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Pathways to kindergarten:
A latent class analysis of children's time in early education and care

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Abstract

Research findings: Using a sample of 568 students from 61 kindergarten classrooms whose primary caregivers completed a questionnaire describing their child's early childhood education and care (ECEC) by year from birth to pre-kindergarten, we identified seven pathways characterizing children's ECEC experiences using a latent class analysis. Once identified, profile membership was included as an independent variable in a multilevel model to predict children's cognitive and social-behavioral outcomes at kindergarten entry. Although a considerable body of work has examined dosage of time in (ECEC) and its associations with children's skills in later grades, we extend this work by expanding the definition of dosage to include multiple care arrangements from birth to kindergarten entry and by examining if profiles of ECEC participation have associations with kindergarten-entry skills. Our findings show membership in profiles in which children spent consistent time in center-based care from birth to five were associated with adverse social-behavioral outcomes including behavioral aggression, school adjustment, peer social skills, and self-efficacy. *Practice or policy:* Our findings suggest the importance of considering more nuanced differences in children's experiences with ECEC and the need for possible interventions to support the social-behavioral development of children with exposure to five years of center-based care.

Keywords: *Early education and care, time in care, kindergarten entry, social-behavioral development, latent class analysis*

Pathways to kindergarten:

A latent class analysis of children's time in early education and care

Early childhood is a unique developmental period for children that has lasting impacts on their lives through K-12 education and into adulthood (Reynolds et al., 2018; Schweinhart et al., 2005). Since the early 2000's, a broad expansion of publicly funded early childhood education and care (ECEC) has been underway across the United States (Barnett et al., 2018). The expansion of publicly funded ECEC stems in part from research findings and policy emphasis on the benefits of preschool participation in promoting positive cognitive and social-behavioral development in children in the years prior to formal schooling (e.g., Duncan & Magnuson, 2013; Yoshikawa et al., 2013). Further, publicly funded ECEC expansion supports the workforce by providing parents with expanded childcare options; evidence demonstrates a high return on investment in ECEC expansion in terms of economic vitality (White, 2001). Yet, even considering public ECEC expansion initiatives, many underserved children remain. Half (51%) of Americans live in "child care deserts," neighborhoods characterized by three or more young children for each licensed child care slot, and 83% of parents with children under age five report finding affordable, quality care to be a problem (Malik et al., 2018). In such contexts, available ECEC options may have limited space, may be too difficult to reach, or may simply be unaffordable for parents (Thomson et al, 2018).

To improve our understanding of the variability of children's ECEC experiences in the years prior to kindergarten, the purpose of the present study was to examine profiles of ECEC participation from birth to kindergarten entry. While there has been considerable attention directed towards characterizing children's ECEC experiences, much of the work on duration and dosage has examined the impact of participation in center-based care (i.e., attendance or number

of hours per week; see Burchinal et al, 2016; Logan et al., 2011) or the timing of entry into center-based care (e.g., Barnes & Melhuish, 2017; Dearing et al., 2015; Li et al., 2013). In the present work, we utilize an alternative analytical approach to examine ECEC experiences by determining the extent to which there may be reliable profiles of children's ECEC experiences from birth to kindergarten entry. In so doing, we may develop a more nuanced understanding of how different combinations of care are related with child outcomes.

Variability in Children's ECEC Experiences

The paths children take through ECEC are more varied than the simple dichotomy of attending or not attending a center-based early childhood program. Further, the time point of entry may not sufficiently capture children's ECEC experiences. The type of care that children are enrolled in may change during their first five years. (Morrissey, 2010; NICHD ECCRN, 2001). Additionally, children's time in ECEC covers many types of experiences. Home-based care alone can range from care provided by a parent, care provided by another relative, or care by a nanny or babysitter. Likewise, early childhood programing outside of the home can vary widely from government funded center-based programs (e.g.: pre-k offered at a public school; Head Start) to more informal care settings (e.g.: home based childcare facilities). Further, it is likely that children spend time in multiple types of care at any given time and transition from one type of care to another with some fluidity between ages 0 to 5 (Morrissey, 2008).

Parents often make decisions regarding care for their children based on several concerns including quality, convenience, practicality, and cost (Kim & Fram, 2009). In the United States parents face the challenge of navigating limited center-based non-profit options and unaffordable for-profit care (Malik et al., 2018). Nationwide 77% of parents of children 5 and under report adverse career impacts for themselves or a family member related to childcare (Halpin et al.,

2018). In neighborhoods with particularly limited resources, parents may be more likely to keep children home, rely on family networks for care, or enroll children in a more affordable informal care setting (Friedman-Krauss et al., 2019). In order to help support low-income and working parents, the Federal government provides heavily subsidized care in the form of Head Start and Early Head Start. Additionally, some states, such as Tennessee (Lipsey et al., 2018) and Oklahoma (Gormley et al., 2005), have made large investments in the expansion of publicly funded ECEC in the form of universal pre-k, available to all residents of the state. However, in many states parents still have a patchwork of care options to navigate. This may be due in part to the absence of a statewide ECEC program or dwindling state-funded support for ECEC (Friedman-Krauss et al., 2019). As such, municipalities and counties may attempt to fill this void by funding local efforts to provide greater access to center-based care (Fischer et al., 2013). Yet, limited state-level investment and a lack of a meaningful statewide programs suggests that access to care may vary greatly for caregivers of young children in under-funded settings. Thus, limited access to public child care options and the high cost of private center-based care may force parents to keep children at home for longer than desired or prompt parents to turn to more informal care (Child Care Aware of America, 2019).

Additionally, the amount of specific types of care a child receives during the early childhood period may be related to the skills they develop, yet the existing literature is unclear about how different combinations of care over time may influence children's development. For example, Weiland and Yoshikawa (2013) show positive effects of pre-k programs on cognitive and emotional development for children. Yet, regardless of participation in center-based early childhood programming, socio-economic status and parental education levels are strong predictors of a child's early development (Anders et al., 2012; NICHHD ECCRN 2001). Further,

the quality of the home literacy environment may have more influence on children's reading and math development than participating in high-quality center-based care (Anders et al., 2012). Finally, meta-analysis has demonstrated that the impacts of center-based care are highly variable between studies and that there is no consistent finding regarding dosage or age of entry into care as it relates to children's cognitive and non-cognitive development (Burger, 2010).

Therefore, identifying and defining profiles of children's pathways to kindergarten has the potential to both expand our understanding of the effects of ECEC and better inform how we conceptualize children's time in ECEC. Previous work has not examined the idea of pathways, but instead has focused on the age at which children enter early education and care as a potential indicator of later outcomes (e.g., Belskey et al., 2007; Li et al., 2013; McCartney et al., 2010; Vandell et al., 2010). While a good foundation, this conceptualization does not account for differences in care type or the fluidity between those types. Examining all types of care, and the transitions children take between them at different time points, has the potential to provide a more complete picture of children's time in ECEC. Further, by identifying and defining children's pathways to kindergarten, we may be able to detect differences in children's kindergarten entry skills. Thus, examining the pathways through different early education and care environments during the first five years of life (which we here call kindergarten pathway profiles).

Relating Pathways to Kindergarten Skills

Children who enter kindergarten socially, behaviorally, and cognitively prepared for school are more equipped to succeed in later schooling (Yoshikawa et al., 2013). Thus, examining kindergarten pathway profiles and how they may relate to better kindergarten readiness or increased social or cognitive skills at kindergarten entry may help improve our

understanding of the impacts ECEC. Specifically, comparisons between profiles of pathways to kindergarten and their related kindergarten entry skills may provide a more nuanced understanding of children's time in ECEC than simply looking at age of entry into care. While it is clear that academic skills such as reading and math are important predictors of academic success and contributions to improvement in reading and math should be considered in any examination of ECEC (Duncan et al., 2007), Bailey and colleagues (2017) argue that, along with academic skills, malleable skills such as executive function, social, and behavioral skills are fundamentally important for children to develop in early childhood to be successful in school.

For example, school readiness is linked with social dynamics between teachers and students and is manifested in how well a child is adjusted to the school environment. (Mashburn & Pianta, 2006). Further, peer social skills and self-control have been identified by teachers as important skills that lead to school success (Meier et al., 2006). Likewise, school liking and school adjustment have been shown to be important predictors of children's success in schooling (Ladd et al., 2000; Ladd et al., 2006). Finally, executive function skills, which are developed primarily in the early childhood period, may predict both later academic success (Harvey & Miller, 2017; Vandenbroucke et al., 2017). Therefore, the current study examines the impacts of both academic skills related to reading and math, and skills related to executive function, social skills, school liking, school adjustment, school self-efficacy, and behavioral control as these skills may provide important contributions to children's later school outcome (Graziano & Hart, 2016; Ladd & Dinella, 2009; McCoy et al., 2017).

While positive predictors of school success are important to identify, it is equally important to be aware of potential obstacles to school success. Behavioral problems, in particular, have been shown to be associated with extended time in center-based ECEC (NICHD

ECCRN, 2001). Yet, children's social skills have been observed to mediate the relationship between self-regulation and literacy achievement growth and as such may mitigate the impact of behavior problems in children with high social skills (Montroy et al., 2014). Likewise, children with high levels of executive function skills are able to overcome behavioral problems, children with low executive function skills struggle to control behavior and succeed in school (Graziano & Hart, 2016). In considering pathways to kindergarten entry, it is also important to consider whether those pathways are associated with children's skills at kindergarten entry.

The Present Study

To this end, the present study was designed to address two research questions: (1) To what extent are there reliable profiles that capture children's participation in early education and care from birth to five years? (2) To what extent are these profiles associated with differences in children's cognitive and social-behavioral development as evidenced at kindergarten entry?

To achieve this, the present study uses latent class analysis (LCA) to determine if latent profiles of kindergarten pathways can be reliably identified. Using an LCA approach can help to reveal unobserved groups, by identifying trends of ECEC attendance within data. Use of LCA in the field of ECEC research has yielded valid findings that increased our understanding of parents' choices in respect to ECEC enrollment (Kim & Fram, 2009). Further, LCA has proved useful and informative in identifying profiles of literacy risk in ECEC classrooms (Justice et al., 2015) and in examining kindergartener's perspectives on school (Timmons & Pelletier, 2016). Thus, LCA may be a valuable tool in helping to identify profiles of children's pathways to kindergarten and to expanding our understanding of ECEC.

We hypothesize that at least three pathway profiles will exist. First, we expect a pathway profile for children who are in center-based care from birth through kindergarten entry. For

families with a single parent or two working parents, the need to continue careers or to simply earn enough income to support a family, it is likely necessary to enroll children in center-based care at an early age and to have them remain in care throughout their childhood, so that a parent or parents are able to maintain employment. Second, we expect a pathway profile for children who remain in parent-family care for the first two to three years of childhood and then transition into a center-based preschool setting at ages three or four. This profile is likely to be identified as infant care is generally the most expensive type of care and the most difficult to access (Child Care Aware of America, 2019). Further, parents who rely on babysitters, or extended family for home care, may find moving children to center-based care at ages three or four to be a more feasible or affordable option. Finally, we expect a pathway profile for children who are only cared for in their home by a parent, relative, or babysitter for the duration of their pathway to kindergarten. Due to the exploratory nature of this study, it is likely that other pathway profiles will emerge from the analysis. However, there is not strong evidence to guide further hypotheses.

With regard to the second research question, to what extent are these profiles associated with differences in children's cognitive and social-behavioral development as evidenced at kindergarten entry, based on existing literature children who spend extended time in center-based child care may be more inclined towards adverse behavioral outcomes, but may likewise inclined toward higher cognitive outcomes at kindergarten entry. Because we do not know the exact nature of the profiles, it is difficult to make any specific *a priori* hypotheses about the strength of these effects or their prevalence any in specific profiles.

Methods

Participants

This study uses a cross-sectional subsample of data from a large federally-funded project designed to improve understanding of classroom ecology from preschool to third grade. The project involves data collected from two large, suburban school districts from a mid-western state; 25 schools, 152 classrooms, and 3,472 students enrolled in kindergarten to 3rd grade are included in the full data set. Together the two school districts are reflective of the socio-economic and racial diversity of adjacent suburban communities. The study sample is 49% Female and 74% White; 87% of the children reside in homes where English is the primary home language and 55% of mothers have less than a 4-year college degree.

Participants were recruited into the study in accordance with the approval of the university's institutional review board (IRB). The IRB is made up of a panel of third-party experts and is the body primarily responsible for the welfare and protection of human subjects in scientific research. Following IRB approval, all parents of children in grades kindergarten to third in the two school districts were asked to consent to allow their children to participate in the study. During the initial enrollment, demographic data was collected on all consented children. Later, in the school year, a second wave of data collection was conducted. In the second wave, a packet was distributed to each parent that included a questionnaire about family background, household routines, and children's care experiences leading up to kindergarten entry. Parents who completed the survey received a $10 gift card. The present study is focused on children enrolled in kindergarten (n=747). Children in later grades were excluded, because the focus of the study is to investigate if pathways result in different outcomes at kindergarten entry. Children whose parents consented to participation in the study but did not complete the survey (n=179) were not included in this study due to insufficient data to conduct the profile analysis. As such, the final analytic sample used in this study includes 568 students, from 61 kindergarten

classrooms. A χ^2 Test of Homogeneity between the study sample and the group excluded for insufficient data was conducted to determine if there was a statistical difference between the two groups. The test indicated that there is a significant difference χ^2 (11, N=747) = 116, $p < .001$. Specifically, the study sample had less racial diversity and a higher percentage of mothers without a four-year college degree. The demographic data for the final sample and the comparison from the full sample are available in Table 1. However, because these data meet the conditions for missing at random and because we include race and mother's education as covariates in the model to control for difference between the two groups, difference between the analytic sample and the children of parents who did not complete the survey are controlled for in our statistical model (Allison, 1990).

Procedures

Parents completed family background surveys either online via the Qualtrics platform, or on paper (based on their preference) at the beginning of the school year. Paper surveys were converted to digital forms via a Teleform system. Trained research staff conducted quality assurance checks of scanned data, conducting a mandatory visual check of each scanned form for accuracy. In addition, data were checked to ensure data were all within the potential observable range for each variable and examined data for consistency between item and sum or total scores. All child outcome assessments were collected in the fall of the kindergarten year. Child assessments were collected via teacher report, direct assessments, and individual interviews with trained project staff. Children were interviewed in quiet areas of the hallway by trained research staff and responses were recorded in accordance with the study protocols.

Measures

Measures used in this study were twofold: (1) parent questionnaire about child's ECEC experiences, and (2) direct assessments of children. All measures were implemented in fall of the academic year over an approximate six-week period.

Parent questionnaire

Parents completed a survey comprising 49 items designed to capture information about their child's ECEC experiences from birth to five years (kindergarten entry). For the purpose of this study, we used responses from a question designed to assess the type of care a child received for the first five years of life. The question asked parents to: "think about regular care arrangements for your child… (at least weekly). Please do not include occasional babysitting or back-up care arrangements. Regular care should be at least five hours per week. Which best describes the type of care your child received at each age?" The prompt encouraged parents to select all appropriate categories of care for their child at each age 0 to 5. The categories included: *parent or guardian*, *a relative*, *babysitter or nanny*, (which we refer to as home care), *in a childcare provider's home* (which we refer to as informal care), and *in a childcare center or preschool* (center-based care). At each of the five time points (age 0 to 1, 1 to 2, etc…) parents were asked to select all appropriate categories that characterized the type of care the child receive at the corresponding time point. For instance, at age 3 to 4 parents could select *parent or guardian*, *childcare center or preschool*, and *babysitter*. Parents could likewise select only a single type of care or all five types of care at any of the five time points.

For analysis, we collapsed the first three options (*parent or guardian*, *a relative*, *babysitter or nanny*) into a single variable to represent home care. We coded 1 for a selected category and 0 for a non-selected category. For a small percentage of cases, we found that parents did not respond to any category in a given year, but did respond in other years. We

hypothesized that these parents either misunderstood the prompt, did not remember the specific type of care at that age, or were suffering from survey fatigue by the time they reached the question. In these cases, all responses for that child in the year in which no responses were captured were coded as missing. In no year did the number of missing cases exceed 5% of the total sample (n=568). Additionally, this missing data was accounted for using maximum likelihood estimation during the examination of latent class membership.

Student level measures

Cognitive measures. In the context of this study we examined outcomes shown to be predictive of later school success. For cognitive outcomes, students were assessed using three subsections of the Woodcock-Johnson III (WJIII) Applied Problems, Picture Vocabulary, and Letter Word Identification (Woodcock et al., 2001). Applied Problems is indicative of both early mathematics knowledge and problem solving. Likewise, letter word identification and picture vocabulary are assessments indicative of early literacy and word knowledge respectively. The mean reliability, as reported in the technical manual, for the subtests are Applied Problems α = .92, Letter Word Identification α = .94, and Picture Vocabulary α = .81 (Woodcock et al., 2001), in the study sample α = .71, α = .84, and α = .76 respectively on the three subtests.

Executive function (EF) skills were assessed using the Head Toes Knees Shoulders task (HTKS; Ponitz et al., 2009). The task asks children to follow a set of directions that increases in complexity to test their EF skills. HTKS correlate significantly with another measure of EF, The Dimensional Change Card Sort, in kindergarten students (r = 0.56; p<.001) and was shown to be predictive of academic growth in kindergarten students (McClelland et al., 2014). Across four studies HTKS demonstrated internal consistency that ranged from α = 0.92 to α = 0.87 (Ponitz et al. 2008). The study sample's internal consistency is α .97.

Social-behavioral measures. We captured social-behavioral outcomes at the beginning of kindergarten using both teacher- and child-reported measures. Teachers completed the peer social skills subscale of the Teacher-Child Rating Scale 2.1 (TCRS; Perkins & Hightower, 2002) to assess children's peer social skills. The TCRS is a brief, objective rating scale designed for teachers to assess children's school behavior, social skills, and competencies. The items are rated on a five-point Likert type scale from *strongly disagree* to *strongly agree* according to how much the teacher believes that the item describes the child. The items included in the subscale for Peer Social Skill are then added together to form a composite score with a range of 0 to 32. Items include prompts such as, *makes friends easily* and *well-liked by classmates*, as well as reverse scored items such as *lacks social skills with peers*. TCRS has strong internal consistency $\alpha = .90$ and Peer Social Skills is considered to make up a single latent factor (Perkins & Hightower, 2002). The factor structure of the Peer Social Skills was validated using a sample of 68,497 students across grades pre-k to 10th grade (Weber et al., 2017). In the study sample the Peer Social Skills subscale has an internal consistency of $\alpha = .95$.

Relational aggression was assessed by teachers using the Preschool Social Behavior Scale–Teacher Form (Crick et al., 1997). The purpose of the relational aggression measure is to measures the aggression a child shows towards their peers. The measure contains six items which the teacher rates on a scale of 0 to 4 with 0 corresponding to *never or almost never true* and 4 corresponding with *always or almost always true*. Internal consistency was reported in Crick and colleagues (1997) as $\alpha = .93$. In the study sample the Relational Aggression subscale has an internal consistency of $\alpha = .95$.

School adjustment was assessed using five items from the Teacher Rating Scale of School Adjustment (Birch & Ladd, 1997). The five included items are follows teacher's

directions, uses classroom materials responsibly, *listens carefully to teacher's instructions and directions, accepts responsibility for a given task*, and *breaks classroom rules*. Items were ranked by teachers using a 5-point Likert scale from *strongly disagree* to *strongly agree* and the *breaks classroom rules* response is reverse coded. Internal consistency for the 8-item scale is $\alpha = .92$ (Birch & Ladd, 1997). In the study sample the internal consistency of the Teacher Rating Scale of School Adjustment is $\alpha = .52$

Finally, we used two child reported assessments through interviews with individual children. School liking was assessed using The School Liking and Avoidance Questionnaire scale developed by Ladd (1990) and used widely to as a direct assessment of children's school and social-emotional adjustment in school and has been shown to be predictive of school readiness (Ladd et al., 2006). Internal consistency of The School Liking and Avoidance Questionnaire has been shown to range from $\alpha = .87$ to $\alpha = .91$ (Ladd et al., 2000); however, in the study sample the internal consistency is $\alpha = .61$.

Child self-efficacy was assessed using seven items from a scale established by Stipek and colleagues (1995). The scale has seven items which ask children to *point to the number of stars* that describe their abilities in certain domains. The scale was from 0 to 2 stars and the seven items included, *how good you are at: reading, making friends*, and *following directions*. The internal consistency in the study sample is $\alpha = .54$.

Covariates. To determine the unique contribution pathway profiles made to child outcomes at kindergarten entry several covariates are included in the model. The demographic covariates included in the analysis are sex, race/ethnicity, use of English as a primary home language, maternal education level, and annual household income.

Analysis Plan

To determine if distinct pathway profiles were present in the time children spent in ECEC, we analyzed data from the parent survey. As noted above, parents were able to select what types of care their child received on a weekly basis during each of the five years preceding kindergarten. Three types of care were created from the survey. The first type of care was *home care*, which was collapsed from *care by a parent*, *care by a relative*, and *care by a nanny / babysitter*. The remaining types of care were center-based care and informal care. Parents were able to select as many categories as applied during each age. The five age categories were 0 to 1 year old, 1 to 2 years old, 2 to 3 years old, 3 to 4 years old, and 4 to 5 years old. The three types of care chosen by parents at each of the five age periods resulted in fifteen indicators of the latent class variable (three types of care x five age periods).

An exploratory latent class analysis (LCA) was conducted following procedures outlined in Muthen and Muthen (2009), and tested models from two to ten classes. Models were fit in Mplus 8.0 but were conducted using the Mplus LCA Helper (Uanhoro & Logan, 2018). Missing data were addressed using maximum likelihood estimation. The resulting models were compared using several model fit indices including Entropy, Lo-Mendell-Rubin Likelihood Ratio Test, Akaike Information Criteria (AIC; Akaike, 1974) and Bayesian Information Criteria (BIC; Stone, 1979).

Once the number of latent classes was determined, we used SAS 9.4 PROC MIXED to conduct multilevel models to examine the relationship between profile membership and cognitive and social-behavioral in pairwise comparisons between assessments in children at kindergarten entry. Multilevel modeling is the appropriate approach for dealing with the nested data that is commonly collected in schools (Raudenbush & Bryk, 2002). By using a multilevel approach, we can account for the effects of teachers and are thus better able to address the

relations between profile membership and cognitive and social-behavioral development as evidenced in the fall of the kindergarten year. Each analysis controlled for the effects of sex, race, primary home language, household income, and maternal education. By controlling for these covariates and accounting for effects of classroom assignment, we can determine the unique contribution of profile membership on the outcome.

To determine whether children's outcomes varied by pathway membership, we next conducted a series of pairwise comparisons for each outcome. In these comparisons, the fitted mean from one profile will be compared to the fitted mean from each of the other profiles on the same outcome. Work by Gelman and colleagues (2012) demonstrates that our use of multilevel modeling addresses any possible Type I error concerns associated with multiple pairwise comparisons. Additionally, due to the exploratory nature of this study, the *p*-values produced in the pairwise comparisons should not be treated as proof of difference, but rather as evidence upon which other studies should build (Schochet, 2008). Accordingly, no procedure to correct for false discovery rate will be performed to avoid increased likelihood of Type II errors.

Results

Are there reliable profiles of children's time in ECEC?

In order to determine if reliable profiles of children's time in ECEC were able to be detected, we tested latent class models that included 2 to 10 pathway profiles through ECEC. Full fit statistics of all tested models are reported in Table 2. Models that included five, six, or seven pathways profiles all demonstrated strong fit based on the available fit statistics. To determine the best fitting model among these, we examined model fit statistics. Entropy values >0.95 are considered good fitting models. Models that included five and six pathway profiles

demonstrated entropy of 0.951 and 0.953 respectively. The seven-pathway profile model had a slightly higher entropy of 0.976. While one model, the nine-profile model, had a higher entropy of 0.979, poor fit was demonstrated in other fit statistics which led us to reject models with eight or more profiles.

The Lo-Mendell-Rubin Likelihood Ratio Test (reported as LMR on Table 2) is a common statistic used in latent class analysis to evaluate overall model fit (Asparouhov & Muthen, 2012). This test is used to determine whether the current model fits better than one with fewer profiles. Models with significant results are considered better fitting models than the previous model. In our analysis, we found that this index suggested that increasing the number of classes was always associated with a significant improvement in model fit. AIC and BIC are two statistics commonly used to compare similar models to determine if more complex models are explaining enough information to justify the addition of freed parameters. Both AIC and BIC do not have specific cut points, however, complex models which reduce AIC or BIC by more than 10 points is considered an improved model (Anderson & Burnham, 2002; Kass & Rafferty, 1995). Further, simulations have shown that AIC and BIC should be considered together in the evaluation of LCA models (Dziak et al., 2012). In our analysis, each model that included a new pathway profile until the eight-profile model reduced the AIC statistic by 100 or more points. Likewise, BIC was reduced by >30 with each additional profile, but the change when the models increased from seven profiles to eight profiles resulted in only -7 BIC change. As BIC has been shown to be more conservative in fitting latent models (Yang, 2006) and the least biased of the two IC measures used (Nylund et al., 2007), we did not examine any models beyond the seven-profile model.

To examine the interpretability of the models beyond the fit statistics, we elected to plot the models with five, six, and seven profiles to determine if there was a justification for selecting one model over the others based on interpretability. After examining all three sets of plots, we determined that while there was a clear interpretation for each of the profiles contained in all three models, the seven profile model included a unique pathway profile (profile 2 - home to center care) which represented 10% of the total sample. Upon examining this profile and comparing the models to the five and six pathway profile models, we felt that this profile was substantively important for the unique pathway profile it represents. Further, in the seven-profile model, other profiles became better defined. For example, members in the new profile (profile 2 - home to center care) were previously distributed into other profiles where their misfit reduced the probabilities of attendance in a particular care type at a given time. The improvement was confirmed by comparing the posterior probabilities of latent profile membership from the six-profile model to the posterior probabilities from the seven-profile model. In the six-profile model, probabilities for most likely latent class ranged from 0.947 to 1.00 with four off diagonal values >0.01. The seven-profile model demonstrated improvement as probabilities for most likely latent profile membership ranged from 0.979 to 1.00 with the largest off diagonal value 0.012 and all other off diagonal values <0.01. Thus, based on clear interpretability, strong fit statistics, and improved posterior probabilities, the seven-pathway profile model was selected as the final model. The proportions of the sample represented by each profile are reported in Table 3.

In the seven-pathway profile model, the identified pathway profiles can be broadly classified in two distinct types: The first type represents profiles of children in a single type of care for the duration of their pathways through ECEC. The second type represents profiles of

children with a combination of care experiences during their ECEC pathway. Complete descriptions of each profile are reported in the next section. Demographic characteristics for each profile are reported in Table 4.

Type 1: Single care type profiles

Three profiles represent pathways in which children receive only one prevalent type of ECEC from birth to kindergarten entry, representing 56% of children. Figure 1 contains three graphs, one that represents each of the single care type profiles. The y-axis of each graph represents the probability of children in that profile to attend each of the three types of ECEC (home, informal, center-based). The x-axis is the age time point for the children; thus, the graphs represent how the probability of children's participation in each care type either changes or remains stable over time. We describe the details of each profile in turn.

Profile 1: Home only. The largest profile of children's pathway through ECEC representing 44% of the total sample received care in the home over the first five years of life. This profile represents children who were cared for only at home throughout the duration of their first five years. Children who made up this profile were 49% Female, 66% White, 9% Black, 10% Latinx, 6% Asian. A total of 85% of these children speak English as their primary language at home and 81% of their mothers have less than a four-year college degree.

Profile 4: Informal prevalent. A total of 5% of the sample is represented in this profile. Profile 4 features children who were served primarily in an informal care setting. These settings are generally home-based childcare providers. Demographically, this profile is made up of children who are 50% Female, 83% White, 3% Black, 3% Latinx, and 10% other. 3% of the children in profile 4 speak English as their first language at home and 50% of their mothers have at least a four-year college degree.

Profile 5: Center-based prevalent. Profile 5 comprised 7% of the total sample and represented children who spent birth to five years primarily in center-based care. Although in the first year of life, children in this profile have a small probability of being at cared for at home during the work week, the majority of their ECEC experience is spent in center-based care. The demographic make-up of this profile is 49% Female, 78% White, 5% Black, 5% Latinx, 8% Asian. 92% of these children use English as their primary home language and 44% of their mothers have less than a four-year degree.

Type 2: Combinations of care profiles

Four profiles characterized children who transitioned across types of ECEC during the first five years of life, representing a total of 44% of our sample. Figure 2 contains four graphs that represent how the probability of children's participation in each care type either changes or remains stable over time. The y-axis is the probability of participation in each care type and the x-axis is the age of the children in the profile. Below we describe each profile that make up combinations of care.

Profile 2: Home to center care. Of the second type of profiles, combinations of care, profile 2 is made up of 10% of the total sample. Children in profile 2 have pathways through ECEC that are characterized by spending the first two years at home, in the third year become increasingly likely to be in center based care instead of home care, and in the last two years are mostly enrolled in center-based care. This profile only appeared in the seven-profile model and its distinct nature added to the evidence for selecting a seven-profile model over a six or five profile model. Children in this profile are 48% Female, 63% White, 17% Black, 6% Latinx, 3% Asian, and 13% other. 89% of children in profile 2 speak English as their primary language at home and 70% of their mothers have less than a four-year college degree.

Profile 3: Home and other care. Profile 3 is characterized by the most diverse combinations of care; it also represents 8% of the children in our sample. In the first four years children are splitting time between home care and informal care. In the final year, this profile switches to a higher likely hood of center-based care. Yet, at all time points, children in this profile participate in multiple types of care. Children in this profile are 49% Female, 83% White, 11% Black, and 6% other. 96% of children in profile 2 speak English as their primary language at home and 52% of their mothers have less than a four-year college degree.

Profile 6: Home and center. This profile of children's pathway through ECEC is characterized by children who are served in a combination of center-based care and home care. Profile 6 represents 5% of the total sample. This profile is distinct from profile 2 (Home to center) and profile 7 (Home to pre-k) because in this profile children are highly likely to be in both home and center-based care throughout the five years of ECEC. This could be children who are in half day programs or only attend certain days of the week and are home at the other times. Children in profile 6 are 40% Female, 70% White, 10% Black, 3% Latinx, 3% Asian, and 13% other. 93% of children in profile 6 speak English as their primary language at home and 68% of their mothers have less than a four-year college degree.

Profile 7: Home to pre-k. The final profile of children's pathways through ECEC is also the second largest group (21% of the sample). Profile 7 is characterized by children who are at home most of their ECEC experience, but in the final year are all enrolled in a center based preschool or pre-kindergarten program. This is the second largest profile representing 21% of the total sample. Children in profile 7 are 50% Female, 79% White, 9% Black, 6% Latinx, 2% Asian, and 5% other. 93% of children in profile 7 speak English as their primary language at home and 57% of their mothers have less than a four-year college degree.

Is profile membership associated with children's kindergarten-entry skills?

Once the seven-class model was established, we fit multilevel models using SAS 9.4 PROC MIXED to test if there were differences in outcomes between the classes. Each model controlled for five demographic covariates: sex, race / ethnicity, primary home language, household income, and maternal education. Each model was conducted using Restricted Maximum Likelihood estimation and allowed for pairwise comparisons between each of the seven profiles.

Cognitive Outcomes

Table 5 reports the Type III Sum of Squares effects for each predictor variable and covariate in model. The effects presented in Table 5 represent the omnibus effect for covariates and profile membership on each cognitive outcome measure. Included in the table are the *F* statistic and its corresponding *p*-value. Additionally, Table 5 provides the fitted means and 95% confidence intervals for each profile on each cognitive outcome. The fitted means are the mean scores for each individual profile on each cognitive outcome. To summarize the findings presented on Table 5, profile membership was not observed to have any significant effect on any of the four tested cognitive outcomes. As such no profile scored significantly higher or lower than any other on Applied Problems, Picture Vocabulary, Letter Word ID, or Executive Function. Next, covariate differences reported in Table 5, were small and there was no consistent pattern present. For example, maternal education and home language were significant contributors to Applied Problems and Executive Function, while sex was a significant contributor to Executive Function only. Further, profile membership, race, and household income were not significant contributors to any of the outcomes. In the second part of the table,

corresponding to the fitted means we see that there were no differences in cognitive outcomes for children across the seven classes.

Table 6 presents all pairwise comparisons between the identified profiles on children's cognitive outcomes. The first column of Table 6, *Profile*, shows which two profiles are being compared. In the first row this comparison is between profile 1 and profile 2. The next column shows the difference (-0.42) in the estimate on the measure (Applied Problems). The comparison in the first row indicates that when profile 1 is compare to profile 2, holding all other factors constant, we would expect the child in profile 2 to score 0.42 lower than a child from profile 1 on the w-score of the Applied Problems measure. The next column reports the standard error (SE), and the fourth column reports the effect size (Cohen's *d*). In this case, *d* represents the difference of 0.02 standard deviations between the two profiles in this measure. To summarize Table 6, children in the profiles which included center-based care tested no better or worse than their counterparts in home-based care or informal care. Likewise, profiles which had higher dosage of center-base care (profile 5—center-based prevalent and profile 6-home and center) were not different from each other, home only, or any of the other profiles with lower dosages of center-based care in terms of cognitive outcomes at kindergarten entry.

Social-behavioral outcomes

Like cognitive outcomes, social-behavioral omnibus effects and pairwise comparisons of outcomes are reported in Table 7 and Table 8 respectively. First, Table 7 provides omnibus profile and covariate effects for social-behavioral outcomes. Table 7 reports these effects using the Type III Sum of Squares effects for predictors and covariates and reporting the *F* statistic and corresponding *p* value for each effect on each outcome measure. Results from Table 7 indicate that there was a significant effect for profile membership on all social-behavioral outcomes,

except school liking (p = .26). However, like cognitive outcomes there was not a consistent impact made by any of the covariates on any of the outcomes. To summarize, sex and race significantly impacted school adjustment and behavioral aggression and sex impacted peer social skills. No other significant covariate effects were evident. Finally, the lower part of Table 7 provides the fitted means estimates for each profile on each outcome; however, these are insufficient for determining the magnitude of difference between individual profiles and, as such, the reader should focus on the pairwise differences reported in Table 8 to understand differences between profiles on social-behavioral outcomes.

A review of Table 8 will show that several significant differences emerged within the social-behavioral outcomes. For social-behavioral outcomes, specific patterns of difference emerged between the pathway profiles. Of the three teacher rated scales, relational aggression, peer social skills, and school adjustment, all showed some significant pairwise differences. Specifically, profile 6 (home and center) is characterized by children who spend time across the five years of early childhood in both home and center-based care. Profile 6 had significant differences when compared to multiple groups in school adjustment, behavioral aggression, and peer social skills. Additionally, profile 5 (center-based prevalent) is comprised of children who spend the duration of their early childhood care for in center-based programs. Profile 5 saw significant difference from several other classes in behavioral aggression and peer social skills. Further, children in profile 5 scored significantly lower in the child direct measure of self-efficacy when compared to all profiles except profile 6 (home and center care). No significant difference on any measure was found between profiles 5 and 6.

In order to visually represent the differences between profiles on the social-behavioral outcomes described above, the plots in Figure 3 illustrate the difference in the fitted means

between each profile on each social-behavioral outcome (behavioral aggression, peer social skills, school adjustment, and self-efficacy). In each plot of the outcomes the profiles are listed on the perimeter with the measurement scale in the middle. The black line demonstrates where each profile measured on the scale. As such, Figure 3 demonstrates visually the difference between the profiles on these specific measures.

To provide fuller context to the difference between profile 6 and 5 (the two significantly different profiles) when compared to other profiles, we review the specific differences. First, profile 6 (home and center), which is characterized by children who spend time throughout their early childhood in a combination of home and center-based care, demonstrated lower scores on school adjustment when compared to all other groups. These differences were significant when compared to profile 1 (home only; p=.025; d=.48), profile 2 (home to center care; p=.031; d=.55), profile 3 (home and other care; p=.006; d=.70), profile 4 (informal prevalent; p=.012; d=.72), and profile 7 (home to pre-k; p=.002; d=.71). There was not a significant difference between profile 6 and profile 5, although profile 6 had lower school adjustment with a moderate effect size (d=.41).

Several group differences were evident in relational aggression scores. As above, children from profile 6 (home and center care) scored the highest overall on relational aggression. This was followed by profile 5, children primarily in center-based care for the duration of their ECEC experience, scoring the second highest. Profile 6 (home and center care) was significantly higher on relational aggression than profile 1 (home only; p<.001; d=.71), profile 2 (home to center care; p=.004; d=.73), profile 3 (home and other care; p=.001; d=.81), profile 4 (informal care; p=.033; d=.59), and profile 7 (home to pre-k; p<.001; d=.80). Profile 5 (center-based prevalent) was significantly higher in relational aggression than profile 1 (home

only; p=.038; d=.40), profile 3 (home and other care; p=.032; d=.50), and profile 7 (home to pre-k; p=.015; d=.49). There was not a significant difference between profile 6 (home and center care) and profile 5 (center care prevalent).

Next, profiles 5 (center-based prevalent) and 6 (home and center care) registered the second lowest and lowest scores respectively on peer social skills. The differences between these profiles and the remaining profiles mirrored much of what was found in the relational aggression results. However, profile 6 (home and center care) showed significant differences from profile 2 (home to center care; p=.040; d=.54), profile 3 (home and other care; p=.011; d=.66), profile 4 (informal prevalent; p=.005; d=.80), and profile 7 (home to pre-k; p<.008; d=.62). Likewise, profile 5 (center-based prevalent) scored significantly lower on peer social skills than profile 3 (home and other care; p=.024; d=.54), profile 4 (informal prevalent; p=.011; d=.69), and profile 7 (home to pre-k; p=.016; d=.50). However, again there was not a significant difference between profiles 5 and 6 in peer social skills.

Finally, in examining the child direct measures, the first child direct measure was of self-efficacy. This measure follows a similar pattern with profile 5 (center-based prevalent) reporting the overall lowest level of school liking. This difference was significant when compared to all profiles except profile 6. Profile 5 (center-based prevalent) reported liking school less than and profile 1 (home only; p<.001, d=.71), profile 2 (home to center care; p=.004, d=.73), profile 3 (home and other care; p=.001, d=.81), profile 4 (informal prevalent; p=.033, d=.59), and profile 7 (home to pre-k; p<.001, d=.80). Finally, on the last outcome, school liking, there was one significant difference in school liking between profile 1 (home care only) and profile 4 (informal prevalent). In this comparison, children cared for exclusively in a home only setting reported liking school significantly more than their counterparts in informal prevalent (p=.034; d=.46).

While this is a somewhat interesting finding, it does not demonstrate the same pattern of multiple differences found in the outcomes discussed above and, as such, this result should be interpreted with caution. Full results of social-behavioral outcomes for pairwise comparisons are reported in Table 8.

Discussion

The purposes of this study were to identify profiles of children's pathways through different types of ECEC and to explore if membership in these profiles predicted difference in cognitive and social-behavioral outcomes at kindergarten entry. Investigating profiles of children's ECEC experience from birth to kindergarten entry that allow for multiple care arrangements and change over time broadens the current definition of children's dosage of time in early care from the previous work that explored dosage of time in center-based care. Additionally, linking pathway profiles to children's outcomes at kindergarten entry improves current understanding of the effects ECEC pathways have on children and has the potential to inform early childhood practices and policy.

Regarding the first aim, whether profiles of children's pathways through ECEC to kindergarten exist, we showed that seven distinct profiles of pathways exist within the first five years of children's lives. The seven profiles as evidenced in Figures 1 and 2 represent distinct pathway profiles of children's pathways through ECEC to kindergarten and can be divided into two clear types of pathways: Single care and combinations of care. The seven profiles demonstrated strong statistical fit and were easy to interpret conceptually. Our *a priori* hypothesis was that at least three specific profiles would be evidenced in the resulting data. Among the seven profiles, the three hypothesized profiles were present as corroborated in profile 1 (home only), profile 2 (home to center) and profile 5 (center-based prevalent). While we made

no further predictions about the number or nature of the other profiles that would emerge in the data, we feel confident that all the profiles represent specific pathways to kindergarten. Yet, because this was an exploratory study, it is not possible to predict if these seven exact profiles would be identified in other studies. However, this work expands the current conceptualization of children's time in ECEC by including multiple care types a child experiences between birth and kindergarten entry. By extending the view of ECEC from dosage of center-based care to latent profiles, researchers may be better able to inform policy makers and practitioners about how the profiles of care a child receives from birth to five may impact their school readiness. Understanding how profiles relate to kindergarten entry skills may serve to inform the improvement of professional development or interventions for ECEC providers.

Many of the profiles identified in this study are consistent with participation levels found in demographic data collected in large U.S. based samples (Friedman-Krauss et al., 2019; Halpin et al., 2018; Malik et al., 2018). For instance, the largest profile in our sample was profile 1 (home care only) which represented 44% of our sample. While this may appear to be a disproportionately large number, in 2012 nationally 39% of children aged 4 and 5 were cared for primarily in the home (Rathbun & Zhang, 2016). Further, in the midwestern U.S. from which our sample was drawn, 49% of 3- to 5-year-olds were not enrolled in any preschool or pre-kindergarten program (Child Trends, 2019). Additionally, nationally 63% of parents of children under age five find it difficult to find convenient childcare (Halpin et al., 2018). Taken together these numbers suggest that 44% of children in home only care may be reflective of other samples of young children.

Beyond the home only care profile, four of the profiles (profile 2 – home to center care; profile 3 – home and other care; profile 4 – informal prevalent; profile 7 – home to pre-k)

demonstrate a trend present in other data sources (e.g.: Friedman-Krauss et al., 2019; Rathbun & Zhang, 2016). The trend these four profiles demonstrate is that as young children age, they become increasingly likely to be in center-based care. What our study adds to the understanding of this trend is that the pathways children take towards increased likelihood in attending center-based care and the specifics of the multiple care arrangement they experience before and during center-based care are diverse and distinct. Further, it is possible that the appearance of these four pathways in our sample is a product of the lack of a statewide, publicly funded, center-based option available to all children. Data from states lacking a statewide publicly funded center-based care option may have more divergent kindergarten pathways from states, such as Tennessee, where access to universal pre-k may result in most children enrolled in one type of care at a given age (e.g.: at age 4). For example, in Oklahoma 85% of children are enrolled in publicly funded ECEC compared to South Dakota where only 22% of children are enrolled in publicly funded ECEC at age 4. Likewise, countries such as Norway, which provides both extended paid parental leave and a robust network of high quality, low cost ECEC options for parents will likely present fewer pathway profiles (Dearing et al., 2015).

Although our sample identified seven profiles of children's pathways to kindergarten, it remains possible that additional profiles exist. To that end, the exploratory nature of this study necessitates further examination into profiles of children's pathways to kindergarten. Future work might explore if similar profiles can be reliably identified in other samples and whether those profiles find similar differences in children at kindergarten entry. Additionally, researchers may consider exploring if these differences continue to exist in later grades or if they fade out over time. Finally, future work may consider how the amount of time during the week a child spends in a specific type of care may impact how profiles are defined. While our study asked

parents to identify care in which the child spent more than five hours in a given week, we did not have specific number of hours in each type of care at each age to include in the profile model.

The second aim of this study was to determine if membership in profiles of children's pathways to kindergarten result in different outcomes for children at kindergarten entry. First, our analysis shows that membership in pathway profiles is only predictive of children's social-behavioral outcomes. A clear trend emerged in our findings that profile 5 (center-based prevalent) and profile 6 (home and center) differed significantly from the other five profiles in several domains: teacher reported relational aggression, school adjustment, and social skills and in child reported self-efficacy. The two profiles were similar to each other and distinct from the other classes in one way, both profile 5 (center-based prevalent) and profile 6 (home and center) were made up of children who were likely to spent time throughout their first five years of life in center-based care. In the case of profile 6, center-based care was complemented by homecare at all time points.

The differences in outcomes between profiles associated with five years in center-based care and the remaining profiles suggests that consistent exposure to center-based care throughout early childhood may lead to some negative, social-behavioral outcomes. Although, we did not make a specific prediction about whether social behavioral outcomes would be impacted by extended exposure to center-based ECEC, we did acknowledge that adverse social behavioral outcomes have been previously linked to higher exposure to center-based ECEC in previous studies (Huston et al., 2015; McCartney et al., 2010; McCoy et al., 2018). As such, the negative social behavioral outcomes associated with children in five years of center-based care in our study are consistent with previous findings.

However, it is important to note that existing literature suggests that high quality care moderates the effects of social-behavioral problems related to high exposure to center-based care, and that these negative relations dissipate over time (Belskey et al., 2007; NICHD ECCRN, 2001). Additionally, social-behavioral issues may be impacted by the specific classroom context that children experience in ECEC (Bulotsky-Shearer et al., 2010; Yudron & Jones, 2016). Because our study did not have access to quality ratings of the centers or data on the classroom context these children experienced, we are not able to determine how differences in social-behavioral outcomes may have been moderated by program quality. Exploring whether quality moderates the relation between pathway and children's social-behavioral outcomes is a possible direction of future research.

An additional finding from the study related to child outcomes was that we found no significant differences on any cognitive measures related to profile membership. Numerous studies have shown that preschool or pre-kindergarten provides an academic advantage for children at kindergarten entry (e.g.: Ansari et al., 2017; Gormely et al., 2005; Shah et al. 2017; Weiland & Yoshikawa, 2013). Our study, which categorized preschool or pre-kindergarten under the slightly broader term center-based care, did not show any academic advantage at kindergarten entry for children enrolled in center-based care. For example, profile 7 (home to pre-k) which represented children care for at home primarily until age 4, had no significant advantage or disadvantage on any cognitive outcome relative to the other profiles. Based on the available data, we are unable to determine what confounding factors may have contributed to the absence of an academic advantage provided by center-based care. However, the absence of quality ratings and the lack of a unified public pre-k program in the area from where our sample

was drawn, may contribute to the absence of academic advantage associated with center-based care in this study.

Finally, this study is correlational, and thus was not attempting to determine the causal relation between schooling pathway and children's outcomes. Although the inclusion of demographic covariates does help to define the contribution of the profiles to student outcomes, it does not allow us to draw causal conclusions. Rather the primary aim of the study was to explore the existing relations among these pathways and outcome constructs, and the lack of a relation here indicates only that the families who elected for the preschool pathway had children who showed similar cognitive skills to their peers who transitioned to kindergarten through different pathways. This is important to note as prior research has documented numerous selection factors into various forms of ECEC (Coley et al., 2014; Crosnoe et al., 2016). An additional future direction of the study would be to explore the causal question of pathways to kindergarten using propensity score matching or another causal modeling approximation.

The current study has several practical implications. First, our study shows that children's ECEC experiences may vary more greatly than previously accounted for in studies of children's time in ECEC. Establishing a model of seven distinct pathway profiles may serve as a guide that helps practitioners anticipate and account for the varying experiences with ECEC that their children encounter. Further, recognizing the diversity of pathways may add evidence to policy makers interested in consolidating and streamlining publicly funded center-based ECEC options to better serve the many parents who experience difficulty in finding dependable, high-quality child care (Halpin et al., 2018). Second, this study adds evidence that extended time in center-based care may be related to adverse social-behavioral outcomes for children. Awareness of the potential of social-behavioral difficulties is important; yet although kindergarten entry skills are

predictive of later school success, the variation in those outcomes is great enough that potential for effective interventions is high (Duncan et al., 2007). As such, it is important for early childhood and early elementary educators, administrators, and policy makers to be aware of potential social-behavioral difficulties and seek ways to address these difficulties through targeted intervention or curriculum. Addressing these concerns must not fall to teachers alone. Administrators should seek out improved curricula or professional development to help address social-behavioral difficulties experiences by some children. Likewise, policy makers may increase support for young children in all education and care settings through assuring adequate funding and rigorous quality standards in center-based ECEC settings.

Limitations

There are several limitations to our study. First, since our measure relied on parent report and did not require the name of the program the child was enrolled in, we are potentially subject to bias due to retrospective reporting and are unable to make any determination related to the quality or size of the ECEC programs. Much of the literature suggests high quality ECEC has been shown to have better cognitive and social-behavioral outcomes for children (McLean et al., 2016; Zaslow et al., 2016; Zaslow et al., 2010). Additionally, in a meta-analysis, Bowne et al. (2017) found very small class sizes and low teacher student ratios in ECEC predicted more positive achievement. However, we have no way to determine program quality, class size or student teacher ratio based on the information provided. In the future, studies which follow children longitudinally from birth to kindergarten and can capture accurate program quality and size data in real time will be better equipped to make determination about the associations between these factors, children's pathway profiles, and how each contributes to children's outcomes at kindergarten entry.

Second, this study's generalizability is limited in a few ways. Our sample is drawn from a suburban district in a midwestern state which currently has no statewide publicly funded center-based ECEC program. This is becoming less common as more and more states or districts have begun to offer expanded ECEC services (Barnett et al., 2018). Other states with robust public center-based options may see fewer combinations of care type profiles as more parents access these options for their children as children approach school age. An additional limit to generalizability is that the study is drawn from a cross sectional sample of data.

Conclusion

Finally, it is important that both the public and policy makers understand the promise and possible limitations of ECEC expansion (Ansari & Purtell, 2018). This is particularly pressing as a national effort is underway to increase public funding to expand access to early childhood education (Barnett et al., 2018). The findings of this study should in no way be interpreted as a denunciation of center-based care. To the contrary, awareness of the potential for adverse social-behavioral outcomes in children who have spent a full five years in ECEC may encourage researchers and policy makes to seek ways to overcome potential adverse impacts through professional development, curricular reform, or programmatic improvements. There is evidence that interventions can positively impact social-behavioral difficulties associated with time in center-based ECEC (Coelho et al., 2019; McCoy et al., 2017; Werner et al., 2015). Thus, it is reasonable to expect that well-funded, well planned programs could provide necessary support to all children.

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Table 1

Demographics of the Sample

	Study Sample		All kindergarten	
Sex	Count	Percent	Count	Percent
Female	276	49%	367	49%
Male	292	51%	380	51%
Race				
Asian	23	4%	32	4%
Black	54	10%	78	10%
Latinx	38	7%	65	9%
White	408	72%	493	66%
Other	45	8%	70	9%
Home Language				
English	507	89%	658	88%
Spanish	33	6%	49	7%
Other	28	5%	40	5%
Maternal Education				
Without 4-year degree	359	68%	374	70%
Median Income	$50,001-$60,000		$50,001-$60,000	

Note: A χ^2 test indicated a significant difference between the analytic sample and a sample of children not included due to insufficient data. Please see the procedures section of the text for additional information.

Table 2

Model Fit Indices

Profiles	-2LL	Free Parameters	AIC	BIC	Entropy	LMR
2	-2732.12	31	5526	5661	0.937	0
3	-2405.66	47	4905	5109	0.957	0
4	-2201.05	63	4528	4802	0.949	0.0002
5	-2099.45	79	4357	4700	0.951	0
6	-2008.07	95	4206	4619	0.953	0.0022
7	**-1941.84**	**111**	**4106**	**4588**	**0.976**	**0**
8	-1887.56	127	4029	4581	0.961	0.018
9	-1844.28	143	3975	4595	0.979	0.0002
10	-1807.26	159	3933	4623	0.973	0

Note: Final model in bold

Table 3

Seven Profile Membership Counts and Descriptions

Profile	Description	n	%
1	Home only	249	44%
2	Home to center	54	10%
3	Home and other	47	8%
4	Informal care prevalent	30	5%
5	Center-based prevalent	37	7%
6	Home and center	30	5%
7	Home and pre-k	121	21%

Table 4

Profile Demographics

Profile	n	Sex		Race / Ethnicity					Child's Home Language			Maternal Education	Income
		Male	Female	White	Black	Latinx	Asian	Other	English	Spanish	Other	Without 4-year degree	Median Household
1	249	51%	49%	66%	9%	10%	6%	8%	85%	6%	9%	81%	$40,001-50000
2	54	52%	48%	63%	17%	6%	2%	13%	89%	11%	0%	70%	$40,001-50000
3	47	51%	49%	83%	11%	0%	0%	6%	96%	2%	2%	52%	$60,001-70,000
4	30	50%	50%	83%	3%	3%	0%	10%	93%	7%	0%	50%	$70,001-80,000
5	37	51%	49%	78%	5%	5%	8%	3%	92%	5%	3%	44%	$110,001-120,000
6	30	60%	40%	70%	10%	3%	3%	13%	93%	3%	3%	68%	$20,001-30,000
7	121	50%	50%	79%	9%	6%	2%	5%	93%	4%	2%	57%	$70,001-80,000

Table 5

Cognitive Outcomes Sum of Squares and Fitted Means

	Applied Problems		Letter Word ID		Picture Vocabulary		Executive Function	
Type 3 SS Test of Fixed Effects	f	p	f	p	f	p	f	p
Profile	0.85	0.54	0.91	0.49	0.44	0.85	0.86	0.53
Sex	0.91	0.34	2.21	0.14	0.10	0.75	6.81	0.01
Race	1.41	0.24	0.56	0.70	1.92	0.11	0.61	0.66
Home Language	4.59	0.02	0.40	0.67	20.93	<.01	4.03	0.03
Maternal Education	2.64	0.03	4.75	0.00	1.20	0.31	2.75	0.02
Household Income	0.67	0.86	1.06	0.39	1.13	0.32	1.00	0.33

Fitted Means	Applied Problems			Letter Word ID			Picture Vocabulary			Executive Function		
Profile	Est.	Upper CI	Lower CI	Est.	Upper CI	Lower CI	Est.	Upper CI	Lower CI	Est.	Upper CI	Lower CI
1	419.5	421.1	417.9	365.8	368.2	363.4	464.0	464.9	463.1	28.2	29.6	26.8
2	419.9	421.5	418.3	369.9	372.3	367.5	463.7	464.6	462.8	28.9	30.3	27.5
3	418.6	420.2	417.0	363.8	366.2	361.4	464.1	465.0	463.2	29.2	30.6	27.8
4	423.7	425.3	422.1	370.7	373.1	368.3	462.8	463.7	461.9	31.2	32.6	29.8
5	414.7	416.3	413.1	362.8	365.2	360.4	462.5	463.4	461.7	27.5	28.9	26.1
6	420.6	422.2	419.0	364.0	366.4	361.7	463.7	464.6	462.8	30.6	32.0	29.1
7	417.4	419.0	415.8	371.0	373.4	368.6	465.0	465.9	464.1	25.3	26.7	23.9

Table 6

Cognitive Outcomes Pairwise Comparisons Controlling for Covariates

Class	Applied Problems			Letter Word ID			Picture Vocabulary			Executive function		
	Est.	SE	d	Est.	SE	d	Est.	SE	d	Est.	SE	d
1 v 2	-0.42	3.04	0.02	-4.06	4.50	0.14	0.32	1.55	0.03	-0.70	2.71	0.04
1 v 3	0.91	3.05	0.05	1.98	4.55	0.07	-0.13	1.57	0.01	-1.05	2.73	0.06
1 v 4	-4.16	3.63	0.22	-4.90	5.43	0.17	1.23	1.87	0.12	-3.00	3.26	0.18
1 v 5	4.80	3.47	0.25	3.04	5.10	0.11	1.46	1.80	0.14	0.70	3.06	0.04
1 v 6	-1.12	3.80	0.06	1.77	5.60	0.06	0.28	1.95	0.03	-2.37	3.45	0.14
1 v 7	2.12	2.16	0.11	-5.20	3.26	0.18	-1.01	1.12	0.10	2.91	1.96	0.17
2 v 3	1.34	3.83	0.07	6.04	5.68	0.21	-0.45	1.96	0.04	-0.36	3.43	0.02
2 v 4	-3.74	4.36	0.20	-0.84	6.47	0.03	0.91	2.24	0.09	-2.31	3.90	0.14
2 v 5	5.22	4.19	0.28	7.10	6.17	0.25	1.14	2.16	0.11	1.39	3.70	0.08
2 v 6	-0.70	4.50	0.04	5.83	6.62	0.21	-0.04	2.29	0.00	-1.68	4.07	0.10
2 v 7	2.54	3.26	0.13	-1.14	4.83	0.04	-1.34	1.66	0.13	3.60	2.91	0.22
3 v 4	-5.08	4.34	0.27	-6.88	6.49	0.24	1.36	2.23	0.13	-1.95	3.89	0.12
3 v 5	3.89	4.19	0.21	1.06	6.21	0.04	1.59	2.17	0.15	1.75	3.72	0.11
3 v 6	-2.03	4.52	0.11	-0.21	6.66	0.01	0.41	2.32	0.04	-1.32	4.07	0.08
3 v 7	1.20	3.26	0.06	-7.18	4.90	0.25	-0.88	1.67	0.09	3.96	2.93	0.24
4 v 5	8.97	4.68	0.47	7.94	6.94	0.28	0.23	2.43	0.02	3.70	4.17	0.22
4 v 6	3.04	4.96	0.16	6.67	7.33	0.24	-0.95	2.55	0.09	0.63	4.47	0.04
4 v 7	6.28	3.79	0.33	-0.30	5.67	0.01	-2.24	1.95	0.22	5.91	3.40	0.36
5 v 6	-5.92	4.71	0.31	-1.27	6.89	0.05	-1.18	2.42	0.11	-3.07	4.22	0.18
5 v 7	-2.69	3.61	0.14	-8.24	5.34	0.29	-2.47	1.89	0.24	2.21	3.20	0.13
6 v 7	3.23	3.99	0.17	-6.97	5.88	0.25	-1.29	2.05	0.12	5.28	3.62	0.32

Note: No significant findings

Table 7

Social-behavioral Outcomes Sum of Squares and Fitted Means

	School Adjustment		Behavioral Aggression		Social Skills		School Liking		Self-efficacy	
Type 3 SS of Fixed Effects	f	p	f	p	f	p	f	p	f	p
Profile	2.18	0.05	3.1	<.01	2.72	0.02	1.31	0.26	2.11	0.06
Sex	17.63	<.01	5.55	0.02	23.04	<.01	3.40	0.07	0.18	0.68
Race	2.84	0.03	2.86	0.03	1.10	0.36	0.58	0.68	0.98	0.42
Home Language	0.25	0.78	1.98	0.16	0.69	0.51	0.86	0.43	0.93	0.41
Maternal Education	0.33	0.90	1.28	0.27	1.57	0.17	1.35	0.25	0.95	0.45
Income	0.70	0.83	0.92	0.57	0.64	0.88	1.08	0.37	0.89	0.60

Fitted Means	School Adjustment			Behavioral Aggression			Social Skills			School Liking			Self-efficacy		
Profile	Est.	Upper CI	Lower CI	Est.	Upper CI	Lower CI	Est.	Upper CI	Lower CI	Est.	Upper CI	Lower CI	Est.	Upper CI	Lower CI
1	2.51	2.56	2.45	0.24	0.30	0.18	24.40	25.00	23.79	9.24	9.46	9.03	11.07	11.27	10.87
2	2.55	2.61	2.50	0.23	0.29	0.17	25.38	25.99	24.77	8.79	9.01	8.58	11.06	11.27	10.86
3	2.65	2.70	2.59	0.17	0.23	0.11	26.23	26.84	25.62	8.77	8.98	8.56	10.76	10.96	10.56
4	2.66	2.71	2.60	0.33	0.39	0.27	27.23	27.84	26.63	8.11	8.33	7.90	11.07	11.27	10.87
5	2.46	2.52	2.41	0.52	0.58	0.46	22.46	23.07	21.86	8.42	8.63	8.20	9.47	9.68	9.27
6	2.20	2.26	2.15	0.74	0.80	0.68	21.67	22.28	21.06	8.57	8.79	8.36	10.36	10.57	10.16
7	2.65	2.71	2.60	0.18	0.24	0.12	25.95	26.56	25.34	9.13	9.35	8.92	10.90	11.11	10.70

Table 8

Social-behavioral Outcome Pairwise Comparisons Controlling for Covariates

Profile	School Adjustment			Behavioral Aggression			Social Skills			School Liking			Self Esteem		
	Est.	SE	d	Est.	SE	d	Est.	SE	d	Est.	SE	d	Est.	SE	d
1 v 2	-0.04	0.11	0.07	0.01	0.12	0.02	-0.98	1.23	0.14	0.45	0.45	0.18	0.01	0.40	0.00
1 v 3	-0.14	0.11	0.22	0.07	0.12	0.10	-1.84	1.21	0.27	0.47	0.47	0.19	0.31	0.43	0.14
1 v 4	-0.15	0.13	0.23	-0.09	0.14	0.12	-2.84	1.44	0.41	1.13*	0.52	0.46	0.00	0.47	0.00
1 v 5	0.05	0.12	0.07	-0.28*	0.13	0.40	1.93	1.36	0.28	0.83	0.49	0.34	1.60**	0.48	0.70
1 v 6	0.31*	0.13	0.48	-0.50***	0.15	0.71	2.72	1.50	0.39	0.67	0.56	0.27	0.71	0.50	0.31
1 v 7	-0.14	0.08	0.23	0.06	0.08	0.09	-1.55	0.87	0.22	0.11	0.32	0.04	0.17	0.30	0.07
2 v 3	-0.09	0.14	0.15	0.06	0.15	0.09	-0.85	1.55	0.12	0.03	0.58	0.01	0.30	0.53	0.13
2 v 4	-0.10	0.16	0.16	-0.10	0.17	0.14	-1.86	1.75	0.27	0.68	0.63	0.28	-0.01	0.57	0.00
2 v 5	0.09	0.15	0.14	-0.29	0.16	0.42	2.91	1.67	0.42	0.38	0.60	0.15	1.59**	0.57	0.70
2 v 6	0.35*	0.16	0.55	-.051**	0.17	0.73	3.70*	1.79	0.54	0.22	0.66	0.09	0.70	0.59	0.31
2 v 7	-0.10	0.12	0.16	0.05	0.13	0.07	-0.57	1.32	0.08	-0.34	0.48	0.14	0.16	0.43	0.07
3 v 4	-0.01	0.16	0.01	-0.16	0.17	0.23	-1.00	1.73	0.14	0.66	0.64	0.27	-0.31	0.58	0.14
3 v 5	0.19	0.15	0.29	-0.35*	0.16	0.50	3.77*	1.65	0.54	0.35	0.61	0.14	1.29*	0.58	0.57
3 v 6	0.44**	0.16	0.70	-0.57**	0.17	0.81	4.56*	1.77	0.66	0.20	0.68	0.08	0.40	0.61	0.17
3 v 7	0.00	0.12	0.01	-0.01	0.13	0.02	0.28	1.30	0.04	-0.36	0.49	0.15	-0.14	0.46	0.06
4 v 5	0.19	0.17	0.31	-0.19	0.18	0.28	4.77*	1.86	0.69	-0.30	0.67	0.12	1.60*	0.62	0.70
4 v 6	0.45*	0.18	0.72	-0.41*	0.19	0.59	5.56**	1.96	0.80	-0.46	0.72	0.19	0.71	0.65	0.31
4 v 7	0.01	0.14	0.01	0.15	0.15	0.21	1.29	1.52	0.19	-1.02	0.54	0.41	0.17	0.50	0.07
5 v 6	0.26	0.17	0.41	-0.22	0.18	0.31	0.79	1.83	0.11	-0.16	0.68	0.06	-0.89	0.64	0.39
5 v 7	-0.19	0.13	0.30	0.34*	0.14	0.49	-3.48*	1.43	0.50	-0.72	0.52	0.29	-1.43**	0.50	0.63
6 v 7	-0.45**	0.14	0.71	0.56***	0.15	0.80	-4.27**	1.58	0.62	-0.56	0.59	0.23	-0.54	0.53	0.24

* p< .05; ** P<.01; ***P<.001

Figure 1

Graphs of Type 1: Single care type profiles (three profiles)

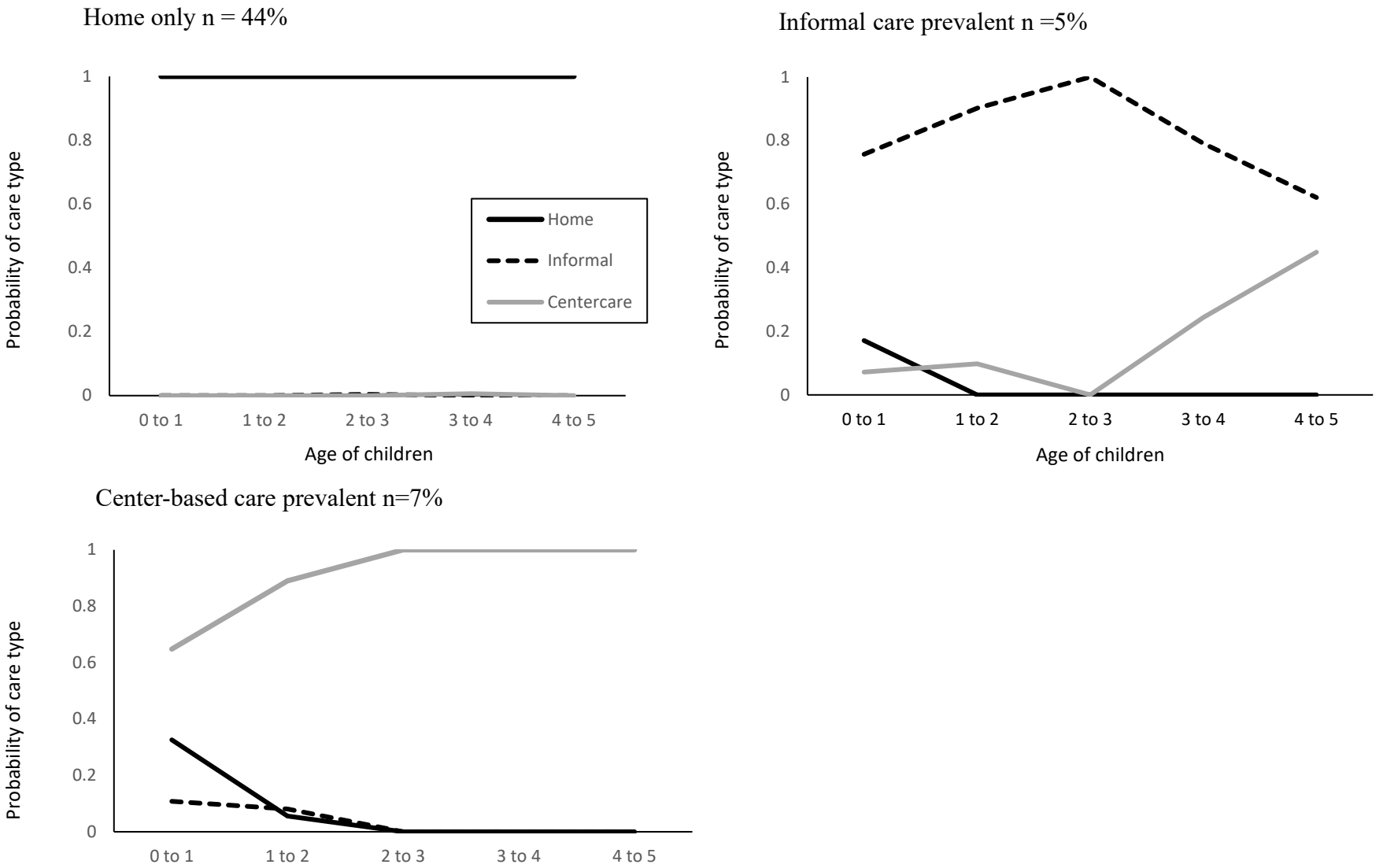

Figure 2

Graphs of Type 2: Combinations of care profiles (four profiles)

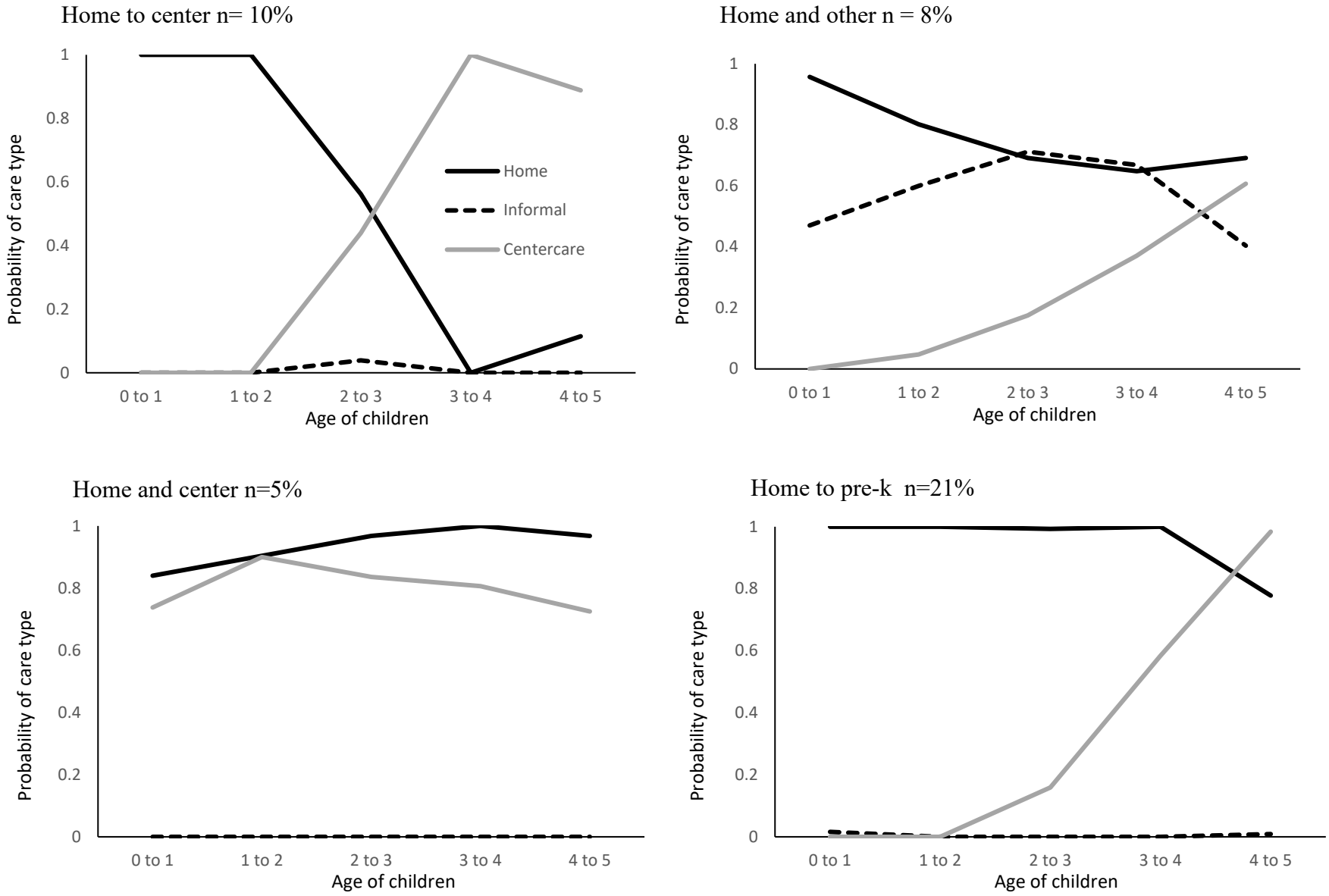

Figure 3

Social-behavioral outcome differences among seven profiles of care