

*Rapport  
de recherche*  
PROGRAMME ACTIONS CONCERTÉES

**BOURSES DE RECHERCHE POSTDOCTORALES**

**Comment la relation maître-élève est-t-elle relié à  
l'engagement scolaire et la  
réussite scolaire au primaire ?**

**Chercheure postdoctorale  
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## **Part A: Research Context**

Disadvantaged individuals continue to experience significantly less physical and mental health than the general population (Woolf & Aron, 2013). Furthermore, differences in well-being emerge in early childhood and then are more likely to remain present at subsequent life stages. Part of these associations can be explained by social factors such as educational attainment. Education helps individuals acquire personal and financial resources which then contribute positively to mental and physical health. Furthermore, education can provide individuals with important information for making sound health-related decisions. Indeed, health economists have estimated that an improvement in educational outcomes in the population would translate into four times more lives saved than similar investments in biomedical procedures and technologies (Wolfe, Johnson, Phillips, & Philipsen, 2007). Consequently, it stands that an improvement in the educational outcomes of disadvantaged individuals is likely to have important health and economic repercussions across the population. An important question therefore becomes, which student skills and features of the schooling environment should be targeted to reduce socio-economically based disparities in achievement?

### ***The importance of school readiness skills***

Promoting children's readiness to learn at kindergarten may represent one of the most efficient ways to improve academic outcomes across the population (High, 2008). Research has shown that the process leading up to high school dropout does not emerge in high school, but rather can be traced all the way back to kindergarten (Entwisle, Alexander, & Olson, 2005). Furthermore, children who begin their academic journey on solid ground experience more academic success (Duncan et al., 2007) and are less likely to drop out of high school (Entwisle, Alexander, & Olson, 2005). More specifically, knowledge of numbers and vocabulary, as well as attention skills upon kindergarten entry reliably forecast later achievement, even when controlling for socio-economic status (Duncan et al., 2007; Pagani, Fitzpatrick, Archambault, & Janosz, 2010).

### ***A New Look at School Readiness***

Although generally neglected in school readiness assessment, child cognitive control skills, which involve the ability to use inhibition, working memory, and focus attention to solve problems, are likely to make an important contribution to early achievement. When surveyed, a large proportion of kindergarten teachers in the United States reported that close to half of their students are ill prepared to meet the challenges of the classroom. Most teachers specifically identified problems with children's ability to focus attention, sit still, and follow instructions in the classroom. In contrast, fewer teachers identified children's lack of skills in math and reading as problematic (Rimm-Kaufman, Pianta, & Cox, 2000). Furthermore, teachers tended to report that children's ability to self-regulate behavior, pay attention, and effectively manage behaviors are among the most important student skills (Rimm-Kaufman et al., 2000). For this reason, neuroscientists increasingly suspect that efficient educational strategies should include components that foster child cognitive control and strong learning skills that enhance the acquisition of knowledge (Blair & Diamond, 2008).

Cognitive control skills have been shown to make a unique contribution to kindergarten school readiness even while controlling for socio-economic status and general IQ (Blair & Razza, 2007). Cognitive control skills are a prerequisite for effortful behavior and help people resist internal or external distractions, delay gratification, and regulate their emotions. Prior research has shown that that directly and ecologically-based preschool cognitive control measures represent robust predictors of children's eventual academic achievement and psychosocial adjustment (Blair & Razza, 2007).

In addition to laboratory-based assessments of cognitive control, ecological measures in the form of classroom engagement provided by teachers also explain an important proportion of variance in student achievement. Kindergarten classroom engagement reflecting the ability to work autonomously, follow directions, and remain attentive predict later academic performance and psychosocial adjustment, even while controlling for kindergarten math, verbal, and attention

skills (Fitzpatrick & Pagani, 2013). Theoretically, classroom engagement represents an ecological manifestation of cognitive control in everyday life since they draw on inhibitory control, working memory, and attention skills (Pagani, Fitzpatrick, Archambault, Janosz, 2010). For example, at school children often need to inhibit the urge to listen to their classmates' disruptive comments in order to concentrate on teacher instructions.

### ***Ecological influences on disadvantage and achievement***

Children facing socio-demographic risk are likely to be at greater academic risk because they begin school with higher levels of academic and behavior problems. Nevertheless, the classroom environments that disadvantaged children face may also contribute to poor academic adjustment. Teachers are likely to hold more negative expectations regarding the academic performance of disadvantaged and ethnic minority students. Eventually, the expectations teachers hold of students can have consequences for their academic performance (Jussim & Harber, 2005). As a result, in addition to identifying individual child skills that are predictive of later academic success, an ecological perspective also warrants a better examination of how broader socio-cultural influences may simultaneously shape the school experiences of disadvantaged and minority children. Furthermore, social stratification theories suggest that class bias in schooling may favor achievement in middle class and advantaged students, even once differences in child ability are taken into account (Brantlinger, 2003; Bowles & Ginitis, 2002; Lareau, 2000).

What remains to be examined is how children's appearance in terms of social class or visible minority status contributes to academic adjustment once student ability, family context, and actual socioeconomic status and academic skills are taken into account. Furthermore, since prior studies on teacher-child relations have generally considered teacher-child relations from the perspective of teachers, it is important to examine these relationships from the perspective of students (Sabol & Pianta, 2012). To study disadvantage in terms of appearance we draw on theoretical work in sociology that suggests that teachers are likely to infer student disadvantage

on the basis of child appearance (Lareau, 2000). As such, we measure indicators of social class using general student demeanor and appearance in terms of sleepiness and cleanliness. We also consider child tardiness and hunger which are likely to convey membership to non-middle or advantaged social classes (Lareau, 2000).

### **Research Questions and Hypotheses.**

In the present research we use an ecological and neuroscience perspective to identify modifiable targets for intervention likely to improve achievement in disadvantaged youth. A first research question addressed the importance of cognitive control relative to other cognitive functions such as general intelligence, speed of cognitive processing, and verbal skills for explaining socioeconomically-based disparities in achievement. The hypothesis is that cognitive control will be uniquely associated with academic achievement outcomes, even once other cognitive functions and child characteristics (age and gender) are controlled. The second hypothesis is that cognitive control will significantly account for part of the association between socioeconomic status and academic achievement even when additional cognitive functions and child characteristics are controlled.

A second research question examines how child profiles of school readiness in terms of intellectual and classroom engagement skills reflective of cognitive control, predict eventual achievement above and beyond disadvantage. A first hypothesis is that distinct risk profiles can be detected on the basis of math and reading skills, general IQ, and classroom engagement. A second hypothesis is that children showing profiles characterised by higher engagement and better academic and intellectual skills would also show better achievement four years later.

A third and fourth research question address visible minority students and students showing visible signs of disadvantage experience less supportive classroom environments as reflected by self-reported relations with teachers and academic motivation and self-concept. We also examine teacher-rated academic adjustment. We hypothesize that visible minority and disadvantaged students will experience poorer academic adjustment.

**PART B: Implications of the Present Results (5 pages)**

The present research was undertaken with the intention of generating information and knowledge which could then be used to improve teacher-training and continuing education efforts. The present research also has the potential to inform when and how to implement social policies aimed at improving academic outcomes in at-risk children. The information gained from this research can help inform a number of school-based interventions and policies. Study 1 and 2 provide insight into the potential benefit of incorporating novel pedagogical techniques implemented in preschool and kindergarten to help boost child cognitive control and classroom engagement to improve achievement. The present research can also shed light on how the experiences of minority and disadvantage children later in elementary school may contribute to academic adjustment problems. In particular, studies 3 and 4 were conducted to examine the potential benefit of reducing the influence of negative stereotypes regarding visible minorities and disadvantaged children for improving classroom dynamics between children and teachers as well as student academic performance.

**Limits of generalization**

The findings of the present research should be interpreted within certain limitations. First, the findings of Study 1 were obtained using a sample of American children which could potentially limit this study's generalizability to Quebec children. Nonetheless, data from studies conducted in Canada and Finland suggest that associations between cognitive control, and socioeconomic status reflect a universal process (Duncan et al., 2007; Klenberg et al., 2001).

Second, of the present findings are correlational. Consequently, it is not possible to make causal inferences from the present data. Nevertheless, by using prospective longitudinal data we can increase our certainty that our hypothesized predictors precede our anticipated outcome in time. In addition, care was given to adjusting the observed associations for potential confounders. Some of the present results merit replication. For instance associations between perceptions of disadvantage and student adjustment should be re-examined with more direct

measures of visible disadvantage and teacher stereotypes. Nevertheless, we believe that the findings of the present research are an important first step in advancing knowledge on the potential influence of stereotypes in the classroom dynamics, a field that has until now been studied mainly using qualitative methods (Lareau, 2000).

Generally we found that cognitive control contributed a substantial effect to achievement and adjustment outcomes. This effect was often as or stronger than the effects of intellectual ability and socio-economic status. As such, in addition to being significant from a research perspective our findings regarding classroom engagement are also likely to have practical significance. Our findings regarding the influence of stereotypes on children's academic achievement were also moderate. However given that "pure" measures of appearing disadvantage were not available, part of these associations maybe be due to confounding factors that we were unable to measure.

### **Key Messages and Proposed Action Courses**

In the present research we examined how disadvantage can influence children's early school readiness and eventual achievement. A first focus was on the influence of environments of poverty on child cognitive development. We also examined how the experience of classroom environments in later elementary may also generate academic risks for disadvantaged children. In the following section key messages and courses of action are presented to address how to improve disadvantaged children's own competencies and school readiness as well as improve the quality of their classroom experiences.

### ***Disadvantage and Child School Readiness***

#### ***Key Messages for Teachers***

- Helping children practice and exercise the mechanisms of learning in the form of cognitive control (mental skills essential for focus, concentration and self-regulation) and classroom engagement (the ability to follow teacher instructions

and remain on-task in the classroom) is as important as helping children learn basic math concepts and reading and writing skills.

- Enhancing cognitive control can help even very young children become better focussed, autonomous, and socially competent in the classroom.

### ***Key Messages for Policy Makers***

- Poor cognitive control in preschool appears to be responsible for a large proportion of socioeconomically-based disparities in school readiness. Consequently it would be advantageous to target these skills in the early grades to circumvent the development of later academic and mental health problems which are more costly to address in later childhood and adolescence.
- In addition to targeting math and reading skills, resources should be devoted to developing curriculum designed to enhance cognitive control and classroom-engagement skills.

### ***Courses of Action for Teachers***

- Tasks that help improve cognitive control can be easily integrated into math and reading learning activities. Teachers can also complete activities during lunch time and recess that are beneficial for children's cognitive control. Examples of such activities include: *Simon says, Freeze tag, and musical chairs*.
- Kindergarten classroom engagement behavior can be easily evaluated and represents a good tool for identifying students that may struggle with cognitive control.
- Classroom engagement skills can be routinely monitored, modelled, and reinforced by teachers in the classroom (for a classroom engagement see ANNEX).

### ***Courses of Action for Policy Makers***

- Cognitive control training programs tend to provide the most benefit to children showing the highest initial deficits and risks for poor cognitive control. This suggests that interventions are a promising avenue for reducing educational disparities.
- Cognitive control skills can be cost-effectively enhanced through teacher-training. Training teachers to use a combination of *Tools of the Mind* curriculum and *CogMed* computer training is likely to represent an especially efficient strategy for reinforcing cognitive control.
- Movement not only benefits children's physical health, but can also help cognitive development in particular in areas responsible for cognitive control. The added benefit of incorporating psychomotor training and aerobic activity should be examined through empirical research.
- In addition to providing children with plenty of opportunities to develop cognitive control and strong learning skills, policies should also devote efforts to "protecting brains". Certain environments are harmful to child brain development. Noisy, chaotic caretaking environments, excessive screen time, exposure to gestational and second hand smoke, limited access to nature and dangerous disorganized neighbourhoods can all undermine the development of brain areas responsible for cognitive control. Consequently, efforts should be directed towards protecting children from the toxic effects of environments in addition to stimulating neurocognitive development.
- Targeting cognitive control in caretakers and educators themselves may help them more easily create the types of environments that are conducive to children's development of cognitive control. In particular boosting educators cognitive control is likely to help them better cope with stressful situations,

regulate their own emotions, and problem solve. These can all have a positive influence on the quality of children's learning environments.

### ***Disadvantage and Classroom Experiences***

#### ***Key Messages for Teachers***

- Around the age of 8 all children become aware of the existence of stereotypes and learn that some social groups are perceived more favorably than others.
- Children who belong to groups that are perceived less favorably by larger society may experience feelings of stigmatization that interfere with positive relations with teachers, academic motivation, and positive self-perceptions.
- Social stereotypes are generally "in the air" and can influence our behavior towards others without us being aware of them.
- Regardless of academic ability some visible minority students are likely to feel less close to teachers.

#### ***Key Messages for Policy Makers***

- Individuals are not immune to negative social stereotypes and these are likely to have an especially negative influence on children from stigmatized social groups already facing academic risk.
- In Quebec, low birth rates, rising immigration, and a growing gap between the rich and poor ensure that teachers will face increasingly diverse and disadvantaged students. As such, developing a better understanding of how social perceptions influence children's well-being, achievement, and relationships with teachers can help improve academic outcomes across the population.

#### ***Courses of Action for Teachers***

- As children become mindful of stereotypes aimed at different social groups, teachers may find it useful to discuss discrimination and group differences in the context of group discussions. Teachers may also find it useful to address such

topics by inviting members of socially stigmatized groups to present their experiences of stigmatization to the classroom to help build tolerance and empathy.

- It is possible to reduce the effects of stereotypes on our behavior towards others through activities that can be completed in classroom by all students. For example, teachers can ask students to complete activities in which they are asked to think about people on the basis of their internal characteristics rather than physical appearance.
- Forming school-based committees of teachers charged with discussing and monitoring the progress of students belonging to stigmatized social groups may also help identify children in need of interventions to increase academic motivation and strengthen relations with teachers.

### ***Courses of Action for Policy Makers***

- The pervasiveness of media and screens ensures that all individuals are bombarded with negative stereotypical messages and images of stigmatized social groups. Taking explicit steps to reduce negative social stereotypes in the elementary classroom, through on-going teacher training and workshops may help overturn the gradual process of school disengagement observed in many disadvantaged students.
- Finally, the present research suggests that the use of uniforms and school-wide lunch programs may be a promising strategy for reducing the visibility of disadvantage and therefore its stigmatizing effect on student outcomes.

**Partie C. Methodology (1 page)**

## Samples

Our research was based on data from two international data sets. A first data set is from 226 English-speaking American children between the ages of 3 and 5 years ( $M = 56.88$ ,  $SD = 9.06$ ) attending daycares in New York City. The second data set is the Quebec Longitudinal Study of Child Development (QLSCD 1998-2010), which comprises a 1997-1998 birth cohort of 2,120 children born in the province of Quebec. The inclusion of two data sets, one of typically developing children in the province of Quebec, and an urban sample of American children characterised by a high level of income disparities allows us to achieve two objectives. First the American sample allows us to examine how preschool cognitive skills contribute to child school readiness in an at-risk sample of children. Second, the Quebec sample allows us to examine how basic classroom processes influence learning in a population-based representative sample.

Several measures were taken to reduce the potential biasing effects of self-selection into attrition. First, all models include variables that predict attrition including child behavior problems, maternal education, and family configuration and functioning. The objective of this data analytic strategy was to reduce bias which might arise from non-random sample attrition. To further reduce the possibility that the observed effects might result from self-selection into attrition, we employed modern missing data treatment practices (Graham, 2009). According to the leading authorities in this field (Graham, 2009), such approaches to data loss are statistically powerful yet remain conservative.

In the present study we used multiple linear regression and logistic regression to examine associations between our predictors of interest and expected outcomes. These approaches were selected because they allow for the assessment of associations between variables while controlling statistically for potential confounders. Regression analyses are considered appropriate in the analysis of longitudinal data. We also used latent class analysis, a person-centered analytic strategy to detect profiles of school readiness in study 2.

**Part D. Results (7 pages)*****Cognitive Control as a Mechanism for Explaining Socio-Economic Disparities in Achievement***

In a first study we examined the potential benefit of targeting cognitive control in a context of disadvantage. In the present paper, we examined how neurocognitive development during the preschool years contributes to early academic indicators of school readiness. More economically disadvantaged children scored lower on all three school entry indicators of academic ability. In support of our first hypothesis, we found that cognitive control independently predicted academic ability, after controlling for general fluid intelligence and speed of cognitive processing. The present study also examined the extent to which cognitive control accounted for the influence of disadvantage on academic ability. In line with the second hypothesis cognitive control but not general fluid intelligence or speed of cognitive processing, accounted in part for the effect of socioeconomic disparities on academic readiness indicators. When we controlled for vocabulary, cognitive control continued to account for variation in math, but not letter-word recognition ability attributable to SES. Furthermore, vocabulary knowledge was a significant mediator of the association between SES and both math and letter-word performance. Our research contributes to a growing literature which suggests that preschool cognitive control skills represent important contributors to academic achievement in early elementary school (Bierman et al., 2008; C. Blair & Razza, 2007; Dilworth-Bart, 2012; Razza, Martin, & Brooks-Gunn, 2010). The present findings are also consistent with prior research which has shown that preschool child cognitive control and verbal skills account for part of the association between SES and later achievement (Dilworth-Bart, 2012; Rhoades, et al., 2011). Finally, the present findings build on previous findings by suggesting that these associations persist once the potentially confounding or competing influence of general IQ and speed of cognitive processing are controlled. In particular, although general intelligence and speed of processing should provide a foreseeable advantage during test taking, their contribution was

consistently less important than that of cognitive control. Much of the emphasis in school readiness has been directed towards promoting strong math and reading skills. While this emphasis remains important, our research is novel in that it helps us better understand which specific preschool cognitive skills are likely to support disadvantaged children's reading and math skills.

### ***Classroom Engagement and School Readiness Profiles***

We also examined whether children show different profiles of school readiness on the basis of their kindergarten characteristics. We found three distinct groups of kindergarten readiness which differed on the basis of their academic, intellectual, and classroom engagement profiles. The majority of children in our population-based sample tended to show an adaptive pattern of school readiness, characterized by high scores on all of the kindergarten skills. The two remaining groups of children demonstrated less than optimal levels of school readiness. Although both of the at-risk groups showed low levels of receptive vocabulary and fluid intelligence, the moderate readiness group scored higher on kindergarten number knowledge and classroom engagement. To our knowledge, this study is the first to identify two at-risk profiles of kindergarten children based on cognitive and intellectual readiness.

The second aim of our study was to examine how school readiness profiles are prospectively associated with subsequent academic achievement four years later. We compared children with high readiness to children showing moderate and low school readiness. Compared to children showing the most adaptive school readiness profile, children in the low and moderate readiness profile had poorer academic achievement in the fourth grade. Belonging to the moderate readiness group also predicted a significant long-term advantage when compared to children belonging to a low school readiness profile. There also appeared to be a dose-response relationship in that larger differences in fourth grade academic performance were observed between children in the low and high groups, than between children with high and moderate readiness.

Our findings provide some evidence that in the absence of strong intellectual skills, classroom engagement can represent a protective factor in the classroom. This edge is likely attributable to comparatively better cognitive control skills (Shonkoff, 2011). These findings provide a more detailed understanding of school readiness and expand on previous research which has mainly used variable-centered approaches to explain the relative importance of school readiness characteristics (Duncan et al., 2007; Pagani et al., 2010).

### ***Disadvantage, Visible Minority Status, and Academic Adjustment***

As children become aware of social stereotypes towards stigmatized social groups, additional influences may also come to bear on their academic adjustment. We found support for the hypothesis that Black or Native children, as well as children who were perceived by teachers as showing signs of disadvantage (e.g., by being inadequately dressed, or coming to school hungry and tired) would perceive their relations with teachers as less supportive. All of the observed associations persisted regardless of measures of student academic risk, actual socioeconomic status, gender, family relationship quality, and classroom engagement behavior. More importantly, number knowledge and measures of socioeconomic status based on occupational prestige, income, and education represent two of the strongest predictors of how children will fare in school (Duncan et al., 2007; Pagani et al., 2010). We also control for classroom engagement, which represents a process-oriented variable that is sensitive to how well children achieve a positive fit to the academic environment. Consequently, even though we do not directly assess classroom quality, classroom engagement can be seen as partially reflecting the interaction between classroom quality and children's ability to navigate the classroom environment. The inclusion of classroom engagement therefore helps reduce the possibility that poor general classroom quality may be accounting for the observed association between indicators of disadvantage and teacher-child relations. Finally, the present study is strengthened by the use of different sources for the measurement of predictor and outcome, and control

variables, which helps to reduce the possibility that social desirability and measurement error account for the observed associations.

Finally in Study 4, we found that signs of student disadvantage (i.e., arriving at school appearing tired and hungry or improperly dressed), are associated with worse academic adjustment. In particular, teachers who described students as appearing more disadvantaged also rated these students as being less competent academically, less engaged, and as having a poorer relationship with them. Corroborating these findings from the student's perspective, students perceived as more disadvantaged had worse academic self-concepts and also reported lower levels of intrinsic motivation to succeed in school. Finally, teachers also reported having less positive interactions, and less effective communication with the parents of students they described as disadvantaged. These results lend support to the idea that students who appear to be of a lower socioeconomic status experience differential treatment and expectations on the part of their teachers.

Interestingly, even after taking into preschool socioeconomic status and school entry academic ability, indicators of disadvantage were still directly associated with academic adjustment. Furthermore, indicators of social class appeared to have both a concurrent and long-term negative association with all of the examined academic adjustment indicators. These findings lend support to the hypothesis that teacher perceptions may be partially responsible for lower SES children's difficulty in progressing up the academic ladder.

### ***Courses of Action***

In the context of the present findings it is possible to identify several promising and potentially effective courses of action. First, it would be beneficial to increase efforts aimed at promoting cognitive control and classroom engagement in preschool and kindergarten context. Although cognitive control and learning skills are not typically targeted through interventions, they can be. Computerized training, classroom instruction and curriculum, aerobic exercise, psychomotor training, and interacting with nature have all been found to have a positive effect

on child cognitive control (Bierman, et al., 2008; Diamond, Barnett, Thomas, & Munro, 2007;Klingberg, Forssberg, & Westerberg, 2002).

In addition, the current findings suggest that more efforts be directed at assessing the potential influence of stereotypes in the classroom. In Quebec, low birth-rates, rising immigration, and a growing gap between the rich and poor ensure that teachers will face increasingly diverse and disadvantaged students. Furthermore, recent social policies such as Quebec's charter of rights, which draw increased attention toward the physical appearance of visible minorities, are likely to reinforce cognitive processes that lead to perceptions of "us vs. them". Increasing attention to differences between minority and majority cultures can in turn contribute to negative stereotypes, which can have repercussions on all social institutions including schools.

Teachers are not immune from the use of social stereotypes which routinely operate in impression formation and interpersonal relations. Although stereotypes are pervasive, biases can be overcome through willful processing and special training programs. Interventions based on developmental systems theory that also provide training to minority students to help these students identify and effectively confront stereotypes, provide cognitive training to teachers to help them reduce prejudice, and classroom curriculum that promotes collaborative learning experiences are most likely to reduce bias in the classroom (McKown,2005).

### ***Principle Contributions of my Work for the Advancement of the Literature***

My research has several general implications. In the province of Quebec, drop-out rates remain high in comparison to other developed countries (Bowlby, 2005). Furthermore, the processes leading up to high school drop-out can be traced back to the early elementary years (Alexander, Entwisle, & Dauber, 1993). As such, promoting cognitive control and classroom engagement in the early elementary school grades represents a promising strategy for reducing the economic, health, and social burdens associated with high school drop-out. Second, children from disadvantaged neighbourhoods as well as ethnic minority children are more likely to

experience a wide range of academic and psychosocial problems in school. The present research can help us better understand how these individual differences contribute to early achievement, classroom engagement, and teacher-child relations.

Second, our results suggest that easily observed classroom behaviors assessed by kindergarten can reliably identify children at-risk of later achievement problems. Although intellectual skills are also important in identifying at risk children, standardized IQ tests are more costly to administer. Furthermore, it appears that children showing the lowest level of classroom engagement were the most at-risk, thus further supporting the usefulness of a classroom engagement checklist.

Research and intervention have been driven by a search for individual child skills and characteristics that predict academic outcomes (Duncan et al., 2007). However, theoretical considerations demand that we also take into account the dynamic interplay between the individual and their context (Blair & Diamond, 2008). Cross disciplinary perspectives converge in highlighting the importance of social interactions in human learning (Meltzoff, Kuhl, Movellan, & Sejnowski, 2009).

The findings of the present research contribute to theory and knowledge on the effects of disadvantage and achievement. First they help us understand that part of the pathways through which disadvantage contributes to early school readiness is likely to be through its influence on cognitive control specifically. In addition, we also obtained some evidence that disadvantage is likely to contribute to achievement not only through its influence on cognitive, behavioral, and academic skills, but also by contributing to teacher-child relations. In particular, we found some evidence that teachers may perceive disadvantaged children more negatively, and these interactions may ultimately influence academic adjustment. These findings additionally suggest that it is beneficial to address disadvantage from an ecological perspective that considers both individual child characteristics as well as teacher-child relations and larger socio-cultural influences on perceptions towards minority cultures and disadvantage.

Students from lower socioeconomic status backgrounds report being increasingly disconnected from their school environments throughout the high school years (Bonny, et al., 2000). According to sociologists, the level of attachment individuals acquire toward formal institutions influences how much they internalize the values and norms of society (Gottfredson & Hirschi, 1990). In the present study we found that disadvantage, irrespective of its influence on cognitive and academic competence, may contribute to a process of disengagement from school characterized by poor relationships with teachers and lower levels of academic motivation. Disadvantaged individuals continue to be overrepresented among high school dropouts and convicted criminals (Bowlby, 2008; Ludwig, Duncan, & Hirschfield, 2001). They are also underrepresented in high prestige, high paying professions, (Bowles & Ginitis, 2002) which often require many years of commitment and engagement to studies. The findings of the present study suggest that social stereotypes of disadvantage in the elementary school context may contribute to eventual social stratification.

## **PART E- Future research**

*Tools of the Mind* and *CogMed* computer training have both been shown to be effective in enhancing children's cognitive control. However their combined influence is yet to be examined. *CogMed* computerised training can be tailored to benefit children showing specific deficits in working memory or presenting more severe symptoms of ADHD. As a result including a *CogMed* component to *Tools* intervention programs may increase its effectiveness with diverse classrooms. Psychomotor training also represents a promising mechanism for improving cognitive control in young children. Psychomotor training includes mindful activities such as martial arts, yoga, and practicing a musical instrument. Similarly, aerobic exercise and participation in sports that require decision making and cooperation, have also been shown to benefit cognitive control. Furthermore, research also provides strong evidence that providing children with the opportunity to engage with nature can help replenish brain areas responsible for cognitive control.

What remains to be examined is the combined effectiveness of these interventions for improving cognitive control with children showing different risk profiles. An important research step is therefore to develop a multifaceted intervention combining key elements of *Tools of the Mind*, *CogMed*, psychomotor training, aerobic exercise, and opportunities for children to interact with nature. The effectiveness of this intervention should then be evaluated with a randomised control trial. Furthermore, an important secondary objective should be to evaluate the relative importance of different intervention strategies combine or on their own, with different types of children. The information gained from this investigation will inform the development of preschool intervention that can be adapted to fit the needs of different children.





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**ANNEX A**  
**STUDY ABSTRACTS**

### **Study 1: Do Preschool Executive Function Skills Explain the School Readiness Gap Between Advantaged and Disadvantaged Children?**

We examine the extent to which executive functions (EFs), as opposed to other cognitive skills, account for socioeconomically based disparities in school readiness. Participants are 226 American children (aged 36- 66 months) enrolled in either needs-based or private preschools. Children completed 6 tasks designed to measure EFs as well as assessments of general intelligence and speed of cognitive processing. Children were also assessed on math, reading, and vocabulary skills. EFs accounted for unique variance across all academic measures even when controlling for speed of processing and general intelligence and partially accounted for disparities in school readiness associated with type of preschool enrollment. When vocabulary was controlled in the model, EFs only mediated associations between type of preschool and math. Vocabulary skills accounted for associations between socioeconomic status and both math and reading achievement. General intelligence and speed of processing did not uniquely account for associations between disadvantage and school readiness.

**Keyword: Cognitive control; Executive functions; Disadvantage; School readiness; Achievement.**

## **Study 2: Person-Centred Approach Reveals two at-risk Profiles of Kindergarten Readiness**

Identifying children at risk of academic difficulty is essential to prevent underachievement and dropout. Evidence suggests children's academic and intellectual, and productive behavior skills are especially important for academic achievement. In this study, we use a person-centered approach to examine the existence of different profiles of child kindergarten readiness, on the basis of academic, intellectual, and classroom engagement skills. We then examine if kindergarten profiles predict fourth grade academic performance. Participants are from the Quebec Longitudinal Study of Child Development (N=670). Trained examiners measured number knowledge, receptive vocabulary, and fluid intelligence. Kindergarten teachers rated classroom engagement. Outcomes included teacher rated achievement and directly assessed math skills. Latent class analyses revealed three school readiness profiles. Using multiple regression, we found that kindergarten profiles predicted fourth grade academic performance. Results suggest the importance of promoting a variety of cognitive, academic, and behavioral skills to enhance later achievement in at risk learners.

**KEYWORDS: School readiness; classroom engagement; intellectual skills; Non-verbal intelligence; Verbal IQ, academic achievement; Person-centered.**

### **Study 3: I Don't Think you like me Very Much:**

#### **Child Minority Status and Disadvantage Predict Relationship Quality with Teachers**

Even when accounting for past performance, academic achievement can be influenced by teacher expectations, which are lower for disadvantaged and visible ethnic minority children. We use a Quebec (Canada) population-based sample (N = 1311) to examine whether ethnicity and teacher perceived signs of disadvantage in kindergarten predict child reports of their relationship with teachers in fourth grade. Results suggest that visible minority children were 50% less likely and perceived disadvantaged children were 32% less likely to report having a positive relationship with their teacher. The findings are discussed in terms of directing efforts toward reducing teacher prejudice and improving child academic success.

**Keywords: Teacher-child relations; socioeconomic status; minority status; academic adjustment.**

**Study 4: Dressed and Groomed for success in Elementary School:****Indicators of Social Class Predict Academic Adjustment**

Disadvantaged children experience more academic problems. The environment of poverty is detrimental to the development of skills required for academic success. However, class bias may also explain socioeconomically-based disparities in achievement. In order to estimate the contribution of class bias to academic adjustment we investigate whether elementary school students who show visible signs of disadvantage, in terms of their overall physical appearance, face greater risk of poor academic adjustment. We examine these associations above child academic competence and family characteristics. We followed 1311 children from birth to grade 4. Children described by teachers as more disadvantaged were prospectively and concurrently perceived as less competent in their academic adjustment. Students perceived as disadvantaged also reported lower intrinsic motivation and poorer academic self-concepts. Our results are consistent with ecological and social stratification theories and suggest that school disengagement experienced by lower status individuals may be partially rooted in elementary classroom dynamics.

**Keywords: Social class; Social perception; Socioeconomic status; minority status; academic adjustment.**

**ANNEX B**

**Measures**

## Study 1

### *Measures*

#### *Socioeconomic status*

We used enrollment in needs-based preschool education or private preschool education as an indicator of child SES. The eligibility requirements set by the New York City Administration for Children and Families for a family to receive subsidized child care is 225% of the State Income Standard (SIS) for a family of four. In 2010, the SIS was \$22,050 and in 2011 it was \$22,350. Most families enrolled in needs-based education had household incomes at or near the poverty line. In contrast, families of children enrolled in private preschool were paying upward of \$25,000 per year for full day enrollment. SES was dichotomized and scored as either 0 for use of needs-based preschool education (3 of 6 participating schools) or 1 for enrollment in private preschool.

High SES preschools provided progressive curricula with an emphasis on active learning, the development of respectful debating and negotiating skills, creative problem solving, collaborative work, communication skills, and independent exploration. In contrast, children in the low SES group attended needs-based programs with more traditional focus and learning environments.

#### *Executive functioning tasks*

Children were administered a battery of six tasks specifically developed and validated to assess executive functions in preschool children (Willoughby et al., 2010, 2011a). Tasks represent age-adjusted versions of operation span and self-ordered pointing measures of working memory; go no-go, spatial conflict arrows, and sound Stroop measures of inhibitory control; and an item selection measure of attention shifting. Tasks were administered at the children's preschools using a touch screen monitor in a standardized order: sound Stroop, item selection, spatial conflict arrows, operation span, go no-go, and self-ordered pointing. For each task, the examiner verified that children had basic knowledge of the task elements (color, shape, etc.) and provided up to three practice trials. Practice trials also helped reduce bias due to touch screen familiarity. The mean percent correct for the executive function tasks were 79 and 80% for the Sound Stroop and item selection tasks, 73 and 50% for the Spatial conflict and operation span tasks, and 86 and 74% for the go no-go and self-ordered pointing tasks respectively. We averaged the percent correct for each task to yield a single score for each child.

In the sound Stroop measure, the child saw images of a cat and a dog at the same time as hearing a bark or a meow. The child was asked to touch the dog after hearing a meow and the cat after hearing a bark. We calculated the score as a percent correct from all 36 trials. In the item selection task, the child saw two images sharing a common feature (e.g., a red cat and a blue cat). After the experimenter identified the common feature, a new image appeared on the screen which matched one of first images on a unique feature (e.g., a red chair). The child identified which of the original pictures matched the new picture. We calculated the score as a percent correct from all 25 trials.

In spatial conflict arrows, the child saw an arrow pointing either to the right or left above one of two targets at the bottom of the screen. The child touched the target on the side of the screen corresponding to the direction the arrow was pointing. On congruent trials, the arrow appeared on the same side of the screen to which it was pointing; on incongruent trials, the arrow appeared on the opposite side of the screen to which it was pointing. We calculated the score as a percent correct from the 12 trials occurring after a switch between congruent and incongruent trials.

In the operation span task, the child saw images of houses with different animals and colors inside and named the animal and color. Then, the child saw images of empty houses and recalled either the animal or color in each house. The task increased in difficulty from two to six houses. We calculated the score as a percent correct from all 24 recall trials. In the go-no go task, the child saw images of animals. The experimenter instructed the child to touch the screen when an animal appeared on the screen, except when the animal was a pig. Scores were derived from the percent correct of 8 no go trials. In the self-ordered pointing task, the child saw an array of line-drawn images and was instructed to touch a picture. Then, the images appeared in a different order and the child touched a new image such that "each picture gets a turn". Sets increased in difficulty from 2 to 8 images. We calculated the score as a percent correct from 32 trials, excluding the first trial of each set.

#### *Speed of cognitive processing*

Speed of cognitive processing was measured using a simple reaction time task administered using a touch screen. Children were instructed to touch a blue dot (7 cm diameter) appearing at random locations across the bottom of the screen. Responses were recorded in milliseconds. The inter-stimulus interval varied between 500ms and 2500ms. Children completed a total of 30 trials. Lower scores represent faster processing speed.

#### *General intelligence*

Raven's Colored Progressive Matrices was administered to measure fluid, non-verbal intelligence (Raven, 1956). Children completed one stimulus set containing plates A1 through A12. Total accuracy across all 12 plates was used for the analyses. The Raven's Matrices represent a reliable and well validated measure of general fluid intelligence (Carlson & Jensen, 1981).

#### *Academic achievement*

Children were administered two subtests from the Woodcock-Johnson III Tests of Achievement and one subtest from the Woodcock-Johnson III Tests of Cognitive Abilities (Woodcock et al., 2001). The reliability and validity of these assessments have been well established and they have been used widely with diverse populations of young children to detect learning difficulties and assess academic competence (Campbell & Ramey, 1994; Gormley Jr, Gayer, Phillips, & Dawson, 2005; Wong, Cook, Barnett, & Jung, 2008). In the present study children completed three subtests: Applied Problems (40 items); Letter-Word Identification (56 items); and Picture Vocabulary (23 items). Total raw scores adjusted for child age in months were used for the analysis.

The *Applied Problems* subtest assesses children's skill in analyzing and solving mathematical word problems. Many of the problems contain extraneous information; consequently the child must decide which information to include in the calculations in addition to selecting the appropriate mathematical operation to perform. This task also assesses children's abilities to select appropriate procedures. The estimated test-retest reliability for 2- to 7-year-old children is  $r = .90$ .

The *Letter-Word Identification* subtest measures children's word identification skills by examining their ability to identify a letter or word printed on a page from the verbal prompt. According to the developers, the estimated test-retest reliability of the Letter-Word Identification subscale for 2- to 7-year-olds is  $r = .96$ .

Finally, the *Picture Vocabulary* subtest assesses children's oral language development and lexical knowledge by examining children's ability to verbally identify objects depicted in pictures. Picture vocabulary tests are indicators of crystallized verbal intelligence and represent a robust indicator of school readiness (Duncan et al., 2007). Test-retest reliability for this measure is between  $r = .91$  and  $.94$  according to developers.

## Study 2

### *Outcomes*

Math achievement was assessed using the Canadian Achievement Test (CAT/2) which children completed with a trained examiner at the end of fourth-grade. This test evaluates mastery of four basic mathematical operations: addition; subtraction; multiplication; and division. Each question requires the application of basic operations to whole numbers. Children received one point for each correct answer. The sum of correct answers was used in the analyses.

Fourth-grade teachers rated child math, reading, science, spelling, and global achievement relative to their classmates by choosing among the following options: Near the top of the class (scored as 2); Above the middle of the class (scored as 1); In the middle of the class (scored as 0); Below the middle of the class (scored as -1); or Near the bottom of the class (scored as -2). This outcome measure has been found to be as sensitive and robust as individual achievement tests in detecting even subtle changes in academic performance over time (Duncan et al., 2007).

### *Predictors: School Readiness Indicators (at 74 months)*

**Intellectual Skills.** Trained examiners administered the Block Design subtest of the Wechsler Preschool and Primary Scale of Intelligence-Revised to assess fluid intellectual skills (WPPSI-R, Wechsler, 1991). This subtest assesses visual perception of the spatial relationships of objects and correlates well with general IQ (Sattler, 2008). Children reproduced 14 models using blocks. For the first 6 models, children received 2 points for every model correctly reproduced within the time allotted (30 seconds). Children were given 1 point if they correctly produced the design on the second trial. Children received 0 points if they failed to reproduce the design in time on trial 1 or 2. On the last 7 models, children received only one trial. Two points were provided for each correct answer reproduced in time.

**Early Academic Skills.** The Number Knowledge Test (NKT) was administered to assess basic knowledge of numbers (Okamoto & Case, 1996). The version adjusted for 5-year-olds measures: Knowledge of the number sequence from one to ten; Knowledge of the one to one correspondence in which a sequence is mapped onto objects being counted; Understanding the cardinal value of each number; Understanding the generative rule which relates adjacent cardinal values; and Understanding that each successive number represents a set which contains more objects. Children also completed the most recent version of the Peabody Picture Vocabulary Test (PPVT, Dunn, Thériault-Whalen, & Dunn, 1993) to assess vocabulary knowledge. This test consists of 175 vocabulary items that increase in difficulty throughout the test. Its French translation has been standardized and is highly correlated with other French vocabulary and intelligence tests (Dunn et al., 1993).

**Classroom Engagement.** Kindergarten teachers rated items pertaining to productive behavior in the classroom. A mean classroom engagement score was computed for each participant from 7 items: Works neatly and carefully; Follows rules and instructions; Follows directions; Listens attentively; Completes work on time; Works autonomously; and Works and plays cooperatively with other children,  $\alpha = .92$ . Each item was rated on a scale from 1 (never) to 3 (always). The

classroom engagement scale has shown good predictive and construct validity (Fitzpatrick & Pagani, 2011; 2013; Pagani et al., 2010). Confirmatory factor analysis was conducted to examine how well our seven item classroom engagement scale can be accounted for by a single factor. Model fit was good, suggesting the items capture a single latent factor (CFI=.98; TLI=.97; RMSEA=.069; SRMR=.034). The measure of children's classroom engagement was negatively skewed. It was therefore transformed into a three category ordinal variable reflecting low (25.5%), medium (35.9%), and high classroom engagement (38.7%) respectively.

### *Control Variables*

*Child Characteristics.* These include child sex, age in months, and kindergarten teacher reports of child behavioral characteristics using the Social Behaviors Questionnaire (Pagani, Tremblay, Vitaro, Boulerice, & McDuff, 2001). Behavioral factors include: Hyperactive (cannot sit still, is restless and hyperactive, and cannot stop fidgeting,  $\alpha = .88$ ); Emotional distress (seems unhappy or sad; is not as happy as other children; has no energy; is feeling tired; cries a lot; has trouble enjoying himself or herself; and is unable to make decisions;  $\alpha = .79$ ); and Prosocial skills (tries to help someone who has been hurt; Comforts a child who was crying or upset; and helps other children who were feeling sick,  $\alpha = .85$ ). Scores were rated on a Likert scale from 1 (often of very true) to 3 (never or not true). Each child's mean was then converted to a continuous score ranging from 0 to 10.

*Family Characteristics.* When children were 5 and 17 months, parents reported on some child context variables including: (1) Family functioning ("planning activities is difficult because we misunderstand each other" or "we avoid discussing our fears or concerns"). Coded from 1 (strongly agree) to 4 (strongly disagree) and rescaled as a continuous score from 1 to 10 (Epstein, Baldwin, & Bishop, 1983); (2) Family configuration (intact = 0 versus non-intact = 1); and (3) Socioeconomic status based on parental education, occupation, and income. In addition, in order to rule out parental non-conformism and unconventionality, history of antisocial behavior in mothers and fathers was assessed by self-report with parents at the 5-month assessment. The items assessed the extent to which parents had engaged in antisocial behavior during adolescence and adulthood and were derived from the NIMH-Diagnostic Interview Schedule. Adolescent items include: Starting fights; Theft; Involvement with youth protection or police; Expulsion or suspension from school; Truancy; and Running away from home. Adult items include: Arrests; Being fired from a job; Trouble at work, with family, or with the police due to drug or alcohol abuse; Starting fights (fathers only); and Hitting or throwing things at the spouse or partner (mothers only). Each item was scored as 1 (yes) and 0 (no) and was summed for each parent. Because scores were severely skewed, parents who received a score about the 70<sup>th</sup> percentile were given a score of 1 and those beneath the 70<sup>th</sup> percentile were given a score of 0. Antisocial scores reflect the sum of dichotomous scores for each parent.

### Study 3

#### **Outcome Variable:**

*Teacher-child relations.* At the end of the fourth grade, children self-reported the extent to which they perceived their relationship with teachers as supportive and warm. Items include: You feel at ease to ask your teacher questions when there is something you don't understand; Your teacher gets mad at you easily (reverse coded); Your teacher congratulates you when you do well in something; You like your teacher; You can talk to your teacher, he/she listens and answers nicely; You are afraid of your teacher (reverse coded); Your teacher yells or swears at you (reverse coded); Your teacher makes fun of you in a mean way (reverse coded); (Pianta, 1992) from 1 (*Never or always true*) to 5 (*Often or always true*)  $\alpha = .76$ . A rescaled mean of these 9 items, ranging from values of 1 to 10, was used as a global measure of the quality of teacher-child relations (see Table 1). The sample mean for this variable was 8.61 (SD=1.44) and the median for the sample was 8.89. This variable was dichotomized to reflect poor teacher-child relations (scores below the 26<sup>th</sup> percentile) and good teacher-child relations (scores above the 74<sup>th</sup> percentile). This cut-off point was selected to reflect a natural separation in the distribution which was negatively skewed, (Skewness = -1.58, SE = .068), reflecting a general tendency to report a positive relationship with one's teacher. We were interested in explaining the distinction between this large group of children who report positive relations with teachers, and those reporting negative relations with teachers.

#### *Measures: Independent Variables*

*Signs of disadvantage.* According to sociological theory, teachers are likely to perceive as "ideal" students who show signs of membership to the middle class. As such children who show signs of material disadvantage, through a lack of access to adequate clothing or to food are likely to be perceived as more disadvantaged. At the end of the fourth grade, teachers reported how often the child had attended class: Over or underdressed for school activities; Too tired for school work: Late; and Hungry. Items were rated from 1 (*Never*) to 5 (*Always*). Means were computed across all four variables, for each child,  $\alpha = .58$ . This measure was moderately correlated with actual socioeconomic status (see Table 2) suggesting some external validity.

*Socio-economic status.* Socioeconomic status was derived from mother and father reports of income, occupational prestige, and level of education (Whilms & Shields, 1996). Scores were standardized to a mean of 0. Socioeconomic status scores represent the mean across all available time points between 5- and 74-months.

*Minority status.* A dichotomous variable was created to reflect whether children belonged to a stigmatized minority group or not. We merged Black and Aboriginal into 'ethnic minority' variable because of the relatively small ethnic diversity of our sample and previous research which suggests that these two groups are particularly likely to suffer from stigmatization and stereotypes. In particular, prior Canadian census data revealed that Blacks and Aboriginals' educational attainments were well below the Canadian average (Davies & Guppy, 1998; Ruck & Wortley, 2002).

#### *Measures: Control Variables*

*Classroom Engagement.* Kindergarten teachers rated 7 items of classroom engagement behaviors from 1 (*never*) to 3 (*always*): Follows rules and instructions; Follows directions; Listens attentively; Completes work on time; Works autonomously; Works and plays cooperatively with other children; and Works neatly and carefully,  $\alpha = .94$  (Fitzpatrick & Pagani, 2011; Pagani, Fitzpatrick, Archambault, et al., 2010; Pagani, Fitzpatrick, Barnett, & Dubow, 2010). From these items, a mean classroom engagement score (ranging from 1 to 3) was then computed for each participant.

*Number Knowledge Test (NKT).* This test was administered by trained examiners to assess basic number knowledge (Okamoto & Case, 1996). These measures were collected at age 5 for all children: Knowledge of the number sequence from one to ten; Knowledge of the one to one correspondence in which a sequence is mapped onto objects being counted; Understanding the cardinal value of each number; Understanding the generative rule which relates adjacent cardinal values; and Understanding that each successive number represents a set which contains more objects. Scores on the Number Knowledge Test are highly correlated with general intellectual ability and have been shown to be robust predictors of elementary school achievement (Duncan, et al., 2007; Pagani, Fitzpatrick, Archambault, et al., 2010).

## Study 4

### *Outcomes*

*Classroom Engagement.* Fourth grade teachers rated classroom engagement after having observed children for approximately 6 months using a 7-item scale (Cronbach alpha = .94): Works and plays cooperatively with other children; Follows rules and instructions; Follows directions; Listens attentively; Completes work on time; Works autonomously; and Works neatly and carefully. Potential responses ranged from 1 (*Never*) to 5 (*Always*) in fourth grade. Higher scores indicate a higher degree of classroom engagement. A confirmatory factor analysis was performed to examine how well a 1 factor model accounted for our 7-item classroom engagement scale. Model fit was very good suggesting that the items capture a single latent factor (CFI=.98; TLI= .97; RMSEA=.07; SRMR=.03). This classroom engagement measure is strongly correlated with academic ability (Pagani, 2010; Fitzpatrick & Pagani, 2012).

*Global Achievement.* Fourth-grade teachers rated child success in *Math, Reading, and Spelling* from: Near the top of the class (coded as 2); Above the middle of class (coded as 1); In the middle of the class (coded as 0); Below the middle of the class (coded as -1); or Near the bottom of the class (coded as -2). An overall mean was computed across all subjects (alpha = .89) (Duncan et al., 2007; Pagani, et al., 2010).

*Teacher-Child Relations.* Teachers rated their relationship with the child in terms of (1) Conflict (This child and I always seem to be struggling with each other; This child easily becomes angry with me; Dealing with this child drains my energy; and When this child is in a bad mood, I know we are in for a long and difficult day, alpha = .83) and (2) Warmth (I share a close and warm relationship with this child; This child spontaneously shares information about him/herself; It is easy to be in tune with what this child is feeling; My interactions with this child make me feel effective and confident, alpha= .78) (Pianta, 1992). All items were rated on a scale from 1 (*Definitely does not apply*) to 5 (*Definitely applies*). Scores were then converted to a mean ranging from 0 to 10.

Some measures were obtained through child self-reports to corroborate the teacher measures. These include: *Academic Self-Concept* reflecting child perception of their academic ability (based on the following items: I have always done well in reading/writing/math; Reading/ Writing/Math is easy for me; and I learn things quickly in reading/writing/math) and *Intrinsic Motivation* referring to child enthusiasm toward school in terms of their agreement (with the following statements: I Like math/reading/writing; Reading/Writing/Math interests me a lot; and I read/write/or do math even when I am not obliged to do so). Items were rated on a Likert scale from 1 (never) to 5 (always).

*Teacher-Parent Partnership.* Teachers rated the quality of their collaborative relations with parents using the following items from 1 (*Strongly agree*) to 4 (*Totally disagree*): I keep the parents informed of their child's behavior; When a child goes through a difficult time in my class, I feel at ease to share it with his/her parents; I keep the parents informed of their child's activities in his/her class; I feel at ease to communicate to the parents that I am dissatisfied with certain aspects concerning the education of their child; Conflicts between the parents and myself get settled quickly; and I use different means to communicate with the parents, alpha =.76. Mean scores were then converted to a scale ranging from 0 to 10 with higher scores reflecting better relationship quality.

*Measures: Independent Variable*

Signs of Disadvantage. At the end of the fourth grade, teachers reported how often the child had attended class: Over or underdressed for school activities; Too tired for school work: Late; and Hungry. Items were rated from 1 (*Never*) to 5 (*Always*),  $\alpha = .60$ . This variable was also measured in kindergarten using the same procedure. This variable has been previously shown to predict teacher-child relations (Fitzpatrick, Côté-Lussier, Pagani, Blair, 2013).

*Measures: Control Variables*

Classroom Engagement. Kindergarten teachers rated 7 items of classroom engagement using the same scale as in the fourth grade assessment.

Number Knowledge. Math ability was measured using the *Number Knowledge Test* (NKT; Okamoto & Case, 1996) adjusted for 5 year olds. This assessment was designed to measure children's conceptual understanding of numbers: Knowledge of the number sequence from one to ten; Knowledge of the one to one correspondence in which a sequence is mapped onto objects being counted; Understanding the cardinal value of each number; Understanding the generative rule which relates adjacent cardinal values; and Understanding that each successive number represents a set which contains more objects. Scores on the Number Knowledge Test are highly correlated with general intellectual ability and have been shown to be robust predictors of elementary school achievement (Duncan, et al., 2007; Pagani, et al., 2010).

Preschool Socioeconomic Status. Socioeconomic status was assessed at each study wave and was derived from mother and father reports of income, occupational prestige, and level of education (Whilms & Shields, 1996). Preschool socioeconomic status scores represent the mean across all available time points from 5- to 74-months.

Family Characteristics. Mothers completed 7 items related to *hostile coercive parenting*: I have gotten mad with my child because he said or did something they were not supposed to; I have raised my voice, scolded, or shouted at my child when he/she misbehaved; I have lost my temper with my child while punishing them; I have used corporal punishment when my child misbehaved; and I have hit my child when they were particularly difficult,  $\alpha = .74$ . Items were rated on a 5-point scale. Mothers also reported *family functioning* at 17 months based on 12 items designed to measure family communication, problem solving, control of disruptive behavior, and demonstrations of affection ( $\alpha = .98$ ). Both measure scores were converted on a scale ranging from 0 to 10.

**ANNEX C Results**

**Study 1**

Table 1. *Descriptive statistics for study variables by socioeconomic status*

	Low Socioeconomic Status			High Socioeconomic Status		
	M (SD)	Min N=92	Max	M (SD)	Min N=134	Max
Child age (months)	55.22 (7.19)	37	71	56.53 (8.46)	38	71
Executive functions	.68 (.18)	0	.90	.79 (.13)	.41	.98
General IQ	6.53 (1.71)	3	11	7.08 (1.66)	1	11
Cognitive speed	97.76 (12.95)	67	139	104.19 (15.08)	65	133
Applied Problems	11.50 (4.44)	0	27	17.69 (4.87)	5	31
Letter-Word	10.66 (4.96)	2	31	14.79 (9.45)	2	51
Picture vocabulary	10.03 (1.52)	5	14	12.42 (2.72)	6	17

Notes. Socioeconomic status was scored as 0 (child enrolled in needs-based daycare) or 1 (child enrolled in private daycare). Executive function scores reflect composite scores derived from the Spatial conflict, Something the same, Pig game, Silly sounds, Operation span, and Pick the picture tasks.

Table 2. *Bivariate correlations between study variables.*

	1	2	3	4	5	6	7	8
1. Socioeconomic status	---	.11	.27***	-.15**	.15*	.48***	.19**	.40***
2. Age		---	.49***	-.56***	.27***	.57***	.57***	.46***
3. Executive function			---	-.51***	.31***	.66***	.44***	.48***
4. Speed of processing				---	-.19*	-.47***	-.42***	-.36***
5. General intelligence					---	.37***	.32***	.37***
6. Applied problems						---	.66***	.67***
7. Letter-word							---	.58***
8. Picture vocabulary								---

*Note.* \*\*\*  $p < .001$ ; \*\*  $p < .01$ ; and \*  $p < .05$ .

Table 3. *Final model predicting academic outcomes as measured by the WJ-III.*

	Applied Problems	Letter-Word	Picture Vocabulary
Socioeconomic status	.39***	.10*	.34***
Age	.28***	.43***	.26***
Speed of processing	-.09	-.08	-.05
General intelligence	.09*	.14*	.18**
Executive functions	.33***	.12*	.17**
R <sup>2</sup>	.68	.40	.45

Note.\*\*\*  $p < .001$ ; \*\* $p < .01$ ; and \* $p < .05$ .

**Results**

**Study 2**

Table 1. *Fit indices and Entropy for different class solutions*

	BIC	Vuong-Lo-Mendell- Rubin Likelihood Ratio Test	Entropy
Two classes	21110.17	-10745.36***	.76
Three classes	21011.25	-10507.29***	.75
Four classes	21008.19	-10437.35	.75
Five classes	20999.76	-10415.38	.72

*Note.* \*\*\*  $p < .001$ .

Table 2. *Estimated class means and probabilities for a 3 class solution*

	Readiness Profile			
	Overall mean	Low Readiness	Moderate Readiness	High Readiness
<i>Class size</i>		34.00%	9.30%	56.70%
<i>Class means</i>				
Block Design	19.95	15.15	13.39	24.10
Peabody Vocabulary Test	80.57	72.68	65.87	88.08
Number Knowledge Test	13.25	11.89	6.34	15.31
<i>Class probabilities</i>				
Low classroom engagement		36.26	<b>56.29</b>	13.31
Intermediate classroom engagement		<b>37.72</b>	28.81	35.94
High classroom engagement		26.02	14.89	<b>50.75</b>

*Note.* Bolded class probabilities represent the most probable level of classroom engagement, for each class.

Table 3. *Unstandardized regression coefficients reporting the relationship between kindergarten school readiness profile membership, and fourth-grade academic adjustment.*

<i>Predictors</i>	Teacher-rated achievement					Direct assessment
	Reading	Writing	Math	Science	Global	Math
Moderate	-.80(.10)***	-.71(.10)***	-.75 (.10)***	-.38 (.09)***	-.40 (.07)***	-.98 (.27)***
Low	-1.37 (.17)***	-1.26 (.17)***	-1.45 (.16)***	-.90 (.14)***	-.72 (.11)***	-4.07 (.43)***
Hyperactive	-.06 (.02)*	-.09 (.02)***	-.07 (.02)**	-.03 (.02)	-.04 (.02)*	-.14 (.60)*
Emotional distress	-.07 (.03)*	-.13 (.03)***	-.08 (.03)**	-.06 (.02)*	-.06 (.02)**	-.14 (.08)
Physical aggression	.01 (.03)	.01 (.03)	-.01 (.03)	-.02 (.02)	.02 (.02)	.02 (.07)
Prosocial skills	.04 (.04)	.00 (.02)	.00 (.02)	.00 (.02)	.00 (.01)	.05(.05)
Family functioning	-.01 (.04)	-.07 (.04)	-.09 (.03)**	-.05 (.03)	.05 (.04)*	.00 (.09)
Family configuration	.01 (.14)	-.08 (.14)	-.08 (.13)	-.09 (.12)	-.07 (.09)	-1.30 (.37)**
Parent antisocial	-.07 (.07)	-.06 (.07)	.01 (.06)	-.07 (.05)	.03 (.04)	.01 (.17)
SES	-.01 (.07)	-.03 (.07)	-.02 (.06)	-.05 (.05)	.03 (.04)	.47 (.17)**
R <sup>2</sup>	.19	.21	.22	.13	.13	.21

Notes. The high readiness profile serves as the omitted category. Models are adjusted for child sex and kindergarten age in months. \* $p < .05$ , \*\* $p < .01$ , and \*\*\* $p < .001$ .

Table 3 (Continued). Descriptive table for independent, dependant and control variables

	M(SD)	Min	Max
<i>Child and Family Controls (continued)</i>			
Parental antisocial (5mo)	.64 (.69)	0	2
Family configuration (17 mo)	.12 (0.32)	0	1
Family functioning (5 - 17 mo)	1.22 (1.27)	-.16	8.15

ANNEX D

Classroom engagement checklist

<b>Classroom engagement</b>	<b>L'engagement dans la classe</b>
Child follows rules and instructions	L'enfant suit les règles et les instructions
Child follows directions	L'enfant suit les directions
Child listens attentively	L'enfant écoute attentivement
Child completes work on time	L'enfant finit ces travaux à temps
Child works autonomously	L'enfant travail de façon autonome
Child works and plays cooperatively with other children	L'enfant travail et joue en coopération avec les autres enfants
Child works neatly and carefully	L'enfant travail proprement et soigneusement

