

Ready for School? Systematic Review of School Readiness and Later Achievement

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Abstract

The association between specific school readiness skills and long-term school-related outcomes are still unclear and under debate. It is the first study to systematically review the literature on factors associated with school readiness evaluation about school-age achievement. This review included longitudinal studies with a minimum follow-up of five years; these studies performed the assessments during early childhood. The authors registered the study in the PROSPERO database (CRD42018089694). Five databases were searched (PubMed, Scielo, Scopus, ERIC, and Psyc Articles). Independent reviewers screened a total of 4,278 articles that were retrieved, and 13 were eligible for inclusion. Results showed that early language and math abilities at preschool age, middle to higher socioeconomic status, and socialemotional skills were the most significant variables in the promotion of positive school-age development. Preschool education and socioemotional or behavioral skills may compensate for academic difficulties in later school achievement.

Index terms— child, achievement, school, readiness, systematic review effects of social skills or internalizing and externalizing behavior as predictors of later academic or emotional outcomes ??Duncan et al., 2007). Pagani, Fitzpatrick, Archambault, and Janosz (2010) extended the studies of ??uncan et al. (2007) by including the measurement of motor skills. They found that attention, motor skills, and general knowledge were much stronger overall predictors of later math, reading, and science scores than were early math and reading scores alone (Pagani et al., 2010).

Recently, Thomson et al. (2019) examined a population cohort of 34,552 children and found that children exhibiting poor social-emotional functioning at school entry had at least two times the odds of a subsequent mental health condition by age 14, including depression, conduct disorder, anxiety and attention-deficit/hyperactivity disorder (ADHD). The authors also observed patterns of symptom continuity between early childhood, measured as internalizing and externalizing symptoms, and adolescent mental health problems, such as depression, conduct disorder, anxiety, and ADHD. They also highlighted that more than 40% of children entered the school system with relative vulnerabilities in social-emotional functioning that were associated with early-onset mental health conditions (Thomson et al., 2019).

Considering the inconsistencies in the literature in regards to school readiness and, to date, and there is no known systematic reviews that conducted in this area, we aimed to clarify which factors evaluated in preschool promote positive outcomes in childhood or adolescence. Also, there are no standardized models of measuring school readiness, and less is known whether existing models might assess individual skills in their childhood, adolescence, and adulthood. Given this context, this systematic review has the following aims: (1) to analyze associations between school readiness and later achievement; (2) to describe factors that are key to school readiness; and (3) to clarify which and how the components of child readiness could promote later positive development.

1 II. Method a) Design

We conducted and reported a systematic review by the reporting guidance provided in Preferred Reporting Items for Systematic Reviews and Meta-T Ready for School? Systematic Review of School Readiness and Later Achievement Marília Mariano ? , Amilton Santos-Junior ? , Jacqueline L. Lima ? , Jacy Perisinotto ? , Clara Brandão ¥ , Pamela J. Surkan § , Silvia S. Martins Global Journal of Human Social Science -Analyses (PRISMA) (Moher et al., 2009). The guidelines and criteria outlined were followed and applied to ensure proper reporting of the data (Moher et al., 2009). We elaborated a systematic review protocol and registered it with PROSPERO (CRD42018089694; https://www.crd.york.ac.uk/prospero/display_record.php?RecordID=89694).

2 b) Search criteria

A literature search was conducted in the following electronic databases: PubMed, Scielo, Scopus, Eric, and Psyc Articles. The keyword-based queries for all databases were the terms "school readiness" AND "achievement" OR "attainment."

The studies included in this systematic review accomplished the following inclusion criteria: longitudinal design with follow-up of a minimum of 5 years (so we could study the academic outcomes later in school), publication in an English-language peerreviewed journal and child assessment during early childhood or preschool, including measurements of general child developmental skills (e.g. language, motor skills, cognition, social-emotional, and executive functioning) that could have an impact on later achievement, transition phases, and/or subsequent stages of human development, including in adolescence and adulthood.

3 c) Selection procedure

The search included articles from 2000 to February 2019, returning 4,278 references. The domain of school readiness is broad, and in the first round of assessment, all titles that could address the following questions were selected without restrictions on study designs: "How is school readiness defined?"; "What are its main components?"; "How do different testing models compare?"; "What are social, environmental, and biological factors that influence school readiness?"; "How does school readiness affect outcomes in the health, socialization, and education of children and their later development?" In this first round, all three study team members performed automated searches in the databases discussed above, removed duplicates, and screened titles. The titles were divided and distributed to three authors (MM, ASJ, and JLL). These same authors conducted an independent selection of abstracts and extraction data. A fourth author (SCC) decided differences in judgment on selection criteria occurred in two articles. .

4 d) Data extraction

The same independent reviewers extracted the data.. All researchers independently read and filled in the table with the summary data from 10% of all articles to ensure internal validity. Data were entered separately into forms of variables, including publication year, country of study, sample size, children's and caregivers' characteristics, analysis/statistical methods, instruments, and main findings and study limitations.

Data were reviewed and collated into tables by the first author (MM).

5 III. Results

Figure 1 displays the flow of search information through the phases of this systematic review. We identified 4,278 records through database searches, and 68 articles remained eligible based on the criteria of having a longitudinal design with a follow-up equal to or greater than five years. We excluded two studies that used six different longitudinal data sets ??Duncan et al., 2007;Grissmer et al., 2010) that could not be used to answer aims (2) and (3). One article that analyzed only social-emotional function or mental health were also excluded (Thomson et al., 2019). The final sample for data extraction consisted of 13 articles.

Table 1 (Kurdek & Sinclair, 2001).

Socioeconomic status was reported in different ways based on various indicators, such as caregivers' jobs (semiskilled, unskilled/unemployed) (Woodward et al., 2016), average family income (Bernier, McMahon, & Perrier, 2016), and a composite of socioeconomic status, occupational prestige, and level of education (Fitzpatrick & Pagani, 2012). The proportion of lowincome families ranged between 12% and 44% of the sample, except one study, in which all children were from families of low socioeconomic status (Quirk et al., 2016). Less than half of the studies (n=5; 38%) had follow-up periods of longer than five years, and the longest follow-up period was ten years (Paschall, Gershoff, & Kuhfeld, 2018). Most studies discussed attrition rates (n=10; 77%), that ranged from 10% (Woodward et al., 2016) to 56% (Fitzpatrick & Pagani, 2012).

The studies used a wide variety of instruments as predictor and outcome measures representing the full range of components included in different definitions of readiness. As noted, standardized assessment tools, such as the Peabody Picture Vocabulary Test, the Woodcock-Johnson Psycho-Educational Battery-Revised, and the Wechsler Preschool and Primary Scale of Intelligence, were the most commonly used academic/cognitive predictor and outcome measures. Social/behavioral measures included parent and teacher reports of behavior using, respectively, the CBCL and TRF. Studies also included assessments regarding the family and school

climate and classroom engagement behavior, e.g., Sabol & Pianta (2012). As expected, all authors showed direct relation between preschool language, math skills, social-emotional skills, family characteristics, poverty, and a later performance at school age. Sex impacted performance differently, but the majority of studies showed that boys had lower cognitive and social-emotional abilities than did girls. The most common study limitations were that the samples were not representative of the population, had limited generalizability, weak reliability of assessments, could not infer causality and had much-missing data at follow-up.

In Table ??, we present the variety of measures evaluated in each study and across studies. Birth weight, a widely used classical variable impacting child development, was present only in a few articles ($n=5$; 38%). Sleep, average weekly hours of television viewing, prenatal smoking, and maternal mental health each appeared once in different studies. More than a half of the works examined the parent-child effects and interactions, classroom engagement and school characteristics, and maternal education. The majority of studies ($n= 11$; 84%) extensively discussed about poverty.

Finally, to describe the components that are important or that contain the constructs of school readiness, we described in Table ?? the assessment of each measure. All studies used language and math skills as measures of the construct of readiness, except for one work (Quirk et al., 2016), which did not use math skills for the same purpose. Behavioral and emotional aspects, such as approaches to learning, social or socio emotional skills, and externalizing and internalizing symptoms, were present in approximately half of the articles ($n= 7$; 54%). Few studies have evaluated memory, motor skills, attention, and health-related behaviors (e.g., consumption of soft drinks or sweet snacks) as factors significant to readiness.

6 IV. Discussion

This systematic review revealed a small but growing body of literature associated with school readiness and later achievement. It is the first review that aims to understand how the preschool experience impacts the child later performance. Also, we synthesize the evidence about factors which promoting positive outcomes in life course. We included thirteen recent studies in the review and found promising evidence for a protective role of the preschool experience in enhancing school readiness. Also, we evidenced a positive influence on child development for behavioral and emotional child functioning, including problematic behaviors, social-emotional skills, and approaches to learning. Factors associated with family characteristics, especially socioeconomic status, also showed a strong influence on readiness. The results of this review provide a unique overview of longitudinal and cohort research focusing on school readiness and later achievement and highlight links among the academic success, social-emotional skills, and behavioral skills that originate in early childhood.), as they are more than two times as likely to enter kindergarten with lower academic and social-emotional readiness (Quirk et al., 2016) and are more negatively affected by parental partnership instability than girls thus contributing to the gender gap in school readiness and educational attainment (Cooper et al., 2011). Li-Grining et al. (2010) found a protective impact of approaches to learning on girls' math growth and boys' reading growth.

7 b) Social-emotional and behavioral factors

This review highlighted the protective role of children's emotional and/or behavioral functioning, such as social-emotional regulation and approaches to learning, motivation, and problematic behavior ?? an increased risk of longer-term mental health and educational problems, especially at risk of language difficulties. This finding is a concern in the integrated development of children, as more effective communication skills offer young children an alternative means of expressing their needs and desires as well as an additional tool for regulating their behavior in the form of self-talk and other strategies. Therefore, delays in one domain, such as regulatory abilities, seem to promote disadvantages in various dimensions (Woodward et al., 2016).

Given the significant impact that emotional and behavioral functioning can have on child readiness and later achievement (e.g., Quirk et al., 2016; Woodward et al., 2016), further research should include evaluation of these domains of human development (Thomson et al., 2019). ??uncan et al. (2007) showed that measures of socioemotional behaviors, including internalizing and externalizing problems and social skills, were generally non-significant predictors of later academic performance, even among children with relatively high levels of problem behaviors. Some years later, Pagani, Fitzpatrick, Archambault, and Janosz (2010) replicated the model of school readiness specified in ??uncan et al. (2007) and showed that behavioral problems (externalizing problems-aggression; internalizing problems-anxiety) and prosocial skills also emerged as predictors of some aspects of later achievement, such as classroom engagement and academic success. The last authors also argued that motor skills contributed significantly to the prediction of later performance above and beyond the original primary elements of school readiness (Pagani et al., 2010). Thus, given inconsistencies in the literature, future research should better clarify the role of behavioral and social-emotional outcomes.

8 c) Poverty factor

Overall, poverty was linked with poor initial and later achievement in academic, social-emotional and behavioral functioning and school readiness ?? ??(2018) demonstrated a link between poverty and race: non-poor White students and poor White students had better performance than nonpoor Black students and poor Black students. The differences in scores between these groups were identified at school entry and remained sizeable across

historical time and developmental age. Disparities in ethnicity and poverty did not grow across time, but gaps in performance remained the same as at initial school entry (Paschall et al., 2018). Thus, poverty and ethnicity seemed to hamper social mobility. Similarly, Raffington et al. (2018) showed that children with low socioeconomic status had lower average starting points and cognitive growth slopes in verbal comprehension and math ability throughout later childhood. In addition, these children continued to have cognitive growth trajectories that were substantially lower than those of never-poor children. Among these children, there were differential effects of income changes predicting child cognition in early childhood that continued into later childhood and early adolescence: income gains positively predicted cognitive performance of poor children in later childhood; otherwise, income losses negatively predicted cognitive performance of poor children in later childhood (Raffington et al., 2018). Finally, Li-Grining et al. (2010) showed that children's approaches to learning (e.g., independence, flexibility, organization, eagerness to learn, concentration) was a protective factor against poverty, indicating that interventions should enhance these skills, especially for children with low socioeconomic status.

Moreover, parental partnership transitions or residential instability (as co-residential and dating) had negative impacts on child development: both types of unbalance were associated with lower verbal ability and more externalizing, social, and attention problems (Cooper et al., 2011).

Regarding language achievement, school readiness and higher levels of early verbal ability were linked to positive effects on later language and math performance, socio emotional development, classroom and school engagement, attention levels, dietary habits and preferences, and behavior problems (Bernier et al., 2014). Regarding later language achievement. For young children with low reading performance, more than 10 hours per week of child school had a compensatory effect, decreasing their chances of maintaining poor reading abilities in kindergarten and elementary school. Concerning the association between language skills and healthier dietary habits and preferences, Pagani and Fitzpatrick (2014) showed that higher receptive vocabulary resulted in a decline in snack consumption (21% unit) and the increase in the intake of dairy products, fruits and, vegetables (15-17% unit).

9 d) Academic abilities

Math skills at school age were positively associated with verbal and behavioral readiness (Hammer et al., 2014) also found that kindergarten math skills were an relevant predictor of engagement in activities of physical effort (9% unit increase), later childreported psychosocial adjustment of intrinsic motivation, attention skills, and academic self-concept (7-19% unit increases). Moreover, poor school readiness in math was associated with: low SES, younger age, being male, being small-for-gestational-age, no early intervention at 24 months, and no preschool experience (Shah et al., 2016).

Few studies have examined associations among cognitive abilities (such as attention and working memory), psychomotor abilities, and intelligence with readiness and later academic performance (Kurdek and Sinclair (2001) found that visuomotor skills were linked to later reading skills, and auditory memory seems significant for both readiness and later success in reading and math. Another study showed that working memory increased classroom engagement, knowledge and receptive vocabulary, and nonverbal IQ predicted receptive vocabulary, number knowledge, and classroom engagement (Fitzpatrick & Pagani, 2012).

10 e) Preterm child

Only two studies in this review found an association between children born preterm and school readiness (Shah et al., 2016; Woodward et al., 2016). Both articles showed that preterm children performed consistently more poorly across all measures of academic functioning, including reading, language, spelling, and math, in preschool and later (Shah et al., 2016; Woodward et al., 2016). In addition, Woodward et al. (2016) discussed that preterm children also had (1) lower levels of positive affect, persistence, regulatory ability, and psychomotor skills; (2) difficulty in transitioning between activities; and (3) higher levels of emotional and behavioral dysregulation and emotional difficulties as hyperactive/inattention problems. Children born preterm were also at a two-fold better rate of delay in language and math abilities (33-45%) (Woodward et al., 2016).

Finally, limitations of the reviewed studies include difficulties in producing causal conclusions, the possibility of unmeasured variables, high attrition rates, and non representative samples (e.g., Cooper et al. As the majority (n= 11) of the studies took place within the USA and Canada, these results could not be generalized to other socio cultural environments. Moreover, the studies used different aspects of child development to assess school readiness. Consequently, the results presented a large variety of conclusions, and it is unclear which dimension of child development (e.g., cognition, verbal ability, early numeracy, problem behavior) and of the environment (e.g., paternity instability, family socioeconomic status, preschool experience) may have a significant influence. Before the results of these studies are generalized to the broader community we need to clarify the inconsistencies in the school readiness framework and predictors

11 V. Conclusion

Our research sought to clarify the associations between school readiness and later achievement (see Figure 2 for the School Readiness Framework). Relevant factors of school readiness that could promote future positive

development were: early language and math abilities (preschool age), middle to higher family socioeconomic status, social-emotional skills, a lack of behavioral problems, the preschool experience of more than 10 hours per week and classroom engagement, partnership transitions or residential instability. Being a girl and being born full-term were also associated with better child performance. Surprisingly, in this review, the motricity and cognition evaluations did not appear consistently as domains relevant to school readiness. These findings are significant for service providers working in human development and education and who are developing interventions for children and adolescents.¹

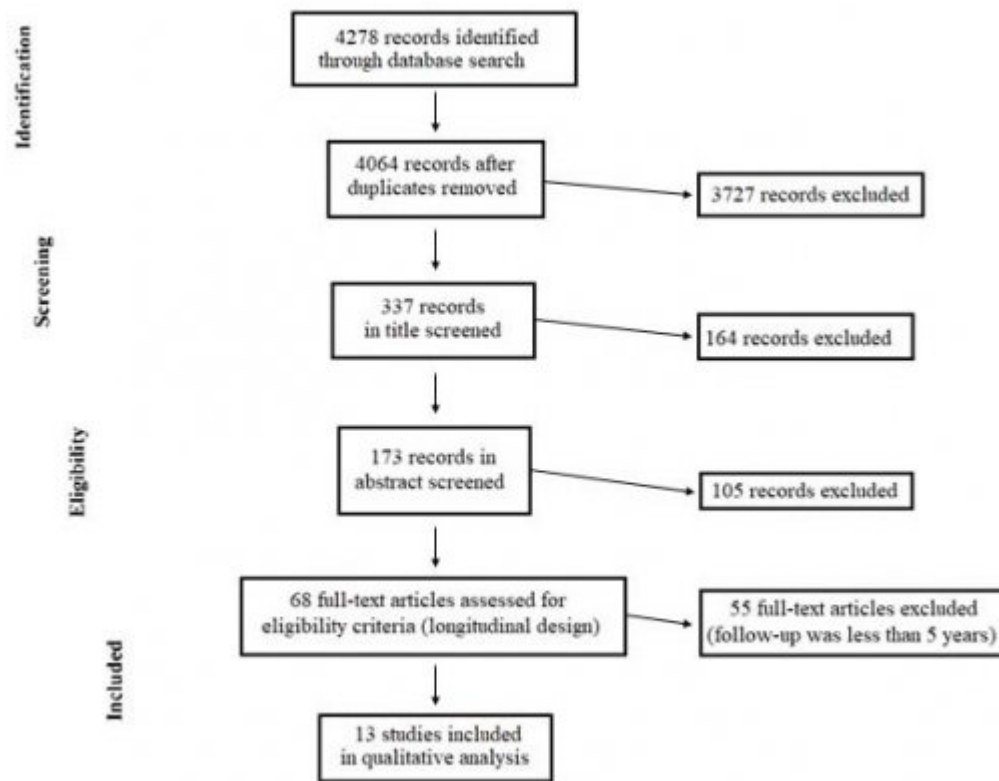


Figure 1:

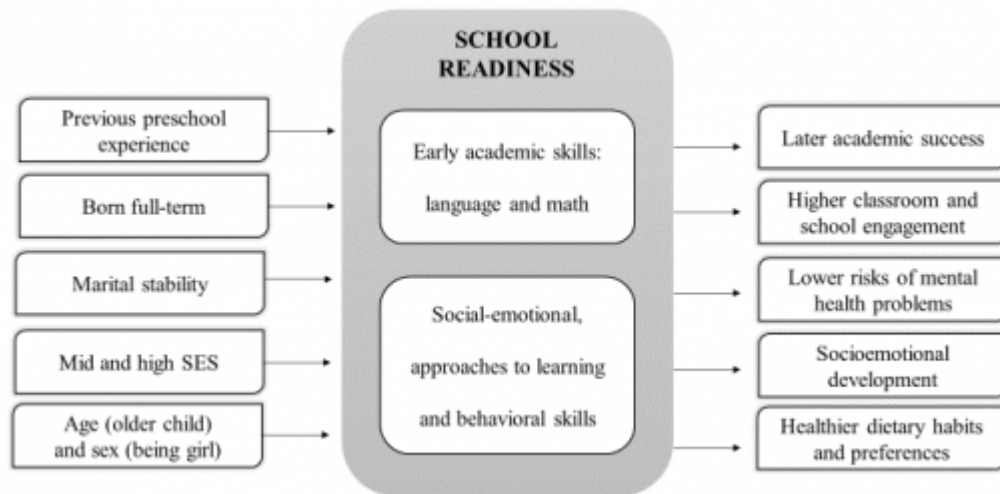


Figure 2:

Figure 3:

Figure 4:

Ready for school? Systematic Review of School Readiness and Later Achievement

Authors and year	Country of study	Sample: 1st study sample size;	Follow up in	Instrument lost to follow-up	Results	Study limitations
		Year cohort or mean age at 1st evaluation; longitudinal				
		dinal race; LIC name				
					-Young child in preschool (VS. older child): not at disadvantage to long-term academic performance	-Not a representative sample
Year	Kurdek US/1981	5/1981	5/1981	5/1981	Readiness in verbal skills: linked to later performance in reading and math -Readiness in visuomotor skills: linked to later performance in reading -Auditory memory may be a core readiness skill linked to later excellence in reading and math -These links occurred independently of age and were generalized across children's age and gender	-Subscores from the readiness assessment were based on different numbers of items -weak reliability -No causal conclusions
2010	Sinclair (2001)	A. children; 47% boys, 93% white; 11.2 y; 17% LIC	Diagnosis: In-strument; CTB			
					-Children with ? ATL tended to experience ? rates	
Volume XIX	Grining, LS-Mal-Isuedonad X o-VerCarreno, sionVotruba-I Drzal & Haas (2010)	US/EC,666 children; 50% boys; 4 y; 58% white/non-Hispanic, 11% black/non-Hispanic, 18% Hispanic; 18% LIC	5/38%AT- of growth in reading and math (VS. ? ATL), such that differences between them in PPVT increased across elementary school -Early ATL: SRS; ? protective for girls' math growth and SSRS; boys' reading growth -Children's ATL: protective for socioeconomic groups in poverty and at educational and occupational risk -Early ATL: particularly protective for children with ? levels of initial academic achievement - Partnership transitions: ? 1.5 points of verbal			- Classroom processes, child IQ, and other developmental phenomena not captured by the ECLS-K may confound the associations -Possibility of unmeasured variables (such as partnership
(G)		4,898 children;			ability and school readiness; ? attention and social problems, and externalizing problems at age 5	

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.2 Conflict of Interest Statement

The authors have no conflicts of interest to declare.

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