Executive Summary

Background

Children's school readiness has long been of interest to policymakers, educators and early childhood practitioners. Children enter school with a range of academic and social skills, with children from disadvantaged backgrounds (e.g., low-income and/or single parent households) lagging behind their more affluent peers on a range of outcomes(Brooks-Gunn & Duncan, 1997; Lee & Burkham, 2002; Reardon, 2011). This gap in school readiness emerges early, is evident even before kindergarten (Fryer & Levitt, 2004; Halle et al., 2009), and is predictive of academic trajectories through later schooling (Entwisle & Alexander, 1999). Concerns about these disparities in skills have focused state and federal efforts on initiatives to improve young children's school readiness, such as through early care and education programs including Head Start, child care and public pre-kindergarten. These initiatives have also led to a proliferation of state early learning guidelines and kindergarten readiness assessments aimed at articulating and evaluating the set of skills and competencies young children need to prepare them for the increased challenges and demands of kindergarten and to succeed in later schooling (Scott-Little, Lesko, Martella, & Milburn, 2007; Stedron & Berger, 2010). Yet, the evidence base available to identify what these guidelines and standards should look like is quite thin. Despite theoretical reasons to believe that early skills are the foundation for later success, few studies have offered more than a piecemeal view of the relationship between specific school readiness skills and later academic, social and emotional outcomes. Research has not clearly articulated what children should know and be able to do by the time they reach kindergarten in order to participate in and benefit from learning in kindergarten and subsequent grades.

Research Questions and Methods

In 2009, the Office of the Assistant Secretary for Planning and Evaluation (ASPE) of the U.S. Department of Health and Human Services funded Child Trends to conduct a review of the literature as well as plan and execute secondary data analyses to examine whether there is evidence of thresholds of school readiness which, when attained, predict skill acquisition in later schooling. This project, entitled *In the Running for Successful Outcomes: Early Education, Care and Comprehensive Services* , focused on understanding what children need to know and be able to do at the start of school in order to be "in the running" for long-term success. The overarching research questions of interest that motivated this project included:

- Are there particular school readiness skills or a level of development that children need to attain in early childhood in order to meet later measures of success?
- Do outcomes in elementary or later schooling depend on the school readiness skills and competencies in various domains at entry to school?

In order to address these questions the study team analyzed two national datasets and employed various methods. The data sets utilized for the analysis were the National Institute of Child Health and Human Development's Study of Early Child Care and Youth Development (NICHD SECCYD) and the Early Childhood Longitudinal Study – Kindergarten Class of 1998-99 (ECLS-K). These data sets were chosen

because of their nationally representative longitudinal data and the available measures in the domains of interest. While these were the best data sources available for these analyses, the extant measures were not ideal and several subpopulations including children who could not be assessed in English were omitted. Therefore, the results, while informative, should not be interpreted as definitive. Two different approaches were used to characterize school readiness and two different approaches were used to characterize success in school. These are represented in Table 1, and described in more detail below.

Table 1. Analytic approaches for characterizing school readiness skills and school outcomes in the *In the Running* project

Analytic Approach: School Readiness Skills	Representation of "thresholds" of School Readiness Skills in Analyses	Analytic Approach: School-age Outcomes
Person-centered	Latent Profiles	**Longitudinal: Growth curve analysis of academic and behavioral skills**
Variable-centered	Nonlinear (linear and quadratic) of individual school readiness skills Piecewise spline of individual school readiness skills	**Retrospective: Fifth grade status in terms of being "in the running"**

School readiness was examined through two approaches: person-centered and variable-centered. The school readiness skills included in all analyses included measures of language or general knowledge, reading, math, attention, social skills, behavior problems, and health scores at kindergarten entry. These were chosen because each is believed to play an important role in school success (Kagan, Moore, & Bradekamp, 1995; Scott-Little, et al., 2007; Stedron & Berger, 2010).

Latent profile analyses were used for the person-centered approach. Latent profile analysis seeks to identify individual children with similar combinations of skills; individuals with similar combinations of school readiness skills are members of the same "profile." The latent profile analyses began with a determination of the groups or profiles of school readiness in the ECLS-K and NICHD SECCYD datasets. In this step, a statistical analysis allowed the individual children to be sorted into groups that were similar in terms of their combination of school readiness skills. The complex regressions conducted as part of the latent profile analysis for the *In the Running* project found four profiles of children in both the ECLS-K and NICHD SECCYD datasets. In other words, analyses identified four groups of children, with each group representing a different profile of strengths and weaknesses in school readiness skills. This approach tested for thresholds by asking whether the profiles showed different patterns of school-age outcomes. Specifically, latent growth curve analyses were used to look at the longitudinal predictions from the latent profiles to the school-age outcomes. The models included demographic and sampling characteristics and child gender and age as covariates.

For the variable-centered approach, the school readiness variables were entered into the analytic models separately first and together second. The models included demographic and sampling characteristics and child gender and age as covariates. The school readiness skills were examined both individually and simultaneously because they were moderately to highly correlated. Accordingly, analyses that included a single school readiness skill asked whether that entry skill predicted subsequent academic and behavioral skills during the school years, while the analyses that included all school readiness skills allowed for the identification of the strongest predictor of school success across the set of school readiness skills. The threshold question was examined by testing whether there were nonlinear associations using a quadratic model to identify a threshold and by setting a threshold and then asking if associations between school entry skills and subsequent school outcomes was different depending on whether the child was above or below the conceptually-determined threshold.

The school-age outcomes were also analyzed in two different ways. Most analyses involved fitting growth curves to the selected outcomes: reading, math, social skills, and behavior problems. Models allowed for nonlinear change during elementary school through middle school in the ECLS-B and high school in the SECCYD. Specifically, quadratic group growth curves and linear individual curves were estimated for each outcome. The quadratic group model allowed for changes in the magnitude in the rate of change over time. Both latent growth curve and hierarchical linear model analyses were conducted, but the individual growth curves would be estimated in the same manner using the two approaches (Burchinal, Nelson, & Poe, 2006).

In addition, as a follow-up analysis, we examined outcomes in fifth grade to determine whether children seemed to be "in the running" at that point. The process used to determine whether children seemed to be in the running at fifth grade is described below.

Four research questions were developed to look for evidence of developmental thresholds in different ways. Table 2 below introduces the four research questions and the analytic method with which it was paired.

Table 2. Research questions and corresponding analytic approaches for the *In the Running* project

Research Question	Analytic Approach
1. Do children who show qualitatively different patterns of school readiness skills have qualitatively different trajectories of performance on academic and social outcomes during elementary school?	Latent profiles of school readiness variables-Longitudinal latent growth curve analysis of school-age outcomes
2. Are there non-linear associations between school readiness skills and subsequent developmental trajectories for academic and social outcomes	Quadratic analyses of school readiness variables -Longitudinal hierarchical linear modeling of

	during elementary school?	school-age outcomes
3.	Do children who are in the low and normal range in school readiness skills differ in terms of their developmental trajectories for academic and social outcomes during elementary school?	Piecewise analyses of school readiness variables –Longitudinal hierarchical linear modeling of school-age outcomes
4.	Do children who have qualitatively different patterns of school readiness skills differ in their likelihood of success based on our categorization of their fifth grade academic and social skills?	Latent profiles of school readiness variables –Related to fifth grade *status*

Below is a more detailed explanation of the four types of analyses used to address the respective research questions. Following the methodological explanations are a descriptions of the results of each analysis.

Latent Profile Analyses - Longitudinal Analysis of School Outcomes

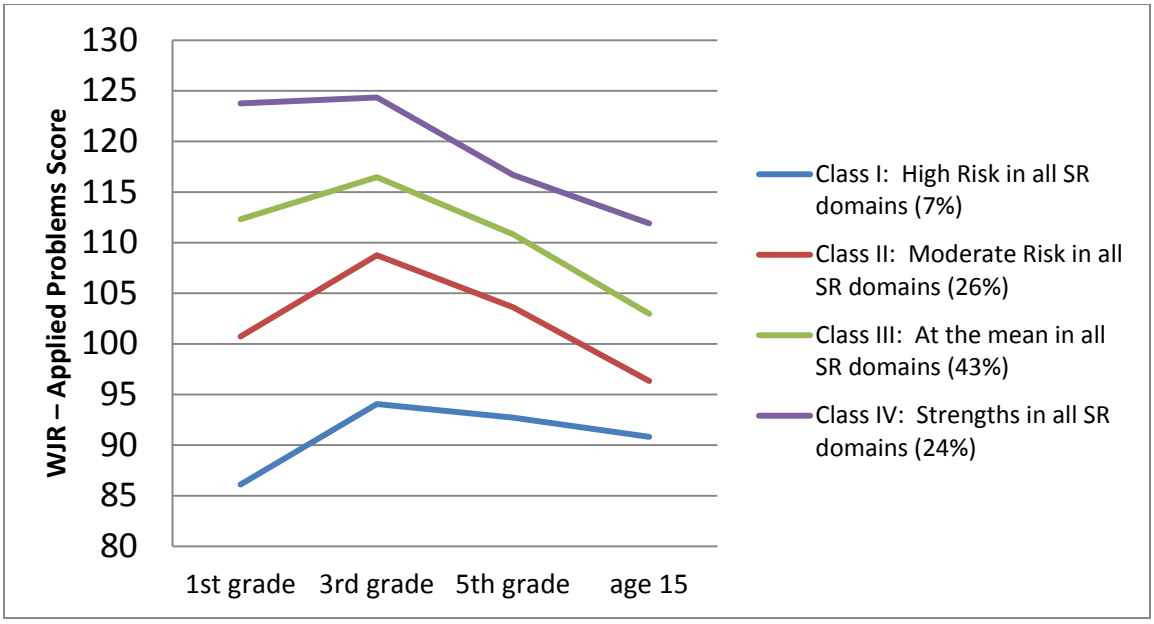
Latent profile analysis and latent growth modeling were used to investigate the first research question – whether children with qualitatively different patterns of school readiness skills have qualitatively different academic and social trajectories in later elementary school. The latent profiles identified four distinct groups of children on their school readiness skills. Subsequent growth curve analyses helped to determine whether individuals with different profiles of readiness at kindergarten entry were similar or different on measures of academic achievement and behavior at spring of kindergarten or in terms of patterns of growth over time (i.e., first grade through middle school).

Using the distinct profile groups of children determined by the latent profile analyses, growth curve analyses were completed to see whether qualitatively different patterns of school readiness predicted to qualitatively different patterns or trajectories of child development over time. Growth curve analysis allowed researchers to look for change (in this case change in child cognitive, social-emotional, and behavioral skills) over time that may not be steadily changing (linear) in pattern. For example, children with a certain profile of skills may have shown very rapid growth in behavioral skills at kindergarten entry and then shown a slowing of their acquisition of these skills in later elementary school; growth curve analysis could show these temporal changes. These analyses allowed for nonlinear change over time in school-age outcomes. We were interested in whether children with different profiles on their school readiness skills would differ in terms of their skills at 15 years of age or in the rates of change over time in their skills.

Overall, results of these analyses indicated that the rank ordering of the profiles from the profile representing the highest levels of skills to the profile representing the lowest level of skills

tended to be maintained over time in children's acquisition of reading and math skills and in teacher ratings of social skills. The rank ordering of the profiles with regard to rate of problem behaviors was in the reverse order, with the profile representing the highest level of skill at kindergarten entry having the lowest ratings of problem behaviors over time. The rates of change over time were slightly higher in the lower profiles. Figure 1 shows the estimated math growth curves in the SECCYD sample for the four latent profiles, illustrating these findings of preservation of relative rank order over time of the latent profiles while showing slightly faster acquisition of math skills in the profile representing the lowest level of skills at kindergarten entry (i.e., Class I).

Figure 1. Developmental trajectories for math from the first grade to age 15 by school readiness profile in NICHD SECCYD



Source: NICHD SECCYD dataset

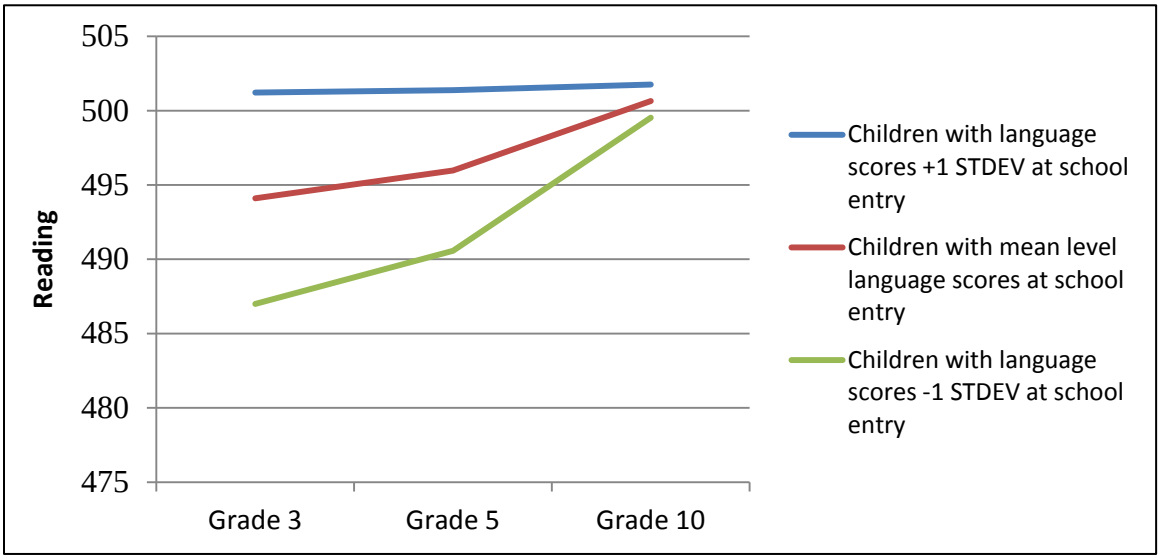
Quadratic Analyses – Longitudinal Analysis of School Outcomes

While the previous set of analyses looked at how school readiness skills grouped together within individuals (a person-centered approach) to predict differential outcomes over time, this set of analyses looked at how school readiness measures, considered singly and together (from a variable-centered approach), predicted later outcomes. In order to examine thresholds, operationalized as any potential non-linear associations between school readiness skills and later social and academic developmental trajectories, school readiness skills – either individually or together – were used as predictors in HLM growth curve analyses of school-aged achievement and behavior. Instead of looking for a linear relationship between school readiness skills and later outcomes (that is, instead of assuming that an incremental increase in a particular skill resulted in the same incremental increase in skills later on), this analysis tested for non-linear relationships between early and later skill development. Using both the school

readiness variable as a linear and quadratic predictor allowed for an estimation of a threshold if the quadratic term was significant.

Overall, these analyses supported the conclusions from the analyses involving the latent profiles. Children who entered school with higher skill levels on language, academic, attention and social skills tended to maintain that advantage over time, but children who entered school with lower skill levels tended to show slightly larger gains over time. Analyses that included all school readiness variables together suggested within-domain prediction was the strongest (e.g., entry skill levels in math were the strongest predictors of later math skills – especially when the same measure was used over time). Aside from within-domain prediction, language and general knowledge tended to provide the best prediction of school-age academic skills while attention tended to provide the best prediction of school-age behavior. No evidence of thresholds emerged that indicated that children who entered with a certain skill level showed more rapid gains during the school years. These findings are illustrated below, showing the predicted regression line for children who entered school with language skills one standard deviation below the mean, at the mean, and one standard deviation above the mean (please note that preschool language skill was entered as a continuous variable so as to plot only three of the possible estimated curves, with the number of curves determined by the number of different language scores in the sample).

Language skills' association with reading skill growth over time



Source: NICHD SECCYD dataset

Piecewise Analyses - Longitudinal Analysis of School Outcomes

The analyses designed to address the third research question involved fitting a piecewise regression model to examine whether and how children's performance at the beginning of kindergarten predicted later outcomes in elementary school in both the NICHD SECCYD and the

ECLS-K data sets. Piecewise analysis allowed school readiness skills to predict school-age trajectories differently for children above and below a specific skill level at entry to school.

Thus, for the piecewise analysis, two groups were created for each school readiness variable:

- Children in the "low range" on a school readiness skill (i.e., those who scored more than one standard deviation below the mean on the school readiness variable), and
- Children in the "normal range" on a school readiness skill (i.e., those who scored at or above one standard deviation below the mean on the school readiness variable).[1]

Performing one standard deviation below the mean was chosen as the cut point differentiating the "normal" and "low" groups as it is a widely accepted marker of being in an at-risk range of performance on a measure (for example, the Achenbach Child Behavior Checklist). The piecewise analyses allowed each school readiness variable to predict the level and rate of change over time in school-age outcomes differently for children in the low group and the normal group. One example of a threshold would involve stronger prediction from readiness skills to either the level or rate of change over time in school-age skills for children in the normal than the low range.

Overall, findings suggested that the prediction from school readiness skills to the overall level of school-age skills was stronger among children in the "normal range" of performance at kindergarten entry, but that prediction from school readiness skills to rates of change overall time in school-age outcomes was stronger among children in the "low range" of performance at kindergarten entry. The same findings regarding which school readiness skills provided the best prediction of each of the school-age outcomes obtained was the same as in these analyses reported above.

Latent Profile Analyses - Regression Analysis of the Fifth Grade Definition of In the Running

In a separate but related set of analyses, "In the Running" was defined as the children's status during fifth grade instead of the children's status at school entry. The rationale here was to see if indicators at this later stage of elementary school performance that are linked to academic and life success (e.g., graduating from high school) had correlates at kindergarten entry. A review of the literature indicated that school-level factors (such as peer interactions, extracurricular activities, small class size, relationships with teachers, parent involvement) and individual-level factors (such as good school attendance, early academic success, and low rates of internalizing and externalizing behaviors) were key predictors of high school completion (Cairns & Cairns, 1994; Dotterer, McHale, & Crouter, 2007; Duchesne, Vitaro, Larose, & Tremblay, 2008; Finn, Gerber, & Boyd-Zaharis, 2005; Jimerson, Egeland, Sroufe, & Carlson, 2000; Kokko, Tremblay, Lacourse, Nagin, & Vitaro, 2006; North Carolina Family Impact Seminar, 2008;

[1] One standard deviation above the mean was used for behavior problems.

Reynolds, Temple, Robertson, & Mann, 2001; Rumberger & Lim, 2008; Temple, Reynolds, & Miedel, 2000; Vitaro, Brendgen, Larose, & Tremblay, 2005).[2]

Regression analysis was employed to examine the prediction of children's performance in fifth grade from their school entry skills. Two methods were used to create the "In the Running" (ITR) indices using data from the fifth grade data wave of the ECLS-K—an "empirical" and a "conceptual" method. As noted above, individual indicators were chosen based on a review of the literature on factors contributing to either staying in school or dropping out of school over time. For each method of creating the ITR index, the research team created continuous and binary versions of the variable. Three sub-domains of being "in the running" (cognitive, social, and engagement) were created by each method. The cognitive indicators of being "in the running" in fifth grade included direct child assessments of reading, math, and science skills, while the social indicators were child self-reports of peer relations and externalizing behavior problem, and the school engagement indicators were child self-reports of interest in school, school reports of total absences for the year, and whether the child was performing below, on or above grade level.

For the "empirical" method, a composite was constructed with principal component factor analysis, which weighted the contributions of individual indicators within the continuous factor. Then, logistic regression analyses used the kindergarten School Readiness profiles and covariates to predict the binary versions of the empirically-derived ITR indices for the full sample. For the "conceptual" method, an *a priori* cutpoint was determined for each individual indicator of being "in the running." Cutpoints were based on the research literature or were placed at 40% of the distribution, similar to what is considered "basic" performance on the National Assessment of Educational Progress (NAEP) exams.

Analyses asked whether the four latent profiles based on school readiness skills differed in terms of being in the running at fifth grade. Again, results suggested that the likelihood of being in the running at fifth grade according to these criteria reflected the average level of skills in each school readiness profile. As in previous analyses, the profile representing the highest levels of skills at kindergarten entry was more likely to be "in the running" at fifth grade than the profiles representing lower levels of skill at kindergarten entry, with the profile representing the lowest level of skills tending to be the least likely to be "in the running" at fifth grade.

Key Findings

This study represents a multi-method approach to examining the evidence for thresholds in the association between children's school readiness and subsequent academic, social and emotional outcomes, both within and across domains. Results across analyses suggested some, albeit limited,

[2] Some of the literature predicts high school dropout rather than high school completion. When this is the case, the reverse statement was used to indicate predictors of high school completion. For example, high levels of aggression and anxiety are positively correlated with high school dropout (Duchesne et al., 2008; Kokko et al., 2006; Vitaro et al., 2005).

support for thresholds of school readiness, but strong associations between school entry skills and later school outcomes.

There was no evidence of thresholds in school readiness skills above which children showed more rapid acquisition of skills during the school years. However, analyses provided some evidence of thresholds related to subsequent acquisition of skills among children who entered school with lower skill levels on the school readiness skills.

- None of the analyses showed any evidence of a "springboard effect" whereby above a threshold of school readiness children showed accelerated growth over time. This conclusion held whether looking at skill levels within individual school readiness domains or when looking at the patterns of skills at school entry across multiple domains.
- All of the longitudinal analyses indicated that children who perform at the lowest levels at kindergarten entry tended to show slightly larger gains over time than other children. These gains reduced the gap in school-age outcomes slightly, but did not result in "catch up" to their peers in absolute levels of performance. The accelerated growth among initially lower-performing children could be considered a threshold effect, albeit a very modest one.

There was evidence that entry skill levels predicted the level of skills during the school years.

- All of the longitudinal analyses indicated that children who entered with stronger school readiness skills tended to maintain their advantage over time, while children who entered with lower school readiness skills tended to maintain their relative disadvantage over time.
- The piecewise analyses suggested that school entry skills were stronger predictors of levels of school-age academic skills and behavior among children who entered school with skills in the "normal" range of performance than among children who entered school with skills in the "low" range of performance.

School readiness variables provided differential prediction of developmental outcomes.

- No single school readiness variable provided the best prediction of all school-age outcomes in any of the analyses.
- All analyses suggested within-domain prediction. For example, entry-level math skills provided the best prediction of subsequent math skills and entry-level social skills provided the best prediction of subsequent social skills.
- Aside from within-domain prediction, content-based skills (e.g., language and general knowledge) were the best predictors of academic skills later in elementary school, whereas social skills and process skills (e.g., approaches to learning and attention) were the best predictors of later behavioral skills.
- There was no compensatory nature between the school readiness domains and their associations with outcomes over time. The HLM and the latent profile analyses did not find evidence that stronger social-emotional skills compensated for weaker cognitive skills or that stronger cognitive skills compensated for weaker social skills.

Summary

Overall, the school readiness skills with which a child enters school do seem to matter in terms of level and rate of acquisition of academic and social skills during elementary school. The analyses presented in this study corroborated findings shown elsewhere: strong school readiness skills were associated with higher performance in later schooling, both for academic and behavioral outcomes, although there was no evidence that they showed faster acquisition of skills during the school years. But, the effects of early skills on later achievement were probabilistic, not deterministic; children with lower school entry skills were likely to show lower achievement later in school, but children with lower levels of entry skills showed slightly larger improvement over time than their peers with higher skills at school entry. Basically, these findings suggest that improving children's school readiness skills will benefit them no matter where they may be on the continuum. **Children do not need to reach the national average for achievement in order to be "in the running" for later school success, but the better a child's skills are when he or she enters school, the better his or her skills are likely to be in elementary school and beyond.**

This study shed new light on the concept of school readiness and its relationship with later outcomes. No one school readiness skill emerged as the strongest predictor of subsequent academic skills and behavior. Instead, not surprisingly, the skill levels within that domain provided good prediction of subsequent skills. Further, the findings indicated that it appears that children who enter school with both strong process skills such as attention and approaches to learning and strong content skills such as language and general knowledge skills are more likely to experience success in terms of both behavior and academic skills during their school years. **The fact that there was differential prediction from entry skills to later skills but no single school readiness skill emerged as the strongest predictor of both academic and behavioral outcomes emphasizes that children need to develop a constellation of school readiness skills in order to have a better chance of being successful in elementary school and beyond**. **Further, the findings may provide additional focus as practitioners, policy makers, and parents make decisions about early education.** The results suggest that a focus on improving content skills is more likely to translate into improved academic skills during the school years and a focus on improving social and process skills is more likely to translate into improved social skills during the school years.

Although there was no evidence that children with lower school-entry skills fully "catch up" to their higher-performing peers during the school years, the data did show some evidence of a reduction in the gap between children who start school with higher and lower skills. This suggests that school itself is likely a critically important intervention for the most at-risk children.

Limitations and Implications for Future Research

The findings of the *In the Running* project present important implications for early childhood research, policy, and practice. In particular, the results suggest that school entry skills are strongly connected to later achievement. However, while there was evidence of differential prediction among school readiness skills, there was no evidence of a specific skill level that young children need to reach in order to succeed

later in school. This importance of school readiness skills but lack of strong evidence for specific school readiness thresholds have significant implications for the goals early care and education programs set for children's growth and development, how State and Federal early childhood initiatives define what it means for children to be "school ready," and how early childhood progress and school readiness are measured. States can use these findings to support continuing efforts to improve children's skills in all domains before school entry and to reassess the appropriateness of their school readiness benchmarks and kindergarten entry assessments.

The *In the Running* project was exploratory and only a first step in looking at this important topic from a systematic, empirical standpoint. All analyses were conducted to describe association, not to estimate causal linkages. More research is needed that explores school readiness levels systematically so that policy and practice decisions can be made on sound research findings. This future research can collect data on more specialized measures of school entry skills, later development, and the measures and benchmarks used by states in their benchmarks or kindergarten entry assessments.

While the *In the Running* project represents a more complex and thorough investigation of school readiness thresholds and trajectories than had previously existed in the literature, the analysis was challenged by measurement issues. Most large-scale national surveys do not use criterion-based measures (i.e., those that measure a child's performance against a fixed or objective scale or benchmark as opposed to measuring their performance in the context of other children) which lend themselves better to cutpoint analyses and which are more similar to the types of measures states and school systems are using currently to assess children's skill levels in kindergarten. Finally, the measurements of the datasets relied heavily on subjective parent and teacher reports of the child's approach to learning and social skills as opposed to direct assessments. These reports tend to be less precise than the achievement, language, and attention assessments, in part because they are subject to respondent bias.

Although the secondary data analysis uncovered only limited evidence of school readiness thresholds needed to achieve later school success, the differential prediction to outcomes over time based on skill level at school entry still suggests important policy and practice implications.

- There was some evidence of a reduction in the gap between children who started school with higher and lower skills, but not strong evidence of "catch up" in terms of absolute level of performance. Schools can and do benefit children who enter kindergarten with low skill levels.
- The evidence suggested that children's later outcomes can be improved by increasing their school readiness skills, regardless of where they are in relation to the national average.
- There are long-term developmental benefits to helping children reach and exceed the "normal range" (i.e., at or above one standard deviation below the mean) at school entry. All children can grow and benefit from early care and education programs. The goal of these programs should be maximizing child growth before school entry rather than achieving specific skill thresholds.

Conclusion

The multiple analytic strategies employed as part of the *In the Running* project were primarily exploratory in nature and involved person-centered and variable-centered approaches to describing school readiness skills and longitudinal and retrospective analyses of school-age outcomes. Regardless of the analytic strategy, a single story emerged with a relatively similar pattern of results across two different datasets. Findings indicated that the level of skill with which children entered school did indeed seem to matter for later outcomes. Children's school readiness skills predicted levels of academic skills and behavioral skills during the school years, with stronger prediction of subsequent *level* among children in the "normal" range of performance at school entry and stronger prediction of *rates* of change among children in the "low" range of performance at school entry. For those who were lower in skill level at the beginning of school, entry skill levels were stronger predictors of growth compared to their higher-performing peers. Collectively, these findings indicate that efforts to support children's school readiness skills prior to school entry are critically important, and that school itself may be an important intervention for those children most at risk of poor outcomes.

The lack of strong evidence for a clear "threshold" for school readiness either within or across domains of development at kindergarten entry or that a single school readiness variable is especially important for subsequent academic achievement and behavior may have been due to limitations of the data sources used in this study. But researchers, practitioners and policymakers should be open to the possibility that there is no specific measure or score on an assessment that will identify which children at kindergarten entry are or are not "in the running" for future success. More studies, perhaps using well-designed criterion-based measures and causal analytic methods, can further explore this timely and policy-relevant question. However, it should be kept in mind that while criterion-based skill measures are critically important to identifying and tracking a child's development, they should not be used to create artificial thresholds of achievement.