66	3.76	45.50	71.59	1150	54.74	3.87	45.10	66.03
Maternal Characteristics - Baseline (Fall 2003)										
Married	1300	48%				950	46%			
Education Level	1300	13.01	1.90	10	16	950	12.77	1.90	10	16
Employed	1300	67%				950	64%			
Maternal/Caregiver Age	1300	31.67	7.68	16.00	68.00	950	31.55	7.72	19	74
Income (Thousands)	1150	31.02	24.47	2.50	87.50	850	29.31	23.11	2.50	87.50
Receiving Welfare Aid	1300	13%				950	17%			
Child Academic Achievement - Baseline (Fall 2003)										
WJ Letter Word	1500	99.08	16.10	65	184	1100	98.75	15.95	51	185
WJ Applied Problems	1450	93.71	15.04	45	137	1100	94.06	15.12	46	132
PPVT	1500	88.60	15.54	40	135	1150	88.42	16.11	40	131
Child Academic Achievement - End of Preschool Year (Spring 2004)										
WJ Letter Word	1500	103.31	13.87	51	172	1150	102.47	13.95	51	158
WJ Applied Problems	1500	96.21	13.50	42	137	1150	95.27	14.71	16	147
PPVT	1550	93.25	15.00	40	134	1150	92.26	15.45	40	132
Preschool Quality Measures (Spring 2004)										
TBRS - Math Quantity	1450	1.18	0.54	0.43	3	1100	1.05	0.48	0.43	2.86
TBRS - Math Quality	1450	1.10	0.71	0	3	1100	0.91	0.60	0	2.86
TBRS - Literacy Quantity	1450	0.14	0.79	-1.14	2.86	1100	-0.16	0.66	-1.31	2.01
TBRS - Literacy Quality	1450	0.16	0.81	-1.28	2.33	1100	-0.19	0.73	-1.44	2.05
ECERS - Interactions	1550	4.79	1.42	1.45	7.00	1150	4.38	1.43	1.00	7.00
ECERS - Provisions	1550	4.00	1.08	1.73	6.18	1150	3.72	1.08	1.27	6.82
Arnett Total	1500	3.21	0.56	1.24	3.92	1100	3.06	0.62	1.12	3.88

Note. Ns are rounded to the nearest 10th in accordance with NCES data policies. TBRS = Teacher Behavioral Rating Scale. TBRS literacy quantity and quality measure are composites of all literacy skills examined (written expression, print and letter knowledge, phonological awareness, book reading and oral language use). ECERS = Early Childhood Environment Rating Scale.

Table 2.

OLS and IV Results of Quality Composite Predicting Academic Achievement.

	OLS				IV		
	PPVT-Vocabulary	WJAP - Math	WJLW-Reading		PPVT-Vocabulary	WJAP - Math	WJLW-Reading
Child Care Quality Composite	.048** (.016)	.028 (.025)	.084*** (.023)		.087** (.034)	.084* (.039)	.050 (.038)
Sample Size	2,700	2,650	2,650		2,700	2,650	2,650

Note.
• Standard errors are in parentheses. Number of observations are rounded to the nearest 10th in accordance with NCES data policies.
• All models presented in the table include the following child level covariates: age in months, gender, race (Black, Asian, Hispanic, or other; White is the comparison group), and baseline achievement as measured in the Fall 2003. Parent (Mother) level covariates include (Fall 2003): age in years, education level, whether married, whether working (full or part time), whether receiving welfare aid, and annual income in thousands.
• Level of random assignment depends on whether the school allowed both treatment and control group to be present. Most sites did not, so level of random assignment is at the study site location level.
• Independent and dependent variables were standardized to have a mean of zero and a standard deviation of one.
• In the OLS models fixed effects for level of random assignment were used and standard errors were adjusted by clustering by preschool classroom id to take into account similarities of children within the same classroom.
• In the IV model, quality was instrumented by treatment, and random assignment level interacted with treatment condition.
• Missing data was handled by setting missing cases in variables to the mean except for categorical variables. An additional variable was entered into the model for whether the variable was missing.
• The quality measure is a composite following quality measures: ECERS-R (provisions and interacts), Arnett, TBRS - Math Quality, TBRS - Literacy Quality (composite of all literacy activities), TBRS - Math Quantity, and TBRS - Literacy Quantity (composite of all literacy activities).
* $p < .05$, ** $p < .01$, *** $p < .001$