

Journal of Educational Psychology

Thriving, Catching Up, Falling Behind: Immigrant and Refugee Children's Kindergarten Competencies and Later Academic Achievement

Monique Gagné, Martin Guhn, Magdalena Janus, Katholiki Georgiades, Scott D. Emerson, Constance Milbrath, Eric Duku, Carly Magee, Kimberly A. Schonert-Reichl, and Anne M. Gademann

Online First Publication, October 22, 2020. <http://dx.doi.org/10.1037/edu0000634>

CITATION

Gagné, M., Guhn, M., Janus, M., Georgiades, K., Emerson, S. D., Milbrath, C., Duku, E., Magee, C., Schonert-Reichl, K. A., & Gademann, A. M. (2020, October 22). Thriving, Catching Up, Falling Behind: Immigrant and Refugee Children's Kindergarten Competencies and Later Academic Achievement. *Journal of Educational Psychology*. Advance online publication. <http://dx.doi.org/10.1037/edu0000634>

Thriving, Catching Up, Falling Behind: Immigrant and Refugee Children's Kindergarten Competencies and Later Academic Achievement

Monique Gagné and Martin Guhn
University of British Columbia

Magdalena Janus
University of British Columbia and McMaster University

Katholiki Georgiades
McMaster University

Scott D. Emerson and Constance Milbrath
University of British Columbia

Eric Duku
McMaster University

Carly Magee and Kimberly A. Schonert-Reichl
University of British Columbia

Anne M. Gadermann
University of British Columbia and Providence Health Care Research Institute, Vancouver, British Columbia, Canada

Immigrant and refugee children and adolescents form a growing socially, culturally, and economically diverse group with the potential for wide-ranging adaptation outcomes. The goal of the study was to examine whether developmental competencies (social-emotional and academic) and sociodemographic disparities (e.g., SES and migration class) identified in kindergarten forecast the academic achievement trajectories of first- and second-generation immigrant and refugee children, from childhood to adolescence. The study used a retrospective, longitudinal, population-based design by making use of linked, individual-level administrative data from four sources (e.g., Immigration, Refugees, and Citizenship Canada and Ministry of Education; IRCC, 2014 and BC MED, 2014) to identify a study cohort of immigrant and refugee children in British Columbia, Canada ($N = 9,216$). We utilized an analytical approach (group-based trajectory modeling) that allowed us to capture heterogeneity in the Grade 4 to Grade 10 academic (literacy and numeracy) trajectories. The resulting literacy and numeracy achievement trajectories were wide-ranging—some children thriving, some catching up, and some falling behind over time. Children's developmental competencies assessed in kindergarten (literacy, numeracy, and social-emotional) were found to predict later trajectory group membership in significant and, at times, interacting ways. Trajectory group membership also differed by migration class (refugee/immigrant), generation status, socioeconomic status, English language learner status, and sex. The findings highlight the need for early, targeted school and community interventions that will help set all immigrant and refugee children onto long-term paths of positive adaptation.

 Monique Gagné and  Martin Guhn, Human Early Learning Partnership, School of Population and Public Health, University of British Columbia;  Magdalena Janus, Human Early Learning Partnership, School of Population and Public Health, University of British Columbia, and Offord Centre for Child Studies, Department of Psychiatry and Behavioural Neurosciences, McMaster University;  Katholiki Georgiades, Offord Centre for Child Studies, Department of Psychiatry and Behavioural Neurosciences, McMaster University;  Scott D. Emerson and  Constance Milbrath, Human Early Learning Partnership, School of Population and Public Health, University of British Columbia; Eric Duku, Offord Centre for Child Studies, Department of Psychiatry and Behavioural Neurosciences, McMaster University; Carly Magee, Human Early Learning Partnership, School of Population and Public Health, University of British Columbia; Kimberly A. Schonert-Reichl, Department of Educational and Counselling Psychology, and Special Education, Faculty of Education, Human Early Learning Partnership, School of Population and Public Health, University of British Columbia; Anne M. Gadermann,

Human Early Learning Partnership, School of Population and Public Health, University of British Columbia, and Centre for Health Evaluation and Outcome Sciences, Providence Health Care Research Institute, Vancouver, British Columbia, Canada.

The authors are grateful for the financial support of the Social Sciences and Humanities Research Council (SSHRC). Anne M. Gadermann also gratefully acknowledges funding through a Michael Smith Foundation for Health Research Scholar Award. We furthermore acknowledge the support of Population Data BC, the Ministry of Health, the Ministry of Education, Immigration, Refugees, & Citizenship Canada, as well as the Human Early Learning Partnership who facilitated access to the data in order to undertake the study. Please note that all inferences, opinions, and conclusions drawn in this study are those of the author, and do not reflect the opinions or policies of the data stewards.

Correspondence concerning this article should be addressed to Monique Gagné, Human Early Learning Partnership, School of Population and Public Health, University of British Columbia, 2206 E Mall, Vancouver, BC V6T 1Z3, Canada. E-mail: monique.gagne@ubc.ca

Educational Impact and Implications Statement

This study tracked the academic achievement of 9,216 immigrant and refugee children in British Columbia, Canada from childhood to adolescence (Grade 4 to Grade 10) and found groups that thrived over time, that were catching up, and that were falling behind. Children's likelihood of following each of these paths depended upon their academic and social-emotional competencies in kindergarten as well as a number of other sociodemographic factors (e.g., socioeconomic status). The findings highlight the need for early, targeted school and community interventions that will help set all immigrant and refugee children onto long-term paths of positive adaptation.

Keywords: immigrant children, refugee children, academic achievement, longitudinal trajectories, kindergarten school readiness

Immigrant and refugee children form a growing socially, culturally, and economically diverse group that may have equally diverse adaptation outcomes. Indeed, researchers have identified significant variations in the academic achievement of immigrant and refugee children and adolescents, particularly when measured over time (Gagné, Schonert-Reichl, Costigan, Guhn, & Shapka, 2019; Han, 2008; Suárez-Orozco et al., 2010; Szalacha, Marks, Lamarre, & Coll, 2005). Developing a better understanding of variations in the academic achievement of immigrant and refugee children over time (e.g., who will thrive, catch up, or fall behind) requires a deeper understanding of where they are at school entry. Consequently, the goal of this study was to examine whether developmental competency disparities (social-emotional and academic) and social disparities (e.g., socioeconomic status [SES] and migration class) identified in kindergarten forecast the long-term academic achievement trajectories from childhood to adolescence of first- and second-generation immigrant and refugee children. The benefit of studying academic trajectories from the point of school entry is twofold: First, it provides an opportunity to identify early differences among immigrant and refugee children and how disparities that appear at the start of school increase or attenuate over time. Second, the transition to school is a natural point for providing early supports and interventions that help to reduce early inequalities before they can widen over the long term (Entwisle, Alexander, & Olson, 1997).

The Diverse Academic Pathways of Immigrant and Refugee Children

Achieving academic success is often perceived as a key aspect of positive adaptation (Masten & Coatsworth, 1998) and those who migrate often go to great lengths to obtain academic success, including spending long hours studying and actively seeking extra help (Fuligni, 1997, 1998; García Coll et al., 1996; Kao & Tienda, 1995). Indeed, in certain settlement countries (e.g., Canada and the U.S.) and for certain immigrant groups, studies often find general patterns of academic achievement that are similar or better than nonimmigrant peers, at least initially (Crosnoe & Turley, 2011; Gagné et al., 2019; McAndrew, 2009; Suárez-Orozco et al., 2010; Szalacha et al., 2005). However, despite this overarching pattern, researchers have identified a range of academic trajectory patterns: Whereas some immigrant and refugee children show consistently high levels of academic achievement, others fare poorly; some show large academic gains over time, while still others academically decline (Gagné et al., 2019; Han, 2008; Suárez-Orozco et al.,

2010; Szalacha et al., 2005). Building upon this work requires developing an understanding of the factors that predict the academic trajectories of immigrant children and importantly, what early factors may help to support positive academic development over time and prevent the more deleterious academic pathways from taking shape.

Factors Associated With the Academic Achievement of Immigrant and Refugee Children

The extant understanding of factors associated with the positive adaptation of immigrant and refugee children has been primarily developed based upon generalized frameworks of development, such as Bronfenbrenner's bioecological model of human development (Bronfenbrenner & Morris, 2006) and Masten's risk and resilience framework of development (Masten, 2015), as well as theoretical models aimed at understanding competence in the context of children's minority status (García Coll et al., 1996). Building upon and extending these theoretical traditions, Suárez-Orozco, Motti-Stefanidi, Marks, and Katsiaficas (2018) developed an integrative risk and resilience model designed with a specific focus on the adaptation of immigrant-origin children and youth. The model posits that meeting normative developmental tasks, such as academic progress, is one of the key indicators of positive adaptation for immigrant-origin children and recognizes that there are specific, multilevel factors that shape migration contexts, children's experiences of adaptation and ultimately, their adaptation outcomes. This includes the global forces that propel migration (e.g., economic inequality and geopolitical unrest), sociopolitical contexts of settlement (e.g., effective policies and programs), and microsystem-level factors (e.g., families and schools).

Within this larger frame, the model also recognizes that there are individual-level factors that influence the positive adaptation of immigrant-origin children. At the individual level, it emphasizes the importance of immigrant-origin children's developmental competencies. Developmental competencies (which include cognitive, social and emotional competencies) are thought to be key for the adaptation of immigrant-origin children; they create the foundation from which children are able to effectively respond to their migration contexts and any adaptation challenges they may face in order to meet normative developmental tasks, such as academic progress, that are required of them in their new context (Suárez-Orozco et al., 2018). The model also recognizes the positionality of immigrant-origin children—that is to say, the sociodemographic factors, such as gender, socioeconomic status,

generation status, language competence, and migration class that shape children's experiences within their migration contexts and influence their ability to adapt successfully. It is these individual-level factors that are the focus of the current investigation. The following section reviews research on these individual-level factors, specifically early academic competencies, early social-emotional competencies, and the sociodemographic factors that may predict variations in the academic trajectories of immigrant and refugee children.

Early Academic Competencies and Later Academic Achievement

Early academic (sometimes termed *preacademic*) competencies such as literacy and numeracy are known to be strong predictors of later academic achievement (Claessens & Engel, 2013; Duncan et al., 2007; La Paro & Pianta, 2000). Much of the research on literacy and numeracy skills in early childhood has found not only differences in the academic competencies of immigrant and refugee children at school entry, but also differences in their subsequent academic trajectories. In a U.S.-based study, Han (2008) followed children of immigrants from kindergarten to Grade 3 and found a range of reading and math achievement trajectory patterns over that time. Certain groups closed the gaps to perform on par with their native-born White peers by Grade 3 (e.g., children from Central America) and other groups performed initially well but showed a pattern of decline over time (e.g., children from East Asia). Leventhal and colleagues (Leventhal, Xue, & Brooks-Gunn, 2006) found that immigrant children had lower initial verbal scores on average in comparison with nonimmigrant children, but they also generally showed greater levels of growth over time. In this study, family resources helped to explain some of the growth for immigrants but not all. Other studies have found that first- and second-generation immigrant children not only started off with higher reading achievement at kindergarten but they also had faster rates of growth in achievement over time than third generation children (Palacios, Guttmannova, & Chase-Lansdale, 2008). With that said, past work has highlighted that certain groups are at risk for lower levels of academic skills upon school entry, including immigrant children from low SES families (Browne, Wade, Prime, & Jenkins, 2018; Milbrath & Guhn, 2019) as well as children from refugee backgrounds (Gagné, Janus, Milbrath, Gadermann, & Guhn, 2018). Furthermore, significant research on language minority children has been conducted with findings to suggest that children who are English language learners perform similarly to their peers on basic cognitive skills (Geva, Yaghouh-Zadeh, & Schuster, 2000). However, English language learners have been found to have lower levels of performance at school entry on a range of literacy skills, although these differences were found to be negligible by Grade 4 (Lesaux, Rupp, & Siegel, 2007). Kieffer (2008) however, did find lower literacy (reading) development up to Grade 5 for language minority students in comparison to native English speakers but only for language minority students who had limited English proficiency by kindergarten.

Indeed, immigrant and refugee children have academic trajectories that are varied and distinct from each other and from their nonimmigrant peers and this variation is likely to depend on multiple factors, including literacy and numeracy competencies upon school entry. However, thus far, the longitudinal work that

has been done has tended to span restricted developmental periods (e.g., childhood or adolescence) and has rarely had the scope to capture the full complement of population-level diversity that we would expect to see in the academic achievement of immigrant and refugee child groups. To address this gap, the current study takes a population-based approach to follow immigrant and refugee children from childhood (kindergarten) through to adolescence (Grade 10).

Early Social and Emotional Competencies and Later Academic Achievement

Social and emotional competencies are thought to be key components in children's readiness for school and, ultimately, their ability to achieve academically (Davies, Janus, Duku, & Gaskin, 2016; Denham, 2006; Diamond, 2010). Although there is variability in the definition, social and emotional competencies are generally thought to include the skills and abilities associated with emotional expressiveness, understanding of emotion, regulation of emotion and behavior, social problem-solving, as well as social and relationship skills (Denham, 2006). To date, research has shown a strong association between children's social and emotional competencies and their academic achievement, concurrently and over time (Caprara, Barbaranelli, Pastorelli, Bandura, & Zimbardo, 2000; Durlak, Weissberg, Dymnicki, Taylor, & Schellinger, 2011; Entwisle, Alexander, & Olson, 2005; Oberle, Schonert-Reichl, Hertzman, & Zumbo, 2014; Rimm-Kaufman & Pianta, 2000). Social competencies such as the ability to work with others, follow rules, and adjust to changing routines and emotional competencies such as pro-social behavior and emotional health will all have an impact on adjustment to school, which in turn may position children to achieve academically over the short and long term (Collie, Martin, Nassar, & Roberts, 2019; Davies et al., 2016; Janus & Offord, 2007).

Up to now, few studies that focused specifically on immigrant and refugee children have taken early social and emotional competencies into account in the prediction of later academic achievement. Studies that used data from the Early Childhood Longitudinal Survey (ECLS-K) in the U.S. have broadly found similar or more favorable social and emotional competencies at kindergarten for immigrant children in comparison to nonimmigrant children, at least for those from Asian and Latino/a backgrounds (Crosnoe, 2006; Turney & Kao, 2012). Studies in a Canadian context using the Early Development Instrument (EDI; Janus & Offord, 2007) overall found no difference in the social and emotional competencies of foreign-born children in kindergarten in comparison to Canadian-born children, although outcomes did vary based upon a series of individual-level interacting predictors, namely gender, SES, and language background (Guhn, Milbrath, & Hertzman, 2016; Milbrath & Guhn, 2019). We might expect the social and emotional competencies of immigrant and refugee children to vary, depending on one's experience with migration. Social and emotional distress may stem from the overall challenges of cultural adaptation (Berry, 2006; Sirin, Sin, Clingain, & Rogers-Sirin, 2019) to negative experiences with racism and discrimination (Suárez-Orozco & Suárez-Orozco, 2001). Furthermore, refugee children may have survived war and other traumatic circumstances, which can have devastating psychological consequences (Fazel, Wheeler, & Danesh, 2005). All in all, we would expect that

some immigrant and refugee children will start kindergarten with lower social and emotional competencies than their peers but there is a dearth of research that has taken social-emotional competencies into consideration in the prediction of long-term academic progress. The current study helps to fill this gap.

Sociodemographic Factors and Later Academic Achievement

Immigrant and refugee children's sociodemographic status within their settlement country (e.g., their gender, socioeconomic status, generation status, language competence, and migration class) play a role in shaping their migration experiences and ultimately their adaptation outcomes in a number of complex ways. Female immigrants (like female nonimmigrants) tend to outperform their male peers academically and although immigrant-specific sex and gender differences remain largely unstudied, there is evidence to suggest that females may experience more support from their ethno-cultural communities and fewer negative cultural stereotypes (Suárez-Orozco & Qin, 2006). Socioeconomically, immigrant-origin children are represented across the spectrum (Gagné et al., 2020). However, they are more likely than their peers to live in poverty across a range of settlement countries (Smeeding, Robson, Wing, & Gershuny, 2012) and recent research suggests that while some immigrant children are able to rise above their low income circumstances, for most, poverty is just as detrimental to the academic outcomes of migrant children as it is for nonmigrant children (Gagné et al., 2020). A key challenge to achieving academic success that faces many immigrant and refugee children is developing competence in the language of instruction. For English language learners, attaining a level of proficiency in certain English language and literacy skills that is comparable to peers who speak English as a first language can take several years—and there are wide variations based upon the type of skill being measured as well as on individual differences such as age, maternal education, and language learning aptitude (Paradis, 2016). Indeed, English language learners often show lower literacy skill development, at least in kindergarten (Lesaux, Rupp, & Siegel, 2007) and poorer early literacy skills in English language learners have been associated with poorer literacy outcomes in later grades (Kieffer, 2008; Mancilla-Martinez & Lesaux, 2017).

Finally, fundamental to understanding the adaptation of immigrant-origin children is the recognition that children may have had vastly different migration experiences. First-generation children are in many cases found to do better than their second-generation and nonimmigrant peers across a number of outcomes, including academic achievement—a pattern that has come to be called *the immigrant paradox* (García Coll & Marks, 2012). Although first-generation children may struggle with learning to communicate in a new language, their better-than-expected outcomes are often attributed to the advantages of having a more optimistic view of their situation, a greater motivation to succeed, and more connection to their heritage culture than their second-generation peers (Suárez-Orozco et al., 2018). Migration experiences can be particularly marked based upon the class of entry into the country. Many settlement countries such as Canada, the U.S., and Australia have both immigrant and refugee/humanitarian pathways. In Canada, refugee children have migrated or been displaced due to untenable circumstances in their home countries and been

accepted into Canada on the humanitarian grounds of protection (Immigration, Refugees, & Citizenship Canada, 2017). By nature of their premigration experiences, refugee children may have experienced considerable trauma, stemming from violence, war or persecution (Heptinstall, Sethna, & Taylor, 2004). By contrast, immigrant children (or families) are selected to settle in Canada based upon their families likelihood of contributing to the Canadian labor market or because of ties to family in the country already (Immigration, Refugees, & Citizenship Canada, 2017)—criteria that likely offer a more advantageous social status in Canada.

The Current Study

The above review establishes that immigrant and refugee children will not all start school on the same foot and these differences have the potential to shape the course of their academic trajectories. From an early intervention perspective, it is important to develop our understanding of what early factors are associated with long-term academic achievement to ensure that all immigrant and refugee children are set onto paths of positive academic achievement. The goal of the current study was to examine the extent to which individual developmental competencies and sociodemographic factors identified at school entry predict variations in the later academic achievement trajectories of immigrant and refugee children from childhood through to adolescence. Taking a person-based analytic approach to understanding how multiple, interacting factors at school entry are associated with the academic achievement of immigrant and refugee children, the study objectives are (a) to model the varying academic trajectories (literacy and numeracy) of immigrant and refugee children from Grade 4 to Grade 10; (b) to determine the extent to which literacy, numeracy, and social-emotional competencies in kindergarten as well as key sociodemographic factors, specifically sex, English Language Learner (ELL) status, neighborhood socioeconomic status, generation status (first or second), and migration class (immigrant or refugee), predict the Grade 4 to Grade 10 academic trajectories of immigrant and refugee children; and (c) to examine how literacy, numeracy, and social-emotional competencies in kindergarten interact to predict the academic trajectories of immigrant and refugee children.

Method

Study Sample

The study cohort was drawn from a population-based linked dataset that included all children from the 10 largest school districts in British Columbia (which together account for well over half of the population). From this dataset, we first selected all children who had an Early Development Instrument (EDI) record for their kindergarten year between 2000 and 2007. For the children with an EDI record, we subsequently identified and retained only children who had exam data for at least two out of the three study time points (at Grade 4, 7, 10). Lastly, we identified and retained children who themselves or a parent had a migration record (i.e., first- and second-generation Canadian children). This resulted in a final study cohort of 9,216 first- and second-generation immigrant and refugee children who attended kinder-

garten between 2000 and 2007. The resulting cohort was 47.6% female ($n = 4,390$) and 68.3% were identified as English Language Learners (ELL; $n = 6,297$). Just over a quarter (25.8%) of the study cohort were first-generation (i.e., foreign-born; $n = 2,375$) and the other 74.2% ($n = 6,841$) were second-generation Canadian. The majority of the study cohort (or their parents) were accepted into Canada under the immigration class (86.3%; $n = 7,955$) but 12.5% ($n = 1,151$) were accepted under the refugee class (note that the remaining 1.2% migrated under Other categories). Children arrived from more than 100 source countries in total but the top three source countries for children in our sample were India (20%; $n = 1,844$), China (16.3%; $n = 1,503$), and Philippines (10.2%; $n = 936$).

Data Sources

The study uses a retrospective, longitudinal, population-based design by utilizing individual-level data from multiple sources: Immigration, Refugees, and Citizenship Canada (IRCC, 2014), the Human Early Learning Partnership (HELP, 2014), the British Columbia Ministry of Education (BC MED, 2014), and the BC Ministry of Health (BC MOH, 2015). IRCC Permanent Residents data provided migration-related information on children and their parents. HELP provided teacher-reported developmental well-being data for children in their kindergarten year via the EDI. Ministry of Education data included standardized achievement test scores for children in Grade 4, 7, and 10. The Ministry of Health data were used to facilitate the data linkage and also provided important demographic information such as sex and socioeconomic status. Population Data BC, a center in BC specializing in population-level data linkage, completed the data extraction and linkage (Population Data BC, 2014). Data were linked using a probabilistic-deterministic approach with a resulting linkage rate of 98.4%. The study and data linkage was approved by the University of British Columbia Behavioral Research Ethics Board (UBC BREB; H10-01154).

Measures—Outcomes

Literacy and numeracy exams scores were used to model literacy and numeracy trajectories over time (from Grade 4 to Grade 10). Scores were based upon province-wide student assessments that occur in Grade 4, Grade 7, and Grade 10 (Time Points 1, 2, and 3 in this study, respectively). Scores in Grade 4 and 7 are based upon the Foundational Skills Assessments (FSA), whereas Grade 10 scores were based upon provincial exam scores. In order for the scores to be interpretable in relation to the general population, the Grade 4–10 scores were z-standardized to have means of 0 (standard deviations of 1). This standardization was completed based upon all children who had completed EDI at kindergarten within the study timeframe for the same 10 school districts (a total of 82,095 children). Analysis of individual change over time comes with measurement concerns related to whether each time point is measuring commensurable constructs (Lloyd, 2010). Measuring achievement in literacy and numeracy from Grade 4 to Grade 10 using different measures is unavoidable (a Grade 10 level test given to a child in Grade 4 would tell us virtually nothing and vice versa). However, the tests measure similar domains across Grade 4, 7, and 10 and literacy and numeracy reported by

teachers in kindergarten consistently predicts scores in Grade 4, 7, and 10. This provides evidence for content validity and predictive validity, respectively, which are recommended checks of assessing construct commensurability with achievement/grades data (Lloyd, 2010).

Grade 4 and 7 literacy and numeracy scores. FSAs are administered annually across schools in the province of British Columbia and assess students' skills developed in reading, writing, and numeracy in Grades 4 and 7 (BC Ministry of Education, 2019). The FSAs are not mandatory but widely completed (85% and 68% completion rates for immigrant and refugee children in Grade 4 and 7, respectively; completion rates were 87% and 71% for nonimmigrant children). To generate an overall literacy score, we calculated the mean of the standardized (z-score) reading and writing FSA scores to create a literacy composite score for each child. The numeracy FSA scores in Grade 4 and 7 served as our numeracy scores.

Grade 10 literacy and numeracy scores. All students in the province of British Columbia are required to undertake a literacy and numeracy assessment as a graduation requirement. Exam percentage scores that fulfilled the Grade 10 literacy (e.g., English) and numeracy (e.g., mathematics) requirement for graduation were included. Grade 10 literacy scores had a .49 correlation with the Grade 4 and 7 literacy scores. Grade 10 numeracy scores had a .55 and .64 correlation with the Grade 4 and 7 numeracy scores, respectively ($p \leq .01$, in both cases). These correlations are lower than would typically be found for the general population, particularly for literacy (e.g., Hulslander, Olson, Willcutt, & Wadsworth, 2010) but are comparable to correlations found in longitudinal studies focused on immigrant children (e.g., Han, 2008).

Measures—Predictors

Academic and social-emotional competencies at kindergarten. Academic and social-emotional competencies at kindergarten were determined by teacher assessments on the EDI (Janus & Offord, 2007). EDI data are collected in systematic 3-year waves across the province of BC in order to obtain a representative, population-based sample of the developmental well-being of children in the province. The EDI measures the developmental outcomes of children in five domains, which are composed of one to four subdomains. Studies in BC and beyond have found psychometric evidence for test–retest reliability, interrater reliability, differential item functioning, and overall EDI domain factor structure (Guhn, Gadermann, & Zumbo, 2007; Janus & Offord, 2007). This includes growing evidence to suggest that the EDI has similar psychometric properties (factor loadings and internal consistency across domains and subdomains) and discriminates across a variety of countries and for different language/cultural groups (Guhn et al., 2007; Guhn et al., 2016; Janus, Brinkman, & Duku, 2011). Preliminary analyses undertaken for this study found no evidence of uniform or nonuniform differential item functioning between immigrant and nonimmigrant children (results not shown).

As with grade scores, the EDI scores for the study cohort (immigrant and refugee children) were z-standardized so that they could be meaningfully interpreted in relation to the general population. Scores were therefore standardized based upon all children (immigrant, refugee, and nonimmigrant) in the same 10 school

district who had completed EDI at kindergarten within the study timeframe (82,095 children).

Social and emotional competencies in kindergarten. Social and emotional competencies at kindergarten were measured based on a composite score created by calculating a mean score for the EDI emotional maturity and social competence domain scores. Because the two domains were highly correlated ($r = .80$), the items from both domains were combined to increase parsimony while retaining maximum contribution of available information on children's early development to the models. The resulting composite score was very highly correlated ($r = .95$) with both the separate emotional maturity and social competence scores (ordinal alphas = .95 and .97, respectively). Emotional maturity was measured based upon teacher assessments on 30 items. These are related to children's anxious and fearful behavior, aggressive behavior, hyperactivity and inattentive behavior, and prosocial and helping behavior (e.g., *Would you say that this child will try to help someone who has been hurt?*). The social competence domain was measured based upon teacher responses to 26 items related to overall social competence, responsibility and respect, readiness to explore, and approaches to learning (e.g., *Would you say that this child listens attentively?*). All item responses were on a three-point scale and the response options were 10 = *often or very true*, 5 = *sometimes or somewhat true*, or 0 = *never or not true*.

Academic competencies at kindergarten. As a measure of children's literacy and numeracy competencies at kindergarten, we utilized the EDI numeracy and advanced literacy subdomain scores from the EDI language and cognitive development domain. The numeracy subdomain was measured based upon teacher responses to seven items related to the child's ability to sort and classify, use one-to-one correspondence, count to 20, recognize numbers 1–10, compare numbers, recognize geometric shapes, and understand simple time concepts (e.g., *Would you say that this child is able to recognize numbers 1–10?*). The advanced literacy subdomain was utilized instead of the basic literacy subdomain because it offered greater variability in literacy scores. It reflected teacher responses to six items related to the child's ability to read simple words, read complex words, read sentences, write voluntarily, write simple words, and write simple sentences (e.g., *Would you say that this child is able to read simple words?*). The items in both subdomains had two response options: *yes* to indicate a child possesses the skills or *no* to indicate the child does not yet possess the skill. Ordinal alphas for the numeracy and literacy subdomains were .94 and .92, respectively. The literacy and numeracy subdomains had a .46 correlation ($p \leq .01$).

Sociodemographic factors. Sex and ELL status were reported by teachers on the EDI at kindergarten (female = 1, male = 0; ELL = 1, non-ELL = 0). Neighborhood socioeconomic status was based upon income quintiles assigned to each child based upon their residential postal code in kindergarten, identified by their Medical Services Plan (health insurance) registration record. Neighborhood income quintiles, which divide Canadian neighborhoods into five equal parts based upon income, were identified based upon postal codes using the Statistics Canada Postal Code Conversion File (PCCF+; Statistics Canada, 2013). Neighborhood income quintiles were then centered around zero for the purpose of this study (-2 = lowest income quintile; $+2$ = highest income quintile). A generation status variable was created such that children born outside of Canada (first-generation)

were coded as 1 and children born in Canada to at least one parent born outside of Canada (second-generation) were coded as 0. A migration class variable was created whereby children or their parents who arrived under the refugee class were coded as 1 and those arrived under the immigration class were coded as 0.

Data Analysis

The analyses were conducted using group-based trajectory modeling (GBTM; Nagin, 2005). GBTM is a form of finite mixture modeling that uses maximum likelihood estimation to identify groups of individuals who follow similar developmental trajectories (literacy and numeracy exam scores in Grade 4, 7, and 10 in the current study). The GBTM procedure achieves this by predicting the shape of each trajectory group and then assigning each individual to the group in which they have the highest probability of belonging. Furthermore, individual predictors (e.g., socioemotional competency in kindergarten) were modeled simultaneously with the trajectory groups based on the multinomial logit model, to predict membership in each group based on our predictor variables. These analyses were conducted simultaneously, using SAS software Version 9.4 and a SAS Proc Traj plugin (Jones & Nagin, 2007). GBTM does not make the theoretical assumption that trajectory groups are distinct subpopulations but rather, a group of individuals who follow similar trajectories. Given this, in a GBTM approach such as this, parameters associated with within-class variability are fixed to zero and the focus of the analysis is on between class differences in slopes and intercepts (see Frankfurt, Frazier, Syed, & Jung, 2016).

Missing data. A total of 868 children (9%) had missing data on at least one of the predictor variables, although this missingness was much lower for any one predictor (between 0 and 4.7%). Given that GBTM uses maximum likelihood estimation, it generates unbiased parameter estimates in the presence of missing data as long as the missing data are missing at random (Nagin & Odgers, 2010). There was a small negative correlation ($-.02$, $p = .05$) between being a refugee (vs. immigrant) and having missing data. However, having missing data was not associated with any statistically significant differences in the outcome variables (literacy or numeracy scores at Grade 4, 7, or 10). Given this we can proceed with reasonable confidence that our data are missing at random (MAR) with minimal impact on the study estimates (Nagin & Odgers, 2010; Schafer & Graham, 2002).

Trajectory model selection. We modeled trajectories of numeracy and literacy scores, based upon three time points (scores in Grade 4, Grade 7, and Grade 10). The number of groups and shape of each trajectory group were determined based upon a stepwise process that involved sequentially modeling unconditional models for two to eight trajectory groups. As recommended by Nagin (2005), multiple factors were weighed in the balance in determining the optimal number of trajectory groups: (a) Bayesian information criterion (BIC) values, Akaike's information criterion (AIC), and the likelihood (L) of the model were examined for each model (see Appendix B). While goodness-of-fit indicators offer important information, they should not be solely used to make decisions about model selection, particularly in studies with large samples where there is a risk of overextracting classes (Klijn, Weijnen, Lemmens, van den Brandt, & Lima Passos, 2017). (b)

We also considered average posterior probability values, which provided an indication of the likelihood that individuals belong in their assigned trajectory group. Higher average posterior probability values are associated with better model fit (we utilized the recommended cut-off of 0.7, Klijn et al., 2017; Nagin, 2005). (c) Finally, we applied a 1% minimum threshold whereby no less than 1% of the sample could be assigned to the smallest group. The 1% cut-off is not only recommended and commonly used in GBTM class enumeration (Klijn et al., 2017), but it was required to ensure that there was adequate statistical power to answer the research questions (in the current study, eight predictor variables requires a sample of at least 107, assuming medium effect sizes at power = .80 and $\alpha \leq .05$; Cohen, 1992). In all, the decision about the optimal number of trajectory groups considered all three factors—such that we ultimately selected the group showing the most optimal goodness-of-fit while also meeting our requirement of an average posterior probability value of at least 0.7, and the smallest group containing no less than 1% of the population. See Appendix B for the information used to make these decisions. After deciding on the optimal number of trajectory groups, we ran models in a stepwise fashion to determine the shape of each group's trajectory (i.e., the order of each polynomial equation). The polynomial order of each trajectory group was ultimately determined based upon optimized BIC scores.

Predicting group membership. The unconditional model was subsequently expanded to include the individual predictor variables, allowing us to estimate the association between the predictors and trajectory group membership, jointly with the estimation of the trajectories themselves. This process used the multinomial logit function (given we identified multiple trajectory groups) to determine the statistical association between each predictor and the likelihood of membership in each trajectory group. For each model, the trajectory group that was closest to average (i.e., a standardized score of 0) and largest was selected as the reference group. The individual predictor variables included were literacy and numeracy at kindergarten, social-emotional competencies at kindergarten as well as interaction terms (Literacy \times Numeracy, Literacy \times Socioemotional, Numeracy \times Socioemotional) although only significant interaction terms were retained in the final models. The following sociodemographic variables were also included: sex, ELL status, neighborhood socioeconomic status, generation status (first vs. second generation), migration status (refugee vs. immigrant).

Results

Descriptive Results

Standardized scores at kindergarten for the study cohort (i.e., immigrant and refugee children) were close to the standardized mean of 0, indicating that they were consistent with scores in the overall population. Literacy and numeracy mean scores in later grades were generally higher for the study cohort than for the overall population (see Appendix A).

Grades 4 to 10 Literacy and Numeracy Trajectories for Immigrant and Refugee Children

Trajectory models with six groups were selected for both literacy and numeracy after fitting models ranging from two to eight

groups. Based upon the trajectory group selection process outlined in the Methods section, we selected six group literacy and numeracy models because they optimized goodness-of-fit scores while also meeting our two additional criteria: The six group literacy and numeracy models retained average posterior probability values above 0.7 (0.79 and 0.73, respectively). Indeed, a value of 0.73 is approaching the cut-off but we note that the two numeracy groups responsible for this lower score cross paths and sit close to the average line. Nevertheless, they represent theoretically important nuance (average-improving vs. average-declining) and therefore we felt it important that they be retained. The six group models both retained sufficient group sample sizes capturing at least 1% of the population ($n = 150$ and $n = 550$, respectively). See Appendix B for the information used to make these decisions. Figures 1 and 2 illustrate the shape of the six trajectory groups identified for literacy and numeracy, respectively.

Literacy trajectory groups. As seen in Figure 1, the Consistently Highest group (linear estimate; $B = 0.04$, $SE = 0.02$, $p = .02$) is characterized by the highest literacy achievement from Grade 4 to Grade 10. The Consistently Above Average group has consistently above average literacy achievement over time (linear estimate; $B = 0.03$, $SE = 0.01$, $p = .05$). The Just Below Average group (intercept only; $B = -0.29$, $SE = 0.03$, $p < .001$) represents literacy achievement just below the population-based average from Grade 4 to Grade 10. The Low-Extreme Improving group is characterized by very low literacy scores at Grade 4 but with trajectories that sharply increase to above average by Grade 10 (linear estimate; $B = 1.76$, $SE = 0.05$, $p < .001$). The Low-Moderate improving group represents literacy scores that start low and show some indication of improvement over time but scores remain below average by Grade 10 (linear estimate; $B = 0.84$, $SE = 0.05$, $p < .001$). Finally, the Low-Declining group is characterized by scores that start below the population-based average and continue to fall to Grade 10 (linear estimate; $B = -0.51$, $SE = 0.04$, $p < .001$).

Numeracy trajectory groups. As seen in Figure 2, the Consistently Highest group (linear estimate; $B = -0.16$, $SE = 0.02$, $p < .001$) is characterized by a slight decline in numeracy scores from Grade 4 to Grade 10 while nevertheless retaining the highest numeracy scores over time. The Above Average-Improving group has scores above the population-based average and slightly increasing numeracy achievement over time (linear estimate; $B = 0.19$, $SE = 0.02$, $p < .001$). The Average-Improving group (linear estimate; $B = 0.44$, $SE = 0.02$, $p < .001$) represents numeracy scores that are below the population-based average in Grade 4 but that improve to above average by Grade 10. In contrast, an Average-Declining group is characterized by numeracy scores that are above the population-based average at Grade 4 but that decline to below average by Grade 10 (linear estimate; $B = -0.45$, $SE = 0.03$, $p < .001$). The "Below Average" group represents numeracy scores that are below the population-based average from Grade 4 to Grade 10 but show slight improvement over time (linear estimate; $B = 0.12$, $SE = 0.03$, $p < .001$). Finally, the Lowest-Declining group is characterized by scores that start below the population-based average and continue to fall through to Grade 10 (linear estimate; $B = -0.20$, $SE = 0.03$, $p < .001$).

Trajectory group characteristics. Based upon the probabilistic assignment of individuals to the literacy and numeracy trajectory groups, descriptive statistics were generated to de-

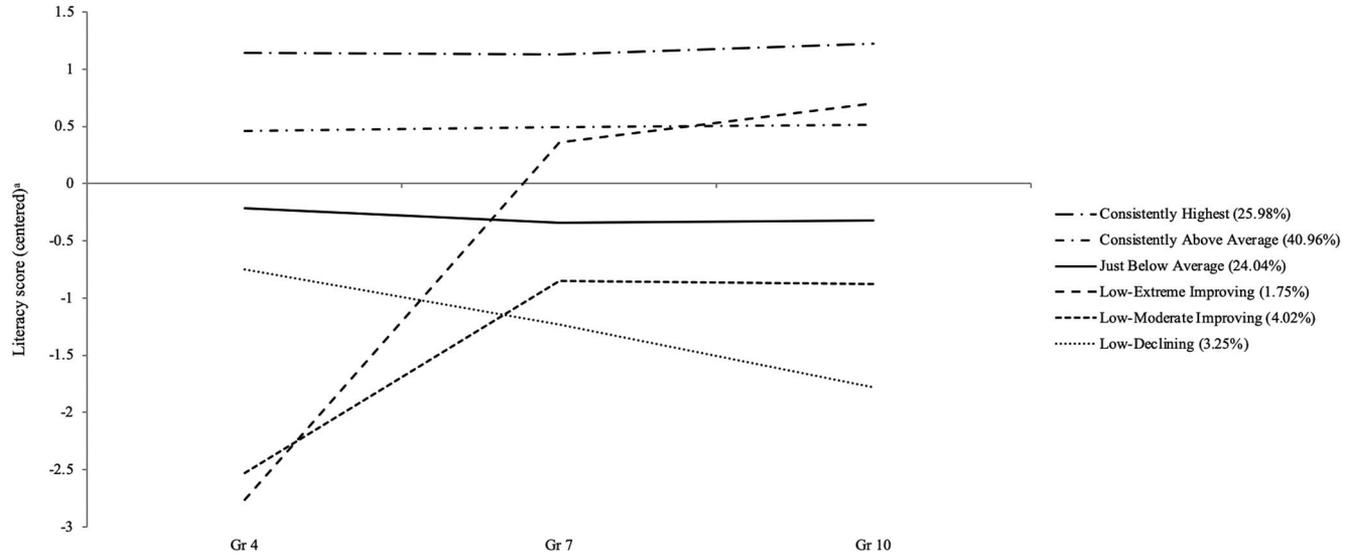


Figure 1. The six group Grade 4 to 10 literacy trajectory model. Grade 4, 7, and 10 values represent observed mean scores for each trajectory group. Percentages represent the estimated proportion of the study population belonging to each trajectory.

scribe the characteristics of each group. Table 1 shows the demographic composition (sex, ELL, SES), migration-related characteristics (generation status, migration class), and average EDI scores in kindergarten for each group.

Predicting Trajectory Group Membership

Table 2 shows the results for the conditional group-based trajectory models—and the extent to which membership in the literacy and

numeracy group can be predicted by literacy at kindergarten, numeracy at kindergarten, social-emotional competence at kindergarten, as well as sex, ELL status, neighborhood socioeconomic status, generation status (first vs. second generation), migration status (refugee vs. immigrant). All group membership likelihood estimates are in relation to the average reference groups. In the case of literacy, the reference group was the Just Below Average group. In the case of numeracy, the reference group was the Average-Improving group.

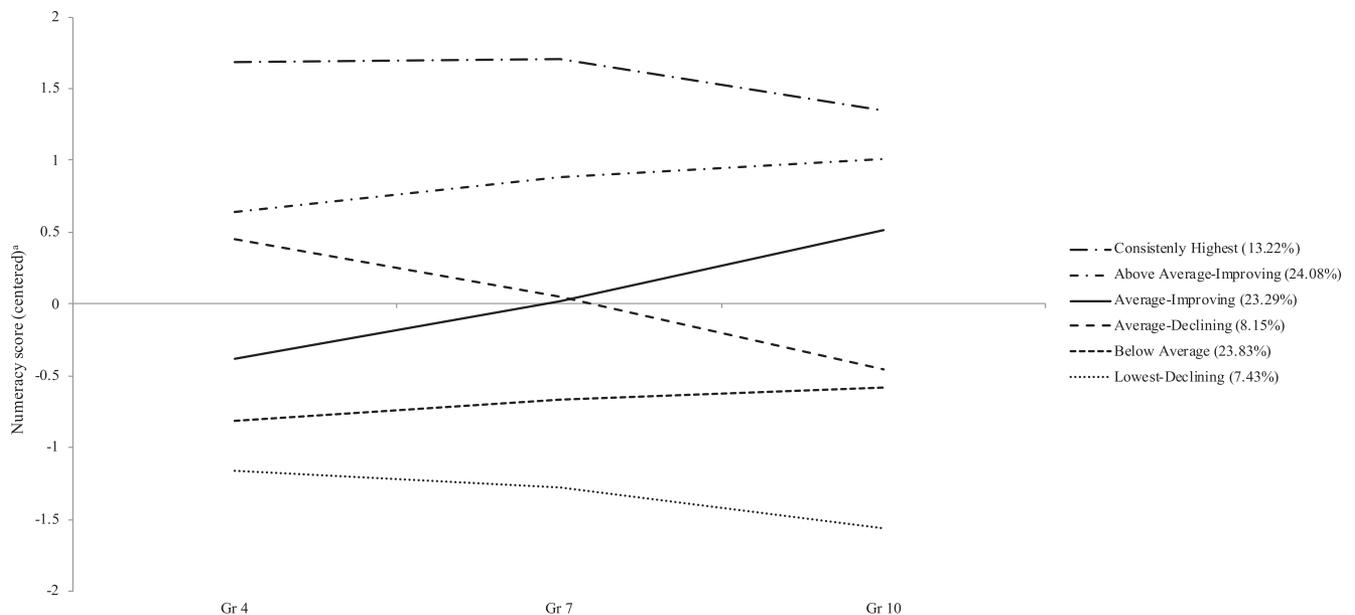


Figure 2. The six group Grade 4 to 10 numeracy trajectory model. Grade 4, 7, and 10 values represent observed mean scores for each trajectory group. Percentages represent the estimated proportion of the study population belonging to each trajectory.

Table 1
Literacy and Numeracy Trajectory Group Profiles Describing the Characteristics of the Group Members

Literacy trajectory groups							
Variables	Low-Declining (n = 245)	Low-Moderate Improving (n = 361)	Low-Extreme Improving (n = 150)	Just Below Average (n = 2,093)	Consistently Above Average (n = 4,051)	Consistently Highest (n = 2,316)	Total Study Population (n = 9,216)
Demographics							
Female	30.2%	37.4%	48.0%	37.6%	48.3%	59.0%	47.6%
ELL	81.8%	75.5%	70.5%	73.2%	68.8%	64.5%	68.3%
SES quintile	2.07 (1.15)	2.18 (1.24)	2.18 (1.24)	2.25 (1.22)	2.32 (1.29)	2.50 (1.36)	2.33 (1.29)
Generation status							
First generation	13.9%	21.1%	36.0%	17.5%	24.7%	36.5%	25.8%
Second generation	86.1%	78.9%	64.0%	82.5%	75.3%	63.5%	74.2%
Migration class							
Immigrant	83.1%	81.6%	89.9%	82.0%	87.1%	93.9%	86.3%
Refugee	16.9%	18.4%	10.1%	18.0%	12.9%	6.1%	12.5%
EDI scores at K ^a							
Literacy	-0.75 (0.87)	-0.66 (0.96)	0.06 (0.91)	-0.37 (0.94)	-0.02 (0.95)	0.44 (0.93)	-0.03 (1.00)
Numeracy	-1.10 (1.71)	-1.04 (1.76)	0.01 (0.66)	-0.45 (1.40)	0.001 (0.98)	0.25 (0.58)	-0.11 (1.13)
Socio-emo	-0.83 (1.18)	-0.69 (1.16)	-0.11 (1.09)	-0.36 (1.07)	-0.03 (0.95)	0.20 (0.87)	-0.10 (1.01)
Numeracy trajectory groups							
Variables	Lowest-Declining (n = 550)	Below Average (n = 2,387)	Average-Declining (n = 595)	Average-Improving (n = 2,193)	Above Average-Improving (n = 2,336)	Consistently-Highest (n = 1,155)	Total study population (n = 9,216)
Demographics							
Female	45.3%	47.3%	40.2%	52.8%	49.2%	40.3%	47.6%
ELL	71.4%	67.6%	57.6%	71.8%	71.1%	69.9%	68.3%
SES quintile	2.08 (1.15)	2.24 (1.22)	2.45 (1.33)	2.36 (1.27)	2.41 (1.34)	2.40 (1.35)	2.33 (1.29)
Generation status							
First generation	18.4%	18.5%	20.2%	23.8%	31.0%	40.3%	25.8%
Second generation	81.6%	81.5%	79.8%	76.2%	69.0%	56.7%	74.2%
Migration class							
Immigrant	78.4%	80.8%	86.1%	88.3%	91.8%	95.3%	86.3%
Refugee	21.6%	19.2%	13.9%	11.7%	8.2%	4.7%	12.5%
EDI scores at K ^a							
Numeracy	-1.00 (1.71)	-0.43 (1.41)	0.03 (0.90)	-0.06 (1.04)	0.16 (0.74)	0.27 (0.54)	-0.03 (1.00)
Literacy	-0.63 (0.95)	-0.38 (0.94)	-0.01 (0.95)	-0.07 (0.96)	0.21 (0.96)	0.55 (0.89)	-0.11 (1.13)
Socio-emo	-0.52 (1.06)	-0.28 (1.08)	-0.04 (1.01)	-0.06 (0.97)	0.05 (0.95)	0.10 (0.94)	-0.10 (1.01)

Note. Group membership is assigned probabilistically based upon the maximum-probability assignment rule (Nagin, 2005). Assignments are based upon the unconditional models.

^a All EDI mean scores are standardized based upon the general population (see Method).

Literacy at kindergarten. Literacy at kindergarten was found to be a significant predictor of both literacy and numeracy trajectory group membership. It was associated with an increased likelihood of membership in the highest literacy and numeracy groups as well as being associated with the decreased likelihood of membership in the lowest literacy and numeracy groups.

Numeracy at kindergarten. High numeracy scores at kindergarten were associated with a greater likelihood of being in the highest numeracy trajectory group as well as with lower odds of belonging in the lowest numeracy trajectory groups. Numeracy also consistently predicted membership in all literacy trajectory groups: Numeracy skills at kindergarten were associated with a greater likelihood of membership in the higher literacy trajectory groups and these relationships were strengthened by the presence of higher literacy at kindergarten. Furthermore, higher numeracy was associated with a lower likelihood of membership in the lower literacy groups.

Social-emotional competencies at kindergarten. Social-emotional competence at kindergarten was consistently negatively associated with membership in the Lowest-Declining groups (literacy and numeracy). Furthermore, for literacy groups, social-emotional competence was positively associated with membership in the Consistently Above Average group and negatively associated with membership in the Low-Moderate Improving group.

Literacy, numeracy, and social-emotional competence interactions. A Significant Literacy \times Numeracy interaction term emerged as predictive of membership in the Consistently Highest literacy and numeracy groups. In both cases, the interaction terms magnified the coefficients, indicating that the likelihood of belonging to the Consistently Highest group was strengthened further in the presence of both high numeracy and literacy at kindergarten. To illustrate these relationships Figures 3 and 4 show the probabilities of membership in the Consistently Highest groups for children based upon literacy and numeracy at kindergarten.

Table 2

Statistically Predicting Literacy and Numeracy Trajectory Group Membership Based Upon Sociodemographic Factors and Kindergarten Competencies

Variables	Literacy trajectory groups									
	Low-Declining		Low-Moderate Improving		Low-Extreme Improving		Consistently Above Average		Consistently Highest	
	<i>B</i> (<i>SE</i>) ^a	<i>OR</i>								
Female	-0.43 (.14)**	0.65	-0.27 (.16)	0.76	0.46 (.19)*	1.58	0.42 (.09)***	1.52	0.95 (.11)***	2.59
ELL	0.01 (.01)	1.01	0.01 (.01)	1.01	-0.26 (.19)	0.77	0.01 (.004)	1.01	-0.20 (.10)	0.82
SES	-0.16 (.07)*	0.85	-0.03 (.08)	0.97	-0.04 (.10)	0.96	0.08 (.04)	1.08	0.13 (.05)**	1.14
First generation	-0.70 (.19)***	0.50	-0.28 (.19)	0.76	1.27 (.20)***	3.56	0.77 (.10)***	2.16	1.52 (.11)***	4.57
Refugee	0.26 (.16)	1.30	-0.02 (.20)	0.98	-0.56 (.34)	0.57	-0.58 (.14)***	0.56	-1.26 (.22)***	0.28
Soc-emo	-0.18 (.07)**	0.84	-0.23 (.07)***	0.79	0.04 (.12)	1.04	0.20 (.05)***	1.22	0.08 (.07)	1.08
K literacy	-0.27 (.08)**	0.76	-0.35 (.10)***	0.70	0.43 (.12)***	1.54	0.20 (.06)***	1.22	1.04 (.13)***	2.83
K numeracy	-0.23 (.08)**	0.79	-0.22 (.09)*	0.80	0.39 (.19)*	1.48	0.59 (.09)***	1.80	0.75 (.15)***	2.12
Lit × Num	-0.01 (.06)	0.99	0.03 (.06)	1.03	0.16 (.15)	1.17	0.11 (.08)	1.12	0.55 (.10)***	1.73

Variables	Numeracy trajectory groups									
	Lowest-Declining		Below Average		Average-Declining		Above Average-Improving		Consistently Highest	
	<i>B</i> (<i>SE</i>) ^a	<i>OR</i>								
Female	-0.13 (.15)	0.88	-0.33 (.11)**	0.72	-1.10 (.15)***	0.33	-0.36 (.11)***	0.70	-1.03 (.11)***	0.36
ELL	-0.75 (.15)***	0.47	0.005 (.01)	1.01	-0.89 (.12)***	0.41	-0.003 (.01)	0.99	0.002 (.01)	1.00
SES	-0.24 (.08)**	0.79	-0.06 (.05)	0.94	0.05 (.07)	1.05	0.03 (.05)	1.03	0.002 (.05)	1.00
First generation	-0.56 (.18)**	0.57	-0.59 (.13)***	0.55	-0.29 (.18)	0.75	0.40 (.11)***	1.49	0.92 (.11)***	2.51
Refugee	0.82 (.18)***	2.27	0.72 (.16)***	2.05	0.37 (.21)	1.45	-0.34 (.18)	0.71	-0.67 (.22)**	0.51
Soc-emo	-0.26 (.08)**	0.77	-0.05 (.06)	0.95	0.03 (.08)	1.03	0.02 (.06)	1.02	-0.05 (.06)	0.95
K literacy	-0.33 (.09)***	0.72	-0.16 (.06)*	0.85	0.16 (.08)*	1.17	0.32 (.06)***	1.38	0.85 (.08)***	2.34
K numeracy	-0.58 (.10)***	0.56	-0.36 (.09)***	0.70	-0.07 (.14)	0.93	0.17 (.10)	1.19	0.57 (.15)***	1.77
Lit × Num	-0.02 (.07)	0.98	-0.13 (.07)	0.88	-0.27 (.11)*	0.76	-0.05 (.10)	0.95	0.33 (.12)**	1.39
Soc-E × Num	-0.10 (.05)*	0.90	0.02 (.05)	1.02	0.15 (.08)*	1.16	0.08 (.06)	1.08	0.06 (.07)	1.06

Note. Females were coded as 1 (males 0). Estimates are multinomial logit-based. The reference group in the literacy model is the Just Below Average group. The reference group in the numeracy model is the Average-Improving group. Soc-emo = social-emotional competence measured at kindergarten; Lit × Num = K literacy K numeracy interaction term; Soc-E × Num = Soc-emo × K numeracy interaction term.

^a* $p < .05$. ** $p < .01$. *** $p < .001$.

Similarly, a significant Social-Emotional × Numeracy interaction term was found to increase the strength in the prediction of membership in the Lowest-Declining numeracy group: Combined low numeracy and low social-emotional competencies in kindergarten magnified the predictive power of the two variables separately (see Figure 5).

For the Average-Declining numeracy trajectory, a Significant Literacy × Numeracy interaction (illustrated in Figure 6) suggested that children with high literacy and numeracy at kindergarten had the lowest likelihood of being in the Average-Declining group whereas children with high literacy but low numeracy at kindergarten had the greatest likelihood of being in this group (vs. the Average-Improving). Notably, confidence in this relationship is only apparent at two standard deviations above and below the mean (confidence intervals overlap when plotted at one standard deviation above and below the mean). Indeed, the Social-Emotional × Numeracy interaction had completely overlapping confidence intervals (figure not shown), even when the relationship was plotted for two standard deviations above and below the mean and as such, we cannot interpret the interaction with confidence.

Sociodemographic factors. Females had a lower likelihood of membership in all numeracy trajectory groups in comparison to

the average numeracy group with the exception of the Lowest-Declining group. In the case of literacy, females had a greater likelihood of membership in the two highest literacy trajectory groups and the Low-Extreme Improving group, while having a decreased likelihood of membership in the Lowest-Declining group (in comparison to the average reference group). ELL status was associated with a lower likelihood of belonging in the declining numeracy groups (i.e., the Lowest-Declining and the Average-Declining). By contrast, ELL status did not have a significant association with literacy group membership. SES was found to be positively associated with a higher likelihood of membership in the Consistently Highest literacy trajectory group as well as a decreased likelihood of membership in the Lowest-Declining groups for both literacy and numeracy. Children who were first-generation Canadian (vs. second-generation) were significantly more likely to belong to the highest literacy and numeracy trajectory groups. They were also less likely to belong to the lowest literacy and numeracy trajectory groups (see Table 2). Refugee children had a significantly lower likelihood of membership in the highest two literacy trajectory groups than immigrant children. Refugee children were also significantly less likely to be members of the highest numeracy group and more likely to be in the Lowest-

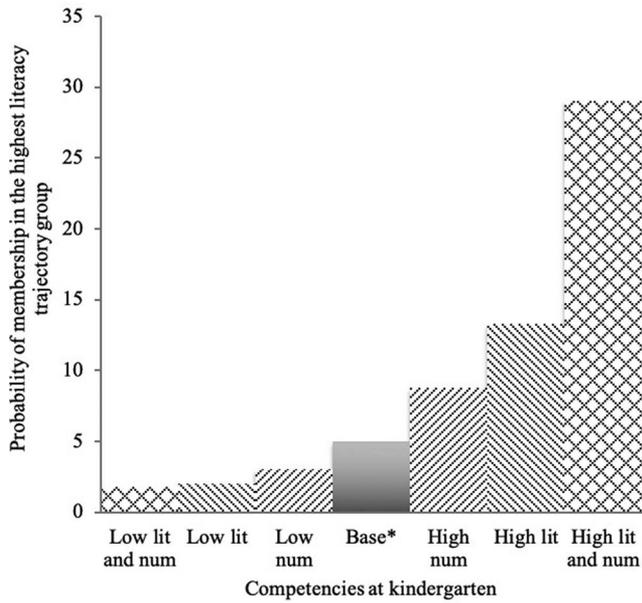


Figure 3. Probabilities of membership in the Consistently Highest literacy trajectory group, based on literacy and numeracy competencies at kindergarten. Low = 1 standard deviation below the mean. High = 1 standard deviation above the mean. Lit = literacy; Num = numeracy. * Base = Probability of membership based upon intercept (i.e., without accounting for numeracy and social-emotional competence at kindergarten).

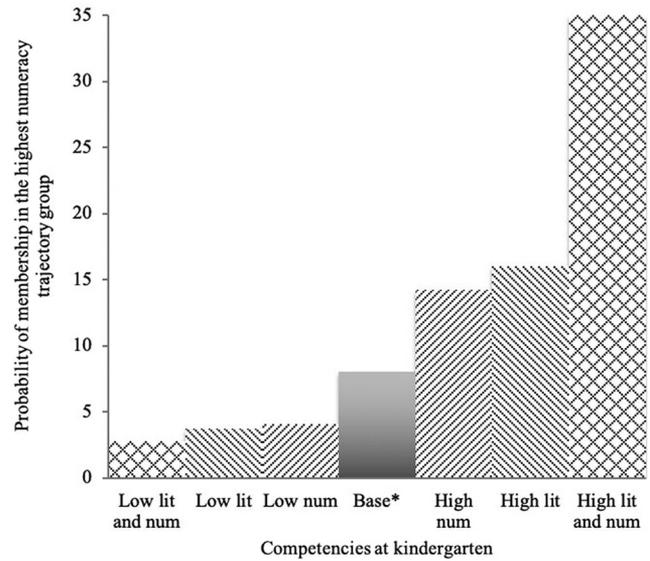


Figure 4. Probabilities of membership in the Consistently Highest numeracy trajectory group, based on literacy and numeracy competencies at kindergarten. Low = 1 standard deviation below the mean. High = 1 standard deviation above the mean. Lit = literacy; Num = numeracy. * Base = Probability of membership based upon intercept (i.e., without accounting for numeracy and social-emotional competence at kindergarten).

Declining and Below Average numeracy groups than immigrant children.

Discussion

The present study examined the diversity of the academic pathways of immigrant and refugee children from early childhood through to adolescence. By utilizing a population-based approach and an analytical methodology that allowed us to capture heterogeneity in the Grade 4 to Grade 10 academic trajectories, we were able to identify that immigrant and refugee children had a range of academic achievement trajectories from Grade 4 to Grade 10—some children thriving, some catching up, and some falling behind over time. The study also identified which immigrant and refugee children would be more likely to follow each trajectory based upon a number of sociodemographic factors, and how their literacy, numeracy and social-emotional competencies in kindergarten played a significant and sometimes interacting role in predicting their Grade 4 to Grade 10 academic trajectories.

Thriving

Over 30% of the immigrant and refugee cohort (over 60% in the case of literacy) had trajectories that could be characterized as academically thriving—that is, they performed above average or consistently high in comparison to the average in the general population in literacy and numeracy from Grade 4 to Grade 10. We did expect to find that a considerable proportion of immigrant and refugee children would perform academically above average in comparison to the general population given that it is a pattern that

has emerged frequently in studies of immigrant children and adolescents, particularly in Canada and the U.S. (Gagné et al., 2019; Han, 2008; Suárez-Orozco et al., 2010; Szalacha et al., 2005).

Teacher-rated literacy and numeracy competencies in kindergarten emerged as strong predictors of later thriving (Grade 4 to Grade 10 literacy and numeracy achievement). High literacy skills

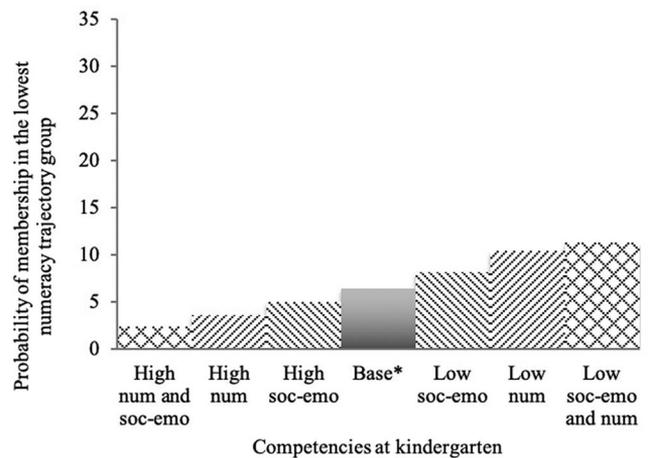


Figure 5. Probabilities of membership in the Lowest-Declining numeracy trajectory group, based on numeracy and social-emotional competencies at kindergarten. Low = 1 standard deviation below the mean. High = 1 standard deviation above the mean. Num = numeracy. Soc-emo = social-emotional. * Base = Probability of membership based upon intercept (i.e., without accounting for numeracy and social-emotional competence at kindergarten).

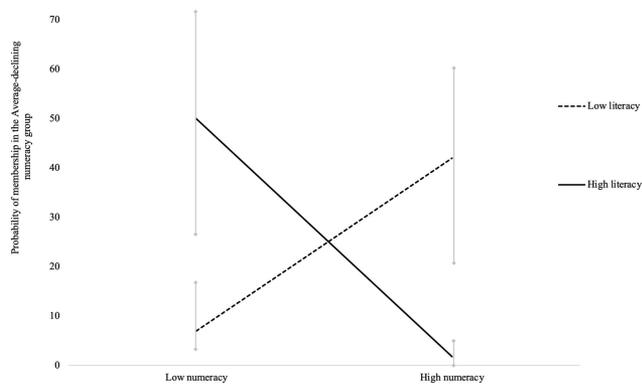


Figure 6. The interaction between literacy and numeracy competencies in kindergarten in their prediction of membership in the average-declining numeracy trajectory group (vs. the average-improving trajectory group). Low and high values represent two standard deviations above the mean (confidence intervals overlap at 1 standard deviation above and below the mean). Gray lines represent 95% confidence intervals using a parametric bootstrap approach (as outlined in Nagin, 2005).

predicted later literacy thriving and high numeracy skills predicted later thriving in numeracy. This was expected and consistent with previous studies in the general population in several countries that have found early academic skills to be strong predictors of later outcomes (Brinkman et al., 2013; Claessens & Engel, 2013; Davies et al., 2016; Duncan et al., 2007; La Paro & Pianta, 2000). It should be underscored that although literacy skills in kindergarten predicted later academic thriving for immigrant and refugee children, ELL status did not, suggesting an important distinction between language minority status and English language competency in kindergarten. This finding is in keeping with previous research that has found language minority learners who enter kindergarten with oral English proficiency follow literacy trajectories (up to Grade 5) that are similar to their native English-speaking peers. However, language minority learners with limited English proficiency in kindergarten had diverging literacy achievement trajectories resulting in substantial gaps in achievement by the fifth grade (Kieffer, 2008). There are many known factors associated with the early English language development of ELL students, including first language, maternal education level and the richness of children's English environment outside of school (Paradis, 2011, 2016). Utilizing this knowledge to bolster the English language development of all ELL students prior to kindergarten could have important, long-term implications given the results identified in the current study.

Literacy and numeracy skills in kindergarten were also strong predictors of thriving *across* domains: High kindergarten numeracy predicted later thriving in the literacy domain and high kindergarten literacy predicted later thriving in the numeracy domain. Furthermore, significant interaction terms revealed that the combination of both high literacy and numeracy at kindergarten was associated with a far greater probability of membership in the highest groups than having high literacy or numeracy alone. These findings illustrate that early literacy and numeracy competencies do not act in isolation but work together. For example, children's storybook reading has been found to engage children regularly and meaningfully in mathematical talk (Anderson, Anderson, & Sha-

piro, 2005) and children's literature has been associated with greater interest and achievement in mathematics (Jennings, Jennings, Richey, & Dixon-Krauss, 1992). Extending this, the current study suggests that early literacy and numeracy competencies not only build upon each other in early childhood but they are associated with higher literacy and numeracy achievement over the long term.

Importantly, immigrant and refugee children in the study were not all equally likely to belong to a thriving group. First-generation Canadian children were more likely to be thriving (i.e., to belong to the above average or consistently highest trajectory groups) than second-generation Canadian children. This is consistent with a good deal of research evidence to suggest that first-generation children tend to academically outperform their second-generation counterparts (Marks, Ejesi, & García Coll, 2014). The finding highlights that the more time spent in the country of arrival does not necessarily translate to better outcomes. The precise mechanism to explain this still requires further investigation. The process of acculturation itself, which may involve a distancing from one's heritage culture has been associated with detrimental outcomes (Harker, 2001; Hwang & Wood, 2009). This could help to explain why second-generation children, who are likely to be more acculturated than their first-generation peers, are less likely to be academically thriving. The pronounced difference is however noteworthy given that the first-generation children included in the present study were necessarily here by age 5. Given that on average first-generation children in the current study had only spent 2 years less in Canada than their second-generation peers, it is surprising we would observe such a consistent and strong predictive association and it represents an important area for further investigation.

Refugee children were also consistently less likely to be in the thriving groups than immigrant children even after accounting for neighborhood SES, literacy, numeracy, and social-emotional competencies at kindergarten. Our findings imply that the gaps in the educational outcomes between immigrant and refugee children persist even after accounting for key sociodemographic factors, as well as academic and social-emotional competencies upon school entry. By the very nature of their migration status, refugee children and their families may have faced severe hardships, including experiences of persecution, violence, and loss of loved ones in addition to gaps in education and other social disadvantages (Stewart, 2011). The ways in which we may close achievement gaps will require a more in-depth investigation into the specific needs of refugee children. The study results suggest that to address this effectively, early supports will likely need to address needs that are beyond the development of basic kindergarten competencies. Immigrant and refugee females were more likely to be in the thriving groups for literacy, whereas males were more likely to be in the numeracy thriving groups. Previous studies focused on young immigrants and refugees have found that females tend to academically outperform males (Gagné et al., 2019; Kao & Tienda, 1995; Suárez-Orozco et al., 2010). Indeed, the male-female discrepancy in literacy and numeracy achievement found in the current study is also often found in general populations (Buchmann, DiPrete, & McDaniel, 2008) but it raises the question of whether the prevalence and strength of this

pattern differs for immigrant and refugee children and this would be an important point for future research.

Catching Up

Patterns of catching up were observed in the literacy and numeracy models. The average-improving numeracy group represented over one fifth of the study cohort of immigrant and refugee children. In the case of literacy, a pattern of extreme catching up was identified (the low-extreme improving group). A low-moderate improving literacy group was also identified, representing children who improved over time but remained below average in Grade 10. Fewer immigrant and refugee children in the study followed a pattern of catching up in the literacy domain—just over 5% in total. The reason why so few children showed patterns of catching up in literacy is unclear. Language skills are important for academic achievement (García-Vázquez, Vázquez, López, & Ward, 1997; Suárez-Orozco, Rhodes, & Milburn, 2009) and there is evidence to indicate that immigrant children overall tend to have more growth in language skills than their nonimmigrant peers (Leventhal et al., 2006). One possibility is that greater emphasis in schools is placed on bolstering the English language skills of immigrant and refugee children early on and because of this, any rapid improvements or catch up effects would occur prior to Grade 4 (the first time point measured in the study trajectories). Indeed, the fact that the immigrant and refugee children were found to have literacy skills that were on par with the population mean by Grade 4 offers support for this hypothesis.

Nevertheless, the catching up trajectories observed in the current study were associated with several factors. Higher literacy and numeracy skills at kindergarten were significantly predictive of being in the low-extreme improving literacy group. This offers an indication that a sufficient foundational competency level in kindergarten may be required to improve in an extreme way. This is further supported by considering the low-moderate improving literacy group who improved at a much slower rate and were still below the population average by Grade 10—in contrast with the extreme improving group, membership in this group was predicted by lower literacy and numeracy levels at kindergarten. Together, these findings suggest that improving is possible, regardless of competency level in kindergarten; however, our study findings suggest that levels at kindergarten are predictive of the degree of the improvement by Grade 10.

Similar to the thriving groups, first-generation Canadian children (vs. second-generation children) were also more likely to belong to the catching up groups (i.e., the average-improving numeracy and the low-extreme improving literacy) in comparison to the average groups. First-generation children may be in a better position to improve academically over time because, seen as a critical strategy for adapting in a new country, their families tend to place a high value on academic success, including the attitudes and behaviours associated with academic achievement (Fuligni, 1997, 1998). It is also possible that more extensive supports are in place within the school as well as at home for children who are newer to Canada (e.g., welcome programs), which may bolster their ability to improve at a faster rate than children who are second-generation Canadian.

Falling Behind

We observed children falling behind in several different ways in the current study. A small proportion of children started off low and continued to decline academically through to Grade 10 (i.e., the low-declining literacy and lowest-declining numeracy groups). Some children started just above average and declined to below average (i.e., the average-declining numeracy group). Each of these declining groups represented less than 10% of the study population. Around one quarter of children were consistently lower than average in literacy and numeracy, respectively (i.e., the just below average literacy group and the below average numeracy group).

As expected, lower literacy, numeracy, and social-emotional competencies in kindergarten were all consistently associated with a greater likelihood of belonging to the lowest-declining groups. Notably, while low social-emotional competence emerged as consistently predictive of negative trajectories, higher social-emotional competence was generally not a significant predictor of positive (i.e., thriving or catching up) trajectories (with one exception). This finding highlights the strength of adopting analytic techniques that are not only able to capture heterogeneity in outcomes but also in the predictors of outcomes. In the case of numeracy, the role of social-emotional functioning as a vulnerability factor was further magnified through a significant interaction, which illustrated that for children with lower numeracy skills in kindergarten, the likelihood of belonging to the lowest-declining numeracy group was higher if children also had low social-emotional competencies in kindergarten. These findings re-assert that building developmental competencies holistically across multiple domains (including noncognitive domains) is important for fostering later academic achievement (Caprara et al., 2000; Davies et al., 2016; Diamond, 2010). Early social-emotional competence is thought to impact later academic achievement outcomes by placing children in a better position to take advantage of their school learning environments (Entwisle et al., 2005; Rimm-Kaufman & Pianta, 2000). For example, children with stronger social-emotional competencies at school entry may be better able to function in an academic setting and therefore benefit from the academic activities offered in kindergarten (Janus & Duku, 2007). Indeed, this notion is consistent with the findings of the present study, suggesting that immigrant and refugee children who lack social-emotional competencies at school entry may be more likely to decline academically over time.

The average-declining group offered an opportunity to examine prediction of a more subtle pattern of decline: This group had close to average numeracy achievement between Grade 4 and 10 but showed slight decline over time. We found that the association between literacy competence in kindergarten and membership in the average-declining group was moderated by kindergarten numeracy levels. More specifically, children with high literacy and numeracy at kindergarten had the lowest likelihood of being in the average-declining group (vs. the average-improving group). However, high literacy in kindergarten along with low numeracy in kindergarten was associated with the highest likelihood of membership in the average-declining group. Although this interaction is difficult to interpret, it may be that the decline we are observing for children

who have high literacy at kindergarten is a reflection of faster acculturation. Children who acculturate more quickly and who have lower numeracy levels in kindergarten may be less likely to engage academically at school. This would be in line with previous studies that have observed an association with acculturation and lower achievement over time (García Coll & Marks, 2012; Marks et al., 2014).

Second-generation children were more likely to belong to the declining groups than first-generation children. Although this group was discussed earlier in relation to their lower likelihood of belonging to the thriving and catching up groups, this finding is worth added mention because it offers some evidence that second-generation children are not only regressing to the population mean (i.e., performing more like average Canadian children), but in fact they have a greater likelihood of declining over time and performing far lower than the population mean. Males were also generally more likely to belong to the declining groups than females, and together with the finding that they were also more likely to be in the highest numeracy achievement groups, it appears that sex has a complex association with academic achievement for immigrant and refugee children. We argue, as have other researchers (Suárez-Orozco et al., 2018), that sex and gender differences in immigrant and refugee children remain understudied. Given the findings, we argue that future research needs to place a closer lens on the mechanisms whereby second-generation, male children seem to be at higher risk than first-generation, female children for declining academically over time.

The Uniqueness and Heterogeneity of Immigrant and Refugee Academic Trajectories

For the general population, there have been inconsistent reports of whether children close the gaps in literacy and numeracy over time. Some studies have found that early gaps widen over time whereas other studies found that gaps in achievement remain constant over time, but most studies report that any decrease in gaps were slow, mild, or not present at all. As Shin, Davison, Long, Chan, and Heistad (2013) have noted, these inconsistent findings are likely due to factors such as context and sampling differences across studies. The current study identified groups who were closing the gap (catching up), widening the gap (falling behind), as well as remaining constant (thriving). The diversity in the trajectories found in the current study is likely a reflection of our population-based approach and the advantage it brings in identifying heterogeneity in outcomes. Importantly, the trajectories captured in this study are specific to immigrant and refugee children. By contrast with studies focused on the general population, the study found significant evidence for immigrant and refugee children who were catching up over time (or, closing gaps). Indeed, one of the key predictors of catching up patterns in the current study was generation status—first generation children were more likely to belong to the catching up trajectory groups. This highlights the utility of studies with a subpopulation focus such as this one because it contributes to our understanding of the unique and nuanced patterns and predictors of the long-term academic trajectories of specific subpopulations, such as immigrant and refugee children.

Intervention Implications

Early care and education programs have been associated with positive academic (Magnuson, Lahaie, & Waldfogel, 2006) as well as social-emotional gains (Votruba-Drzal, Coley, Collins, & Miller, 2015) in immigrant children. Yet, immigrant children have been found to be less likely to attend early care and education programs (Magnuson et al., 2006; Miller, Votruba-Drzal, & Coley, 2013). Indeed, the current study findings suggest that investments made in early education could have a magnified and long-term impact on the adaptation of immigrant and refugee children. For those designing early interventions for immigrant and refugee children, the study results also offer some key considerations. First, programming targeted toward immigrant and refugee children should go beyond language interventions to ensure they start school with a full complement of competencies required for kindergarten. Second, the study findings suggest that those requiring support may not be those who are traditionally targeted in interventions (e.g., second-generation children). Indeed, our findings suggest that the most effective early interventions will need to go beyond our traditional conceptualizations of support for immigrant and refugee children (i.e., focused on bolstering the English language skills of first-generation children) to ensure that all children are prepared for paths of academic success.

Study Limitations

There are a number of study design limitations to highlight. First, children's developmental competencies were measured via teacher ratings. While teacher observations and ratings, especially for children as young as 5–6 years, have been found to be highly reliable and strongly correlated with parent and direct assessments (Janus & Offord, 2007), having multiple sources of data on children's developmental status would have enriched our analyses. Second, although the study accounted for a range of key sociodemographic factors, it did not account for cultural background factors such as ethnicity or ethnic identity. Having the ability to understand how cultural factors contributed to the academic trajectory models, independently or in combination with other early social inequities, would have added important insight to the findings. Third, although the study's statistical design was chosen for its strength in identifying and examining variations in academic trajectories, it should be underscored that the process of identifying the optimal number of trajectory groups involves subjectivity and that the groups are formed on the basis of probabilities and do not represent literally distinct subpopulations. Finally, we remind the reader that the statistical associations found in the current study are predictive and not causal in nature.

Conclusion

The study highlighted the varying academic trajectories of immigrant and refugee children over the course of childhood and adolescence and in conclusion, we might most accurately summarize that we found many children to be thriving, some catching up, and some falling behind. The findings showcased the importance of taking a longitudinal perspective to understanding the positive adaptation of immigrant and refugee children: As illustrated in the study, achievement at one point in time does

not give a complete picture of the adaptation process. Importantly, the study also highlights that immigrant and refugee children do not all start school on equal footing and these differences were associated with long-term academic outcomes. The study also contributes to our understanding of which immigrant and refugee children may be particularly at risk for low academic achievement upon school entry and most importantly, over time. Well-designed early interventions that consider the diverse needs and experiences of immigrant and refugee children will help to ensure that all children who migrate have an equal chance of academic success over the long-term.

References

- Anderson, A., Anderson, J., & Shapiro, J. (2005). Supporting multiple literacies: Parents' and children's mathematical talk within storybook reading. *Mathematics Education Research Journal*, *16*, 5–26. <http://dx.doi.org/10.1007/BF03217399>
- BC MED. (2014). *British Columbia Ministry of Education school data*. Retrieved from <https://www.popdata.bc.ca/data/childhood/MED>
- BC Ministry of Education. (2019). *Foundation Skills Assessment (FSA) Province of British Columbia*. Retrieved from <https://www2.gov.bc.ca/gov/content/education-training/k-12/administration/program-management/assessment/foundation-skills-assessment>
- BC MOH. (2015). *British Columbia Ministry of Health Consolidation Files (MSP Registration & Premium Billing) [2014]*. Retrieved from <http://www.popdata.bc.ca/data>
- Berry, J. (2006). Stress perspectives on acculturation. In J. Berry & D. Sam (Eds.), *Cambridge handbook of acculturation psychology* (pp. 43–57). New York, NY: Cambridge University Press. <http://dx.doi.org/10.1017/CBO9780511489891.007>
- Brinkman, S., Gregory, T., Harris, J., Hart, B., Blackmore, S., & Janus, M. (2013). Associations between the early development instrument at age 5, and reading and numeracy skills at ages 8, 10 and 12: A prospective linked data study. *Child Indicators Research*, *6*, 695–708. <http://dx.doi.org/10.1007/s12187-013-9189-3>
- Bronfenbrenner, U., & Morris, P. (2006). The bioecological model of human development. In W. Damon & M. Lerner (Eds.), *Handbook of child psychology: Vol. 1. Theoretical models of human development* (6th ed., pp. 793–828). Hoboken, NJ: Wiley.
- Browne, D., Wade, M., Prime, H., & Jenkins, J. (2018). School readiness amongst urban Canadian families: Risk profiles and family mediation. *Journal of Educational Psychology*, *110*, 133–146. <http://dx.doi.org/10.1037/edu0000202>
- Buchmann, C., DiPrete, T., & McDaniel, A. (2008). Gender inequalities in education. *Annual Review of Sociology*, *34*, 319–337. <http://dx.doi.org/10.1146/annurev.soc.34.040507.134719>
- Caprara, G. V., Barbaranelli, C., Pastorelli, C., Bandura, A., & Zimbardo, P. G. (2000). Prosocial foundations of children's academic achievement. *Psychological Science*, *11*, 302–306. <http://dx.doi.org/10.1111/1467-9280.00260>
- Claessens, A., & Engel, M. (2013). How important is where you start? Early mathematics knowledge and later school success. *Teachers College Record*, *115*, 1–29.
- Cohen, J. (1992). A power primer. *Psychological Bulletin*, *112*, 155–159. <http://dx.doi.org/10.1037/0033-2909.112.1.155>
- Collie, R. J., Martin, A. J., Nassar, N., & Roberts, C. L. (2019). Social and emotional behavioral profiles in kindergarten: A population-based latent profile analysis of links to socio-educational characteristics and later achievement. *Journal of Educational Psychology*, *111*, 170–187. <http://dx.doi.org/10.1037/edu0000262>
- Crosnoe, R. (2006). Health and the education of children from racial/ethnic minority and immigrant families. *Journal of Health and Social Behavior*, *47*, 77–93. <http://dx.doi.org/10.1177/002214650604700106>
- Crosnoe, R., & Turley, R. N. (2011). K-12 educational outcomes of immigrant youth. *The Future of Children*, *21*, 129–152. <http://dx.doi.org/10.1353/foc.2011.0008>
- Davies, S., Janus, M., Duku, E., & Gaskin, A. (2016). Using the Early Development Instrument to examine cognitive and non-cognitive school readiness and elementary student achievement. *Early Childhood Research Quarterly*, *35*, 63–75. <http://dx.doi.org/10.1016/j.ecresq.2015.10.002>
- Denham, S. A. (2006). Social-emotional competence as support for school readiness: What is it and how do we assess it? *Early Education and Development*, *17*, 57–89. http://dx.doi.org/10.1207/s15566935eed1701_4
- Diamond, A. (2010). The evidence base for improving school outcomes by addressing the whole child and by addressing skills and attitudes, not just content. *Early Education and Development*, *21*, 780–793. <http://dx.doi.org/10.1080/10409289.2010.514522>
- Duncan, G. J., Dowsett, C. J., Claessens, A., Magnuson, K., Huston, A. C., Klebanov, P., . . . Japel, C. (2007). School readiness and later achievement. *Developmental Psychology*, *43*, 1428–1446. <http://dx.doi.org/10.1037/0012-1649.43.6.1428>
- Durlak, J. A., Weissberg, R. P., Dymnicki, A. B., Taylor, R. D., & Schellinger, K. B. (2011). The impact of enhancing students' social and emotional learning: A meta-analysis of school-based universal interventions. *Child Development*, *82*, 405–432. <http://dx.doi.org/10.1111/j.1467-8624.2010.01564.x>
- Entwisle, D. R., Alexander, K. L., & Olson, L. S. (1997). *Children, schools, and inequality*. Boulder, CO: Westview Press.
- Entwisle, D. R., Alexander, K. L., & Olson, L. S. (2005). First grade and educational attainment by age 22: A new story. *American Journal of Sociology*, *110*, 1458–1502. <http://dx.doi.org/10.1086/428444>
- Fazel, M., Wheeler, J., & Danesh, J. (2005). Prevalence of serious mental disorder in 7000 refugees resettled in western countries: A systematic review. *Lancet*, *365*, 1309–1314. [http://dx.doi.org/10.1016/S0140-6736\(05\)61027-6](http://dx.doi.org/10.1016/S0140-6736(05)61027-6)
- Frankfurt, S., Frazier, P., Syed, M., & Jung, K. R. (2016). Using group-based trajectory and growth mixture modeling to identify classes of change trajectories. *The Counseling Psychologist*, *44*, 622–660. <http://dx.doi.org/10.1177/0011000016658097>
- Fulgini, A. J. (1997). The academic achievement of adolescents from immigrant families: The roles of family background, attitudes, and behavior. *Child Development*, *68*, 351–363.
- Fulgini, A. J. (1998). The adjustment of children from immigrant families. *Current Directions in Psychological Science*, *7*, 99–103. <http://dx.doi.org/10.1111/1467-8721.ep10774731>
- Gagné, M., Janus, M., Milbrath, C., Gadermann, A., & Guhn, M. (2018). Early emotional and communication functioning predicting the academic trajectories of refugee children in Canada. *Educational Psychology*, *38*, 1050–1067. <http://dx.doi.org/10.1080/01443410.2018.1475627>
- Gagné, M., Janus, M., Muhajarine, N., Gadermann, A., Duku, E., Milbrath, C., . . . Guhn, M. (2020). Disentangling the role of income in the academic achievement of migrant children. *Social Science Research*, *85*, 102344. <http://dx.doi.org/10.1016/j.ssresearch.2019.102344>
- Gagné, M., Schonert-Reichl, K., Costigan, C., Guhn, M., & Shapka, J. D. (2019). Factors predicting the stratified academic achievement trajectories of foreign-born Canadian adolescents: A population-based study. *Applied Developmental Science*, *23*, 255–272. <http://dx.doi.org/10.1080/10888691.2017.1418668>
- García Coll, C., Lamberty, G., Jenkins, R., McAdoo, H. P., Crnic, K., Wasik, B. H., & Vázquez García, H. (1996). An integrative model for the study of developmental competencies in minority children. *Child Development*, *67*, 1891–1914. <http://dx.doi.org/10.2307/1131600>
- García Coll, C. T., & Marks, A. K. (2012). *The immigrant paradox in children and adolescents: Is becoming American a developmental risk?*

- (1st ed.). Washington, DC: American Psychological Association <http://dx.doi.org/10.1037/13094-000>
- García-Vázquez, E., Vázquez, L. A., López, I. C., & Ward, W. (1997). Language proficiency and academic success: relationships between proficiency in two languages and achievement among Mexican American students. *Bilingual Research Journal*, *21*, 395–408. <http://dx.doi.org/10.1080/15235882.1997.10162712>
- Geva, E., Yaghoub-Zadeh, Z., & Schuster, B. (2000). Understanding individual differences in word recognition skills of ESL children. *Annals of Dyslexia*, *50*, 123–154.
- Guhn, M., Gadermann, A., & Zumbo, B. D. (2007). Does the EDI measure school readiness in the same way across different groups of children? *Early Education and Development*, *18*, 453–472. <http://dx.doi.org/10.1080/10409280701610838>
- Guhn, M., Milbrath, C., & Hertzman, C. (2016). Associations between child home language, gender, bilingualism and school readiness: A population-based study. *Early Childhood Research Quarterly*, *35*, 95–110. <http://dx.doi.org/10.1016/j.ecresq.2015.11.003>
- Han, W.-J. (2008). The academic trajectories of children of immigrants and their school environments. *Developmental Psychology*, *44*, 1572–1590. <http://dx.doi.org/10.1037/a0013886>
- Harker, K. (2001). Immigrant generation, assimilation, and adolescent psychological well-being. *Social Forces*, *79*, 969–1004. <http://dx.doi.org/10.1353/sof.2001.0010>
- HELP. (2014). *Human Early Learning Partnership (HELP)–Early development instrument*. Retrieved from <http://www.popdata.bc.ca/data>
- Heptinstall, E., Sethna, V., & Taylor, E. (2004). PTSD and depression in refugee children: Associations with pre-migration trauma and post-migration stress. *European Child & Adolescent Psychiatry*, *13*, 373–380. <http://dx.doi.org/10.1007/s00787-004-0422-y>
- Hulslander, J., Olson, R. K., Willcutt, E. G., & Wadsworth, S. J. (2010). Longitudinal stability of reading-related skills and their prediction of reading development. *Scientific Studies of Reading*, *14*, 111–136. <http://dx.doi.org/10.1080/10888431003604058>
- Hwang, W.-C., & Wood, J. J. (2009). Acculturative family distancing: Links with self-reported symptomatology among Asian Americans and Latinos. *Child Psychiatry and Human Development*, *40*, 123–138. <http://dx.doi.org/10.1007/s10578-008-0115-8>
- Immigration, Refugees, and Citizenship Canada. (2017). *Immigration, Refugees, and Citizenship Canada, Departmental Plan 2017–2018* (No. Cat. no. Ci1-27E-PDF). Retrieved from <https://www.canada.ca/content/dam/ircc/migration/ircc/english/pdf/pub/dp-pm-2017-2018-eng.pdf>
- IRCC. (2014). *Immigration, Refugees, and Citizenship Canada (IRCC) Permanent Residents File*. Retrieved from <http://www.popdata.bc.ca/data>
- Janus, M., Brinkman, S. A., & Duku, E. K. (2011). Validity and psychometric properties of the early development instrument in Canada, Australia, United States, and Jamaica. *Social Indicators Research*, *103*, 283–297. <http://dx.doi.org/10.1007/s11205-011-9846-1>
- Janus, M., & Duku, E. (2007). The school entry gap: Socioeconomic, family, and health factors associated with children's school readiness to learn. *Early Education & Development*, *18*, 375–403.
- Janus, M., & Offord, D. R. (2007). Development and psychometric properties of the Early Development Instrument (EDI): A measure of children's school readiness. *Canadian Journal of Behavioural Science/Revue Canadienne Des Sciences Du Comportement*, *39*, 1–22.
- Jennings, C. M., Jennings, J. E., Richey, J., & Dixon-Krauss, L. (1992). Increasing interest and achievement in mathematics through children's literature. *Early Childhood Research Quarterly*, *7*, 263–276. [http://dx.doi.org/10.1016/0885-2006\(92\)90008-M](http://dx.doi.org/10.1016/0885-2006(92)90008-M)
- Jones, B. L., & Nagin, D. (2007). Advances in group-based trajectory modeling and an SAS procedure for estimating them. *Sociological Methods & Research*, *35*, 542–571. <http://dx.doi.org/10.1177/0049124106292364>
- Kao, G., & Tienda, M. (1995). Optimism and achievement: The educational performance of immigrant youth. *Social Science Quarterly*, *76*, 1–19.
- Kieffer, M. J. (2008). Catching up or falling behind? Initial English proficiency, concentrated poverty, and the reading growth of language minority learners in the United States. *Journal of Educational Psychology*, *100*, 851–868. <http://dx.doi.org/10.1037/0022-0663.100.4.851>
- Klijn, S. L., Weijenberg, M. P., Lemmens, P., van den Brandt, P. A., & Lima Passos, V. (2017). Introducing the fit-criteria assessment plot—A visualisation tool to assist class enumeration in group-based trajectory modelling. *Statistical Methods in Medical Research*, *26*, 2424–2436. <http://dx.doi.org/10.1177/0962280215598665>
- La Paro, K. M., & Pianta, R. C. (2000). Predicting children's competence in the early school years: A meta-analytic review. *Review of Educational Research*, *70*, 443–484. <http://dx.doi.org/10.3102/00346543070004443>
- Lesaux, N. K., Rupp, A. A., & Siegel, L. S. (2007). Growth in reading skills of children from diverse linguistic backgrounds: Findings from a 5-year longitudinal study. *Journal of Educational Psychology*, *99*, 821–834. <http://dx.doi.org/10.1037/0022-0663.99.4.821>
- Leventhal, T., Xue, Y., & Brooks-Gunn, J. (2006). Immigrant differences in school-age children's verbal trajectories: A look at four racial/ethnic groups. *Child Development*, *77*, 1359–1374. <http://dx.doi.org/10.1111/j.1467-8624.2006.00940.x>
- Lloyd, J. E. V. (2010). Construct commensurability and the analysis of change. *Educational and Psychological Measurement*, *70*, 252–266. <http://dx.doi.org/10.1177/0013164409355689>
- Magnuson, K., Lahaie, C., & Waldfogel, J. (2006). Preschool and school readiness of children of immigrants. *Social Science Quarterly*, *87*, 1241–1262. <http://dx.doi.org/10.1111/j.1540-6237.2006.00426.x>
- Mancilla-Martinez, J., & Lesaux, N. K. (2017). Early indicators of later English reading comprehension outcomes among children from Spanish-speaking homes. *Scientific Studies of Reading*, *21*, 428–448. <http://dx.doi.org/10.1080/10888438.2017.1320402>
- Marks, A. K., Ejesi, K., & García Coll, C. (2014). Understanding the U.S. immigrant paradox in childhood and adolescence. *Child Development Perspectives*, *8*, 59–64. <http://dx.doi.org/10.1111/cdep.12071>
- Masten, A. S. (2015). *Ordinary magic: Resilience in development*. New York, NY: Guilford Press.
- Masten, A. S., & Coatsworth, J. D. (1998). The development of competence in favorable and unfavorable environments. Lessons from research on successful children. *American Psychologist*, *53*, 205–220. <http://dx.doi.org/10.1037/0003-066X.53.2.205>
- McAndrew, M. (2009). *Educational pathways and academic performance of youth of immigrant origin: Comparing Montreal*. Toronto, Vancouver, Canada: Canadian Council on Learning.
- Milbrath, C., & Guhn, M. (2019). Neighbourhood culture and immigrant children's developmental outcomes at kindergarten. *Early Childhood Research Quarterly*, *48*, 198–214.
- Miller, P., Votruba-Drzal, E., & Coley, R. L. (2013). Predictors of early care and education type among preschool-aged children in immigrant families: The role of region of origin and characteristics of the immigrant experience. *Children and Youth Services Review*, *35*, 1342–1355. <http://dx.doi.org/10.1016/j.childyouth.2013.04.024>
- Nagin, D. (2005). *Group-based modeling of development*. Cambridge, MA: Harvard University Press. <http://dx.doi.org/10.4159/9780674041318>
- Nagin, D. S., & Odgers, C. L. (2010). Group-based trajectory modeling in clinical research. *Annual Review of Clinical Psychology*, *6*, 109–138. <http://dx.doi.org/10.1146/annurev.clinpsy.121208.131413>
- Oberle, E., Schonert-Reichl, K. A., Hertzman, C., & Zumbo, B. D. (2014). Social-emotional competencies make the grade: Predicting academic success in early adolescence. *Journal of Applied Developmental Psychology*, *35*, 138–147. <http://dx.doi.org/10.1016/j.appdev.2014.02.004>
- Palacios, N., Guttmannova, K., & Chase-Lansdale, P. L. (2008). Early reading achievement of children in immigrant families: Is there an

- immigrant paradox? *Developmental Psychology*, 44, 1381–1395. <http://dx.doi.org/10.1037/a0012863>
- Paradis, J. (2011). Individual differences in child English second language acquisition: Comparing child-internal and child-external factors. *Linguistic Approaches to Bilingualism*, 1, 213–237. <http://dx.doi.org/10.1075/lab.1.3.01par>
- Paradis, J. (2016). The development of English as a second language with and without specific language impairment: Clinical implications. *Journal of Speech, Language, and Hearing Research*, 59, 171–182. http://dx.doi.org/10.1044/2015_JSLHR-L-15-0008
- Population Data BC. (2014). *The data linkage process*. Retrieved from <https://www.popdata.bc.ca/datalinkage/process>
- Rimm-Kaufman, S. E., & Pianta, R. C. (2000). An ecological perspective on the transition to kindergarten: A theoretical framework to guide empirical research. *Journal of Applied Developmental Psychology*, 21, 491–511. [http://dx.doi.org/10.1016/S0193-3973\(00\)00051-4](http://dx.doi.org/10.1016/S0193-3973(00)00051-4)
- Schafer, J. L., & Graham, J. W. (2002). Missing data: Our view of the state of the art. *Psychological Methods*, 7, 147–177. <http://dx.doi.org/10.1037/1082-989X.7.2.147>
- Shin, T., Davison, M. L., Long, J. D., Chan, C.-K., & Heistad, D. (2013). Exploring gains in reading and mathematics achievement among regular and exceptional students using growth curve modeling. *Learning and Individual Differences*, 23, 92–100.
- Sirin, S. R., Sin, E., Clingain, C., & Rogers-Sirin, L. (2019). Acculturative stress and mental health: Implications for immigrant-origin youth. *Pediatric Clinics of North America*, 66, 641–653. <http://dx.doi.org/10.1016/j.pcl.2019.02.010>
- Smeeding, T. M., Robson, K., Wing, C., & Gershuny, J. I. (2012). Income poverty and income support for minority and immigrant households with children in rich countries. In A. S. Masten, K. Liebkind, & D. J. Hernandez (Eds.), *Realizing the potential of immigrant youth* (pp. 63–89). Cambridge, UK: Cambridge University Press. <http://dx.doi.org/10.1017/CBO9781139094696.005>
- Statistics Canada. (Ed.). (2013). *Census of Canada, 2011. Postal code conversion file*. Retrieved from <http://abacus.library.ubc.ca>
- Stewart, J. (2011). *Supporting refugee children: Strategies for educators*. North York, Ontario, Canada: University of Toronto Press.
- Suárez-Orozco, C., Gaytán, F. X., Bang, H. J., Pakes, J., O'Connor, E., & Rhodes, J. (2010). Academic trajectories of newcomer immigrant youth. *Developmental Psychology*, 46, 602–618. <http://dx.doi.org/10.1037/a0018201>
- Suárez-Orozco, C., Motti-Stefanidi, F., Marks, A., & Katsiaficas, D. (2018). An integrative risk and resilience model for understanding the adaptation of immigrant-origin children and youth. *American Psychologist*, 73, 781–796. <http://dx.doi.org/10.1037/amp0000265>
- Suárez-Orozco, C., & Qin, D. B. (2006). Gendered perspectives in psychology: Immigrant origin youth. *The International Migration Review*, 40, 165–198. <http://dx.doi.org/10.1111/j.1747-7379.2006.00007.x>
- Suárez-Orozco, C., Rhodes, J., & Milburn, M. (2009). Unraveling the Immigrant Paradox: Academic Engagement and Disengagement Among Recently Arrived Immigrant Youth. *Youth & Society*, 41, 151–185. <http://dx.doi.org/10.1177/0044118X09333647>
- Suárez-Orozco, C., & Suárez-Orozco, M. M. (2001). *Children of immigration*. Cambridge, MA: Harvard University Press.
- Szalacha, L. A., Marks, A. K., Lamarre, M., & Coll, C. G. (2005). Academic pathways and children of immigrant families. *Research in Human Development*, 2, 179–211. http://dx.doi.org/10.1207/s15427617rhd0204_2
- Turney, K., & Kao, G. (2012). Behavioral outcomes in early childhood: Immigrant paradox or disadvantage? In C. T. García Coll & A. K. Marks (Eds.), *The immigrant paradox in children and adolescents: Is becoming american a developmental risk?* (pp. 79–107). Washington, DC: American Psychological Association. <http://dx.doi.org/10.1037/13094-004>
- Votruba-Drzal, E., Coley, R. L., Collins, M., & Miller, P. (2015). Center-based preschool and school readiness skills of children from immigrant families. *Early Education and Development*, 26, 549–573. <http://dx.doi.org/10.1080/10409289.2015.1000220>

Appendix A

Study Score Means and Standard Deviations From Kindergarten to Grade 10 for the Study Cohort of Immigrant and Refugee Children (N = 9,216)

Domain	Kindergarten	Grade 4	Grade 7	Grade 10
	<i>M</i> (<i>SD</i>)			
Literacy	−0.03 (1.00)	.03 (1.02)	.09 (.97)	.08 (1.01)
Numeracy	−0.11 (1.13)	.09 (1.04)	.08 (1.04)	.26 (1.03)
Social-emotional	−0.09 (1.01)	—	—	—

Note. Mean scores in this table for the study cohort were first z-standardized based upon the full population mean. Scores above and below zero indicate scores that are higher and lower than the population mean, respectively.

(Appendices continue)

Appendix B

Fit Information Used to Decide Optimal Number of Trajectory Groups for the Literacy and Numeracy Models

Number of groups	BIC	BIC ²	AIC	L	Avg posterior probability (AvePP)	Smallest group size
Literacy						
2 groups	-35200.31	-35203.44	-35178.93	-35172.93	.88	4049
3 groups	-34696.24	-34700.94	-34664.16	-34655.16	.84	991
4 groups	-34165.78	-34172.05	-34123.01	-34111.01	.86	433
5 groups	-34094.70	-34102.53	-34041.23	-34026.23	.81	196
6 groups	-33970.22	-33979.62	-33906.06	-33888.06	.79	150
7 groups	-33952.46	-33963.43	-33877.61	-33856.61	.78	85
8 groups	-33948.65	-33961.18	-33863.11	-33839.11	.73	90
Numeracy						
2 groups	-32954.50	-32957.51	-32933.12	-32927.12	.93	4063
3 groups	-32063.14	-32067.64	-32031.06	-32022.06	.86	2315
4 groups	-31866.63	-31872.63	-31823.86	-31811.86	.80	1317
5 groups	-31711.45	-31718.96	-31657.99	-31642.99	.77	473
6 groups	-31650.33	-31659.34	-31586.18	-31568.18	.73	550
7 groups	-31600.38	-31610.89	-31525.54	-31504.54	.74	52
8 groups	-31602.96	-31614.96	-31497.39	-31493.42	.69	51

Note. Values reflect the unconditional models (i.e., prior to including predictor variables). Bold values represent the final selected models. In all cases, the BIC scores reflect the use of linear polynomial terms. BIC = Bayesian information criterion; AIC = Akaike's information criterion; L = likelihood of the model.

Received January 21, 2020
Revision received May 28, 2020
Accepted July 16, 2020 ■