

Time in care: Longitudinal outcomes from a latent class analysis of time in early education and care

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Nathan P. Helsabeck, MEd^{1,2}

¹The Crane Center for Early Childhood Research and Policy

²The Ohio State University College of Education and Human Ecology

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Correspondence concerning this article should be directed to Nathan Helsabeck, The Ohio State University, College of Education and Human Ecology, 29 Woodruff Ave., Ramseyer Hall #211, Columbus, OH 43210. Email helsabeck.1@osu.edu

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At present, a national effort is underway to increase public funding to expand access to early childhood education (Barnett et al., 2018). While researchers have suggested this expansion can help close the achievement gap (Yoshikawa et al., 2013) and reduce income inequality (Heckman, 2006), it is important that both the public and policy makers understand the promise and possible limitations of this expansion (Ansari & Purtell, 2018). Whereas, a solid foundation of literature exists showing academic benefits of center-based care for children as they enter kindergarten (e.g. Gormley, Gayer, Phillips, & Dawson, 2005; Puma et al, 2012), the impacts beyond Kindergarten entry are more varied and not always positive (Bailey et al., 2017; Duncan & Magnuson, 2013; Lipsey, Farran, & Durkin, 2018). Thus, it is crucial to understand the best practices and potential benefits of early childhood education (Whitehurst, 2018). This study contributes to this on-going effort by focusing on two guiding questions. (1) Are different latent profiles evident in the pathways children take through early education and care? (2) Are academic benefits or connection to school predicted by membership in these latent profiles evident over the first two years of children's time in elementary school?

Background

The experience of early childhood education and care covers many types of experiences. For instance, parental care of an infant is substantively different from a pre-k program. Further, it is likely that children spend time in multiple types of care and transition from one type of care to another with some fluidity between ages 0 to 5. By conducting a latent profile analysis (LCA), it is possible to determine if such pathways can be reliably identified. It is reasonable to expect that

certain children spend ages 0 to 5 strictly in a home care setting and others spend their time primarily in center-based care. However, other paths are likely to exist and understanding the effect of membership in these groups may provide important lessons for later school success. 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.

Child Outcomes

Multiple factors contribute to later school success and it is important to examine how these factors may be influenced by a child's early care. (Yoshikawa et al., 2013). For instance, Bailey, Duncan, Odgers, & Yu (2017) argue for targeting malleable, non-cognitive skills that would not develop naturally outside of intervention. Specifically, they suggest targeting skills related to academics and social-emotional well-being.

Academics

Children who have attended early childhood education programs enter kindergarten significantly more academically prepared than their peers (Yoshikawa et al., 2013), but such advantages tend to regress to the mean within the early elementary grades (Bailey et al., 2017). No study has yet examined potential relations between cumulative pathways through early care and later academic success.

School connection.

Strong social-emotional skills can lead to better cooperative learning and school engagement (Ladd & Dinella, 2009). Additionally, positive interpersonal relationships, help to

foster emotional knowledge which in turn predicts academic achievement (Torres, Domitrovich, & Bierman, 2015). Among several contributing factors of positive social-emotional outcomes is connect to school. The degree to which a child likes being in school is linked to both cooperative behavior in the classroom and overall school engagement (Ladd & Dinella, 2009). Taken together academic and school connection outcomes are important indicators of a child's potential for school success.

The Present Study

This study explores whether there are identifiable latent profiles of pathways through early education and care. Further, it explores if differences in academic achievement and school connection exist as a function of the identified latent profiles in a cohort of students followed from kindergarten through first grade. While no a priori hypothesis is made regarding the number of profiles to be identified, I do hypothesize that differences will exist within children's outcomes will be apparent between profiles.

Methods

Participants

This study uses a cross-sectional subsample of data from a study which includes two school districts, 25 schools, and 152 classrooms. This sample represents a racially and economically diverse sample that is representative of the local population. Participants were recruited into the study in accordance with the approved IRB.

Measures

This study uses longitudinal data collected through the Early Learning Ohio study. Time variables in ECEC and demographics were gathered from a family questionnaire and outcome

variables were collected during one-on-one child interviews and assessments. Children (n=568) were assessed in fall and spring of kindergarten and first grade.

Time in Care

Parents received a \$10 gift card to complete a survey on their demographic background. For the purpose of this study, we used data from a question designed to assess the type of care a child received for the first five years of life. The question, “which best describes the type of care your child received at each age?”, allowed 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, in a childcare provider’s home, and in a childcare center or preschool. For the purpose of analysis, we collapsed the first three options (Parent or guardian, a relative, babysitter or nanny) into a single variable to represent in-home care. We coded 1 for a selected category and 0 for a non-selected category. We excluded surveys where the parent failed to respond to this question (sample n=568).

Child Outcomes

All assessments were made in the fall and spring of the kindergarten and first grade school years. Students were assessed academically using the Woodcock-Johnson III (WJIII). For this study two subsections, applied problems and letter word identification, were examined as academic outcomes. Applied problems is indicative of both early mathematics knowledge and problem solving and is a commonly used academic outcome in early childhood studies (Woodcock et al., 2001). To assess school connection, two child direct measures were used. First, 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). Child's school 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.

Covariates

In order to determine the unique contribution pathway profiles made to child outcomes at kindergarten entry several covariates were 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. Additionally, classroom variance was controlled for in the multilevel model.

Analysis Plan

To determine if distinct profiles were present in the time children spent in early care and education, we conducted an exploratory LCA following procedures outlined in Muthen and Muthen (2009), and tested models from two to eight profiles. Models were fit in Mplus but were conducted using the Mplus LCA Helper (Uanhoro & Logan, 2018).

Once the best fit of latent profiles was determined, we used multiple regression to examine the possible impact of profile membership on academic, behavioral, and social-emotional outcomes. Regressions were conducted using SPSS and were performed by rotating each profile as a reference group to determine the effect of profile membership on the outcome. Each analysis controlled for the effects of sex, grade, race, household income, and maternal

education. By controlling for these covariates, we were able to determine the unique contribution of the latent profile membership on the outcome variable.

Results

Latent Class Analysis

We first tested models that included 2 to 8 latent profiles and found good support for either five, six, or seven profiles. Entropy ranged (0.932 - 0.976), and both AIC and BIC saw sharp decreases for every additional profile from 2 to 5, plateaued slightly to 6 and then decreased again for seven. Tech 11 and tech 14 statistics were significant at the $<.001$ level for all profiles two through seven; they were not significant for the eight-profile model (Table 1). Thus, we decided to plot the profiles for the five, six and seven profile models to see if there was any theoretical justification for one over the other. After examining all sets of plots, I determined that there was a clearer theoretical interpretation for the seven-profile model, and so it was selected as the final model. The seven profiles can be described as follows and are split into two types to increase interpretability. The demographic make-up of each profile is reported in Table 2:

Type 1: Single care type profiles

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.

Profile 4: Informal only. 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 child care providers.

Profile 5: Center-based only. 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 home during the work week, the majority of their ECEC experience is spent in center-based care.

Type 2: Combinations of care profiles

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

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 this 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 likelihood of center-based care. Yet, at all time points, children in this profile participate in multiple types of care.

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.

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.

Longitudinal Outcomes

Once the seven-profile model was established a multilevel linear growth model was conducted to test if there were differences in outcomes between the profiles. Each regression controlled for five demographic covariates (sex, race, household income, maternal education, and home language). The first dependent variable tested was the applied problems from the WJIII. While controlling for the demographic covariates, there was one significant difference between two profiles. Profile 4 (informal only) scored significantly higher at all four time points compared to profile 5 (center only). Second, letter word identification from the WJIII was tested. Again, there was one significant difference. However, in this outcome the difference did not appear until the final time point spring of first grade. For letter word identification profile 7 (home to pre-k) scored significantly higher in the final time point (spring of first grade) than profile 5 (center only). Outcomes reported in Figure 1 and 2.

In terms of school connection, two outcomes were tested. For school liking, children in profile 1 (home only) liked school significantly more at all four time points than children in profile 5(center only). Additionally, children in profile 1 (home only) liked school significantly

more than children in profile 4 (informal only) at the first time point (fall of kindergarten). Outcomes reported in Figure 3. However, this difference faded over the other three time points. The final measure tested was of school related self-efficacy. Again, there was significant difference between profiles at all time points. First, children in profile 1 (home only), profile 2 (home to center), profile 3 (home and other), profile 4 (informal care), and profile 7 (home to pre-k) all expressed significantly higher levels of school related self-efficacy at the first three time points (kindergarten fall, kindergarten spring, and first grade fall) compared to profile 5 (center only) children. This difference was also present at the fourth time point between all profiles except profile 4 (informal only) which was no longer significantly different from profile 5 (center only) at spring of first grade. One additional change was that profile 6 (home and center) was significantly lower in school related self-efficacy than profile 2 (home to center) at the last time point, spring of first grade. Although not significantly different, there were two profiles (profile 5 – center only and profile 2 home to center) which had positive slopes over the four time points of school related self-efficacy. All other profiles demonstrated negative slopes over the four time points. Outcomes reported in Figure 4.

Discussion

Better understanding the effects of the pathways children take through early education and care has the potential to inform early childhood practices and policy. This study demonstrates that latent profiles of pathways through care exist within the first five years of children's lives. Further, this study shows that membership in these groups does predict some different academic and school connection outcomes in children over the first two years of elementary school.

While at first glance the reported finding seems to suggest that participation in center-based care is predictive of lower levels academics, school liking, and school related self-efficacy, it is important to emphasize a few key points. First, we know from the existing literature that high quality care moderates the effect of relational aggression and that behavior problems related to center based care dissipate over time. (Belskey et al., 2007; NICHD Early Child Care Research Network, 2001). Since this study did not have access to quality ratings of the centers these children were enrolled in it is impossible to account for these differences. Second, this finding may help add evidence to the argument that we need all center-based care centers to achieve high quality status as that status predicts better academic, behavioral, and social emotional outcomes (Auger et al., 2014). This second point has important implications for policy makers and educators specifically in the context of what professional development, curricular interventions, and programmatic improvements can be made to assure children's time in center-based ECEC is as beneficial as possible to children's cognitive and non-cognitive development. Further, findings highlight the need to assure ECEC programming is high quality, as this has been shown to mitigate some of the adverse outcomes found in this study (Li, et al., 2013).

Moving forward the next steps in this research are (1) to determine if similar profiles of children's time in early education and care are present in different samples and (2) to determine if the differences in outcomes demonstrated in this study fade over time.

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Table 1*Latent profile fit statistics*

Profiles	LL	Free Parameters	AIC	BIC	Entropy	tech11 p	tech14 p
2	-11601.1	31	23264.23	23438.23	0.932	0	0
3	-10477	47	21048.02	21311.82	0.941	0	0
4	-9622.46	63	19370.92	19724.52	0.958	0	0
5	-9179.63	79	18517.26	18960.67	0.963	0	0
6	-8916.45	95	18022.91	18556.13	0.971	0	0
7	-8517.44	111	17256.88	17879.9	0.969	0	0
8	-8530.32	127	17314.64	18027.47	0.976	0.7377	1

Table 2*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

Figure 1

Applied Problems Outcome by Profile

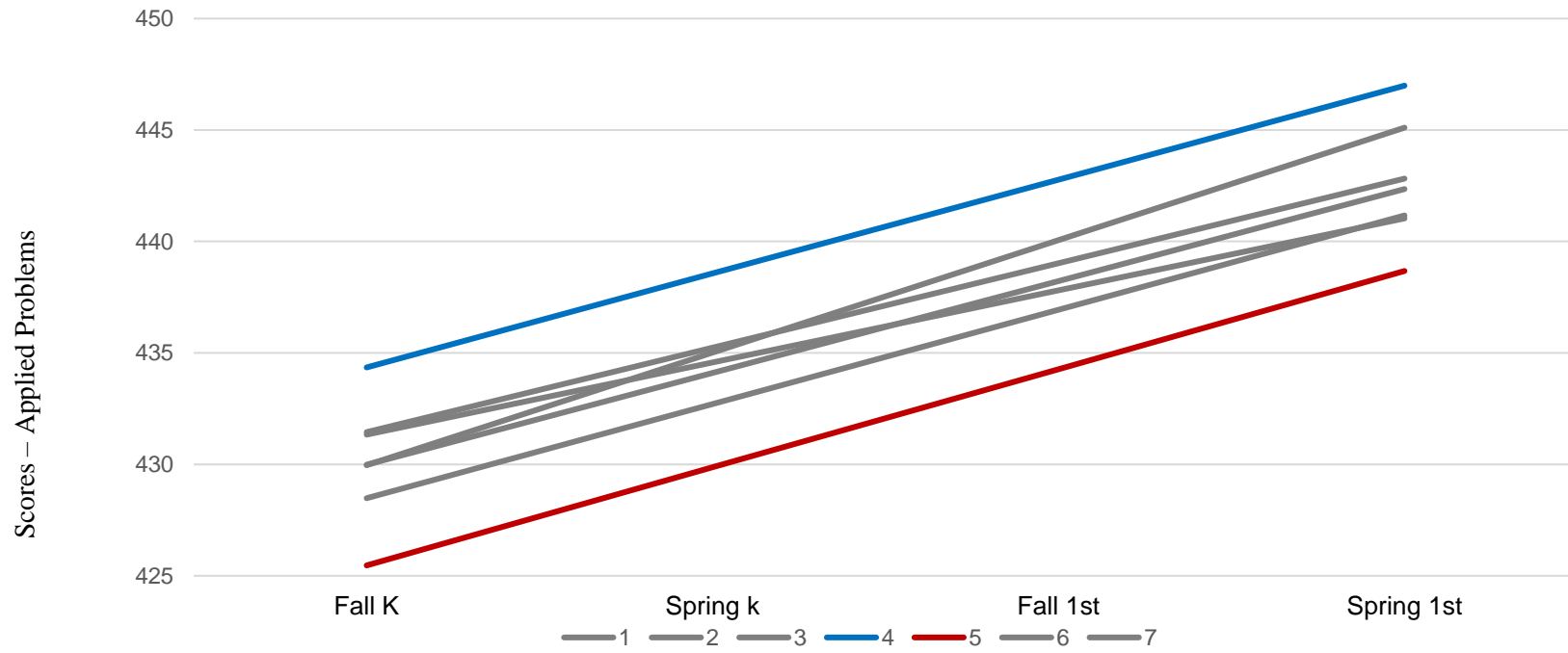


Figure 2

Letter Word Identification Outcome by Profile

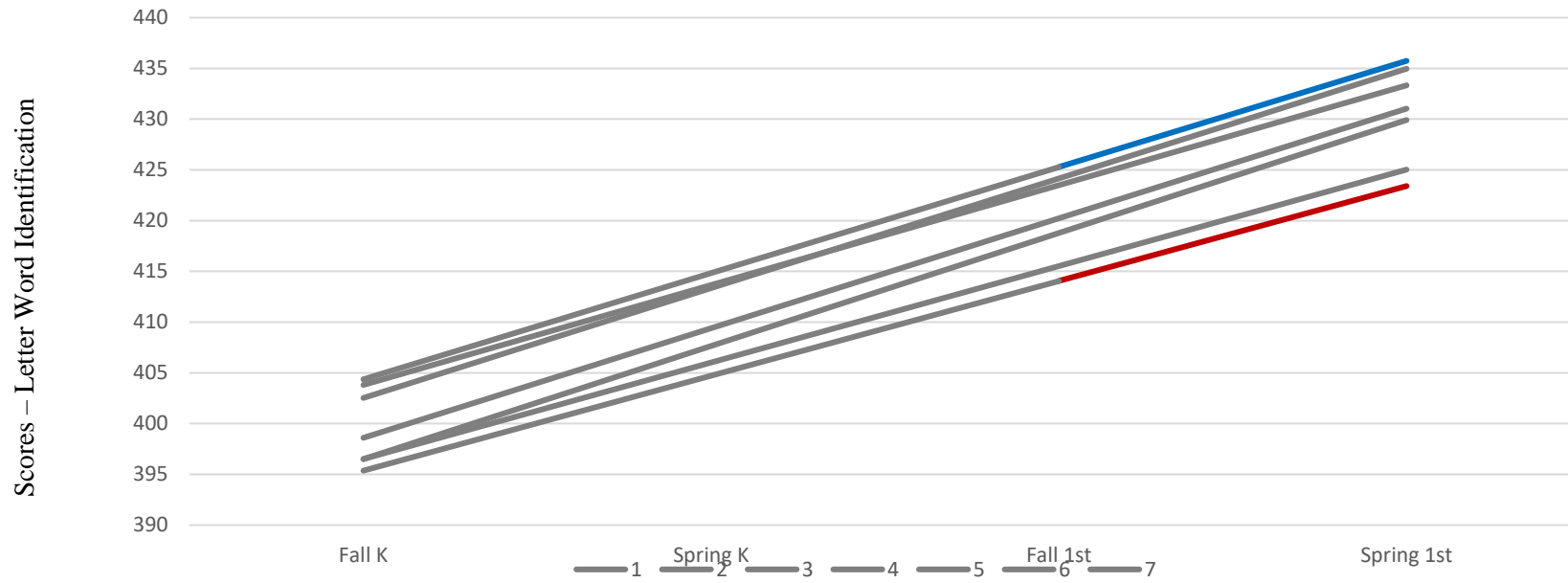


Figure 3

School Liking Outcome by Profile

Time in Early Education and Care

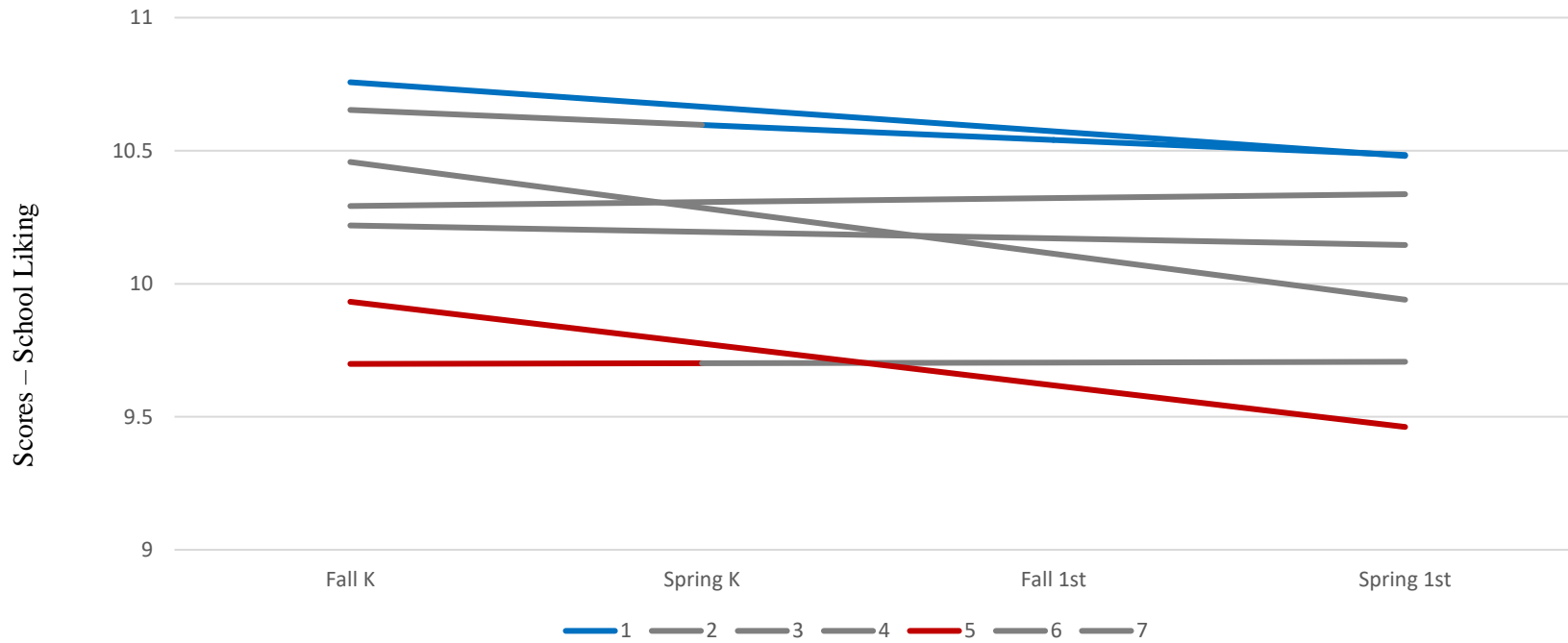


Figure 4

School Related Self-Efficacy Outcomes

Time in Early Education and Care

