Published in final edited form as:

J Appl Dev Psychol. 2012 ; 33(1): 1–12. doi:10.1016/j.appdev.2011.11.001.

Accounting for Movement between Childcare Classrooms: Does it Change Teacher Effects Interpretations?

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Abstract

Child care studies that have examined links between teachers' qualifications and children's outcomes often ignore teachers' and children's transitions between classrooms at a center throughout the day and only take into account head teacher qualifications. The objective of this investigation was to examine these traditional assumptions and to compare inferences made from these traditional models to methods accounting for transitions between classrooms and multiple teachers in a classroom. The study examined the receptive language, letter-word identification, and passage comprehension skills of 307 children enrolled in 49 community-based childcare centers serving primarily low-income families in Colorado. Results suggest that nearly one-third of children and over 80% of teachers moved daily between classrooms. Findings also reveal that failure to account for daily transitions between classrooms can affect interpretations of the relationship between teacher qualifications and child outcomes, with the model accounting for movement providing significant improvements in model fit and inference.

Keywords

Child care; Continuity of caregiver; Transitions; Teacher education; Classroom quality; Child development

Over the past decade, increased labor-force participation by females has resulted in a marked increase in the number of children in child care centers (Cohany & Sok, 2007; Iruka & Carver, 2006). The burgeoning use of child care, combined with concerns about the school readiness of young children entering kindergarten, has led to a large body of research that focuses on the relationships between children's participation in child care programs and their language and cognitive development. Studies of high-quality early learning intervention programs have consistently shown a range of positive effects of these programs on children's school readiness skills (Karoly, Kilburn, & Cannon, 2005). Similarly, high-quality community-based child care programs have been linked to children's later academic achievement (NICHD Early Child Care Research Network [ECCRN], 2003), especially for

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children considered at risk for later school difficulties (Peisner-Feinberg et al., 2001). In a review of the conditions that influence children's development, Shonkoff and Phillips (2000) concluded that "one of the most consistent and ubiquitous findings in this literature links the quality of child care that children receive to virtually every measure of development that has been examined" (p. 310).

In light of these findings, in an effort to inform the development of program quality standards, policymakers and child welfare advocates have tried to identify factors in the child care setting that are most likely to promote children's school readiness. One line of research in particular that has received much policy attention is the qualifications of teachers in child care programs. Maxwell, Feild, and Clifford (2005) reviewed child care studies that examined the relationships among teachers' professional development, classroom quality, and children's development and identified three important components of professional preparation: formal education, experience, and training. Teachers with more experience, more child-related training, and more formal education are thought to possess the child development knowledge necessary to accurately read children's cues, respond in a supportive and age-appropriate manner, and set a positive emotional classroom tone. Greater knowledge of child development is also thought to make teachers better able to build on children's emerging skills and to structure a developmentally appropriate and stimulating instructional environment (LoCasale-Crouch et al., 2007).

Despite the intuitive appeal of this premise, research has provided a mixed and inconsistent picture of the relationships among teacher qualifications, classroom quality, and child outcomes. Some studies have reported that teacher qualifications are positively associated with global classroom quality, as well as with children's social and cognitive outcomes (de Kruif, McWilliam, Ridley, & Wakely, 2000; Howes, Whitebook, & Phillips, 1992; NICHD ECCRN, 2002; Scarr, Eisenberg, & Deater-Deckard, 1994). Using data from the Cost, Quality and Child Outcome Study, Howes (1997) found that teachers with a bachelor of arts degree (B.A.) in early childhood education were more responsive to children than were teachers without one, and children whose early childhood teachers had a B.A. tended to have higher receptive language abilities than children who were cared for by teachers without a B.A. Burchinal, Cryer, Clifford, and Howes (2002) also found that professional qualifications other than a formal degree in child development were associated with beneficial effects for children. In their study, children whose teachers attended specialized workshops in child development demonstrated better language skills than children whose teachers lacked such training. In a recent review of the literature, Tout, Zaslow, and Berry (2005) concluded that there was enough evidence to establish links between higher levels of early childhood education and both classroom quality and children's cognitive development.

Other studies, however, have failed to find such relationships. Phillipsen, Burchinal, Howes, and Cryer (1997) reported that the effects of teachers' education on global classroom quality disappeared when contextual factors, such as child-staff ratios and teacher wages, were taken into account. They also found that staff with more experience provided poorer-quality care than staff with less experience. Similarly, Phillips, Mekos, Scarr, McCartney, and Abbott-Shinn (2000) found no relationship between the quality of caregiving and the teacher's education level or number of early childhood education courses taken. Focusing on the subset of teachers who did not have a formal degree, Howes (1997) found no differences in literacy outcomes between children whose teachers had taken some early childhood courses and children whose teachers did not complete any courses. These findings are consistent with those reported by Howes, Birchinal, and colleagues (2008), who have argued that contradictory relationships exist between teacher qualifications and both classroom quality and children's outcomes.

Despite differences in methodologies used and conclusions derived, prior research in the area of teacher qualifications often shares two fundamental analytic assumptions. First, these studies do not account for the daily transitions of teachers and children between classrooms. Therefore, they implicitly assume that such movement is not relevant to estimations of the effects of teacher qualifications on children's outcomes. However, if children and teachers change classrooms fairly frequently, or if transitions into other classrooms last for non-trivial amounts of time, then this assumption may not be tenable.

Indeed, prior research has confirmed that children can experience much variation in the number of staff caring for them throughout the day (Howes & Hamilton, 1992). One of the first studies to examine daily teacher changes on a large scale was the National Child Care Staffing Study. Whitebook, Howes, and Phillips (1990) reported that, in more than 60 percent of the preschool-aged classrooms they sampled, centers practiced accordion grouping, in which children were grouped and regrouped among classrooms throughout the day. Similarly, in a national survey of child care centers serving infants and toddlers, Cryer, Hurwitz, and Wolery (2000) found that children did not necessarily spend all or even most of their time in the classroom to which they had been assigned. They reported that nearly 50 percent of centers indicated that they temporarily moved children to other classrooms to meet state child-staff ratio requirements. This figure may be an underestimation of the true prevalence of daily classroom movement nationally because the sample of centers in this study was of higher quality than the average found in the general population, based on the proportion of responding centers that were accredited by the National Association for the Education of Young Children. Furthermore, Whitebook and colleagues (1990) found that daily between-classroom transitions occurred more frequently in centers with higher teacher turnover rates, most likely because the centers were trying to maximize scarce personnel resources in the face of staff shortages. Given that higher teacher turnover rates are correlates of lower-quality centers (Whitebook & Sakai, 2003), it is possible that the incidence of daily classroom movement reported by Cryer and colleagues (2000) would be even more prevalent had more directors from lower-quality centers responded to the survey.

A second assumption often made in traditional approaches to studying the effects of teacher qualifications on children's developmental outcomes is the notion that head teachers are primarily responsible for instructing children and setting the tone for the care and education of the children in their classrooms. Consequently, many models that predict children's outcomes based on teacher qualifications have examined only the credentials of the head teacher (for example, Helburn et al., 1995). This assumption may be inaccurate, as it overlooks the potential effects of assistant teachers (i.e., floater teachers, aides, and other staff in the room who are not designated as head teachers). As noted by Whitebook, Gomby, Bellm, Sakai, and Kipnis (2009), co-teaching often occurs between assistant teachers and head teachers because young children in group care require the presence of multiple adults to meet their needs. Furthermore, full-time child care programs typically operate between 10 and 12 hours a day, so assistant teachers may be responsible for the classroom for a third of the day or more, either before the head teacher arrives or after his or her shift ends. Consequently, children may be spending large portions of their day under the care of someone other than a head teacher.

There is some evidence to suggest that the qualifications of assistant teachers influence classroom processes. For example, Howes, Whitebook, and Phillips (1992) examined how both head teachers' and assistant teachers' qualifications contribute to the classroom emotional climate and teacher behaviors. They noted that higher levels of formal education across all teaching staff predicted more sensitivity, less harshness, and less detachment toward children. Shim, Hestenes, and Cassidy (2004) have also shown that lead and assistant teachers can demonstrate similar caregiving behaviors, despite differences in job title and

education level. These results, combined with an understanding that children spend large portions of time with assistant teachers, have led to the development of recommended educational standards for assistant teachers (Barnett, Hustedt, Robin, & Schulman, 2004).

It is unclear whether these two factors—the daily movement of teachers and children into different classrooms and assistant teachers’ qualifications—constitute trivial noise in an analytical model of the effects of teacher qualifications on children’s outcomes, or whether those factors are significant enough to materially change or bias the estimates of teacher effects and any interpretations based on those estimates. If children are receiving a significant proportion of instruction from assistant teachers, then the omission of assistant teachers from the conceptualization and measurement of teacher qualifications can lead to inaccurate estimates of teachers’ effects on children’s outcomes. In a similar manner, if daily classroom changes mean that children receive a considerable amount of their care and instruction from teachers outside of their primary assigned classrooms, then a failure to control for movement can render the observed associations between teacher qualifications and children’s outcomes inaccurate. In both situations, it is unclear whether the estimates of teacher effects would be biased upward or downward.

Purpose of the Study

The purpose of this study was to quantify the prevalence of teacher and child movement between classrooms, to examine the link between head and assistant teachers’ qualifications and children’s language development and mathematical proficiency, and to explore how child and teacher movement between classrooms may affect estimates of the relationship between children’s outcomes and teacher qualifications in community-based child care centers serving primarily low-income children.

This study was part of a larger research effort to understand the possible processes that can lead to the closure of the “opportunity gap” between disadvantaged children and their higher-income peers in community-based child care centers. Low-income children typically enter kindergarten with lower levels of vocabulary proficiency, pre-literacy, and practical problems-solving skills than higher-income peers (Zill & West, 2001); centers in the study were taking part in an initiative designed to help low-income children meet national norms for school readiness upon kindergarten entry. Although school readiness encompasses a broad range of developmental skills (Kagan, Moore, & Bredekamp, 1995), literacy, language, and mathematical skills were a priority for the initiative because increased accountability demands in the upper elementary grades have raised the academic expectations at kindergarten (Lincove & Painter, 2006) and because such skills are correlates of later academic success (Duncan et al., 2007; Tabors, Snow, & Dickinson, 2001). Given the initiative’s goals, we focused on children’s literacy, language, and mathematical skills.

This study also focused on centers serving low-income preschool children because previous research has shown that low-income children tend to enroll in lower-quality centers (Adams, Tout, & Zaslow, 2007) and that daily classroom changes may be more prevalent among lower-quality centers (Whitebook et al., 1990). Thus, misinterpretations of the effects of teacher qualifications on children’s outcomes could potentially be most severe for teachers of lower-income children.

Finally, many publicly funded child care programs serving lower-income children are mandating that teachers either have at least a B.A. or aspire to this standard (Early et al., 2007; Whitebook, 2003). Consequently, it is imperative that estimates of the relationship between teachers with a B.A. and children’s outcomes are accurate if policymakers are to

effectively set guidelines about the types of educational credentials that teachers should possess.

Consequently, this study was guided by the following research questions:

1. How prevalent is teacher and child movement between classrooms? Are there times in the day when classroom changes are more likely to occur?
2. How do findings about the quality of care change when teacher and child classroom movement is taken into account?
3. Using a traditional approach in which only head teachers' characteristics are considered, is there a relationship between teacher qualifications and child literacy, receptive language, and mathematics skills? Do interpretations of teacher effects change when we model the qualifications of assistant teachers or when we take into account daily classroom transitions?

Methods

Study Sample

Participating centers—The sample of centers used for this study included 49 community-based child care centers that were participating in a longitudinal evaluation of the State of Colorado's Quality Rating and Improvement System (QRIS). Nineteen counties throughout Colorado were selected to participate in the QRIS initiative; child care centers were eligible if at least half of the children enrolled were from low-income families, if the center was located near low-performing elementary schools, and if the center enrolled at least 20 three- or four-year-old children. To expand socioeconomic representation, four of the 49 centers in the sample were drawn from six eligible university-based child care programs that served no more than 30 percent low-income children. Centers participating in the study were located throughout the state and included urban, suburban, and rural representation. There was a mix of center types, with 21 percent of the sample consisting of Head Start centers, 33 percent for-profit centers, and the remaining 46 percent non-Head Start, nonprofit centers.

Based on the eligibility criteria, we approached 78 programs to participate in our study. Representatives from 68 of the centers attended an information session to learn more about the study, and 49 of the attending center directors agreed to participate. Of the 29 programs that declined to participate, 10 were located in large public school systems where principals felt that obtaining approval for study participation was too cumbersome. Thus, inferences from this study are restricted to community-based child care programs; the subset of public school programs that declined to participate may have differed with respect to teacher credentials or program goals.

Participating teachers—Teachers who were eligible to participate in the study included all those employed in the centers for at least 30 percent of the time that the program was operational. The consent rate among teachers was very high (98 percent), resulting in an initial teacher sample size of 365.

Participating parents and children—All three- to five-year-old children who attended one of the centers for at least 10 hours per week were eligible to participate in the study. We focused on children between the ages of three and five because children younger than three are considered developmentally unreliable test-takers (Meisels & Atkins-Burnett, 2006). Furthermore, because this study was concerned with the effects of the child care context, we excluded children older than five because they were likely to be enrolled in kindergarten for

at least part of their day, and we were unable to control for the effects of their kindergarten experience.

To obtain a random sample of three- to five-year-old children, we used the birth date method of participant selection (Forsman, 1993). Directors approached families starting with the child with the most recent birthday relative to the study start date. Ordering the children by month and day of birth, the directors then proceeded to contact the family of the child with the next birthday, until they had enrolled in the study 20 children who were between three and five years of age. Because birth month and day are mostly random and not expected to predict children's outcomes, this method led to a random sample. Center directors were the primary recruitment agents, and parental consent was required for children to be eligible to participate. Overall, 94 percent of the parents who were approached agreed to allow their children to participate in the study. This resulted in an initial sample of 790 children.

Measures of Children's Skills, Children's Background, Classroom Quality, and Classroom Transitions

Child-level measures

Woodcock Johnson Tests of Achievement: The Woodcock-Johnson Tests of Achievement, Third Edition (Woodcock, McGrew, & Mather, 2001) was used to provide a relatively brief assessment of several dimensions of children's cognitive development endorsed by practitioners as critical for young children's success in school. We administered three subsets of the Woodcock-Johnson achievement test—the letter-word identification subtest (WJ-LWI), the passage comprehension subtest (WJ-PC), and the applied problems (WJ-AP) subtest. The WJ-LWI examines children's symbolic learning skills (i.e., matching a word against its pictorial representation) and reading identification skills (i.e., the child's ability to name letters). The WJ-PC examines children's reading comprehension by asking children to supply a missing word removed from a sentence based on the context of the passage. The WJ-AP requires children to listen to a presented math problem and perform simple math operations to solve the problem. Participation rate on the WJ was 81 percent, and the reliability coefficients for the WJ-LWI, PC, and AP were 0.83, 0.84, and 0.82, respectively.

Peabody Picture Vocabulary Test: The Peabody Picture Vocabulary Test, Third Edition (PPVT) (Dunn & Dunn, 1997) was used to assess children's receptive language skills, or the ability to understand spoken language. Children were presented with four black-and-white pictures and asked to select the picture that matched the spoken word. We obtained PPVT scores from 86 percent of the participating children, and the reliability coefficient was 0.85.

Child background characteristics: Because research has found that performance on the PPVT and WJ subtests correlate with children's background characteristics (Zill et al., 1998), we administered a family background questionnaire to obtain information about key covariates to include in the analysis. The family background questionnaire included items about the child's non-familial care history, including his or her length of time in the program and the amount of time spent in the center per week. The survey also asked families to provide information on their child's birth date, race/ethnicity, language(s) spoken at home, and whether or not the child had an identified learning disability. There were also items about the family's income and the parents' highest level of education. We received survey responses from 62 percent of the families.

Classroom-level measures

Teacher qualifications: To obtain information about teacher qualifications, we administered a questionnaire that asked about teachers' highest level of education, years of

teaching experience with children from birth to age five (including experience in other child care settings), and number of course credits taken in early childhood education or child development. Our research team verified staff members' early childhood education (ECE) credits and degrees via transcripts and training certificates. We obtained information about these qualifications for all 365 teachers in the study.

Global classroom quality: We used the Early Childhood Environment Rating Scale–Revised (ECERS-R) (Harms, Clifford, & Cryer, 1998), a 43-item measure, to assess aspects of classroom process and structural quality. The ECERS-R rates classrooms on a seven-point scale with 1 considered poor and 7 considered excellent quality of care. The ECERS-R specifically measures the classroom physical environment, health and safety practices, materials and activities that support children's learning, classroom interactions, and the daily schedule of activities. For this study, we did not administer the Parents and Staff subscale because of the known limitations of respondent bias associated with scales that primarily rely on self-reporting (Achenbach, McConaughy, & Howell, 1987). This reduced the scale to 36 items. Although some studies have reported that the ECERS-R reflects two dimensions relating to structural and process quality (Cassidy et al., 2005; Helburn et al., 1995), in our study, a unidimensional factor scale structure was found. This is consistent with other studies that have also found the ECERS-R to be a unidimensional scale of global classroom quality (Perlman, Zellman, & Le, 2004). Thus, only the total ECERS-R scale score was used for the analysis. We collected ECERS-R data from 102 classrooms, and the reliability coefficient was 0.86.

Transition between classrooms and child-staff ratios: To assess the frequency of classroom transitions and to obtain a measure of child-staff ratios, we used a sign-in/sign-out procedure. This procedure asked parents to sign their children in and out of the classroom in which they dropped off or picked up the child. Throughout the day, teachers were responsible for signing themselves and the children in their care out of one classroom into the next classroom whenever they moved, unless it was just for a very brief period (e.g., restroom break). Staff recorded the room number for the room from which they (or the children in their care) moved, the room number they moved into, and the time they departed from and arrived at each classroom. Sign-in/sign-out data were obtained from 120 classrooms.

Center-level measures

Method for enrolling children in new classrooms: Because of the year-round enrollment policies of community-based centers, some children were enrolled in their classrooms longer than other children and therefore had more exposure to their teachers at the time of assessment. Thus, to obtain an accurate indication of the effects of teacher qualifications on children's outcomes, our analyses accounted for the length of time a child had been in the classroom prior to being assessed. How this length of time was determined depended, in part, on the method used by directors to enroll children in new classrooms. We conducted a brief phone interview with center directors and asked them about their methods for assigning children to new classrooms. All directors responded to the interview, with three indicating that they did not transition children into new classrooms once enrolled in the center, four indicating that they used the academic calendar method (i.e., children enroll into new classrooms in the fall), and the remaining directors indicating that they used the birthday method (i.e., children enroll in new classrooms on their birthdays).

We calculated the length of time a child had been enrolled in the classroom based on the method by which the centers enrolled children in new classrooms. For centers that used the academic calendar method, we calculated the difference between the date when children

took the assessments and the beginning of the academic year. For centers that used the birthday method, we used information relating to the age group of the children served in a classroom, the length of time the child had been enrolled in the center, the child's date of birth, and the date on which the child took the assessments to compute the length of time a child had been assigned to his or her primary classroom prior to being assessed. For the remaining centers that did not transition children, the length of time the child had been enrolled in the classroom was the same as the length of time they had been enrolled in the center.

Procedures

Each participating center was assigned a one-month data collection window, during which Colorado's quality rating agency dispatched trained research staff to the centers to collect data. The staff consisted of early childhood educators who had obtained at least a B.A.

Each child was assessed for approximately 30 minutes. Although there were children in the study who may have spoken Spanish as their primary language at home, all participating children were deemed by their teachers to be sufficiently proficient in English to be assessed using the English version of the assessments. To minimize distractions, test administrators separated targeted children from their classmates, and children took the tests in a quiet corner of the classroom, in a vacant classroom, or at a table set up in the hallway. During the testing session, children were not informed of the correctness of their answers but were encouraged to try their best and were praised for their participation.

During this same time frame, data collectors distributed questionnaires to center directors, who handed the surveys directly to the parents who had agreed to have their children participate in the study, or they placed the surveys in the targeted child's cubbyhole. Surveys were available in both English and Spanish. Parents were asked to return the surveys via an enclosed postage-paid envelope. Parents who completed the survey received a \$10 honorarium and entry into a raffle with an opportunity to win an additional \$100 grocery certificate.

Data collectors also distributed the training and education survey to teachers and verified the responses through training certificates and transcripts. In addition, data collectors conducted a 4.5-hour morning observation in each classroom using the ECERS-R. All data collectors met the reliability standards outlined by the ECERS-R authors (Harms et al., 1989), including three consecutive observations in which a trainee scored 85 percent of the items on the ECERS-R within one point of the rating assigned by an expert trained by one of the authors of the ECERS-R. Inter-rater reliability was reassessed after every 10th observation conducted, and every data collector was found to have met the reliability standard during the reassessments.

Finally, data collectors asked parents and teachers to complete the sign-in/sign-out sheets for 10 consecutive days. Data collectors undertook sustained efforts to ensure the accuracy of responses by providing frequent reminders to staff and parents to complete the forms and by using center records to verify information related to room numbers and the presence of staff members.

Selection Criteria

For our analysis, we included only those children for whom we had complete family background data and who had completed either the PPVT or WJ. As noted earlier, not all parents returned the surveys, and the lack of survey responses was, by far, the largest contributor to missing data. Comparing the characteristics and outcomes of children whose parents returned the questionnaire ($n = 490$) with those of children whose parents declined to

return the questionnaire ($n = 300$), we observed no differences with respect to age, gender, performance on the PPVT and WJ, or quality indicators, including ratios, ECERS-R, and teacher qualifications. We also examined the characteristics of children whose parents completed all the relevant survey items ($n = 307$) with the characteristics of children whose parents skipped particular survey items ($n = 183$). There were no differences with respect to disability status or the length of time these two groups of children spent at the child care center. However, children with complete survey information were less likely to be Hispanic, more likely to report that English was the most frequently spoken language at home, and were more likely to come from better-educated families with higher incomes than children with incomplete survey data. Eliminating cases with missing data resulted in a final analytic sample of 307 children linked to 295 teachers in 96 classrooms in 46 centers. On average, there were approximately three children per classroom and seven children per center.

Results

Descriptive Statistics for Children

Table 1 shows the descriptive statistics for selected child-level covariates. On average, children had been receiving care at their center for more than a year and were considered full-time enrollees (i.e., received more than 30 hours of care at the center per week). Approximately 93 percent of the children's parents reported that English was the most frequently spoken language at home, and 16 percent reported that their child had an identified learning problem. Approximately 19 percent of children came from families in which at least one of the parents had a B.A.-level degree or higher. White children comprised nearly 57 percent of the sample, African-American children comprised 16 percent, Hispanic/Latino children comprised 15 percent, and children of other races/ethnicities accounted for the remaining 12 percent. As in the general population, girls represented approximately half of the sample.

Validation of the Sign-In/Sign-Out Responses

We calculated the rate of movement by counting each time a teacher moved into another classroom as a movement for that teacher. For example, if a teacher started in Classroom A, then moved to Classroom B, then moved back to Classroom A, we counted it as two moves. We made analogous calculations to determine the frequency of transitions for children.

To calculate child-staff ratios, we used the sign-in/sign-out data to find the total number of children present in a given classroom at a given time and divided by the total number of teachers present. We then averaged these measurements over the 10 days of data collection to yield an overall average child-staff ratio.

As previously reported in Le, Perlman, Zellman and Hamilton (2006), validation analyses suggested that the sign-in/sign-out method could accurately capture transitions between classrooms and provide reliable estimates of child-staff ratios. Namely, both the percentage of teachers who reported moving between classrooms (82 percent) and the frequency with which they reported moving between classrooms (i.e., 83 percent reported moving at least once a week) corresponded with the sign-in/sign-out data, in which 82 percent of teachers were empirically identified as moving between classrooms, and 88 percent moved at least once a week. In a similar vein, the child-staff ratios derived from the sign-in/sign-out data were highly correlated with the child-staff ratios reported by observers two weeks prior to the collection of the sign-in/sign-out data ($r = 0.78, p < 0.001$). Overall, the analyses suggested that the sign-in/sign-out data could be validly used to assess frequency of transitions and child-staff ratios.

Prevalence of Movement

A key assumption of our study was that transitions were of sufficient pervasiveness and duration to warrant modeling. Table 2 presents information related to the number and duration of daily child and teacher between-classroom transitions. Nearly 31 percent of children temporarily changed classrooms, with an average frequency of seven moves over the 10-day period (i.e., 0.73 moves per day). When children moved, they spent approximately one hour (63.43 minutes) of their care each day outside of their assigned classrooms. Given that transitioned children spent an average of 30 hours per five-day workweek in center care, this meant that 12.9 percent of their care was experienced outside of their assigned classrooms (i.e., 63.46 minutes multiplied by 0.73 moves per day multiplied by five days for a total of 3.86 hours of movement per 30 hours of care).

Transitions were even more prevalent among teachers; the sign-in/sign-out data indicated that 82 percent of teachers temporarily changed classrooms, with an average of a little more than one classroom transition per day (i.e., 1.2 moves per day). When teachers moved classrooms, they spent an average of 2.5 hours (i.e., 150.11 minutes) outside of their assigned room. Because most teachers worked an average of 40 hours per workweek, this translated to teachers spending approximately 38 percent of their working hours in other classrooms. Overall, only 8 percent of children did not experience any type of transition, 61 percent of children did not move to another classroom but had teachers who temporarily relocated to another classroom, and the remaining 31 percent of children both moved to another classroom and had teachers who relocated to another classroom.

We also examined whether classroom changes were more likely to occur during some periods than others. Table 3 presents the distribution of movement for teachers and children by time of day. While children were most likely to move classrooms during the early morning and late afternoon hours, teachers were equally likely to change classrooms at any time of the day.

A consequence of these transitions is that children were exposed to a greater number of teachers than would be the case if there were no transitions. Had children and teachers stayed in their assigned classrooms, then children would have encountered an average of two teachers. Taking movement into account, children who transitioned between classrooms encountered an average of eight teachers, whereas children who did not transition but whose teachers moved between classrooms encountered an average of five teachers. Taken together, the results suggest that transitions were common in our sample.

Descriptive Statistics for Teacher Qualifications Under Different Model Specifications

Given the non-trivial incidence of daily classroom changes, we explored how the effects of teacher qualifications on children's outcomes may change under different model specifications; some models took movement into account while others did not. In the first model, which is the most common in the literature, we considered only head teachers' qualifications in children's assigned classrooms. In the second model, we assumed that both the head teachers' and assistant teachers' qualifications in children's assigned classrooms had an effect on children's outcomes. In the third model, we assumed that all the teachers encountered would have some effect on the children, irrespective of the teachers' position and whether or not the teachers had been formally assigned to the child's classroom. Thus, the third model controlled for children's and teachers' transitions between classrooms, whereas the first two models did not.

For the third model, we used the sign-in/sign-out data to calculate the length of time that each child and each teacher shared the same classroom. The length of time a child spent with a given teacher was used to account for the different quality of care that a child experiences

when moving from one classroom setting to another. This approach is similar to Sanders, Saxton, and Horn's (1997) value-added assessment system technique, which assumes that teacher effects on children's outcomes are proportional to the percentage of time spent with each child. Conceptually, this means that, for each child, a teacher's characteristic—namely, his or her qualifications (TC)—is equal to the weighted average of all the teachers, where time spent with each teacher served as the weight. Thus, if a child were in contact with p different teachers of characteristics $C_1, C_2, \dots, C_p$ for lengths of time $t_1, t_2, \dots, t_p$, respectively, then the teachers' characteristic for that child would be defined as

$$TC = \frac{t_1 C_1 + t_2 C_2 + \dots + t_p C_p}{t_1 + t_2 + \dots + t_p} \quad \text{Equation (1)}$$

To illustrate how Equation (1) takes movement into account, we provide an example that focuses on teaching experience. Suppose a child spends one hour in his or her primary classroom (hereafter referred to as Classroom A) and 30 minutes in another classroom (hereafter referred to as Classroom B). Suppose further that there are three teachers in Classroom A: The head teacher has 10 years of experience and the two other assistant teachers have seven and five years of experience, respectively. In Classroom B, the head teacher has eight years of experience, and the two assistant teachers have seven and three years of experience, respectively. Under the traditional model, which takes into account only head teachers' qualifications, the child would be exposed to 10 years of teaching experience. Under the second model, which takes into account both head teacher and assistant teacher qualifications, the child would be exposed to an average of 7.3 years of teaching experience. Under the third model, which takes into account head teacher and assistant teacher qualifications as well as movement, the child would be exposed to an average of 6.9 years of teaching experience.

For the B.A. versus no-B.A. variable, the score represents the likelihood of a child spending some time with a teacher with at least a B.A. and can take on any value between 0 and 1. A value of 0 would be assigned to children who have contact only with teachers who do not hold a B.A., a value of 1 would be assigned to children who have contact only with teachers who hold a B.A., and a score between 0 and 1 would be assigned to children who have contact with a mixture of teachers with and without a B.A., weighted according to the time spent with the teachers.

Table 4 provides the descriptive statistics for teacher characteristics by model specification. We used a paired t -test to compare mean differences in a teacher's characteristics by model type and found that analyses that failed to account for movement led to a different picture of children's exposure to teachers with a B.A. than was the case under analyses that controlled for movement. While there were no differences between the traditional and average teacher qualification models with respect to exposure to teachers with a B.A., both of these models suggest significantly lower exposure to teachers with a B.A. than was the case in the movement model ($t = 5.14$, d.f. = 306 for the traditional model; $t = 9.17$, d.f. = 306 for the average teacher qualifications model; $p < 0.001$ for both comparisons). Under the movement model, children were twice as likely to encounter teachers with a B.A. than under the head teacher qualification model, and nearly three times as likely to encounter teachers with a B.A. than under the average teacher qualification model. These differences in exposure to teachers with a B.A. stems from the fact that frequent teacher transitions allowed more children to be exposed to teachers with a B.A. than would be the case if no movement had occurred.

Descriptive Statistics for the ECERS-R and Child-Staff Ratios Under Different Model Specifications

Our approach to analyzing the ECERS-R and child-staff ratios was similar to that for teacher qualifications. For models that did not control for movement, the ECERS-R and child-staff ratios were simply the scores observed for the child's assigned classroom. Under the movement model, we used the sign-in/sign-out data to calculate a weighted ECERS-R rating, with the time a child spent in each classroom serving as the weight. We adopted an analogous approach for child-staff ratios, in which we computed ratios that took into account the departure and arrival of children or teachers in the classrooms due to movement.

Table 5 provides the descriptive statistics for the ECERS-R and child-staff ratios under models that did and did not control for movement. We tested for differences among the model specifications via a paired t-test, but, as shown in Table 5, the mean child-staff ratios and ECERS-R ratings were similar, regardless of whether or not movement was taken into account.

Relationships Between Child Care Quality and Children's Outcomes Under Different Model Specifications

Accounting for the clustering of children—Our next step was to explore how interpretations of teacher qualifications may change under different model specifications. Previous studies that have examined teacher qualifications in relation to children's outcomes have typically accounted for the clustering of children within the same classroom. In our study, these cluster-adjustment methods could not account for classroom-level clustering in the context of movement (Meyers & Beretvas, 2006) because such methods assume that children who share the same classroom are more similar to each other than to children enrolled in a different classroom. This assumption is partly based on the notion that these children experience a similar instructional environment stemming from having the same teachers and the same classmates and that this instructional environment is not shared by children who are assigned to other classrooms. However, if both children and teachers are moving between classrooms, as was the case in our study, then the instructional environment is no longer unique to a particular classroom. In other words, due to movement, all children in the same center can share similar instructional environments, despite being assigned to different classrooms. Thus, the similarity of children's responses, or clustering, occurs at the center level, not the classroom level.

For all our models, we used the Huber-White method, a method similar to the typical hierarchical linear model (HLM), to adjust for correlated errors at the center level and to account for increased heteroscedasticity resulting from movement. The Huber-White sandwich estimator has the advantage of providing more robust estimates of cluster-correlated variance in the presence of heteroscedasticity than does the HLM (Chaplin, 2003). More information about the Huber-White estimation method can be found in Huber (1967), White (1980), and Williams (2000).

Regression coefficients—Tables 6A–D display the unstandardized and standardized regression coefficient estimates measuring the associations between teacher characteristics, classroom quality variables, and children's outcomes under the three multivariate models. For the most part, the two analyses that did not control for movement produced comparable coefficient estimates and standard errors, and they yielded similar inferences about the relationship between the quality variables and children's outcomes. For example, both models found no relationships between children's literacy, language, and mathematical skills and the ECERS-R and child-staff ratio. In addition, both models generally found no

relationship between these outcomes and teacher qualifications, although under the traditional model, ECE credits were negatively related to PPVT performance.

The results for these two models contrast with the model that accounted for daily teacher and child classroom transitions. Under the movement model, having a B.A. was positively associated with enhanced vocabulary performance (PPVT), and having more teaching experience was positively associated with both WJ-PC and WJ-LWI. Neither of these relationships was observed under the two models that failed to control for movement. In addition, under the movement model, there were significant relationships between ECE credits and the PPVT and between child-staff ratios and children's WJ-AP scores. The latter result was not replicated with either the head teacher qualification model or the average teacher qualification model.

As a sensitivity analysis, we examined whether more experienced teachers were more likely to hold a B.A. and whether teachers who had a B.A. were more likely to have completed the degree in a specialized child-related field. While the correlations between teaching experience and having a B.A. were weak ($r = 0.15$, *n.s.*), the correlations between having B.A. and having taken ECE courses were moderately strong ($r = 0.45$; $p < 0.001$; see Appendix A for correlations among the quality variables under the different model specifications). We explored the additive effects of having a B.A. in a child-related field by including both variables in the models and adding interaction terms, but none of the interaction terms was significant.

Model Comparisons

We used the Davidson-MacKinnon bootstrap J-test to compare non-nested linear models to explore which model best fit the data (Davidson & MacKinnon, 2002). The Davidson-MacKinnon method uses "double testing" to determine whether one model contains additional explanatory information not captured by another model. Specifically, the method entails including the fitted values of the second model into the set of regressors in the first model to test the null hypothesis that the first model contains no additional improvements in fit over and beyond the second model. If we fail to reject the null hypothesis, we conclude that the first model fits the data as well as the alternative second model. Conversely, if we reject the null hypothesis, then we conclude that the first model provides a better fit to the data than the alternative second model. The test is then repeated "in reverse," with the fitted values of the first model being included in the set of regressors in the second model so as to determine the robustness of the results. For each outcome, we conducted six J-tests, corresponding to the pairwise testing of each of our three models.

Tables 6A–D also report the test statistic for the J-test for each pairwise model comparison (i.e., the last three rows in the tables). For the PPVT, the J-test statistics indicated that controlling for movement provided significant improvements in model fit over the other two models that ignored movement. The J-test statistics for the WJ-LWI and WJ-PC also indicated that the movement model fit the data better than the head teacher qualification model. Similarly, for the WJ-AP, the movement model was superior to the average teacher qualification model in terms of fit to the data. Taken together, the J-tests indicate that the head teacher qualification-only model was not significantly different from the average teacher qualification model in terms of explaining variation in the data, but both models tended to be poorer fits to the data than the models that controlled for teacher and child transitions.

Discussion

The results in the present study add to the body of evidence indicating that continuity of caregivers in child care settings is rare (Cryer et al., 2000) and extends it by suggesting that this discontinuity may bias estimates of the relationship between teacher qualifications and children's developmental outcomes. Our study compares the traditionally used model, which examines the relationship between head teacher qualifications only and children's developmental outcomes, with other models that consider the qualifications of all teachers in a child's primary class and the qualifications of all teachers a child encounters due to daily child and teacher movement between classrooms. For the literacy, language, and mathematical outcomes, we found that the estimated relationships under models that averaged teacher qualifications in a given classroom tended not to differ appreciably from the estimates obtained under models that focused only on children's assigned head teachers. However, both of these models tended to have a poorer fit than the model that considered the dosage of teacher qualifications across all the teachers children encountered due to daily classroom changes, which gave slightly different estimates and interpretations of the association between teacher qualifications and outcomes.

The finding that the estimates from the movement model generally differed from those obtained under the other two models reflects the fact that daily classroom changes were a fairly common phenomenon in our study, with nearly one-third of children and more than three-fourths of teachers transitioning between classrooms, for an average of approximately one hour and 2.5 hours for each transition, respectively. The fact that children spent a non-trivial amount of time away from their assigned teacher may also help explain the mixed results in the research literature linking teacher qualifications with children's developmental outcomes (Howes, Burchinal, et al., 2008; Tout et al., 2005).

Indeed, prior research has provided some indication that teachers with a B.A. offer more support for children's language development than teachers who lack a B.A. For example, several studies have found that teachers with a B.A. have higher global classroom quality, offer more language-rich classroom environments, and create more emotionally supportive classroom climates than teachers who lack a B.A. (Blau, 2000; de Kruif et al., 2000; Howes, Whitebook, & Phillips, 1992; Phillipsen et al., 1997). These classroom processes, in turn, have been found to contribute to increases in children's language skills (Administration for Children Youth and Families, 2003; Brown, Malfrese, & Malfrese, 2008; Helburn, 1995). Other studies have indicated that there also may be some links between teacher experience levels and classroom processes that may further enhance children's language development. For example, McDonald, Son, Hindman, and Morrison (2005) found that teachers with more experience were more responsive to children and spent more time in instructional activities than teachers with less experience, while Brown and colleagues (2008) observed that children who were instructed by more highly experienced teachers showed greater improvements in their language and pre-literacy skills.

When we considered daily classroom transitions and operationalized them in terms of the dosage of professional qualifications across all teachers in our study sample, we found support for the above studies. Our results indicate that both a B.A. and the amount of teaching experience are significantly related to children's language skills, although to different dimensions of language achievement. Because the correlation between teacher experience and having B.A. was relatively weak, it is reasonable to expect each of these variables to show different relationships with child outcomes. Perhaps through their formal education, teachers with a B.A. have developed an expanded vocabulary that they use with children to stimulate the receptive language skills that are measured on the PPVT. This relationship has indeed been noted in the parenting context (Hart & Risley, 1995).

Alternatively, our results may indicate a selection bias such that teachers with an extended vocabulary and more sophisticated language skills are more likely to enroll in and complete a formal degree program. In either case, our study suggests that being cared for and instructed by teachers holding a B.A. is associated with children's increased vocabulary development. However, it will be important for future research to examine how much exposure to teachers with a B.A. is required before children experience developmental benefits in their language skills.

In contrast, more teaching experience was positively related to children's letter and word recognition and passage comprehension. Skills tested on the WJ, such as filling in missing words and naming letters, represent more traditional approaches to instruction. It is possible that teachers with more experience rely on these traditional instructional techniques, and subsequently their children score better on tests whose content is well aligned with these instructional approaches. However, these speculations need much more research as to how teacher characteristics, such as teaching experience or degree attainment, are related to instructional practices and subsequent child outcomes. Ideally, such research should take place in experimental settings in which causality can be inferred.

Our study did not find that formal courses in early childhood education, under any model, were associated with improvements in children's language or mathematical proficiency. In fact, our study suggested a slight decrease in PPVT scores for children who encountered teachers with more ECE credits. However, this counterintuitive result needs to be interpreted carefully because more than half of the teachers in our sample had not completed any ECE coursework, and two-thirds of the teachers had completed nine ECE units (approximately three ECE classes) or fewer. It may be that teachers had simply not taken enough early childhood courses to make a difference in their practices with children. It could also mean that the content of their courses was not focused on children's language development. But it is unclear why children's receptive language scores may have declined slightly when in the care of teachers with more ECE coursework. The correlational aspect of this study and the small size of these estimates could also explain these unexpected results. More research that includes the content and quality of teachers' coursework is needed to better understand this counterintuitive result.

Teacher education has been an important topic across sectors of early care and education. It can be seen in the reauthorization of Head Start (Iruka & Carver, 2006), in pre-kindergarten standards (Barnett et al., 2004), and in quality rating and improvement system standards (Zellman & Perlman, 2008). Consequently, many early learning programs, including community-based centers, have made concerted efforts to hire head teachers with B.A.-level degrees in an effort to improve children's school readiness skills (Gilliam & Marchesseault, 2005). Our research demonstrates that this could be an effective strategy, at least in supporting children's receptive language skills. It is important to point out, however, that the absolute differences in the magnitude of the standardized coefficients estimated by the three models were typically small (within the range of 0.05 to 0.12), even when there were differences in statistical significance.

Nonetheless, if children are to reap the benefits of having teachers with a B.A., they must have sustained contact with such caregivers. Transitioning children out of classrooms staffed by teachers with a B.A., or transitioning such teachers away from children may derail programs' efforts to improve children's outcomes through enhanced teacher qualifications. Thus, if programs continue to rely on frequent between-classroom transitions, then increasing qualifications among all types of teaching staff may be an important strategy to ensure that children have a developmentally supportive environment in which to enhance their language skills.

In the context of this study, discontinuity of care was found to be potentially beneficial to preschool children's language skills if the high prevalence of daily teacher and child transitions resulted in a higher likelihood of children interacting with teachers who held a B.A. Had there been no movement, children would have encountered an average of two teachers, of whom less than 10 percent held a B.A. If both teachers and children moved, children encountered an average of eight teachers, and the likelihood of children encountering a teacher with a B.A. improved to nearly 25 percent.

However, it will certainly be necessary for future research to examine these transition practices in relation to a wide variety of developmental outcomes, including social outcomes, before such transition policies are endorsed as beneficial for children. For example, it will be important to understand whether movement—by nature of its frequency, duration, or the number of different teachers encountered—damages the closeness of the teacher-child relationship found to be beneficial to a number of developmental outcomes for young children (Peisner-Feinberg et al., 2001) or disrupts peer relationships, and whether such impairments, in turn, affect different domains of children's functioning. A study by de Schipper, Van Ijzendoorn, and Tavecchio, (2004) did not find any relationship between teacher reports of daily caregiving instability and toddlers' well-being or problem behaviors. This suggests that, at least in some contexts, daily classroom transitions may not necessarily be associated with adverse outcomes. However, it is possible that these and our results are partly due to self-selection effects, in which programmatic factors that disproportionately influence children's selection into child care in their communities are also associated with teacher background characteristics or the frequency of movement throughout the day. More research on the conditions under which daily classroom transitions are beneficial or harmful to young children is essential to help centers create developmentally supportive transition policies.

In addition, our study has methodological implications for child care researchers. It suggests that estimates of teacher effects may require linking children to all teachers with whom they have contact, regardless of the teacher's job title or primary classroom assignment. However, more research is needed to investigate the methodological issues associated with daily classroom movement, especially as they relate to the weighing of the effects of different teachers on children's outcomes. In our study, we derived weights from the time that teachers and children spent in the same classroom, such that teachers who spent more time with children were assumed to have greater effects on children's outcomes. This is a common assumption when modeling teacher effects (Sanders, Saxton, & Horne, 1997). Nonetheless, it may be the case that some teachers can have a greater influence on children's outcomes than other teachers, despite spending less time with the children. It may also be that different times of the day require different weightings of teacher effects. For example, having a teacher with a B.A. may be most critical during the later morning period, when the bulk of instruction presumably occurs, and less important during naptime. Because we did not have the instruction schedules of the centers, we could not explore this possibility, but future research that examines differential weighting of teacher effects by program activity would provide a better indication of the robustness of our results.

Because of the lack of extensive knowledge about the prevalence of movement, we do not know whether the frequency of movement found in this study's sample of centers primarily serving low-income children in Colorado is representative of movement in centers serving more advantaged children or those in states with different licensing requirements. Additional research is needed to determine whether the exposure of specific children to specific teachers as captured during this time frame is indicative of their interactions over longer periods, as well as whether these same patterns of association hold for a broader sample of centers.

In the absence of a randomized design, we do not know the degree to which self-selection factors may influence results. Although we controlled for a host of observable child characteristics and did not find strong relationships between these characteristics and teacher qualifications, we cannot rule out selection bias. It could be the case that children with higher-level cognitive skills were more likely to be enrolled in higher-quality centers (Smolensky & Gootman, 2003; Fuller, Kagan, Loeb, & Chang, 2004). We could not fully disentangle child care context from child characteristics, as we did not have access to data on children's cognitive skills prior to child care entry. In addition, compared to children who were excluded from the analysis because their parents failed to complete the relevant survey items, the children in our analytic sample came from wealthier, better-educated families. Although this finding is consistent with other studies in which children from advantaged families are more likely to have complete data records than children from disadvantaged families (Glantz & Layzer, 2000; Wang, 2001), it also means that our findings may have limited generalizability due to non-response bias.

Despite the fact that developmental theory suggests that discontinuity in care may be harmful to young children's well-being (Bowlby, 1973), many centers appear to be intentionally engaging in daily teacher and child classroom transitions that create caregiving discontinuity (Cryer et al., 2000; de Schipper et al., 2004; Whitebook & Phillips, 1990). To date, little is known about the effects of this practice on young children. This study provides some initial evidence that discontinuity may not necessarily be harmful to academic outcomes and can potentially be beneficial when it is used to expose children to more teachers with B.A.-level degrees. However, to help inform sensible transition policies, further research into daily classroom transitions will be needed in the areas described here to determine the robustness of our findings under different model specifications and with a wider range of developmental outcomes.

Highlights

- We examine children and teachers transitions between classrooms at a center.
- We model the effect of transitions and teachers' qualifications on child outcomes.
- One-third of children and over 80% of teachers moved daily between classrooms.
- Failure to account for transitions can change effects and impacts interpretations.

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Appendix A

Correlations Among Quality Variables Under Different Model Specifications ($n = 307$)

Variable	ECE credits	Teachers with B.A.	Teaching Experience	Child-staff Ratio
Head Teacher Qualifications				
ECE credits	1.00			
Teachers with a B.A.	N/A	1.00		
Teaching experience	0.20**	N/A	1.00	
Child-staff ratio	-0.11	N/A	0.06	1.00
ECERS-R	0.25**	N/A	0.15**	-0.37**
Average Teacher Qualifications Model				
ECE credits	1.00			
Teachers with a B.A.	0.45***	1.00		
Teaching experience	0.13*	0.12*	1.00	
Child-staff ratio	-0.12*	-0.06	0.12*	1.00
ECERS-R	0.22**	0.29**	0.08	-0.37**
Movement Model				
ECE credits	1.00			
Teachers with a B.A.	0.45**	1.00		
Teaching experience	0.17*	0.14*	1.00	
Child-staff ratio	0.08	0.02	0.13*	1.00
ECERS-R	0.23**	0.15**	0.06	-0.31**

Notes:

N/A indicates not applicable.

*

$p < .05$.

**

$p < .01$.

$p < .001$.

Table 1

Descriptive Statistics for Selected Child-Level Covariates

Variable	<i>n</i>	<i>M</i>	<i>SD</i>	Range
Age at assessment (months)	307	45.65	6.86	29.61–70.70
Income	307	\$47,947.88	\$50,401.81	\$2,500–\$25,0000
Hours of weekly care	307	30.79	13.30	3.00–55.00
Length in classroom (months)	307	6.01	3.42	0.00–24.00
Length in program (months)	307	13.86	12.30	1.00–6.00
PPVT	295	93.47	14.67	20.00–132.00
WJ-LWI	287	102.98	19.62	69.00–181.00
WJ-PC	275	120.80	13.18	85.00–171.00
WJ-AP	272	100.23	14.89	64.00–139.00

Table 2

Duration and Frequency of Children and Teacher Movement

	Children (<i>n</i> = 95)			Teachers (<i>n</i> = 241)		
	<i>M</i>	<i>SD</i>	Range	<i>M</i>	<i>SD</i>	Range
Number of movements per day	0.73	0.49	0.07–1.92	1.20	0.83	0.11–5.80
Time (in minutes) movers spent in other classrooms	63.46	55.67	2.00–332.00	150.11	61.37	5.00–287.80

Note: 95 of the total 307 children, and 241 of the total 295 teachers, moved temporarily.

Table 3

Percent of Total Movement, by Hours of the Day, Among Children and Teachers Who Moved

	Children (<i>n</i> = 95)	Teachers (<i>n</i> = 241)
Very early morning (7:00–8:59 AM)	45	22
Morning (9:00–11:59 AM)	5	21
Early midday (12:00–1:59 PM)	4	20
Late midday (2:00–3:59)	9	21
Late afternoon (4:00–6:00 PM)	37	16

Table 4Descriptive Statistics for Teacher Qualifications Under Different Model Specifications ($n = 307$)

Characteristic	<i>M</i>	<i>SD</i>	Range
Head Teacher Qualifications			
ECE credits	13.77	16.33	0.00–71.00
Teaching experience	8.60	6.29	0.00–26.00
Teachers with a B.A. (%)	12.35	—	—
Average Teacher Qualifications			
ECE credits	9.46	10.50	0.00–45.00
Teaching experience	7.06	4.99	0.00–26.50
Teachers with a B.A. (% likelihood)	7.94	21.40	0.00–10.00
Movement Model			
ECE credits	10.11	10.79	0.00–45.47
Teaching experience	7.15	6.80	0.00–6.00
Teachers with a B.A. (% likelihood)	22.35	31.45	0.00–100.00

Table 5Descriptive Statistics for the ECERS-R and Child-Staff Ratios Under Different Model Specifications ($n = 307$)

Variable	<i>M</i>	<i>SD</i>	Range
Models that ignore movement ^a			
ECERS-R	4.94	1.01	2.06–6.72
Child-staff ratio	6.19	1.98	3.00–12.00
Movement model			
ECERS-R	5.02	1.01	1.91–6.72
Child-staff ratio	5.99	2.21	1.50–18.32

Note:

^aRefers to the head teacher qualification model or average teacher qualification model.

Table 6

A Regression Coefficients Under Different Model Specifications for PPVT ($n = 295$)

Parameter	Ignored Movement					
	M1: Head Teacher Qualifications			M2: Average Teacher Qualifications		
	B (SE)	β (SE)	B (SE)	β (SE)	B (SE)	β (SE)
ECE credits	-0.09 (0.04)	-0.10 (0.04) *	-0.08 (0.08)	-0.05 (0.06)	-0.20 (0.08)	-0.15 (0.06) *
Teachers with a B.A.	2.01 (1.95)	0.04 (0.04)	0.03 (3.97)	0.00 (0.06)	5.91 (2.42)	0.13 (0.05) *
Teaching experience	0.10 (0.12)	0.04 (0.05)	0.24 (0.13)	0.08 (0.04)	0.11 (0.07)	0.05 (0.03)
Child-staff ratio	-0.12 (0.47)	-0.02 (0.06)	-0.25 (0.46)	-0.03 (0.06)	-0.00 (0.41)	-0.00 (0.06)
ECERS-R	2.02 (1.29)	0.14 (0.09)	1.68 (1.23)	0.12 (0.08)	2.15 (1.20)	0.15 (0.08)
Age at assessment	0.40 (0.12)	0.19 (0.06) **	0.40 (0.12)	0.19 (0.06) **	0.41 (0.11)	0.19 (0.05) ***
Income	0.00 (0.00)	0.20 (0.04) ***	0.00 (0.00)	0.21 (0.04) ***	0.00 (0.00)	0.21 (0.05) ***
Hours of weekly care	-0.04 (0.06)	-0.04 (0.06)	-0.06 (0.07)	-0.05 (0.06)	-0.05 (0.06)	-0.04 (0.05)
Length in program	-0.03 (0.07)	-0.02 (0.05)	-0.03 (0.07)	-0.02 (0.05)	-0.06 (0.07)	-0.05 (0.05)
Length in classroom	-0.40 (0.25)	-0.09 (0.06)	-0.40 (0.25)	-0.09 (0.06)	-0.38 (0.25)	-0.09 (0.06)
Parent with a B.A.	2.68 (2.11)	0.07 (0.06)	2.71 (2.14)	0.07 (0.06)	2.67 (2.14)	0.07 (0.06)
Black	-1.55 (2.33)	-0.26 (0.06) ***	-1.28 (2.36)	-0.26 (0.06) ***	-1.01 (2.18)	-0.25 (0.05) ***
Hispanic	-5.54 (1.85)	-0.13 (0.05) **	-5.51 (1.93)	-0.13 (0.05) **	-5.61 (1.75)	-0.14 (0.04) **
Other race	-3.54 (2.29)	-0.08 (0.05)	-3.45 (2.28)	-0.08 (0.05)	-3.05 (2.43)	-0.07 (0.05)
Speaks mostly English at home	9.90 (3.08)	0.18 (0.06) **	9.87 (3.09)	0.18 (0.06) **	9.26 (2.85)	0.18 (0.05) ***
Learning problems	-6.73 (2.71)	-0.17 (0.07) *	-6.62 (2.77)	-0.17 (0.07) *	-6.87 (2.68)	-0.17 (0.07) *
Female	1.74 (1.71)	0.06 (0.06)	1.58 (1.73)	0.05 (0.06)	1.72 (1.73)	0.06 (0.06)
R ²	0.31		0.31		0.33	
J-test t-statistics						
Model vs. $H_A = M_1$	NA		0.95		2.44 *	
Model vs. $H_A = M_2$	1.72		NA		2.76 **	
Model vs. $H_A = M_3$	0.66		1.02		NA	

B Regression Coefficients Under Different Model Specifications for WJ-LWI ($n = 287$)

Parameter	Ignored Movement					
	M1: Head Teacher Qualifications			M2: Average Teacher Qualifications		
	B (SE)	β (SE)		B (SE)	β (SE)	M3: Movement Model
ECE credits	0.04 (0.10)	0.03 (0.08)		0.23 (0.16)	0.12 (0.09)	0.03 (0.07)
Teachers with a B.A.	4.20 (3.67)	0.07 (0.06)		-8.44 (8.25)	-0.10 (0.09)	0.08 (0.06)
Teaching experience	0.34 (0.19)	0.11 (0.06)		0.48 (0.25)	0.12 (0.06)	0.08 (0.03) *
Child-staff ratio	0.41 (0.66)	0.04 (0.07)		0.24 (0.67)	0.02 (0.07)	0.06 (0.05)
ECERS-R	1.22 (1.37)	0.06 (0.07)		1.29 (1.33)	0.07 (0.07)	0.08 (0.07)
Age at assessment	-0.43 (0.18)	-0.15 (0.06) *		-0.39 (0.18)	-0.14 (0.06) *	-0.14 (0.06) *
Income	0.00 (0.00)	0.11 (0.07)		0.00 (0.00)	0.13 (0.07)	0.11 (0.07)
Hours of weekly care	-0.03 (0.10)	-0.02 (0.06)		-0.04 (0.09)	-0.03 (0.06)	-0.01 (0.06)
Length in program	-0.10 (0.13)	-0.06 (0.07)		-0.08 (0.12)	-0.05 (0.07)	-0.08 (0.07)
Length in classroom	0.10 (0.37)	0.02 (0.06)		0.11 (0.35)	0.02 (0.06)	0.03 (0.06)
Parent with a B.A.	4.24 (3.85)	0.08 (0.08)		3.88 (3.66)	0.08 (0.07)	0.09 (0.08)
Black	-3.09 (4.60)	-0.06 (0.09)		-2.74 (4.65)	-0.05 (0.09)	-0.03 (0.08)
Hispanic	-0.28 (3.04)	-0.01 (0.06)		-0.16 (3.00)	-0.00 (0.05)	0.00 (0.05)
Other race	-3.04 (4.02)	-0.05 (0.07)		-2.68 (3.95)	-0.04 (0.07)	-0.03 (0.07)
Speaks mostly English at home	2.35 (7.90)	0.03 (0.11)		1.52 (7.60)	0.02 (0.10)	0.03 (0.10)
Learning problems	-7.70 (2.59)	-0.15 (0.05) **		-8.42 (2.62)	-0.16 (0.05) **	-0.15 (0.05) **
Female	1.63 (2.41)	0.04 (0.06)		1.10 (2.40)	0.03 (0.06)	0.03 (0.06)
R ²		0.12		0.13		0.14
J-test t-statistics						
Model vs. $H_A = M_1$		NA		1.75		2.03 *
Model vs. $H_A = M_2$		0.75		NA		2.01
Model vs. $H_A = M_3$		1.17		1.61		NA

C Regression Coefficients Under Different Model Specifications for WJ-PC ($n = 275$)

Parameter	Ignored Movement					
	M1: Head Teacher Qualifications		M2: Average Teacher Qualifications		M3: Movement Model	
	B (SE)	β (SE)	B (SE)	β (SE)	B (SE)	β (SE)
ECE credits	-0.04 (0.05)	-0.05 (0.06)	-0.03 (0.07)	-0.02 (0.06)	-0.07 (0.06)	-0.06 (0.05)
Teachers with a B.A.	0.50 (1.81)	0.01 (0.04)	-3.53 (2.44)	-0.06 (0.04)	-2.02 (1.89)	-0.05 (0.05)
Teaching experience	0.12 (0.10)	0.05 (0.05)	0.20 (0.11)	0.08 (0.04)	0.10 (0.04)	0.06 (0.02) *
Child-staff ratio	-0.13 (0.32)	-0.02 (0.05)	-0.18 (0.33)	-0.03 (0.05)	0.01 (0.27)	0.00 (0.05)
ECERS-R	0.47 (0.71)	0.04 (0.05)	0.63 (0.71)	0.05 (0.05)	0.66 (0.63)	0.05 (0.05)
Age at assessment	-1.15 (0.09)	-0.60 (0.05) ***	-1.14 (0.09)	-0.59 (0.05) ***	-1.13 (0.09)	-0.59 (0.05) ***
Income	0.00 (0.00)	0.15 (0.05) **	0.00 (0.00)	0.16 (0.05) **	0.00 (0.00)	0.16 (0.05) **
Hours of weekly care	0.00 (0.06)	0.00 (0.06)	0.00 (0.05)	0.00 (0.05)	-0.01 (0.05)	-0.01 (0.05)
Length in program	-0.07 (0.04)	-0.06 (0.04)	-0.06 (0.04)	-0.05 (0.04)	-0.07 (0.05)	-0.06 (0.04)
Length in classroom	-0.22 (0.21)	-0.06 (0.05)	-0.23 (0.20)	-0.06 (0.05)	-0.21 (0.22)	-0.05 (0.06)
Parent with a B.A.	0.86 (1.75)	0.03 (0.05)	0.77 (1.74)	0.02 (0.05)	0.93 (1.82)	0.03 (0.05)
Black	0.20 (2.40)	0.01 (0.07)	0.27 (2.32)	0.01 (0.06)	0.37 (2.17)	0.01 (0.06)
Hispanic	2.04 (2.32)	0.06 (0.06)	1.91 (2.41)	0.05 (0.07)	2.10 (2.33)	0.06 (0.06)
Other race	1.11 (1.61)	0.03 (0.04)	1.12 (1.57)	0.03 (0.04)	1.22 (1.52)	0.03 (0.04)
Speaks mostly English at home	-2.19 (3.05)	-0.04 (0.06)	-2.41 (3.06)	-0.05 (0.06)	-2.47 (3.05)	-0.05 (0.06)
Learning problems	-0.60 (2.09)	-0.02 (0.06)	-0.55 (2.10)	-0.02 (0.06)	-0.69 (2.13)	-0.02 (0.06)
Female	1.47 (1.21)	0.06 (0.05)	1.30 (1.18)	0.05 (0.04)	1.36 (1.19)	0.05 (0.05)
R ²	0.41		0.41		0.42	
J-test t-statistics						
Model vs. H _A = M ₁	NA		1.99		2.91**	
Model vs. H _A = M ₂	-0.58		NA		1.76	
Model vs. H _A = M ₃	0.69		1.17		NA	

D Regression Coefficients Under Different Model Specifications for WJ-AP ($n = 272$)

Parameter	Ignored Movement								
	M1: Head Teacher Qualifications			M2: Average Teacher Qualifications			M3: Movement Model		
	B (SE)	β (SE)	B (SE)	β (SE)	B (SE)	β (SE)	B (SE)	β (SE)	
ECE credits	0.05 (0.07)	0.06 (0.08)	0.11 (0.11)	0.08 (0.08)	0.00 (0.11)	0.00 (0.08)	0.00 (0.11)	0.00 (0.08)	
Teachers with a B.A.	3.76 (4.27)	0.08 (0.09)	-2.64 (5.13)	-0.04 (0.08)	3.08 (3.85)	0.07 (0.08)	3.08 (3.85)	0.07 (0.08)	
Teaching experience	-0.17 (0.15)	-0.07 (0.06)	-0.10 (0.19)	-0.03 (0.06)	-0.11 (0.11)	-0.05 (0.05)	-0.11 (0.11)	-0.05 (0.05)	
Child-staff ratio	0.20 (0.54)	0.03 (0.07)	0.12 (0.57)	0.02 (0.08)	0.71 (0.33)	0.11 (0.05) *	0.71 (0.33)	0.11 (0.05) *	
ECERS-R	1.05 (1.21)	0.07 (0.08)	0.86 (1.31)	0.06 (0.09)	0.75 (1.29)	0.05 (0.09)	0.75 (1.29)	0.05 (0.09)	
Age at assessment	-0.06 (0.11)	-0.03 (0.05)	-0.03 (0.11)	-0.01 (0.05)	-0.03 (0.11)	-0.01 (0.05)	-0.03 (0.11)	-0.01 (0.05)	
Income	0.00 (0.00)	0.16 (0.06) *	0.00 (0.00)	0.16 (0.06) *	0.00 (0.00)	0.15 (0.06) *	0.00 (0.00)	0.15 (0.06) *	
Hours of weekly care	0.02 (0.08)	0.02 (0.07)	0.01 (0.10)	0.01 (0.09)	-0.00 (0.09)	-0.00 (0.08)	-0.00 (0.09)	-0.00 (0.08)	
Length in program	0.00 (0.08)	0.00 (0.06)	0.01 (0.08)	0.01 (0.06)	-0.00 (0.08)	-0.00 (0.06)	-0.00 (0.08)	-0.00 (0.06)	
Length in classroom	-0.39 (0.21)	-0.09 (0.05)	-0.40 (0.22)	-0.09 (0.05)	-0.38 (0.22)	-0.09 (0.05)	-0.38 (0.22)	-0.09 (0.05)	
Parent with a B.A.	3.56 (2.46)	0.09 (0.06)	3.70 (2.41)	0.10 (0.06)	3.78 (2.59)	0.10 (0.07)	3.78 (2.59)	0.10 (0.07)	
Black	-7.64 (2.55)	-0.19 (0.06) **	-8.01 (2.52)	-0.20 (0.06) **	-8.46 (2.54)	-0.21 (0.06) **	-8.46 (2.54)	-0.21 (0.06) **	
Hispanic	-6.73 (2.07)	-0.16 (0.05) **	-6.88 (2.00)	-0.17 (0.05) **	-7.00 (2.07)	-0.17 (0.05) **	-7.00 (2.07)	-0.17 (0.05) **	
Other race	-2.24 (2.54)	-0.05 (0.06)	-2.05 (2.56)	-0.04 (0.06)	-1.77 (2.57)	-0.04 (0.06)	-1.77 (2.57)	-0.04 (0.06)	
Speaks mostly English at home	6.62 (3.63)	0.12 (0.06)	6.47 (3.54)	0.11 (0.06)	6.51 (3.40)	0.12 (0.06)	6.51 (3.40)	0.12 (0.06)	
Learning problems	-5.90 (1.98)	-0.15 (0.05) **	-6.37 (2.16)	-0.16 (0.05) **	-6.03 (2.06)	-0.15 (0.05) **	-6.03 (2.06)	-0.15 (0.05) **	
Female	2.61 (1.95)	0.09 (0.07)	2.51 (2.00)	0.08 (0.07)	2.53 (1.95)	0.09 (0.07)	2.53 (1.95)	0.09 (0.07)	
R ²	0.19		0.19		0.20		0.20		
J-test statistics									
Test vs. H _A = M ₁	NA		1.99		1.77		1.77		
Test vs. H _A = M ₂	1.18		NA		2.25 *		2.25 *		
Test vs. H _A = M ₃	1.44		1.17		NA		NA		

Notes:

B and β are the unstandardized and standardized estimates, respectively.

J-test is a goodness-of-fit test that the model contains no additional information above and beyond the alternative model H_A .

M1 indicates the head teacher qualification model (movement ignored).

M2 indicates the average teacher qualifications model (movement ignored).

M3 indicates the movement model.

- * $p < .05$.
- ** $p < .01$.
- *** $p < .001$.