READINESS TO LEARN IN MINORITY FRANCOPHONE COMMUNITIES

REPORT OF PROGRAM EFFECTS IN GRADE 1

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1.0 Summary

The purpose of this report is to document the 12-month post-program impact of the Readiness to Learn in Minority Francophone Communities project (abridged titled: Readiness to Learn project; formerly the Child Care Pilot Project, CCPP), a demonstration project funded by Human Resources and Skills Development Canada (HRSDC). The services of the Social Research and Demonstration Corporation (SRDC) were retained to implement, manage, collect and analyze project data. The project is testing a preschool program[1] that combines a child care program specifically developed to meet the needs of Francophone children in minority communities with a family literacy component targeting the parents of these children. The goal of this program is to develop the child's language skills, knowledge and use of the French language, knowledge and identification with the French culture, and to foster school readiness and overall development.

The program is evaluated using a quasi-experimental approach with non-equivalent control groups. The methodology involves three experimental groups: a Program Daycare group consisting of children enrolled in a Francophone daycare centre offering the new preschool program; a comparison group consisting of children enrolled at a Francophone daycare centre that does not offer the new preschool program; and a comparison group of children who are cared for at home or in an informal family daycare setting. The objective of the formal daycare control group is to determine the influence of a formal daycare centre on a child's development, which is a treatment in itself. The objective of the comparison group not enrolled in a formal daycare centre is to determine the influence of an informal daycare on the child's development. The project has two participant cohorts; the first cohort was enrolled in 2007 and the second was enrolled in 2008.

The Readiness to Learn project takes place in two phases. In the first phase, we sought to answer the following question: *Does the new preschool program, which includes a da0ycare component and a parent-child workshop component, have a significant impact on children's language skills, Francophone cultural identity and school readiness beyond the development that would take place in its absence, and independently of any other external factors that may come into play?* In the second phase, which is the subject of this report, we are seeking an answer to a new question: *Does the new preschool program better prepare Francophone children raised in minority settings to succeed in tasks essential to academic achievement, such as reading and mathematics?* While the first phase of the Readiness to Learn project focused on the preschool period, the second phase focuses on the formal education period (grades one and two).

This report deals with data collected 12 months after the end of the intervention, which corresponds to data collected in October 2010 for the first cohort and October 2011 for the second cohort. This period corresponds to the second phase of the project when the children's mean age was six and they were entering grade one. A mixed research methodology was used for the Readiness to Learn project. This approach favours the use of a range of tools, both quantitative and qualitative, from several sources selected based on research objectives, that is, to determine whether the program has had the desired

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[1]   Officially known as enriched child care services in HRSDC documents, the Social Research and Demonstration Corporation, or SRDC, in agreement with HRSDC, will henceforth refer to the program as the "preschool child care program".

effect and to understand how it exerts that effect. Analyses were performed using data from child assessments and parent surveys. Impact analyses incorporated program fidelity and quality indices related to the delivery of the two components of the tested program emerging from the program implementation study (conducted during the first phase of the project).

The main findings of the impact study revealed positive medium term program impacts for both child and parent outcomes. For child outcomes, significant impacts in favour of the Program Daycare group were observed on certain predictors of academic achievement relative to the Comparison Daycare group and the Informal Care group. A clear pattern in the impact of the tested program emerged for language skills. Specifically, children from homes characterized by initial high exposure to French made significant gains in skills required for academic achievement (i.e. language skills, executive functions, reading, mathematics) whereas children from homes characterized by low exposure to French showed gains on a few language variables, including the Ability to Communicate in French and use French. This pattern was replicated in analyses that take into account the program's fidelity and quality. The observed effect size represented a developmental gain of a few months in executive functions, language skills, reading and mathematics, with more pronounced gains observed for comparisons with the Comparison Daycare group. Of note, findings of comparisons with the Informal Care group were difficult to interpret due to the wide diversity in care environments for this group; this diversity made it impossible to obtain accurate measurements for the language environment and quality indicators.

With respect to parent outcomes, positive impacts of the Family Literacy component were observed in the language chosen to engage in literacy activities and the mother's and father's use of the French to speak with their child. Findings of mediation analyses suggest that the effects of the Family Literacy component on parents influenced child development, particularly in the area of language skills. At this stage, the pattern of results suggests that the Family Literacy component has been a significant indirect source of program effect on the children.

Together, the above findings suggest that the tested program continues to significantly impact the development of skills required for academic achievement (i.e. language skills, executive functions, reading, mathematics) among the sub-group of children from Francophone endogamous homes. However, children considered most likely to experience learning difficulties, that is, children from homes characterized by low exposure to French at the onset of the project, benefited from the program mainly in terms of language competencies. These observed effects have a practical significance, not only in fostering children's academic achievement, but also in strengthening the vitality of minority Francophone communities. With regard to social policies, the results of this research correspond to the priorities identified by the federal government in its Roadmap for Canada's Linguistic Duality 2008–2013.

This document is one of a series of reports prepared by SRDC, the first of which was titled *Readiness to Learn in Minority Francophone Communities: Reference Report* (Legault, Mák, Verstraete, & Bérubé, 2014). Moreover, this report supplements the following reports:

- *Readiness to Learn in Minority Francophone Communities: Project Implementation Report* (Bérubé, Legault, Janisse, Carson, Saucier, & Lefebvre, 2014)

- *Readiness to Learn in Minority Francophone Communities: First Cohort Findings Report* (Thompson, Legault, Lalonde, & Bérubé, 2014)

- *Readiness to Learn in Minority Francophone Communities: Report of Findings from the Preschool Phase* (Legault, Thompson, Patry, Carson, Lefebvre, & Lalonde, 2014).

In a final report, we will be examining whether enhanced school readiness and a greater command of the French language increase children's chances for long term academic achievement (measured through predictors of academic achievement) and the development of cultural identity in children by the age of 7.

2.0 Readiness to Learn project

2.1 Project Background

The Readiness to Learn in Minority Francophone Communities project (Readiness to Learn project) is part of the Government of Canada's 2003–2008 Action Plan for Official Languages and continues under the 2008–2013 Roadmap for Canada's Linguistic Duality. The project's guiding principles include a desire to help minority Francophone communities give children a good start in life, as well as to encourage parents to participate actively in their child's education (Human Resources and Skills Development Canada, or HRSDC, 2006). At the community level, the Readiness to Learn project is intended to be a rigorous assessment of a promising intervention whose goal is to maintain and even to renew the ethnolinguistic vitality of the minority Francophone community.

The project's main contribution is the recognition of the import of a minority linguistic context on the development of linguistic and identity-related dimensions in young children. While members of the linguistic majority may take this developmental process for granted, its true complexity is exposed within a minority-language setting. The development of linguistic and identity-related dimensions is the end result of a socialization process that spans multiple settings, including the family environment, school and other socio-institutional settings (Landry & Allard, 1997) Pioneering studies on the importance of culture to child development were conducted by Vygotsky (1978). The culture in which a child is raised affects the development of his or her language skills and learning in general through the integration of social symbols to which he or she is exposed. Thus, the child's social environment is inseparable from the construction of his or her cultural and linguistic identity, as well as his or her overall development.

In the public sphere, the reality of the minority context means that young Francophone children are exposed to two different cultures while their identity is taking shape. According to Gilbert (2003), exposure to French in all social contexts is especially important for a child raised in a highly minority Francophone setting where, by virtue of demographic weight alone, the English language predominates in every aspect of daily life. The tested program was designed to influence the various contexts that are necessary to the development of cultural and identity dimensions in young children. The importance of measuring cultural identity is based on research findings emphasizing that children's exposure to French in several spheres of their life strengthens their sense of identity and belonging to the Francophone community (Landry & Allard, 2000). For example, the study by Landry and Allard (1997) showed that in a minority Francophone setting, a strong exposure to French at home and at school from kindergarten through to the end of high school is a strong predictor of the development of a Francophone and bilingual identity, the desire and ability to integrate the Francophone community, identification with the Francophone community, and the use of French in different contexts. A more recent study supports these findings and shows that a strong Francophone identity is highly linked to the use of French in a variety of social contexts: at gatherings with family or friends, in public institutions and in the media (Landry, Deveau & Allard, 2006). In these studies, language behaviour is an important outcome of ethnolinguistic vitality and identity building.

The concept of cultural identity is not typically measured during childhood since, according to developmental theories (e.g., Erik Erikson's Theory of Personality, 1994), it is not fully crystallized until adolescence. Hence, it is difficult to directly measure the different dimensions of cultural identity in young children. It should be noted, however, that identity shaping is a dynamic process which grows out of social structures and the linguistic and cultural interactions beginning in early childhood (Landry et al., 2006). *L'Association canadienne d'éducation en langue française* (ACELF) defines identity construction as a highly dynamic process in which a person defines and identifies himself or herself through their behaviours and actions in social contexts and in the natural environment in which they are raised (ACELF, 2006, p.12). According to this definition, the construction of children's identity is not only influenced by the context in which they are raised, but also by their own language behaviour. Spoken language is a fundamental part of a population's culture and a means of expressing its cultural identity (Landry & Rousselle, 2003). Based on these findings, it is proposed that spoken language can be a predictor of cultural identity in school age children.

Other authors advocate the availability of French-language daycare services and schooling in childhood as key vectors of community vitality (Commission nationale des parents Francophones, 2005; Landry & Allard, 1997; Gilbert, 2003). According to proponents of Francophone community vitality, the ideal would be for rights holder parents to enrol their children in high quality French-language daycare services and schools. However, the reality of the situation is quite different.

A significant number of francophone parents enrol their children in French-immersion or English schools. According to the findings of the 2006 Survey on the Vitality of Official-Language Minorities (SVOLM; Corbeil, Grenier & Lafrenière, 2007), only 56% of children of eligible parents attend French elementary schools. This figure drops to 44% among teens. Parents choose immersion or English schools for many reasons: English is the child's mother tongue or the language best known by the child, school proximity, non-availability of a French-language school, and the quality of the program or school.

Several studies have shown that Francophone children enrolled in French schools obtain lower scores in reading and mathematics than their Anglophone peers. This disparity between the two groups was observed in the results for international tests like the Programme for International Student Assessment (PISA) where Francophone children enrolled in a French school in a minority linguistic setting obtained lower scores in reading than their Canadian Anglophone peers (Bussière et al., 2001; Canadian Council on Learning, 2008). The few studies on young minority Francophones indicate that this achievement gap appears at a young age. A recent study of Franco-Manitoban children aged four to six concludes that they score lower on vocabulary tests[2] and this is particularly true of children who live in a majority Anglophone environment every day. The trend continues when these children reach Grade 3 of primary school. Children who grow up in a Francophone family and preschool environment score higher in Grade 3 reading than Francophone children living in a majoritarily Anglophone linguistic environment (Chartier, Dumaine, and Sabourin, 2011).

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[2] Peabody Picture Vocabulary Test – Revised, or PPVT-R, and the communication and general knowledge scales of the Early Development Instrument, or EDI.

The minority context also has a noticeable influence on the linguistic and identity-related dimensions of adult minority Francophones. A greater use of English in daily life partly explains why 62% of Francophone adults outside of Quebec taking a literacy test in French (rather than in English) score below the level of literacy proficiency deemed necessary to function in society (i.e., aliteracy level greater than 3 on a scale of 5; Statistics Canada and HRSDC, 2005, Table 3.24). This percentage would no doubt be higher if all Francophone adults outside of Quebec took the test in French (65% of them chose to take the test in English despite identifying French as their mother tongue; Statistics Canada and HRSDC, 2005, p. 54). In fact, nearly all Francophone adults living in a minority community know both official languages with 39% of them believing they have a better command of English than French (Corbeil, Grenier & Lafrenière, 2007). According to these results, there is every reason to shore up language acquisition among minority populations and encourage parental engagement in the Francophone community.

2.2 Acquiring a Language and Cognitive Skills in a Minority Setting

The primary cause of the above-mentioned greater difficulty Francophone children to achieving academic success is presumably the limited exposure to French both at home and at school and in the public sphere (see Figure 2.1). To ensure their full integration into society, children growing up in minority communities must, sooner or later, learn the language of the majority (i.e. English) in addition to their mother tongue. We estimate that close to two thirds of young minority Francophones are from exogamous households (67%) and most adopt English as the household language spoken (Landry, 2010).[3] Only 20% of exogamous couples choose to raise their children ages zero to four in French (Martel, 2001). Further, the latest data from the 2006 Census indicate that almost 39% of Francophones outside Quebec speak English instead at home, although French remains a language that is used (Corbeil and Blaser, 2007).

Mastering two languages yields many cognitive benefits, including better attention control, enhanced working memory and greater mental flexibility (i.e. enhanced executive functions; for a meta-analysis, see Adesope, Lavin, Thompson & Ungerleider, 2010). However, children whose mother tongue is that of the minority are at great risk of developing a form of bilingualism that tends to adversely affect child development at the linguistic and cognitive levels, i.e. subtractive bilingualism (Landry, Allard & Deveau, 2009).

This form of bilingualism differs from additive bilingualism, which refers to individual who master a second language without incurring any costs in terms their cultural and the development of their mother tongue. Conversely, subtractive bilingualism is a form of bilingualism in which the mother tongue is not mastered well enough to withstand the acquisition of a second language without causing delays in the development of the mother tongue (UNESCO, 2010). The child's ability to learn (and consequently, succeed in school) may then be compromised *in both languages,* not just in French. According to Bialystok (2009), children with a limited knowledge of the language of instruction are more likely to experience academic and social problems. Weak language skills limit children's ability to

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[3]   Landry, R. (2010). *Petite enfance et autonomie culturelle : Là où le nombre le justifie…V.* Rapport de recherche réalisé pour la Commission nationale des parents francophones. Institut canadien de recherche sur les minorités linguistiques. Moncton, Nouveau-Brunswick.

benefit from what is taught in kindergarten and grade one (see also Cummins, 1979; Doherty, 1997; Hindman, Skibbe, Miller & Zimmerman, 2010), which is in itself a determining factor in academic achievement in the long term (Cummins, 1979). The variance observed in academic achievement between Francophone children living in a minority community and their Canadian peers might be explained by the higher risk of subtractive bilingualism and, by extension, a weaker knowledge of the language of instruction.

If the primary means of mastering *one* language is exposure to this language, then the primary means of developing *additive bilingualism* is exposure to the child's mother tongue. Pearson (2007) found that there is a minimum threshold of exposure to the mother tongue must be exceeded to avoid negative consequences on language and cognitive development, and to benefit from the advantages of learning a second language. For various reasons (e.g., motivation to use and master the majority language due to its predominance in many contexts, Landry et al., 2009), this threshold is higher when the mother tongue is the minority language (Pearson, Fernandez, Lewedag & Oller, 1997; Vihman, Lum, Tierry, Nakai & Keren-Portnoy, 2006). As noted by Landry (2010), it is not possible to find equal use of English and French in a minority community. In that context, greater attention is required to develop French language skills so that they can remain on equal footing with English language skills.

This finding led us to consider the benefits of an early intervention for young minority Francophone children, with the goal of strengthening their language skills. In addition, the intervention would have to include a component targeted at parents to make them aware of the challenges of living in a minority community and the steps they could take to pass on this rich cultural heritage to their children. The many benefits of programs that modify a child's environment at the daycare centre and at home have been established in studies on other populations considered to be vulnerable (see the literature review by Reese, Sparks & Leyva, 2010; Engle et al., 2007). These effects can be maximized by having the parent and educator adopt similar approaches with the child. The results of a study by Corter and Pelletier (2005) showed that a dual-component program (parent and educator), focused on early literacy activities, had a greater impact on skill acquisition in this area than a similar program with only one of the two components. Furthermore, children whose daycare and home environments had changed as a result of adopting these strategies were more advanced in vocabulary development, early reading and numeracy. The purpose of the Readiness to Learn project is to evaluate the short, medium and long term impact of such an intervention. This project is now described in the next section.

2.3 Description of the Readiness to Learn Project

The Readiness to Learn project tests whether a two-pronged preschool program benefits children living in minority communities. The tested preschool program combines a childcare component developed specifically to meet the needs of Francophone children in minority settings with a family literacy component targeting the parents of these children. This family literacy component seeks to encourage the parents' active participation in their child's development and school readiness, as well as in the transmission of French language and culture. The project itself is one of many studies on preschooler development and on the vitality of the French language in minority settings.[4]

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[4]   See Guimond (2003) for an overview of studies on ethnolinguistic vitality in minority settings.

The program's effect on child development is examined by comparing a group of participants who were exposed to the new program (referred to as the Program Daycare group) to two comparison groups consisting of participants who *were not* exposed to the new program (referred to as the Comparison Daycare group and the Informal Care group).

The program was delivered to two cohorts of participants. The first cohort began the program in fall 2007 in six minority Francophone communities (Saint John and Edmundston in New Brunswick; Orleans, Cornwall and Durham in Ontario; and Edmonton in Alberta). Program delivery to the second cohort began in fall 2008 in two communities (Orleans and Cornwall in Ontario). The study was conducted over a four year period. The children are followed from age three to age seven, when they enter Grade 2 of primary school. The length of the study allows us to monitor the development of young minority Francophones from preschool until their education commences. Final data will be collected in fall 2011 for first-cohort families and in fall 2012 for second-cohort families.

The Readiness to Learn project is unfolding in two phases. In the first phase, we sought to answer the following question: *Does the new preschool program, consisting of a daycare component and a parent/child workshop component, have a significant impact on children's language skills, Francophone cultural identity and school readiness beyond the development that would take place in its absence, and independently of any other external factors that may come into play?* Related questions have also been examined, such as: *Who benefits the most from this program? Is this program profitable? Can the new program be replicated?*

In the second phase, which is the subject of this report, we seek to answer a new question: *Does the new preschool program better prepare Francophone minority children to succeed in reading and mathematics, tasks essential to academic achievement?* While the first phase of the Readiness to Learn project focused on the preschool period, the second phase focuses on the formal education period (grades one and two). Child participants will then be aged 6 and 7.

2.4 Mechanisms Whereby the Program Has an Effect

In any evaluation, it is useful to explicitly state the mechanisms through which it is believed the program will impact outcomes of interest. This analysis can serve many purposes, including specifying the expected outcomes of the program and the constructs that must be measured to evaluate these outcomes.

The theoretical model in Figure 2.1 indicates that the tested program is an intervention with two components. The first component attempts to optimize the daycare environment (in green) while the second component seeks to achieve the same objective in the home environment (in blue). This model illustrates the main environments in which the child is being raised so as to optimize the child's learning, in terms of school readiness, development of language skills and French culture, and acquisition of skills that promote academic achievement. According to the mechanisms represented in the model, the components of the tested program influence the acquisition of the French language which, in turn, may have an impact on the predictors of academic achievement. Specifically, we are putting forth the following mechanisms:

1. the tested intervention increases exposure to the French language of children from Francophone families in minority communities by means of a quality program at the daycare centre and at home, through family workshops;

2. greater exposure to the French language results in greater mastery of the language (this outcome is/will be more significant in children from exogamous homes and Anglophone endogamous homes);

3. mastery of the French language determines, in part, a child's ability to learn in that language;

4. the ability to learn in senior kindergarten and grade one, the learning taking place at that time (i.e., acquisition of reading and mathematics skills), and the development of executive functions (affecting children's attention span), are predictors of academic achievement.

Scientific research has shown that reading and mathematics skills, along with those related to executive functions, are the best predictors of academic achievement. This will be the topic of the next section.

Figure 2.1   Theoretical Model of Academic Achievement in Young Minority Francophones
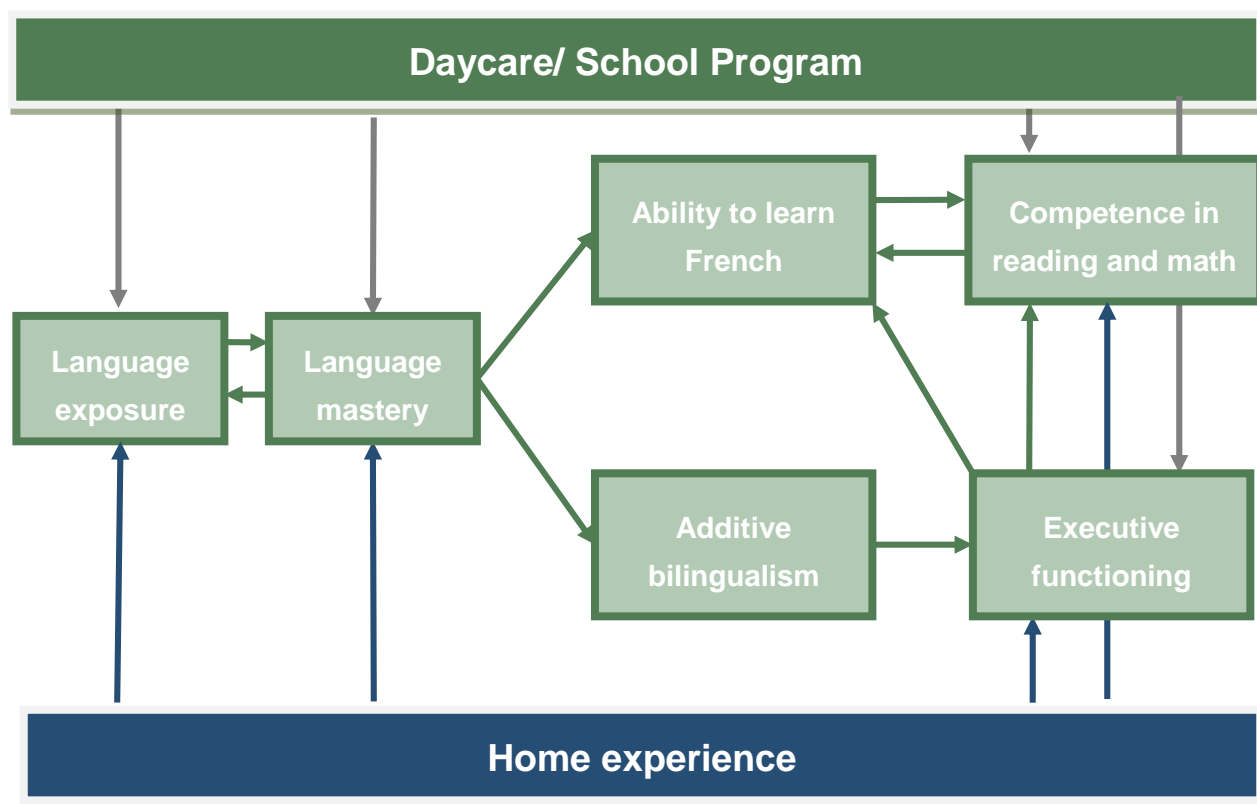
2.5 Academic Achievement

The long term objective of the Readiness to Learn project is to have a positive influence on the academic achievement of minority Francophones. This is accomplished by better preparing them for school, thereby fostering their growth and well-being not only during childhood, but also once they

reach adulthood. Academic achievement is a cumulative process in which children acquire new skills and learn to further develop those that they already possess (Duncan, Dowsett, Claessens, et al., 2007). It translates into the quality and quantity of what the child learns in relation to the objectives of the school program or curriculum.

Children's academic achievement is generally established through teacher assessments, report cards or results of school tests (whether standardized or not) (Duncan et al., 2007). It is measured by examining the child's performance in many areas, such as reading, writing, mathematics and sciences, cognitive skills and repeating grades (Pagani, Fitzpatrick, Archambault & Janosz, 2010; Reynolds, Temple & Ou, 2010). Some provincial governments in Canada systematically test the academic achievement of all children in the province in core subjects in grades 3, 6 and 9. This is true for Ontario, Alberta and New Brunswick. These provincial tests are another source of information on children's academic achievement and provide provincial standards on the subject.

In most studies, a reliable assessment of academic achievement is typically established using direct and indirect measurements administered starting in third grade (Duncan et al., 2007).[5] Since there is no intention to track the children from the Readiness to Learn project after the beginning of grade two, we plan to infer the long term impacts of the program using predictors of academic achievement measured at the beginning of grades one and two (basically, the equivalent of an assessment at the end of senior kindergarten and grade one). The meta-analysis done by Duncan et al. (2007) proved relevant in identifying the elements of school readiness (i.e., school proficiency level, listening ability and affective social competence when a child begins school) that help predict a child's academic achievement later in life. The conclusions of this meta-analysis are based on six longitudinal studies conducted in the United States (4), Canada (1) and Great Britain (1). According to their meta-analysis, the best predictors of academic achievement are, in order of importance: mathematics skills, reading skills and attention skills when children begin school.

The study by Duncan et al. was reproduced by Canadian researchers Romano, Babchishin, Pagani & Kohen in 2010. They conducted the first Canada-wide study on predicting academic achievement using longitudinal data gathered from 1,521 children through the National Longitudinal Survey of Children and Youth (NLSCY). They studied the influence of a child's reading and numeracy skills, listening ability, and affective social competence at kindergarten age on the child's academic achievement in reading and mathematics by grade three. The results of the study by Romano et al. support the findings of the Duncan study, namely that: 1) the best predictor of academic achievement is the child's skill level in mathematics when the child is in kindergarten; and 2) the child's reading skills and listening ability in kindergarten also predict the child's future academic achievement.

Finally, a study conducted by Pagani, Fitzpatrick, Archambault & Janosz (2010) examined the link between elements associated with school readiness (i.e., children's cognitive skills, listening ability and affective social competence in kindergarten) and overall academic achievement, as well as performance in mathematics and reading at the end of grade two. This study was based on data gathered through the study "In 2002... I will be 5 years old!" The Quebec Longitudinal Study of Child Development (QLSCD;

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[5] According to some developmental models, it is not possible to diagnose a learning problem until grade three. That is when a gap can be detected between a child's IQ and academic achievement. Note that this model has major limitations (see Siegel, 1989; Siegel, 2003).

Institut de la statistique du Québec, 1998-2010). Pagani et al. (2010) discovered that cognitive skills, measured by children's Knowledge of Numbers and breadth of vocabulary, as well as their listening ability in kindergarten, predict their academic achievement by the end of grade two.

To summarize, all of these studies agree that the best predictors of academic achievement are children's mathematics skills, reading skills and attention level when they begin school. These key predictors of academic achievement remain the same in grades one and two. Furthermore, longitudinal studies show a strong correlation between a child's performance in grade two and their performance in grade three (between 0.85 and 0.98 according to Wagner et al., 1997). If the program tested by the Readiness to Learn project enhances school readiness, and eventually academic achievement, then we expect that the program will have a positive impact on one or more of the predictors of academic achievement.

2.6 Correlates of Academic Achievement

To determine whether the preschool program has a real positive effect on the academic achievement of participating children, we must first identify the main factors that affect the academic achievement of children in minority communities, so we may then be able to distinguish the unique contribution of the tested program from that of other sources of influence. Research has shown various factors likely to influence children's academic achievement; some are closer to the child (e.g., the parents' characteristics) than others (e.g., the characteristics of the community in which the child lives). Furthermore, the importance of these factors and the valence (positive or negative) of their effect on academic achievement varies.

The ecological model developed by Bronfenbrenner (1979) has proven useful in depicting a coherent portrait of the factors influencing children's academic achievement. This researcher was the first to express in words and images the entire system of influences that shapes child development. His model is based on three premises:

- the child is at the centre of the model;

- the central role of the child's experiences (considered to be "drivers" of development); and

- the nature of the relationships between the child's different environments is fundamental.

Bronfenbrenner's model consists of five systems (refer to Figure 2.2):

- *Microsystem*: the child's immediate environment (family, school, type of child care, peers, neighbourhood).

- *Mesosystem*: the interactions between the immediate environments (e.g.., between home and school).

- *Exosystem*: the external environment that affects the child indirectly (e.g. parents' work).

- *Macrosystem*: the broader cultural context (western culture versus eastern culture, national economy, political culture, subculture).

- *Chronosystem*: the structure of events affecting the environment and life transitions.

Figure 2.2   Bronfenbrenner's Complete Ecological Model (1979)
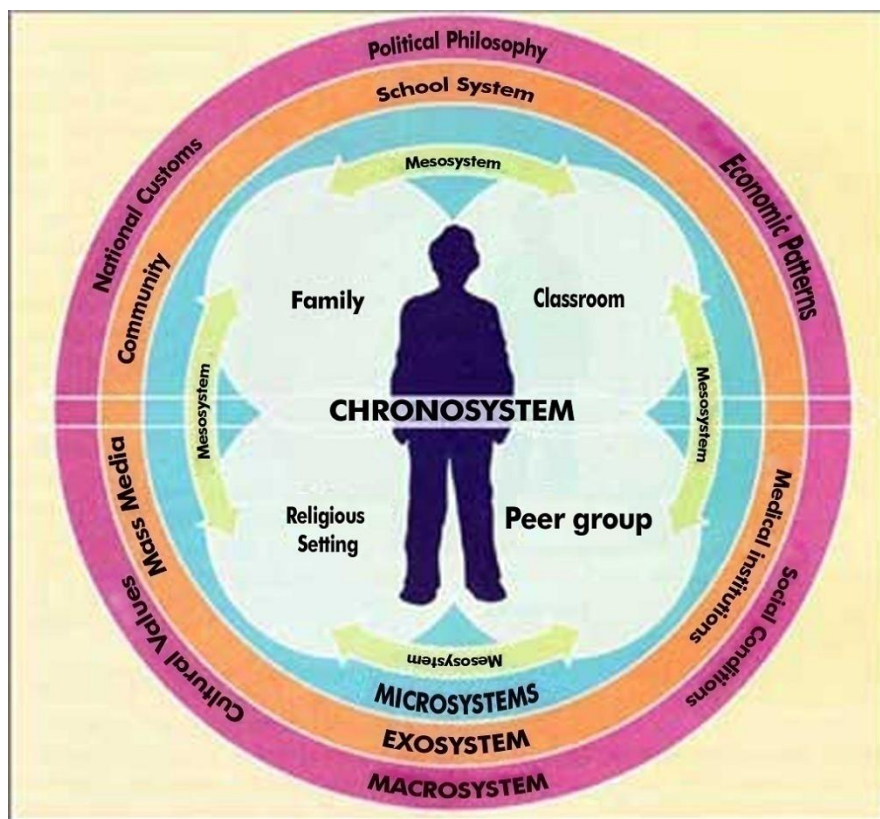
Source: From UW-Extension ABC Project, Appendix B (November 2004).

In the context of the second phase of the Readiness to Learn project, where the focus is on young children in minority language settings, three systems of Bronfenbrenner's model are of particular importance. First, the microsystem, via the family characteristics and school setting characteristics[6] influence children's academic achievement. In terms of family characteristics, we distinguish between contextual variables and family processes (this division is based on the National Longitudinal Survey of Children and Youth, or NLSCY; Statistics Canada and HRSDC, 2006). Contextual variables refer to "factual" data known to be important to children's academic achievement (e.g., family composition). Next is the mesosystem, such as ties between the home and the school, also plays a role in academic achievement. Lastly, the macrosystem is among the influences of interest for the project because it consists of the community in which the child is raised and its linguistic characteristics in particular.

In the following paragraphs, we will be presenting the main correlates to the development of reading and mathematics skills, beginning with the child`s characteristics, then moving on to the contextual variables and family processes derived from the family environment, and then the link between the family and the school setting, and finally, community factors.

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[6]   In contrast with the first phase of the project, when childcare was the main setting of influence.

2.6.1   Characteristics of the child

As indicated below, a large body of research has shown that children's listening ability is a predictor of academic achievement as the child grows. This listening ability is made possible by cognitive skills known as executive functions. According to many expert researchers in the field (Diamond, Barnett, Thomas & Munro, 2007; Monette & Bigras, 2008), executive functions include three types of highly interrelated skills: (1) *self-control* (e.g., resisting the temptation to strike out at someone to get revenge, concentrating on a task to be performed despite distractions), (2) *working memory* (e.g., connecting two ideas, following a conversation while retaining what you want to say, performing mental calculations) and (3) *cognitive flexibility* (e.g., easily changing the focus of attention, adjusting to changing requirements and modifying the frame of reference). Complex tasks generally require all three aspects of executive functions.

Blair & Diamond (2008) maintain that the development of executive functions should foster children's self-control, school readiness and academic achievement.[7] In fact, these cognitive skills assist children in being disciplined in the classroom and focusing their attention. Of the three aspects of the executive functions, self-control is considered to be the most predictive of academic outcomes (Blair & Razza, 2007). For example, research has shown that this aspect promotes perseverance, which in turn predicts academic achievement (e.g., Duckworth & Seligman, 2005). Research has also shown that self-control is an important correlate for math and literacy skills in grade one and in subsequent school years (Blair & Razza, 2007; Gathercole et al., 2004; McClelland et al., 2007). Some researchers have pointed to the fact that executive functions are affected by contextual factors (e.g. the child's emotional state, environmental context). Hence, Monette & Bigras (2008) made a distinction between focusing attention in a neutral context and in an emotional context, the second context requiring greater focus due to the additional aspect.

Finally, certain health issues and learning problems, attention deficit disorders and language problems are associated with difficulties in school and tendencies to drop out (Aram & Hall, 1989).

2.6.2   The microsystem: family environment

The **contextual variables of the family environment** are among the factors contributing the most to children's academic achievement (Sanders & Morawska, 2006). They include culture, income, family composition, the parents' level of education, the mother's age at birth of the child, and languages used at home. Studies have shown that ethnic minorities, low-income families and single-parent families tend to get less involved in their children's education than middle class white families. It follows that there is a lower chance of success for the children from poorer homes (Deslandes & Bertrand, 2004; Lee & Bowen, 2006; Pettit et al., 1997).

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[7] The ability to self-regulate is closely linked to self-control, one of the three dimensions of the executive functions. These two similar constructs can be measured by examining a child's degree of attention and concentration in completing a task, the ability to suppress inappropriate behaviour such as aggressive gestures, and the ability to resist temptation (Kurdek & Sinclair, 2000; McClelland, Morrison & Holmes, 2000).

The parents' level of education is another important factor in a child's academic achievement (Haveman & Wolfe, 1995). Klebanov, Brooks-Gunne & Duncan (1994) have shown that the mother's education level and family income are important factors in setting up a physical environment that encourages learning, but that educational one has proven to be an important factor in the practices of "loving" parents. A series of studies by Davis-Kean (2005) concluded that parents' education influences their child's academic achievement not only through their social success, but also through their beliefs and their behaviour toward their child. Finally, the family language environment is also associated with the child's academic achievement (Chartier et al., 2011). In a minority context, the languages most often spoken in the home by the parents and the child are connected to the passing on of a language and the vitality of French in the home (Forgues & Landry, 2006).

Family processes such as family functioning, parenting style, parental involvement in the home, as well as the parents' hopes and expectations regarding the child's education, are all sources of influence on the child's academic achievement. Family functioning affects the quality of relationships within the family, in terms of the quality of communications, agreement between members and support available within the family. Family functioning is associated with children's vocabulary acquisition (Desrosiers & Ducharme, 2006).

Parenting style influences a child's social, intellectual, moral and emotional development (Bornstein & Bornstein, 2007). Parenting styles have two components: *sensitivity* which measures to what degree the parent listens to the child and is able to respond to the child's needs and interests; and *control* (or *strictness*) which refers to the degree of supervision and discipline, and the degree to which the parent demands from the child obedience and self-control (Canadian Council on Learning, 2007). There is a clear link between the quality of the parent–child relationship, the parent's sensitivity during early childhood and academic achievement (Pettit, Bates et Dodge, 1997; Centre of Excellence for Early Child Development, 2007; Harvard Family Research Project, 2007). Sensitivity can have a particular impact on the development of academic abilities since it affects the development of a positive self-image, and talking with a child promotes the development of his or her conflict resolution skills, which in turn can lead to calmer behaviour in the classroom, along with attention and interest in school activities (Pettit, Bates & Dodge, 1997). Sensitivity also assists in the development of positive relationships with peers and the ability to ask the teacher for help when needed and to manage school-related tasks (Harvard Family Research Project, 2007). Studies on the subject indicate that children display better language skills and have higher IQ test scores when their parents are more encouraging and less controlling (Sanders & Morawska, 2006).

Parental involvement in the child's education at home is another important correlate of academic achievement. This type of involvement includes activities that take place in the home and encourage learning, such as helping with homework, making educational resources available and discussing the parent's love of learning (Sénéchal & Young, 2008). The parent's involvement during the first few years of elementary school has a positive impact on reading skills, especially when the parent is equipped to act as a tutor (Arnold, Zeljo, Doctoroff & Ortiz, 2008; Sénéchal & Young, 2008; Weiss, Little, Bouffard, Deschenes & Malone, 2009). Regularly taking time to read with a child is associated with growth in verbal vocabulary. It provides an opportunity for quality time between the parent and child in which the child is exposed to a language and new ideas and concepts, more varied and complex than those normally discussed in a conversation between a parent and a child (Sénéchal & Young, 2008).

Furthermore, results of longitudinal studies (QLSCD and the Quebec Study of Newborn Twins) have shown that joint parent-child reading activities contribute to the child's reading performance in grade two beyond the influence of sociodemographic variables (Dionne, 2009). Evidence that written and verbal exposure to French also assist in passing on the French culture to the children (Salerno in Lafrance, 1993) is of particular interest to the Readiness to Learn project. The frequency of activities done with children that promote the development of multiple literacies is a key variable to be considered throughout the project since it contributes to school readiness and academic achievement.

Finally, the parent's aspirations and expectations regarding the child's personal growth and academic achievement have proven to be a strong influence on the child's academic achievement (Fan, 2001; Fan & Chen, 2001; Jeynes, 2005). According to Fan (2001), parents' aspirations can prove to be more than a simple expectation; they can translate into a variety of activities and positive educational behaviour throughout the child's life.

2.6.3   The microsystem: school

In a minority Francophone context, language is of particular importance. According to Allard (2004), many *ayant droit* parents believe that the ideal school program for their child would be one in which course material was taught in English half of the time and French half of the time, thereby promoting bilingualism. However, these parents are not considering how social and family settings affect the development of children's language skills. Landry's compensation balance model shows that school and family must work together to offset the powerful effects of an anglo-dominant setting (Landry & Allard, 1997). Choosing a French immersion program in an English school does not ensure that the children will become bilingual. Students enrolled in an immersion program do not have the same French performance level as students at French schools and tend to develop a more Anglophone identity.

According to Landry, Allard & Deveau (2007), French schools — particularly those in a school system that enables Francophone children to study in French from preschool through to the postsecondary level — have a key role to play in preserving and passing on the French language and culture. The importance of attending a French school has been demonstrated in studies showing that where education is concerned, the development of language skills varies between anglo-dominant, franco-dominant and bilingual children. The limited knowledge of French in anglo-dominant children often delays learning for franco-dominant and bilingual children (Coghlan & Thériault, 2002).

2.6.4   The mesosystem: family-school interactions

Many studies support the notion that the link between the school setting and the family contributes to a child's development. Family–school communications include parent communications to the school and school communications to the parent, regarding the child's academic achievement, feeling of belonging and progress. Two-way communications imply that both the parent and the teacher are involved and engaged in the process.

Beyond communication, the parents' involvement in their child's school has a positive impact on academic achievement (Harvard Family Research Project, 2007; Lee & Bowen, 2006), although it is somewhat less significant than the parents' involvement at home (Stelmack, n.d.). This involvement takes the form of volunteering in the classroom or participating in fundraising activities, school

meetings, performances or field trips. Study findings have shown that both types of parent involvement— at home and at school —positively impact on various aspects of the child's education, such as attendance, academic achievement, behaviour and motivation (Deutscher & Ibe, 2002) in addition to increasing the child's knowledge, skills and sense of ability to succeed in school (Deslandes & Bertrand, 2004).

On the other hand, school teaching staff and administration can adopt concrete attitudes and gestures that will encourage more parents to become engaged in their child's education in a more effective manner. Parents tend to participate more often when they feel welcome at their child's school (Ontario, 2005). Parents who get involved by talking to the teacher/educator and asking questions about the child's day have children with a more extensive vocabulary, better phonological awareness and better pre-writing skills (Arnold et al., 2008). Epstein (n.d.) claims that parents who are well-informed and involved in their child's school life can have a positive impact on their child's attitude and achievement. Research shows that effective regular two-way communications between the parent and teacher foster academic achievement (Izzo, Weissberg, Kasprow & Fendrich, 1999; Weiss et al., 2009).

2.6.5   The macrosystem: community variables

Deslandes & Bertrand (2001) identified the educational community as one in which the partners want to see students succeed and develop their full potential, and in which the partners share a vision and common values. Members of these communities maintain healthy and caring interpersonal relationships with other members of the same community. In a minority Francophone context, a community's ethnolinguistic vitality[8] helps to preserve a feeling of pride and identity, supporting integration, rather than assimilation, of the French language and culture in the majority community. This ethnolinguistic vitality is expressed in the diversity of educational institutions and access to cultural resources in the community. The presence of multiple Francophone settings fosters preservation and expansion of the ethnolinguistic identity and language (Landry et al., 2007). Empiric studies have shown that access to French only resources helps to offset the strong demographic and social influence of English on the daily lives of members of the Francophone community. Speaking in terms that are more relevant for the project, availability of resources and services in the language of education is one of the key factors influencing children's academic achievement. This availability has been identified as an element that protects the Francophone identity and preserves the French language (*Commission nationale des parents Francophones*, 2005).

2.7 This Report

This report documents the midterm impact of a preschool program on child and parent outcomes. The elements presented will assist in determining whether the new preschool program enabled Francophone children being raised in a minority community to be better equipped for reading and mathematics, tasks that are essential to academic achievement. We are therefore examining the midterm impact of the tested program on children from the combined first and second cohorts, twelve months after the end of the intervention, when the children are aged six. The findings reported in this document are based primarily on data gathered in October 2010 for the first cohort and October 2011

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[8]   See Guimond (2003) for an overview of studies on ethnolinguistic vitality in a minority setting.

for the second cohort. Data were extracted from children's assessments and the parents' follow-up survey, both done 12 months after completion of the preschool program.

Chapter 3 discusses aspects related to project methodology, such as sampling, measuring instruments and research hypotheses. In chapters 4 and 5, respectively, we will be describing the preliminary analyses done to ensure the validity of the study findings and the analysis strategies used. Chapter 6 will describe the results of the impact analyses done 12 months after the tested program. In Chapter 7, we will conclude with a review of the major findings and a discussion of the results in general.

The *Report of Program Effects in Grade 1* is part of a series of reports. The last one, entitled *Readiness to Learn in Minority Francophone Communities: Report of Findings from the Preschool Phase* was submitted to HRSDC on May 31, 2011. This document will be followed by a report entitled *Readiness to Learn in Minority Francophone Communities: Report of Program Effects in Grade 2*, which will be submitted to HRSDC on March 31, 2013.

3.0 Methodology

This chapter concerns the methodological aspects used in the Readiness to Learn project. The first section describes the eligibility criteria and the target population while the second presents the project's experimental design. A third section explores certain threats to internal validity and the strategies introduced to counter them. The fourth section describes the study sample, specifies changes in the composition of the experimental groups and retention rates across time. The following section details the measures used in the impact analyses for the tested program. The last section examines the series of hypotheses tested in the impact analyses.

3.1 Target population

Parents and children were recruited based on specific eligibility criteria. The ***first criterion*** was that children in the first cohort had to be born between January 1, 2004 and January 31, 2005, and children in the second cohort had to be born in 2005. This criterion corresponded to the eligibility criterion of enrolment for kindergarten in September 2009 for the first cohort and in September 2010 for the second cohort, set by the Ontario Ministry of Education and the New Brunswick Department of Education and Early Childhood Development. The ***second criterion*** required that one of the child's parents be an "*ayant droit*" as defined by section 23 of the *Canadian Charter of Rights and Freedoms* [9]. Since the purpose of the tested program was to enhance children's language skills and school readiness, this criterion ensured that the target population, that is, children entitled to attend a French-language school, was reached.

The ***third criterion*** related to the parents' intention to register their child in a French school. This criterion was in fact rarely applied since the children were quite young (age 3 or less) when they were enrolled and parents of children that young have generally not made a decision regarding their choice of school. However, if the parents indicated that they had chosen an English school, SRDC made a decision not to obtain the parent's informed consent since the new preschool program was designed in part to better prepare children for French-language school.

3.2 Experimental design

The mid-term outcomes of the program were evaluated using a quasi-experimental design with non-equivalent control groups. As with experimental studies in the field, a quasi-experimental design is intended to test, by means of comparison groups and pre-intervention measures (i.e., measures taken before the intervention), the causal hypothesis that an intervention has a significant effect on the variables in question beyond changes that would occur in the absence of that program and independently of other external factors that may come into play.

The methodology involves three experimental groups: a Program Daycare group, consisting of children enrolled in a French-language daycare that offers the new preschool program; a Comparison Daycare group, consisting of children enrolled in a French-language daycare that does not offer the preschool program being tested; and an Informal Care group, consisting of children whose daytime care is

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[9] *Canadian Charter of Rights and Freedoms* available at http://laws.justice.gc.ca/eng/Charter/page-1.html

provided at home or at an unregulated family daycare. The Comparison Daycare group takes into account how formal daycare affects the development of preschoolers, which is a treatment unto itself. The purpose of the Informal Care group is to factor in how an informal childcare environment affects the development of preschoolers, especially with respect to the French language. Children enrolled in an English-language daycare were added to the Informal Care group for the impact analyses. Although these children were exposed to a formal daycare environment, they were not exposed to a French environment. By not classifying these children in the Comparison Daycare group, we maintained language homogeneity in the Comparison Daycare group in regards to exposure to a French-language daycare program.

3.3 Internal validity

Since random assignment was not possible, there are likely inherent differences between the Program Daycare group and the comparison groups from the outset. This makes it even more important to implement conditions to ensure the study's internal validity, thereby eliminating from the start any *plausible* alternative explanations for results. In fact, it is less advantageous to use control techniques, often statistical, after the study ends.

Under the Readiness to Learn project, several necessary conditions were put in place to ensure the internal validity, such as:

- using a sample size large enough to achieve the statistical power needed to detect a medium effect size with a very high degree of confidence that the true value of the estimated effect falls within a specific interval (i.e., we would obtain the same results 19 times out of 20 with other samples);

- using a sampling strategy that ensures a relatively homogenous distribution of sociodemographic and community factors across experimental groups;

- taking pre-intervention measures for the anticipated program effects or outcomes (in this case, the correlates to academic achievement) and associated factors;

- verifying the effects of sample attrition on group composition;

- preventing the contamination of comparison groups.

Profiles for the children, their family, and the communities before the first year of formal education can be found in the report *Readiness to Learn in Minority Francophone Communities: Report of Findings from the Preschool Phase* (Legault et al., 2014). Details of the considerations taken to maintain the study's internal and external validity can also be found in Section 3.3.

3.4 Description of the Sample by Community and by Experimental Group

The first cohort of project participants was from the minority Francophone communities of Cornwall, Orleans and Durham, Ontario; and Edmundston, New Brunswick[10]. The recruitment period for this first

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[10]   Originally, the project included the communities of Edmonton, AB and Saint John, NB. We do not report data for these communities as they were not included in the impact analyses presented in this report.

cohort extended from May to October 2007. Participants from the second cohort live in the minority Francophone communities of Cornwall and Orleans, Ontario. The recruitment period for the second cohort took place in the fall of 2008.

The statistics reported below describe the sample for both cohorts of participants combined. Further information on the sampling strategy used in the context of the study can be found in the report *Readiness to Learn in Minority Francophone Communities: Report of Findings from the Preschool Phase* submitted to HRSDC on May31st, 2011.

Total sample at enrolment: At the time of enrolment, the project involved 356 children from 352 families. As observed in Table 3.1, the communities of Edmundston and Cornwall (first cohort) had the highest proportion of participants (23.9% and 20.2%, respectively), followed by the communities of Orleans (15.5% for the first cohort and 15.7% for the second cohort), Cornwall (12.9% for the second cohort) and Durham (11.8%).

The average age of the children when they enrolled in the project was 38 months. There was a balanced number of boys (49.4%) and girls (50.6%). The mother tongue of the children in the sample (according to the most knowledgeable respondent) was mainly French (71.1%) followed by English or another language (19.4%).

The mother's age at birth of the child in question was 27.5 on average. In terms of education, 80% of these mothers had at least a college diploma, and half of them had a university degree. Average household size was four members; 8.4% of families were headed by single parents. Over half of the participating families (59.1%) had an annual income of over $70,000; median annual income ranged from $80,000 to $99,999. With respect to the linguistic profile of the participating families, over half of the mothers (61.7%) and fathers (55.0%) spoke only French to their child. Most children were from Francophone endogamous homes (49.3%), followed by exogamous homes (39.2%)[11].

Total sample at 12 months post-program: The sample described in this section consists of participants who were included in the 12-month post-program impact analyses (see Table 3.1). This sample reflects families who were still enrolled at the end of the program and, consequently, includes participants who withdrew during the second phase of the study, for whom missing data were imputed (see Section 4.2 for a description of analyses on missing data and attrition). At 12 months post-program, the total sample (i.e., the sample used for impact analyses) consisted of 336 children from 332 families. It included 165 boys (49.1%) and 171 girls (50.9%). The children's average age was 74.4 months, or 6 years and 2 months. The mother tongue of the children in the sample (according to the most knowledgeable respondent) was primarily French (71.1%), followed by English or another language (19.4%).

In terms of education, 80% of the mothers had at least a college diploma, and half of them had a university degree. Average household size was four members; 8.6% of families were headed by single

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The lack of French-language daycares that could be used as counterfactuals made it impossible to properly measure the impact of the program in these two communities.

[11]   Type of homes or household type was determined by combining the mother and the father's first official language spoken (FOLS).

parents. Two-thirds of the participating families (66.7%) had an annual income of over $70,000; median annual income ranged from $80,000 to $99,999. With respect to the linguistic profile of the participating families, over half of the mothers (58.0%) and fathers (54.3%) spoke only French to their child. Most children were from Francophone endogamous homes (50.1%), followed by exogamous homes (38.8%)[12].

Table 3.1   Participant breakdown by community at enrolment and at 12 months post-program

Community	At enrolment	36-month evaluation (12 months post-program)
Cornwall - Cohort 1	72 (20.22%)	67 (19.94%)
Cornwall - Cohort 2	46 (12.92%)	45 (13.39%)
Durham	42 (11.80%)	35 (10.42%)
Edmundston	85 (23.88%)	83 (24.70%)
Orleans - Cohort 1	55 (15.45%)	53 (15.77%)
Orleans - Cohort 2	56 (15.73%)	53 (15.77%)
Total	**356 (100%)**	**336 (100%)**

Sample by experimental group: At the time of enrolment, the project involved 110 children in the Program Daycare group (G1), 135 children in the Comparison Daycare group (G2) and 111 children in the Informal Care group (G3). These figures shifted to 95, 130 and 111 respectively for G1, G2 and G3 at 12 months post-program (see Table 3.2). A child's experimental group was determined by the number of hours exposed to one of the three types of child care during the first eight months of program delivery.[13] This decision was made when significant fluctuations were observed in the second year of program delivery as Ontario children began attending junior kindergarten.

Any change in group composition is likely to bias program impact estimates. This threat to statistical validity was controlled in two ways. Firstly, we verified whether changing groups or withdrawing from the study was associated with dependent variables or with the experimental group. Based on the results of these analyses, we proceeded with data imputation (see Section 4.2 for a description of attrition analyses) and included the variable "Changed group in the first year" as a covariate (see Appendix A). These two strategies assisted in maximizing the validity of the program impact estimates.

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[12]   Household type was determined by combining the mother and the father's first official language spoken (FOLS).

[13]   Data collected during the summer months were excluded. The most reliable measurement of the average effect of treatment exposure relies on information collected during the school year.

Table 3.2   Participant breakdown by experimental group at time of enrolment in the preschool program and at 12 months post-program

Study group	At enrolment	36-month evaluation (12 months post-program)
Program Daycare group	110 (30.9%)	95 (28.3%)
Comparison Daycare group	135 (37.9%)	130 (38.7%)
Informal Care group	111 (31.2%)	111 (33.0%)
Total	**356 (100%)**	**336 (100%)**

3.4.1   Retention rate

The Readiness to Learn project has an excellent retention rate, with only 35 withdrawals (9.8%) since the project's inception in 2007. The main reason for a child's withdrawal from the project is a family move outside the community. Note that some children continued to be tracked in cases where the move was to another community participating in the project. From that point on, these children were considered participants in the new community. The second most cited reason for withdrawal was a loss of contact with the family, and the third, a desire not to participate in the study's extension. At the onset, parents had originally consented to participate in a study for a little over two and a half years (summer 2007 to January 2010 for the first cohort). HRSDC's decision to extend the study for an additional two years involved obtaining parental consent, in spring 2009, for their child to continue participating in the project.[14] Some parents chose, at that time, to withdraw their participation.

Table 3.3 lists the reasons for withdrawal from the project during the two phases of the study; i.e. from enrolment to the end of the second year of preschool program delivery (24 months), and during the 12 month post-program follow-up period (36 months).

Table 3.3   Reasons for Child Withdrawal from the Readiness to Learn Project at the end of the preschool program and at 12 months post-program

Reason for withdrawal	Phase 1 (from enrolment to the end of the program at 24 months)	Phase 2 (during the 12-month post-program period)	Total
Move outside of a participating community	8	3	11
The child transferred to an English daycare/not enough English in at the Program Daycare	3	0	3
Family lack of availability	4	0	4

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[14]   This extension enabled us to evaluate the medium and long term effects of the new preschool program on the children's academic achievement. Incidentally, the extension was the reason for recruiting a second cohort of project participants.

Reason for withdrawal	Phase 1 (from enrolment to the end of the program at 24 months)	Phase 2 (during the 12-month post-program period)	Total
Bothered by questions in the baseline survey	1	0	1
Loss of contact with the family	2	5	7
The child has a developmental problem	2	0	2
The parent no longer wishes to have their child assessed due to the number of assessments being done at school	0	1	1
Refused to participate in the study's extension	0	6	6
Total number of withdrawals	**20**	**15**	**35**

3.5 Measures

This section discusses the measures used to conduct the 12-month post-program impact analyses. The section begins with an overview of the data collection plan and response rates observed for parents' surveys and children's assessments. It then continues with a description of the measurement tools used with both the parents and children.

3.5.1 Data Collection Plan

The Readiness to Learn project took place over a four year period during which several waves of data collection were held. It is worthwhile at this point to take a brief look at the overall implementation of the project evaluation plan. Recall that the project has two phases. The first phase of the Readiness to Learn project covers the preschool period, while the second phase covers the early years at school (grades one and two). Figure 3.1 below illustrates the administration timeline of parent surveys and child assessments. During the first phase, data were collected regularly every four months, beginning in October 2007 for participants in the first cohort and October 2008 for those in the second cohort. Thereafter, data were collected annually during the second phase, beginning in September 2009 for the first cohort and September 2010 for the second cohort. This point in time corresponds to 24 months in Figure 3.1, the period immediately following completion of program delivery.

Data collected during the 12-month post-program follow-up are the subject of the analyses presented in this report. Data collected at 12 months following the end of the program included children's assessments and parents' survey, administered at the same time in October 2010 for the first cohort and in October 2011 for the second cohort. At that time, children in both cohorts were starting grade 1 in school.

Figure 3.1   Schedule for project data collection
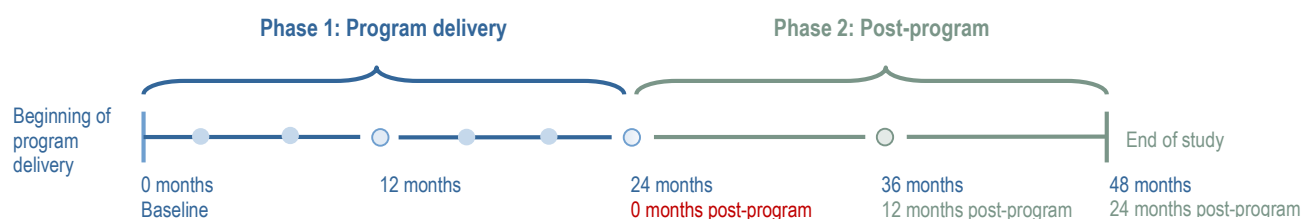
Child Assessments

We observe in Table 3.4 that 319 child assessments were completed across the combined Readiness to Learn project cohorts, for a response rate of 89.6%. The average length of time to complete an assessment was 27 minutes.[15]

Table 3.4   Response rate for child assessments at enrolment, upon program completion and 12 months post-program

	Baseline assessment (Enrolment)	24-month assessment (Upon program completion)	36-month assessment (12 months post-program)
Children assessed	346	334	319
Absent	4	4	2
Withdrawals	6	18	35
Response rate	**97.2%**	**93.8%**	**89.6%**

Parents' Surveys

The 12-month post-program survey was administered by phone to the parents of both Readiness to Learn project cohorts. The survey took on average 30 minutes to complete. Table 3.5 shows that 316 surveys were completed, for a response rate of 88.8%[16].

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[15]   However, analyses covered 336 children since it was possible to impute data for fifteen families who had withdrawn during the second phase of the project and the two missing children from the 36-month assessment, using data collected at 24 months. Section 4.2 contains details on imputation of missing data.

[16]   However, analyses covered 336 parents since it was possible to impute data for fifteen families who withdrew and five families who were absent during the 36-month project evaluation using data collected at 24 months. Section 4.2 contains details on imputation of missing data.

Table 3.5   Response rates for parent surveys at enrolment, upon program completion, and at 12 months post-program

	Baseline survey (Enrolment)	24-month survey (Upon program completion)	36-month survey (12 months post-program)
Surveys administered	356	331	316
Absent	0	7	5
Withdrawals	0	18	35
Response rate	100%	93.0%	88.8%

3.5.2   Child Measures

Executive Functions

Digit Span Test (Wechsler, 2004; Wechsler, 2005): This test is a subscale of the Wechsler Intelligence Scale for Children adapted for Francophone Canadians (Franco-Ontarians, Quebecois; WISC-IV[CDN-F], Wechsler, 2005). WISC-IV[CDN-F] consists of several tests designed to assess intelligence, each with excellent psychometric properties. The test used for this study includes two tasks. In the first task, the child simply repeats a series of numbers as heard (***Forward Digit Span***). Completing this task is an exercise of the working memory. In the second task, the child repeats a sequence of numbers in reverse order (***Backward Digit Span***). In addition to the working memory, this second task also requires mental flexibility. In other words, to successfully complete this task, the child must be able to retain the numbers heard and manipulate them before answering. In both tasks, the sequence of numbers to be memorized gets longer and longer as the child progresses in the test. Each sequence of numbers is read out loud to the child once. The child successfully completes the task if he or she can correctly repeat the sequence of numbers in the order requested. The test is stopped after two failed attempts for the same item (each item is comprised of two trials). The working memory exercise has been validated and has French-Canadian norms. The first composite score represents the number of sequences repeated correctly as heard (Forward Digit Span). A second composite score represents the number of sequences repeated correctly in reverse order (Backward Digit Span). The range of scores for the current sample is 0 to 12 for the Forward Digit Span and 0 to 8 for the Backward Digit Span.

Dots Task (Diamond et al., 2007): The Diamond Dots Task is complex and measures inhibition, working memory and mental flexibility, the three fundamental executive function skills. This computerized test consists of presenting the child with an image which randomly appears on the left or right side of the screen. For the purposes of our project, the computerized version of the Dots Task was adapted to create a pencil and paper version. The test was subdivided into three series of plates, each with a specific rule. In the first series of 12 plates, the child was presented with two rows of three boxes separated by a black stripe. In the top row, a picture of a heart appeared, alternating between left and right (an addition sign appeared in the middle box). The child had to stamp the box in the bottom row (for example, the left box) that matched the position of the picture of the heart in the top row (in this

instance, the left box). The first four plates were used to ensure that the child fully understood the first rule. In the second series of 12 plates, the image was a flower. The child had to indicate the position of the picture of the flower (for example, the box to the right) by stamping the box that was *opposite* to the position of the picture (in this instance, the box to the left). The first four plates were used to ensure that the child fully understood the second rule. Then, in the third series of 20 plates, the picture presented was either that of a heart or a flower placed randomly in the box to the left or the right in the top row. This third series required the child to apply both rules learned during the first two series; in other words, stamp the box that matched the position of the heart and stamp the box that was *opposite* the position of the flower. There was no plate to practise the exercise combining the two rules that had been learned beforehand. The child had to complete all plates by himself or herself. The child's score was calculated based on the total number of successful trials for the last series of items that combined both of the rules previously learned. Scores for this study sample varied from 3 to 20.[17]

Language Skills

Domain C (Language and Communication) Early Years Evaluation — Direct Assessment
(Willms, 2007): This test consists of 14 four-point items measuring the child's communication and comprehension abilities. The evaluator asks the child to point to pictures that represent a word she says, repeat seven syllable sentences, answer questions with complete sentences, use pictures to tell a story, and demonstrate the meaning of four action words. Although children could be assessed for this test in either French or English, only French results were used for analysis purposes. Only results from the baseline assessment were retained (score range = 0 to 50).

Word Reasoning (Wechsler, 2004; Wechsler, 2005): This test is a subscale of the WISC-IV[CDN-F]. It measures children's ability to understand sentences (rather than simply words) and their ability to use verbal information to guess a target word. The test consists of asking the child to guess a word based on a series of clues given by the evaluator (for example, an animal that goes "woof"). The child has five seconds to answer correctly based on the given clue. If the child does not answer, the evaluator repeats the clue and gives the child another five seconds to answer. Each of the 24 items in the subscale provides one or more clues. When an item had several clues, the child received a point for correctly answering *one* of the clues. No additional clues were given, other than those indicated on the answer sheet. The test was stopped when the child was unsuccessful for five consecutive items. The child obtained an overall score that reflected the number of clues that were correctly answered. For the current study sample, scores varied from 0 to 14.

Verbal Fluency (Cormier, Desrochers & Sénéchal, 2006): This test is part of the *Batterie de tests pour l'évaluation multidimensionnelle de la lecture en français* (BÉMÉL) which has the benefit of having been validated in French-Canadian minority communities. Verbal Fluency refers to the ease with which a person accesses linguistic information (for example, naming the item quickly and automatically; Plaza, 2003). The test consists of presenting the child with a category (for example, fruit) and asking the

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[17] Note that this measure was not retained for the impact analyses due to a ceiling effect; in other words, the task was too easy for the children to complete. More than 80% of the children obtained a score between 17 and 20. Also, it was not possible to impute the missing data for this variable since it was not strongly correlated with any of the dependent variables measured during the 24-month evaluation period (see Section 4.2.3 for a description of the strategy used to impute missing data).

child to name as many examples as possible in the given category within a specified time (for example, apple, orange, etc.). The child obtains an overall score based on the total number of acceptable examples given for each category within 30 seconds. The score partially reflects the child's efficiency at retrieving his or her semantic network (Rosen & Engle, 1997). Validation studies show an acceptable temporal fidelity index when the score used is the total number of examples given for only two categories ($r = 0.76$; Korkman, Kirk & Kemp, 1998). Several categories are involved in measuring the BÉMÉL semantic fluency. For the purposes of this project, only four categories were considered to be necessary to obtain a good measure of verbal fluency (i.e., animals, fruit, vegetables, and drinks). The overall score represents the total number of examples given for all of the categories combined (score range = 0 to 44).

Reading Skills

Letter Names and Sounds (Thompson, Desrochers, Marchand & Cormier, 2008): Knowledge of the *sounds* of alphabet letters was measured using a booklet in which upper case letters are presented in increasingly difficult order for Francophone children. Knowledge of the *names* of alphabet letters was measured using a booklet in which lower case letters were presented in increasingly difficult order for Francophone children. The test was stopped if the child failed to identify the name or sound of four consecutive letters. The overall score, measured on a 5-point scale, represents the number of letters that were named correctly. A score of 0 represents "0 to 5 letters named correctly", a score of 1 represents "6 to 10 letters named correctly", a score of 2 represents "11 to 15 letters named correctly", a score of 3 represents "16 to 20 letters named correctly", and a score of 4 represents "21 to 26 letters named correctly". The same scoring system was used to calculate the overall score for the number of Letter Sounds pronounced correctly (i.e., a 5-point scale). For the current study sample, overall scores for the two measures (Letter Names and Letter Sounds) varied from 0 to 4.

Reading Simple Words (Cormier, Desrochers &Sénéchal, 2006): This test is part of the *Batterie de tests pour l'évaluation multidimensionnelle de la lecture en français* (BÉMÉL). It assists in assessing precursors to reading as well as children's reading skills from kindergarten to grade six. It consists of 36 one- or two-syllable words (with simple spelling) presented in increasing order of difficulty for young Francophone Canadians (from Ontario and Quebec). The test is stopped if the child fails to read four out of six consecutive words. The total score represents the number of words that were read correctly. The range of scores for this study sample was 0 to 36.

Mathematics skills

Knowledge of Numbers (Case & Okamoto, 1994): This test is a French translation of the *Number Knowledge Test* (NKT) by Case & Okamoto (1994). It is designed to assess children's age-appropriate levels of comprehension of the system of whole numbers (Okamoto & Case, 1996). The test is subdivided into five levels that correspond to the normal levels of mathematics knowledge in children aged 4, 6, 8, 10 and 12. Given the age of the children in this project, only three of the five levels that measure their abilities to count (5 items), add (14 items) and compare (17 items) were used. Depending on the items, children are asked to manipulate objects (e.g., tokens, coins or felt shapes) or use stimuli plates. Children are asked questions verbally and must successfully answer a minimum number of questions before moving on to the next level (for example, three of the five items at the first

level; seven of the fourteen items at the second level). Children have about 30 seconds to answer each question after which, the item is scored as failed. Simple arithmetic problems measured in this test proved to be predictive of a child's ability to succeed in mathematics. The total score represents the number of problems solved until a child can no longer answer the questions at a given level.

3.5.3   Parent Measures

The scales used in the parent surveys of the Readiness to Learn project were obtained from studies on Canada's Francophone populations, such as the National Longitudinal Survey of Children and Youth (NLSCY; Statistics Canada and Human Resources and Social Development Canada, 2005, 2006), the Quebec Longitudinal Study of Child Development (QLSCD; *Institut de la statistique du Québec*, 2003) and the Survey on the Vitality of Official Language Minorities (SVOLM, Statistics Canada, 2006). The questions selected for the surveys of the Readiness to Learn project were those relevant to the children's age group at the time of the baseline survey and the 12-month post-program survey. Note that only the scales included in the impact analyses are detailed in this section. Consequently, the list of scales differs somewhat from those found in previous Readiness to Learn project reports. Several other constructs were measured though they were not retained in impact analyses. The decision to include them or not was based on preliminary analyses, results of which are reported in Chapter 4.

Sociodemographic Characteristics

The sociodemographic characteristics of children and parents stem from questions asked on the parental consent form (for example, the child's gender and date of birth) and in the baseline survey. The follow-up surveys were an opportunity to make any necessary changes to this initial profile. This section identifies the sociodemographic variables used in the impact analyses.

Information on the mother's age at the child's birth, parents' mother tongues and knowledge of official languages were gathered in the baseline survey. Parents' immigrant status was established by means of a question in the 24-month follow-up survey (i.e., upon program completion). The 12-month post-program follow-up survey was used to update information on parents' education level, family income, household size, family composition (i.e. single-parent families) and family income (see Appendix A for a complete list of covariates considered for the impact analyses). Other variables included in the analyses remained constant throughout the study (child's gender, child's age at baseline assessment, mother's age at the child's birth, immigrant status, social capital and social support).

Linguistic Variables

Some questions in the 12-month post-program follow-up survey were used to update the linguistic profile of participating families, especially the languages spoken by the respondent with the child at home. The same information was also gathered for the respondent's spouse.

SRDC created two variables to measure the **Household Type**, which describes the child's linguistic home environment. The first variable, **Household Type Based on FOLS**, was created by crossing the mother's first official language spoken (FOLS) with that of the child's father. This variable takes into consideration knowledge of both official languages, mother tongue and the language most often spoken at home (Forgues and Landry, 2006). The Household Type Based on FOLS score was then dichotomized

with 1 indicating "Francophone endogamous" and 0 grouping together all other categories. This dichotomized variable was used in analyses identifying confounding variables (see Appendix A).

SRDC created a second variable to measure the language spoken at home, based solely on the *Language Spoken by Mother to Child and Language Spoken by Father to Child*.[18] This variable, *Household Type Based on the Language Spoken to the Child*, is considered to be a more accurate reflection of the child's linguistic home environment. Respondents had several options from which to choose the category that was most representative of their experience (i.e., whether they spoke English only to their child, English and French, French more than English, etc.). Like the first definition given for Household Type, this variable was dichotomized, creating two balanced categories with the score of 1 indicating signifying "French only" (52% of the sample) and 0 reflecting all other categories (48% of the sample). The dichotomous variable was included in analyses identifying confounding variables (see Appendix A) and in impact analyses by linguistic profile (see Section 6.4).

The *Continuum of French spoken by Child* is based on the languages the child normally uses to communicate with his or her mother, father, friends and siblings at home and outside of the home. Languages spoken by children in a variety of social contexts are a good indication of the languages in which they feel the most comfortable expressing themselves. We postulate that the Continuum of French Spoken by the Child is an expression of the child's language experience and represents a predictor of his or her cultural Francophone identity. Items were answered on a three-point scale where a score of 1 indicates that the child did not communicate at all in French and a score of 3 indicates that he or she communicated in French only. A total score is obtained by averaging the scores obtained on each item. The scale's internal consistency is very good with a Cronbach alpha of 0.88.

The *Ability to Communicate in French* was measured using five items reflecting the frequency with which the child succeeds in communicating clearly and in understanding directions or the thread of a conversation with ease. The items ranges on a 3-point scale, where a score of 1 indicates "Never" and 3 indicates "Often". An overall score is obtained by averaging the scores for each item. The scale's internal consistency is relatively reliable, with a Cronbach alpha of 0.58.

Sociolinguistic Environment

Questions pertaining to the sociolinguistic environment in which the child is being raised were measured from the baseline survey.

The *Vitality of the Francophone Community* was assessed by way of four items pertaining to the frequency with which French is used in public areas (i.e., businesses, work places, and government services) and access to French-language services (media). The overall score gives us an indication of how often French is used in the community. The answers are scored on a 6-point scale where 1 indicates "Never" and 6 indicates "Always". An overall score is obtained by averaging the scores for each item. The scale's internal consistency is very high, with a Cronbach alpha of 0.82.

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[18] For single-parent families, only the language spoken by the parent living with the child was considered in the creation of both variables that measure the home language environment. The languages spoken to the child by the mother and father are also used as dependent variables in impact analyses in Section 6.5.

Engagement in Francophone culture includes four items designed to measure to what degree the parents are willing to take part in Francophone cultural activities in their community and get involved in organizing them. The items extend over a 4-point scale where a score of 1 indicates "Not at all/rather weakly" and a score of 4 indicates "Very strongly". An overall score is obtained by averaging the scores for each item. The scale's internal consistency is acceptable, with a Cronbach alpha of 0.72.

Sense of belonging to Francophone culture is measured using a question designed to determine the cultural group with which the parents identify. Choices included primary or sole identification with the Francophone group, primary or sole identification with the Anglophone group, and identification with both groups equally or another linguistic group.

Family Processes

Most family process measures were gathered from the baseline survey. Some of these processes were measured again in the follow-up surveys. A total of seven family processes were computed as scales, including Family functioning, Depression, Positive parenting practices, Authoritarian parenting practices, Empowerment (supporting autonomy), Frequency of literacy activities and Language of literacy activities.

The *Family functioning* scale, consisting of eight items, assesses the quality of connectedness within the family. The items pertain to emotional openness, expression of feelings, and positive interactions within the family. The choice of answers for the items on the scale ranged from 1, "Strongly disagree," to 4, "Strongly agree." An overall score is obtained by averaging the scores for each item. The Family functioning scale shows excellent internal consistency, with a Cronbach alpha of 0.81.

The *Depression* scale has eight items that reflect a despondent mood (e.g., feeling depressed or sad, crying, feeling lonely). The answers for these items extend over a 4-point scale, where 1 indicates that the respondent felt this way "Rarely or none of the time" and 4 signifies that she felt this way "Most or all of the time." The Depression scale has a high internal consistency with a Cronbach alpha of 0.80.

The *Positive parenting practices* scale consists of five items measuring the frequency of positive interactions between parent and child (for example, the number of times the parent praises the child, laughs with him or her or expresses affection). Items are scored on a five-point scale, where 1 indicates "Never" and 5 indicates "Many times a day." An overall score is obtained by averaging the scores for each item. The scale's internal consistency is acceptable, with a Cronbach alpha of 0.62.

The *Authoritarian parenting practices* scale consists of four items measuring the degree of supervision and discipline. It tells us, among other aspects, whether the child complies with the punishments imposed or whether punishments vary depending on the parent's mood. Items are scored on a five-point scale where 1 indicates "Never" and 5 indicates "Almost always." An overall score is obtained by averaging the scores for each item. The scale shows an acceptable internal consistency with a Cronbach alpha of 0.61.

The *Empowerment* (supporting autonomy) scale considers the opportunities afforded to the child to develop his or her autonomy (for example, does the child have specific daily chores to do, does the child have the possibility to explore his or her own interests, does the child care for a pet or another person). The five items extend over a 4-point scale where 1 indicates "Strongly disagree," and 4 indicates

"Strongly agree." An overall score is obtained by averaging the scores for each item. The empowerment scale internal has poor internal consistency with a Cronbach alpha of 0.33.

The ***Frequency of literacy activities*** scale consists of five items from the baseline survey, and three items from the 12-month post-program (36 month) evaluation period, measuring the frequency of reading, writing and numeracy activities. Measured activities are those parents do with their child, including reading with the child, teaching the child how to read letters or words, and teaching the child to write letters or words. These items are scored on a 5-point scale, where 1 indicates that an activity is done "Rarely or never" and 5 indicates that an activity is performed "Every day". An overall score is obtained by averaging the scores for each item. The scale's internal consistency is acceptable, with a Cronbach alpha of 0.52 at baseline and 0.64 at 12 months post-program.

The ***Languages of literacy activities*** consists of five items from the baseline survey and two items from the 12-month post-program evaluation period, measuring languages used when the parent leads the child in reading books, letters or words, and in writing letters or words. Respondents have several categories from which to choose the one most representative of the language used in literacy activities. These categories were combined to create a 5-point scale representing a language continuum *for each group of similar activities* where a score of 1 indicates that the activity is done in "English only", a score of 3 indicates that the activity is done in "French and English and/or another language", and a score of 5 indicates that the activity is done in "French only". An overall score is obtained by averaging the scores for each item. Internal consistency ranges from very high with Cronbach alpha estimate of 0.94 for the baseline survey to high with a Cronbach alpha estimate of 0.78 for the 12-month post-program survey.

School Environment

Questions pertaining to the child's school environment are taken from various surveys administered after the child starts school.[19] The12-month post-program survey held several questions on the type of school (French language, English language or immersion) the child attends, his or her participation in a francization program the previous year, and the need for additional assistance or tutoring. Furthermore, three questions dealt with homework: how often during a typical month did the child have homework/schoolwork, the number of hours spent on homework each day, and how often parents checked their child's homework. Finally, two scales served to establish parents' perception of their child's school and teacher.

The ***Perception of the school*** scale measures the parent's perception of the child's school based on five items. The dimensions measured include school climate indicators (for example, most children seem to be happy at school; parents feel welcome at school; students have a strong sense of belonging). The items are scored on a 4-point scale where 1 corresponds to "Strongly disagree" and 4 corresponds to "Strongly agree". An overall score is obtained by averaging the scores for each item. The scale's internal consistency is very high, with a Cronbach alpha of 0.83.

The ***Perception of the teacher*** scale consists of six items measuring communications between the teacher and the parents. Various dimensions were measured, including the amount of information

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[19] In Ontario, a child begins school at the age of four; in New Brunswick, a child begins at the age of five.

provided by the teacher concerning the child's behaviour and the child's activities during the school day. The items are scored on a 4-point scale where 1 signifies "Strongly disagree" and 4 corresponds to "Strongly agree". An overall score is obtained by averaging the scores for each item. The scale's internal consistency is very high, with a Cronbach alpha of 0.84.

Daycare Environment

Dosage: The number of hours per week spent in child care is an important variable to consider in measuring the program "dosage" that children receive at daycare. To gather this information, SRDC used the attendance record already filled out by the educators as part of their duties, which includes the time of arrival and departure for each child. The total number of hours the child spent at daycare is compiled on a weekly basis and sent once a month to SRDC's Ottawa office. Impact analyses used the average number of hours per week at daycare in the first eight months of program delivery (see Section 5.4.1).

Fidelity and quality of daycare component implementation: A growing number of studies have shown the importance of considering an intervention's degree of implementation when interpreting the program's observed effects (Charlebois, Brendgen, Vitaro, Normandeau & Bourdreau, 2004; Conduct Problem Prevention Research Group, 1999; Dane & Schneider, 1998; Durlak & DuPre, 2008). In this regard, based on data from five meta-analyses, Durlak and DuPre (2008) found that the effect size of an intervention is two to three times greater when program implementation is evaluated and program elements are implemented as planned. Moreover, consideration of the integrity and quality of the daycare program implementation helps to better understand and provide a nuanced interpretation of impact analysis results. Consequently, two global indices were integrated into the analyses — implementation fidelity and quality.

These indices were created based on observation notes at program and comparison daycares. For impact analysis purposes, these observation notes were converted into measures based on a set of subscales of the Early Childhood Environment Rating Scale – Revised Edition, or ECERS-R (Harms et al., 1998).[20] Its French version, the *Échelle d'évaluation de l'environnement préscolaire — Révisée* (ÉÉEP–R), was validated as an instrument for assessing the quality of childcare services as defined by the early childhood education specialists of the National Association for the Education of Young Children (NAEYC, 1984; Bredekamp & Copple, 1999). It should be noted that only the indices used in the impact analyses are discussed below. A full description of the processes and tools used to study the integrity of the day care program implementation can be found in the *Project Implementation Report* (Bérubé et al., 2014).

Global fidelity index indicates the proportion (percentage) of program elements that were implemented. This global index was calculated by averaging two indices. The first index, structural fidelity, examines the presence of certain elements in the daycare environment, such as cards displaying a picture and a word or the presence of a routine chart. The second index, content fidelity,

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[20] At the outset of the Readiness to Learn project, it was decided not to complete the ECERS–R grid directly, since this type of observation could be perceived as too intrusive and impede the full cooperation of program and comparison daycares. It was therefore decided that the observers would take notes on the ECERS–R elements for the targeted subcategories.

examines how program elements were integrated in child care programming, such as reading to children during Circle Time or reasoning activities.

Global quality index reflects the extent to which key program elements have been implemented, using a 7-point scale where 1 signifies that care is well below fundamental childcare requirements and 7 signifies personalized, high-quality care (Harms, Clifford & Cryier, 1998). Three subscales of the ECERS-R were used to establish the global quality index for childcare settings. The first index, structural quality, measures the overall quality of the environment in childcare settings. It includes the ECERS-R subscales "Indoor Space", "Health Practices", and "Greeting/Departing". The second index, reading quality, only includes items from the "Books and Pictures" subscale, given the importance of reading in a child's vocabulary acquisition. The third index, quality of educational content, focuses on activities that encourage children to communicate and broaden their vocabulary. This index includes the ECERS-R subscales "Encouraging Children to Communicate", "Using Language to Develop Reasoning Skills", and "Informal use of language".

Finally, other elements of structural quality, such as the educators' salary, training, education level and number of years of experience, were difficult to ascertain through observation. This information was instead obtained through in-depth interviews or through data collected in the educator's signed consent form.

3.6 Hypotheses Being Tested

3.6.1   Impact of the Tested Program at 12 Months

Through its two components – the daycare component and the family literacy component – the Readiness to Learn project seeks to enhance the school readiness of young Francophones living in a minority community and positively influence their abilities in dimensions associated with academic achievement so that their school performance is ultimately enhanced. The main objective of the daycare component is to directly influence child outcomes, while the objective of the Family Literacy component is to indirectly influence the child outcomes by modifying the parents' attitudes and behaviour. If the program has the desired positive effects, then we will observe enhancements in children in the Program Daycare group compared to children in the comparison groups, with respect to academic achievement predictors identified in the Duncan et al. (2007) meta-analysis. These predictors are executive functions, reading skills and mathematics skills. We therefore expect to observe the most pronounced program effects where these dimensions are concerned.

Further to the research results reported in *Readiness to Learn in Minority Francophone Communities: Report of Findings from the Preschool Phase* submitted to HRSDC on May 31, 2011, we expect that an increase in the effects of the tested program, 12 months after the completion of program delivery, will be directly related to the extent to which the children have been exposed to the program, as well as the quality and fidelity of implementation.

Below are the hypotheses as to the impact of the tested program on the children:

1. Compared to children in the comparison groups, children in the Program Daycare group will have higher scores in domains measuring executive functions such as working memory, inhibition and flexibility.

2. Compared to children in the comparison groups, children in the Program Daycare group will perform better in measures of language skills such as oral comprehension and Verbal Fluency. Children in the Program Daycare group will also have higher scores for linguistic variables measured in the parents' survey (i.e., Continuum of French Spoken by the Child and Ability to Communicate in French).

3. Compared to children in the comparison groups, children in the Program Daycare group will perform better in measures of reading skills such as knowledge of the alphabet and oral reading.

4. Compared to children in the comparison groups, children in the Program Daycare group will perform better in measures of mathematics skills, especially Knowledge of Numbers.

5. The magnitude of the daycare program's impact on the children's outcomes will be influenced by their degree of exposure to the program. Greater exposure to the tested program will be associated with better performance by the children in the Program Daycare group on scales measuring executive functions, language skills, reading skills and mathematics skills.

6. The magnitude of the daycare program's impact on children's executive functions, language skills, reading skills and mathematics skills will vary according to the quality and fidelity of the tested program from which they have benefited.

7. The family literacy component will have an impact on the parents' behaviour, especially in terms of the frequency of literacy activities, the language used during the literacy activities, and the language spoken to the child.

3.6.2 Children's Linguistic Profile

The literature on bilingualism makes a clear distinction between cases where the acquisition of a second language benefits a child's general development and cases where development is affected (e.g., Landry et al., 2009). The research identifies two types of bilingualism: additive and subtractive. The form of bilingualism depends on the answer to the following question: Is the *mother tongue* developed enough to support the acquisition of a second language without delaying the age-appropriate development of the child's cognitive skills or language skills in the mother tongue (Ball, 2010)? In the affirmative, the form of bilingualism is additive. In the negative, the bilingualism is subtractive.

The condition required to develop additive bilingualism is not met for many Francophone children living in minority environments, a population that experiences certain delays in literacy in comparison with their peers. For bilingualism to be additive, a minimal threshold of exposure to, or use of, the mother tongue must be exceeded. This minimal threshold of exposure is more difficult to achieve when the child's mother tongue is the language spoken by only a minority of people in the child's environment. Furthermore, the minimal threshold required is higher when the mother tongue is a minority language. Thus, Francophone children who grow up in a bilingual environment need ongoing

support to improve their likelihood of achieving additive bilingualism. According to scientific literature, children with low exposure to French at home are more likely to develop subtractive bilingualism. The risk is even greater with low exposure to French outside the home because these children live in a minority linguistic setting.

It's with this in mind that we examined, within the framework of the Readiness to Learn project, the possibility that children exposed to languages other than French (usually English) benefit most from the tested preschool program. This research question was tested in the report *Readiness to Learn in Minority Francophone Communities: Report of Findings from the Preschool Phase* submitted to HRSDC on May 31, 2011. The series of analyses performed assisted in discovering that in the short term, children with a low initial exposure to French benefited more from the tested program, in terms of developing their language skills, than children with a high initial exposure to French, who benefited more from the tested program in terms of cognitive development. Hence, during the first phase of the study, the program enabled children in the Program Daycare group, who had low exposure to French at home at the beginning of the project, to further enrich their knowledge of French compared to their counterparts in the two comparison groups[21], and this effect should persist in the medium term. Moreover, children with a strong initial exposure to French should benefit from the program by giving them an advantage in their readiness to learn for all subjects taught in French (see the theoretical model of academic achievement presented in Figure 2.1, Chapter 2).

Considering these research results and scientific literature on bilingualism, we expect that the tested program will have different medium term effects on the children depending on their linguistic profile. Specifically, we propose the following hypotheses:

1. The tested program will have a greater impact on the *language skills* of children in the Program Daycare group from exogamous homes or Anglophone endogamous homes (identified in the next few chapters as the sub-group of children with "low exposure to French at home"), compared to children from Francophone endogamous homes (identified in the next few chapters as the sub-group of children with "high exposure to French at home").[22]

2. The tested program will have a greater impact on *executive functions*, as well as *reading skills* and *mathematics skills* of children in the Program Daycare group from Francophone endogamous homes compared to those from exogamous homes or Anglophone endogamous homes.

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[21]   Note that the result pattern is not as clear when the Informal Care group is used as a reference.

[22]   For the linguistic profile analyses, the household type, either exogamous, endogamous Francophone or endogamous Anglophone, was calculated on the basis of the Language Spoken by the Mother to the Child crossed with the Language Spoken by the Father to the Child.

4.0 Preliminary Analyses

This chapter describes the steps used to validate quantitative data from both cohorts of the Readiness to Learn project. These preliminary analyses have two primary goals: to optimize the database and to determine the data's limitations with respect to the external[23] and internal[24] validity of the results.

The preliminary analyses presented in this chapter primarily address the 12-month post-program evaluation period, or the +36-month evaluation period (see Figure 3.1 for the timeline of the two phases of the study). The next sections discuss respectively: the quality control process (Section 4.1), treatment of missing values and attrition (Section 4.2), identification of confounding variables (Section 4.3) and assessment of the project sample's representativity (Section 4.4). The chapter ends with a summary of the preliminary analysis and its implications in evaluating the impact of the tested program (Section 4.5).

4.1 Quality Control Process

SRDC applied a rigorous quality control process for data used in the preliminary analyses and the impact analyses. These precautions rule out errors from the outset and optimize the database in accordance with the basic assumptions of each analysis (e.g., no outliers).

Ensuring the quality of the data collected comprises multiple steps ranging from instrument selection or conception, to data collection and data entry. The selection or design of measuring tools (e.g., survey, interview grid, field observation grid, etc.) is a first step in producing a "clean" dataset. Whenever possible, the Readiness to Learn project team selected pre-existing scales that have been tested and validated. When such measures were unavailable, the Readiness to Learn project research team developed new instruments (e.g., scales, observation grids or interview grids) by applying solid psychometric principles. For instance, care was taken to ensure that various sources of measurement error were minimized. Questions were written in a clear, precise and simple language. Among other considerations, the format of measurement instruments and questions were conceived so as to avoid placing an excessive burden on the recall memory of participants. All measurement tools were pilot-tested prior to their use in the field.

For the child outcome measures specifically, a pilot test was conducted in September 2010 with a sample of children to determine if the measuring tool could be used with children in the target age group, and to identify any potential problems in administering the new tools included in the evaluation. In sum, SRDC took proactive steps to minimize various sources of measurement error that might arise in these circumstances.

Incidentally, high standards in the quality of data collection by research personnel were ensured by developing tool-specific technical material and instruction manuals. These materials were distributed

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[23]   Concerning the following question: "Is it reasonable to assume that the effect would be obtained with a sample representative of the target population?"

[24]   Concerning the following question: "To what degree can we state that the reported effects are solely the result of the tested program?"

to all relevant personnel, who were also trained in the practical administration of the measurement instruments. The interviewers who administered the parent surveys were also trained.

A control of the data quality was put in place at the outset of the Readiness to Learn project. The raw data were collected in two steps. Community coordinators served as the initial hub, receiving the data collected in their respective communities. Once the information was collected, it was sent to the SRDC Ottawa office. The community coordinators ensured that missing data was minimal in the parent surveys and child assessments by verifying whether they were completed properly. Where errors or omissions were found, interviewers or evaluators were asked to retrieve the missing information by contacting the parent or by completing the child's assessment. Community coordinators were instrumental in guaranteeing the high response rates and retention rates observed in the Readiness to Learn project.

Incidentally, the quality of the data entered and the psychometric properties of the measurement scales were verified by the Ottawa office. Data were entered into an electronic database and then submitted to a rigorous verification system to ensure accuracy. In a first step, a random check of 10% of the data was conducted to verify accuracy of data entry. Next, descriptive analyses were conducted to verify if item frequencies fell within the expected range. Crosschecks were conducted based on the electronic databases to ensure that responses were consistent within respondents. Inconsistent or implausible values were verified with the paper copy or the data collector.

Statistical methods were used to confirm the quality of the scales. The internal consistency of scales and the validity of the measured dimensions were verified respectively using Cronbach alpha and factor analysis. The construct validity of the measured variables was verified by examining whether the direction of the observed inter-correlations between variables was consistent with expectations.

Lastly, the data were routinely screened for univariate and multivariate outliers prior to analysis. All collected survey data were subjected to imputation of missing values, according to accepted procedures (Cohen, Cohen, West & Aiken, 2003; pp., 431–451; Tabachnick & Fidell, 2006, pp. 62–71).

4.2 Missing Data and Attrition Analyses

Missing values in a database can threaten the validity of an analysis. This threat stems from two main sources. First, cases with missing values for a variable are usually excluded from an analysis, which may be problematic when they have characteristics that differ from cases that remain in the analysis. If the sample composition changes after a subsample of children are excluded, this has implications for the external validity of the results. For example, if the missing values occur disproportionately for girls, the results may not generalize to this population. Similarly, the internal validity of the estimates of the program effects depends on the stability of group composition over time. If missing values disrupt group composition, then this may bias estimates of the program effects. Next we present an analysis of the missing values that assesses the potential for both types of bias. The strategies applied to cancel out these effects are also identified.

4.2.1   Source of Missing Data

There were missing values in the data collected from the assessments and surveys for the 12-month post-program (36-month) evaluation period. These unexpected missing values can be placed into two main categories: a) complete missing data; and b) incomplete data. The next few paragraphs will discuss the sources of the missing values and their effects on the selection of an imputation strategy.

First, during the 12-month post-program evaluation period, there was a low percentage of complete missing data. These were due to either the non-administration of the survey or participant attrition. Participant attrition can prove to be particularly problematic if it results in a change in the sample composition. If that is the case, it is preferable to use a data imputation strategy for these participants to avoid doubt as to the external and internal validity of the program.

Moreover, data from assessments or surveys are sometimes incomplete, which means that valid data are obtained for certain questions but not others, either because the interviewer made a mistake or because the participant refused to answer. In such a situation, it must be determined whether an aspect of the question systematically increases the possibility that a participant will not answer the question. For example, it is well known that respondents at the extreme ends of an income bracket are more likely to not respond to income-related questions. In this example, the process that produces the missing values is clearly systematic. If the mechanism producing the missing values is systematic (not random), excluding cases with missing values may significantly change the characteristics of the gross sample.

In such a situation, it is best to use a data imputation technique. In a longitudinal design, the same question can be asked several times in order to increase the chance that the desired information will be obtained from all participants. To illustrate this in the context of the project at hand, we asked about family income three times in the first two years of the study.[25] For participants who remained in the project until the eighth survey, such a redundancy can be used fully by imputing the missing values for these questions when they occur.[26]

The analysis in Section 4.2.2 explains the nature of the mechanism that generated the missing data, while Section 4.2.3 describes the imputation strategies used to minimize the effect of the missing values in the impact analyses.

4.2.2   Pattern of Missing Data

Missing values are like any other outcome in that it is possible to model the process that generated them. The conclusions drawn from this modeling exercise determine what steps are taken to preserve the internal validity and external validity of the study. If the process that led to the missing data is random, validity is not threatened. However, if the process is not random, steps must then be taken to

[25]   This question was asked in the baseline survey and during the fifth, seventh and eighth evaluation period.

[26]   It must also be assumed that the measured variable is unlikely to change systematically over time or to be affected by the treatment. We consider family income an excellent example of a variable that can evolve over time, but does not really show a systematic relationship with time (over the period of one to three years in question) or with the participants' assignment to groups in the study.

avoid introducing bias by excluding cases that have been self-selected. Below we describe the modeling strategy used to elucidate the pattern of missing data in the project database.

According to Little and Rubin (1987), there are three types of unpredictable missing values: a) missing completely at random (MCAR); b) missing at random (MAR); and c) missing not at random (non-ignorable MNAR). The most desirable scenario is a situation where a small number of missing values is distributed randomly throughout the data (i.e., MCAR). Conversely, the worst scenario is having a large number of missing data distributed non-randomly. In the first case, the problem of missing values can be solved by applying a listwise deletion without risk of biasing the results of an analysis (i.e., removal of cases with missing values). This solution is not advisable for the second scenario. Using this method to deal with missing values that are distributed non-randomly may bias estimates of the treatment's effects. This bias can be avoided by: a) excluding any irregular variables from the analysis; b) applying a data imputation strategy; or c) accepting bias in the analysis and considering its nature when interpreting results (e.g., missing values were more common in population X, therefore the results based on cases with complete data may not apply to population X).

The first step in this decision process is to determine the prevalence of missing values in the database (i.e., the percentage of missing values across all variables in the database) and the pattern of these missing values. The prevalence of the missing values is simply assessed by means of basic descriptive analyses. However, a more in-depth analysis is required to determine the pattern of the missing data.

The most vital question to answer is whether the missing values are predictable or not. As we have already seen, unpredictable missing values or those missing "at random" are classified as MCAR. One necessary condition for demonstrating MCAR is to show that the relationship between the occurrence of the missing values and the observed values of variables in the database is statistically null. This property can be verified by conducting independent tests of association for each variable in the database. For continuous variables, one may also use Little's MCAR test. If the MCAR test or another association test reveals that values are systematically missing, then the working hypothesis of an MCAR distribution must be rejected in favour of a less restrictive assumption: the distribution of missing values is actually MAR (i.e., missing at random).

For a pattern of missing data to be considered MAR, two conditions must be respected: a) the missing values are non-randomly distributed and b) it must be possible to predict the value of the missing value. The first condition is met when one or more variables in the database allow us to predict the incidence of missing values; the second condition is met when strong predictors of the measured variable allow us to accurately predict the value of the missing observation. When the first condition is met but not the second, there is an MNAR-type distribution of missing data. In this case, we have no other option but to describe the pattern of missing data in enough detail to properly understand the limitations with respect to the study's validity.

In the following section, we report the results of the missing-values analysis conducted in preparation for the impact analyses of the Readiness to Learn project. First we report the results of a quantitative analysis of participant attrition. We then present an analysis of complete missing values due to a failure to assess a child or administer a survey. For each analysis, we describe the missing values from two angles: as a function of their breakdown by experimental group and as a function of their relationship to other variables in the database.

Missing Values Due to Attrition

The attrition rate is relatively low for both cohorts of participants. Since the beginning of the study, only 35 of the 356 families in the sample recruited in the four communities retained for the impact analyses (9.8%) withdrew from the study. Specifically, in the first phase of the study, 18 families in both cohorts left the study, for an attrition rate of 5.0% for the first two years of the project. At the beginning of the second phase of the study (third year of the project), the attrition rate rose to 9.3% of the sample for the four communities. Specifically, 15 families were no longer participating in the project. Of the 15 families who left the project, 13 were from the first cohort and 2 were from the second cohort (see Chapter 3 for further details on the sample). In total, both cohorts combined constituted an enrolment sample of 356 children with a 90.2% retention rate for the first three years of the study.

A formal analysis was performed on all of the participants who have withdrawn since the project began. Results indicate that the withdrawals were linked to the groups; in other words, there was a link between the frequency of withdrawals and the experimental group, χ^2 (2, $N = 356$) = 7.44, $p < 0.05$. In total, 15 families in the Program Daycare group, 6 families in the Comparison Daycare group and 14 families in the Informal Care group left the study. Furthermore, withdrawal from the study was significantly linked to several dichotomous covariates, such as family income,[27] χ^2 (1, $N = 354$) = 4.86, $p < 0.05$, mother's education level at the baseline survey, χ^2 (1, $N = 356$) = 4.52, $p < 0.05$, and a change in experimental group during the first year, χ^2 (1, $N = 356$) = 18.06, $p < 0.01$. Specifically, the percentage of withdrawals from the study was higher in families with an income below \$60,000 and in families where the mother's education level at the baseline survey was less than a college diploma. Changing experimental group during the first year was also a predictor of withdrawal; i.e., 64% of the children who changed experimental groups during the first year withdrew from the study. Among the children who did not change groups, only 9% withdrew from the study.

Finally, withdrawal from the project was also significantly linked to several outcomes measured at baseline. The children who withdrew from the study tended to have lower scores on the baseline assessment for the communication, $t(38.58)$ = 4.98, $p < 0.001$, self-awareness, $t(31.16)$ = 3.27, $p < 0.01$, cognition, $t(31.54)$ = 2.88, $p < 0.01$, expressive vocabulary, $t(36.55)$ = 5.03, $p < 0.001$ and receptive vocabulary, $t(27.83)$ = 3.71, $p < 0.01$ domains. It should be noted that these analyses do not include participants who completed the assessment in English or the four participants who left the study before the first assessment. The same pattern was observed for outcomes measured in the parent survey. Specifically, participants who withdrew had lower scores for certain linguistic variables on the baseline survey, including language of literacy activities, $t(39.20)$ = 2.57, $p < 0.05$, language spoken by the mother to her child, $t(39.51)$ = 2.19, $p < 0.05$, and language spoken by the child to others, $t(41.85)$ = 2.13, $p < 0.05$.[28] These results suggest that the children who withdrew were less exposed to French and

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[27] It should be noted that among the families who withdrew, two data items relating to family income are missing from the baseline survey.

[28] Since the variance is assumed to be unequal between the group of participants who withdrew and the group of participants who did not withdraw, the Welch robust heterogeneity estimator was used to evaluate the difference between these groups. The adjusted degrees of freedom are presented in parentheses.

communicated less in French at the beginning of the project than the participants who are still enrolled in the study.

It should be mentioned that during the first phase of the study (the first two years of the project), attrition frequency was too low (20 families withdrew) to formally test whether participation retention was tied to experimental group assignment in the study. The descriptive analysis of frequency did not show a systematic relationship during the first phase. Descriptive analyses were also used to examine the attrition pattern for the 15 families who withdrew during the second phase of the study (third year of the project). Overall, attrition results for the second phase follow the same pattern seen in attrition analyses since the beginning of the project. Specifically, withdrawals appear to be linked to group assignment, with a larger number of participants from the Program Daycare group (7 families) and Informal Care group (6 families) withdrawing from the study than those in the Comparison Daycare group (2 families). Furthermore, withdrawal in the second phase of the study was significantly negatively linked to family income ($r = -0.18$) and the mother's education level ($r = -0.12$), and positively linked to a change in experimental group during the first year of the program ($r = 0.16$). A negative correlation was also observed between withdrawal in the second phase of the study and the score obtained at baseline in the communication ($r = -0.20$), self-awareness ($r = -0.17$), cognition ($r = -0.14$), expressive vocabulary ($r = -0.19$) and receptive vocabulary ($r = -0.19$) domains.

Although the attrition rate for the Readiness to Learn project compares favourably to those of other assessment studies (e.g., Rogers, Fernandez, Thurber & Smitley, 2004), analyses suggest that, since the beginning of the project, the attrition rate has been linked to experimental group assignment, certain covariates and several outcomes collected at baseline. These analyses suggest that some of the participants' characteristics at baseline can predict withdrawal from the study, including a family income below $60,000, the mother's education level, and a change in experimental group during the first year of the study. Analyses also reveal that children from families who withdrew from the study had lower scores on the baseline assessment. In conclusion, there is a risk of attrition biasing the estimate of the tested program's effect and limiting the generalization of results. The fact that there is a negative link between withdrawal and performance on the baseline assessment means that simply excluding these cases would artificially increase the sample's language skills level, which would in turn limit the generalization of results. This aspect is particularly important since program impact is assumed to vary based on French language skills. The problem posed by the missing values must be managed using a more sophisticated strategy: replacing the missing values by imputation.

Complete Missing Data from Families Enrolled in the Project (Assessment or Survey)

For the 12-month post-program evaluation period, we observed a low percentage of missing data. Among the 321 families still enrolled in the study, five parent surveys (1%) were not completed and two assessments (less than 1%) were not administered to children. The incidence of missing data is too low to test its association with experimental group assignment. Analyses indicate that three of the families are from the Program Daycare group and the other four are from the Comparison Daycare group. The missing data represents families from both cohorts (four families from the first cohort and two families from the second cohort) across three of the four communities.

The cases in which the parent survey or child assessment is missing seem to be comparable to other participants in terms of covariates and outcomes measured at baseline, with the exception of one covariate. A positive correlation was observed between missing surveys or assessments at 12 months post-program and the covariate single-parent family (r = 0,19).

In short, missing values are infrequent and their real values can be estimated accurately given the many predictors and the repeated administration of several measuring instruments. Despite the negligible quantity of missing values, the fact that the missing data is not broken down equally across the experimental groups could bias the results. Imputation of the missing values is therefore deemed necessary to offset any bias in the generalization of results that could be produced by excluding cases with missing values.

Missing Values Due to Partially Missing Data (Survey Only)

An analysis of the missing values due to partially missing data was conducted for the 316 surveys administered to the parents during the 12-month post-program period. This analysis examined the confounding variables to be included in analyses (for a complete list, see Section 4.3) and the outcomes measured through surveys. For some of these variables, there is enough redundancy in the database (e.g., the question on family income is asked three times in the first three years) to perform a simple imputation of the missing values.[29] After this first imputation, the list of covariates is subjected to a formal missing values analysis (this section) and to an imputation (see Section 4.2.3).

All the variables in the impact analyses have less than 1% of data missing, with the exception of family income with a rate of 8.5%. Little's MCAR test is significant, χ^2 (25) = 44.85, *p*< 0.01, suggesting that the missing values are not distributed randomly. Further analysis of survey data for the 12-month post-program period revealed that missing data for the income question was linked to a lower incidence of literacy activities by the parent with his or her child. Furthermore, since the rate of missing values associated with this variable is greater than 5% (Tabachnick & Fidell, 2006, p. 63), data imputation was conducted in order to include cases with missing data in the impact analyses.[30]

Missing Values Due to Partially Missing Data (Assessment Only)

An analysis of the missing values due to partially missing data was conducted for the 319 assessments administered to children during the 12-month post-program period. This analysis examined the child outcomes included in the impact analyses. The analysis indicated that these variables have less than 1% of missing data: one missing data item for the Knowledge of letters variable and three missing data items for the Knowledge of Numbers variable. Since Little's MCAR test is not significant, χ^2 (1) = 0.005,

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[29]　When a given question or scale is administered several times, the various instances can be combined in order to create a single variable for the impact analyses that contains the greatest amount of information and the fewest missing values. In some cases (e.g., income), a difference in measurement scale required a regression imputation to bridge the two measurement instances for this variable, thereby creating a single variable that contains all the information available in the database on the measured concept.

[30]　The Family income variable was imputed, but was not used as a covariate in the 12-month post-program impact analyses since it was not associated with the experimental group in this sample.

p = 0.94, it is suggested that the missing values are distributed randomly. In such a situation, where there is a low incidence of missing data and they are distributed randomly, it is acceptable to eliminate the participants with the missing data from the analyses (Tabachnick & Fidell, 2006, p. 63).[31]

4.2.3   Data Imputation Strategy

An analysis of missing data has pointed to the importance of imputing missing data, particularly for the data that is completely missing due to attrition and to the inability to assess a child or administer a parent survey. This analysis suggests that the process leading to the missing data was not random, and therefore represents a threat to the internal validity and external validity of the study. To offset the potential bias associated with attrition, imputation of missing data was used only for participants who withdrew during the second phase of the study. This decision was based on two main reasons: (1) descriptive analyses for attrition seem to indicate that withdrawal in the second phase is more likely to bias the validity of the study than withdrawal during the first phase; and (2) actual data obtained from the previous assessment (+24 months) are only available for the children who withdrew during the second phase (76%), making it possible to estimate the missing data with greater accuracy (MAR type missing data). Finally, the completely missing data for participants still enrolled in the study were also imputed (MAR type data).

The strategy used to address missing values changes depending on the variable. In every instance, we aim for the use of repeated measures in the study. As noted above, the fact that we repeatedly measure the same variables (or very similar variables) with the same people over the course of the study makes it possible to accurately estimate the value that would have been obtained had the variable been observed. We will describe, in separate sections below, the imputation strategy used for assessment measures (i.e., child outcomes) and for survey measures (i.e., covariates and a few outcomes).

Imputation of Child Outcomes

Of the 336 participants retained for the impact analyses, we imputed outcomes for a total of 17 children (5% of the sample), corresponding to 15 children who withdrew in the second phase and two children who were still enrolled but absent during the 12-month post-program evaluation period (+36 months). These participants are spread across the experimental groups as follows: eight participants from the Program Daycare group, three participants from the Comparison Daycare group and six participants from the Informal Care group. Scores for variables measured during the previous evaluation (+24 months) were used for imputation purposes. These variables included five subscales related to the ÉPE-AD, including Communication, Self-awareness, Cognitive skills, Receptive vocabulary and Expressive vocabulary, along with Knowledge of Letters and Knowledge of Letter Sounds. Table 4.1 shows the correlations between these variables measured at 24 months and during the 36-month evaluation period. As demonstrated in the table, all correlations have a definite significance *p* < 0.01.

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[31]   We nevertheless chose to replace the missing scores by estimating a participant's missing score based on his or her answers to other items for the given outcome (e.g. Knowledge of Letters). Specifically, missing data was replaced by the participant's average score for the other items measuring the same variable (Roth, Switzer III & Switzer, 1999). This approach enabled us to maintain all of the participants who were assessed for the purposes of the impact analyses. This approach was also used to replace partially missing survey data when variables consisted of several items.

Note that the Dots Task variable was not used for the impact analyses since it proved to be too easy for the children participating in the study. Over 80% of the children obtained a score of 17 to 20. Furthermore, the findings revealed weak to moderate correlations between the Dots Task and the dependent variables measured during the 24-month evaluation period (correlations varying from 0.04 to 0.21), limiting the possibility of properly imputing the missing data.

Table 4.1   Correlations between dependent variables at 24-month and 36-month evaluations

		24-Month Evaluation (r (n))						
		Know. Letter Names	Know. Letter Sounds	Self-awareness	Comm.	Cognition	Expressive vocab.	Receptive vocab.
36-Month Evaluation	Know. Letter Names	0.58*** (319)	0.42*** (319)	0.45*** (318)	0.43*** (319)	0.54*** (319)	0.41*** (319)	0.36*** (319)
	Know. Letter Sounds	0.59*** (319)	0.48*** (319)	0.39*** (318)	0.44*** (319)	0.56*** (319)	0.33*** (319)	0.31*** (319)
	Knowledge of Numbers	0.58*** (315)	0.54*** (315)	0.51*** (314)	0.50*** (315)	0.62*** (315)	0.41*** (315)	0.41*** (315)
	Reading Simple Words	0.70*** (319)	0.63*** (319)	0.48*** (318)	0.59*** (319)	0.65*** (319)	0.42*** (319)	0.42*** (319)
	Word Reasoning	0.28*** (319)	0.29*** (319)	0.59*** (318)	0.43*** (319)	0.38*** (319)	0.54*** (319)	0.55*** (319)
	Verbal Fluency	0.38*** (319)	0.35*** (319)	0.59*** (318)	0.46*** (319)	0.46*** (319)	0.58*** (319)	0.53*** (319)
	Digit Span (Forward)	0.20*** (318)	0.26*** (318)	0.29*** (317)	0.34*** (318)	0.25*** (318)	0.26*** (318)	0.21*** (318)
	Digit Span (Backward)	0.41*** (318)	0.32*** (318)	0.30*** (317)	0.34*** (318)	0.40*** (318)	0.27*** (318)	0.29*** (318)

Note: ***$p < 1\%$; **$p < 5\%$; *$p < 10\%$. Know. = Knowledge; Comm. = Communication; Vocab. = Vocabulary.

The SPSS Missing Value Analysis (MVA) module, designed to address missing data, was used to estimate the missing values for eight outcomes of the direct assessment of the children. Specifically, we performed a multiple regression using the full sample, which made it possible to estimate scores based on significant and relevant data that are, in this case, the seven variables from the 24-month child assessment for which we have complete data. The residuals for a randomly sampled case are added to the value estimated by the regression model to imitate the "random" variability typical of a real observation (Roth & Switzer, 1995).

Imputation of Survey Data

Survey data was imputed for the 21 covariates retained for the impact analyses and for the six outcomes measured through the survey. First, with respect to covariates, most of them (19 of the 21) came from the baseline survey or information gathered during the first year of the project. Note that 12 of these were also included in the impact analyses for the first and second years of the program, and missing data associated with these covariates was imputed during the first phase of the study (for further details, see the *Report of Findings from the Preschool Phase*, Legault et al., 2014). Of the nine other covariates retained for the impact analyses, only four baseline variables and two variables from the +36 months evaluation period had missing data: Family functioning (baseline), Depression (baseline), Educator's years of experience (baseline), Early childhood diploma (baseline), Father's education level (+36 months) and Type of school in which the child is enrolled (+36 months).

There were more incidences of missing values for the two variables associated with the educators since these variables were not collected for families in the Informal Care group. The only other missing data for these two variables was in the Comparison Daycare group, with a total of 14 data items missing for the two variables. For the "Years of experience as an educator" variable, we replaced the missing values with "zero" for participants in the Informal Care group, and with the mean number of years of experience as an educator for participants in the Comparison Daycare group. A similar procedure was used for the Educator's diploma dichotomous variable: we replaced the missing values for this variable with "zero" for participants in the Informal Care group, and with the most likely value, depending on the experimental group and community, for participants in the Comparison Daycare group. The two missing data items for the Family functioning variable and the nine missing data items for the Depression variable were imputed using multiple regressions, with random residuals from baseline survey variables. Missing values for the two covariates measured at +36 months — Type of school board (public versus Roman Catholic) and Father's education level — were replaced based on previous follow-up surveys.

Finally, the six dependent variables taken from the survey at +36 months are: Frequency of Literacy Activities, Language of Literacy Activities, Language Spoken by Mother to Child, Language Spoken by Father to Child, Child's Executive Functions, and Continuum of French Spoken by Child. Missing values for these variables were from participants who withdrew during the second phase and from five families who were still enrolled in the study, but unable to respond to the survey during the +36-month evaluation period. These values were imputed directly based on data collected in previous follow-up surveys. We recognize that these variables could change over time. It should be noted, however, that the dependent variables for the +36-month evaluation period are strongly correlated to the respective variables of the previous waves (e.g., correlation of 0.94 between the Continuum of French measured at 24 months and 36 months). Descriptive analyses (and correlations) for child and parent dependent variables are presented in Tables 4.2 and 4.3, respectively.

Table 4.2   Descriptive analyses and correlations between dependent variables for children

Dependent Variables	Descriptive Statistics					Correlations									
	N	Min	Max	Mean	SD	1	2	3	4	5	6	7	8	9	10
1 – Forward Digit Span	336	3.00	12.00	6.55	1.75	1.00									
2 – Backward Digit Span	336	0.00	8.00	3.73	1.79	0.24**	1.00								
3 – Continuum of French	336	1.00	3.00	2.24	0.64	0.12*	0.09	1.00							
4 – Communication Skills	336	2.00	3.00	2.84	0.22	0.09	0.19**	0.21**	1.00						
5 – Word Reasoning	336	0.00	14.00	5.76	2.53	0.32**	0.21**	0.28**	0.22**	1.00					
6 – Verbal Fluency	336	0.00	44.00	23.26	7.55	0.29**	0.32**	0.23**	0.26**	0.50**	1.00				
7 – Knowledge of Letters	336	0.00	4.00	3.60	0.81	0.12*	0.41**	0.08	0.19**	0.30**	0.42**	1.00			
8 – Knowledge of Sounds	336	0.00	4.00	3.40	1.09	0.17**	0.40**	-0.03	0.21**	0.29**	0.37**	0.77**	1.00		
9 – Reading Simple Words	336	0.00	36.00	17.99	10.53	0.28**	0.42**	0.07	0.26**	0.38**	0.42**	0.57**	0.67**	1.00	
10 – Knowledge of Numbers	336	2.00	34.00	20.19	5.24	0.31**	0.43**	0.02	0.27**	0.42**	0.40**	0.44**	0.50**	0.58**	1.00

Note: Min = Minimum value observed; Max = Maximum value observed; Mean = Unadjusted mean; SD = Standard deviation; Continuum of French = Continuum of French spoken by the child.* $p<0.05$, **$p<0.01$.

Table 4.3   Descriptive analyses and correlations between dependent variables for parents

Dependent Variables	Descriptive Statistics					Correlations			
	N	Min	Max	Mean	SD	1	2	3	4
1 – Language Spoken by Mother to Child	331	1.00	3.00	2.53	0.60	1.00			
2 – Language Spoken by Father to Child	293	1.00	3.00	2.31	0.82	0.51**	1.00		
3 – Language of Literacy Activities	336	2.18	5.00	4.43	0.58	0.04	0.07	1.00	
4 – Frequency of Literacy Activities	336	1.50	5.00	4.51	0.75	0.65**	0.60**	0.00	1.00

Note: Min = Minimum value observed; Max = Maximum value observed; Mean= Unadjusted mean; SD = Standard deviation.* $p<0.05$, **$p<0.01$.

4.3 Identifying Confounding Variables

This section summarizes the relevance of the variables measured as part of the Readiness to Learn project impact analyses. This exercise involves listing the variables to be retained as covariates in the impact analyses. The selection criteria can be summarized as follows: a variable is deemed useful as a covariate if it is significantly associated with the outcomes and if it varies significantly by experimental group. The importance of these two criteria is easy to understand. To affect the results (e.g., increase statistical power, correct a bias in group composition), a variable must be significantly associated with the outcomes. For a variable to bias the estimate of program effect, the variable must be significantly associated with the experimental groups. If one of these conditions is missing, controlling for the variable or not in the impact analyses will not dramatically change the estimate of program impact. In particular, controlling for biases related to group composition is essential to maximizing the internal validity of the comparisons of interest in a quasi-experimental study.[32]

Accordingly, preference has been given to variables that are associated with both the study outcomes and membership to experimental groups. Note that redundant variables were excluded from these preliminary analyses. Variables deemed potentially affected by the program (e.g., literacy activities) were taken from the baseline survey administered prior to the intervention, while demographic and socio-economic factors were taken from data collected at the baseline survey and from data collected more recently (at 12 months post-program) to capture changes in these variables over time. When one of these variables meets covariate selection criteria for both measuring periods, we favoured the measurement that is most strongly associated with experimental group membership.[33] Finally, education variables from the 12-month post-program survey were also analyzed.

We began by checking a variable's association with experimental groups and with child outcomes for the 12-month post-program evaluation period in a series of preliminary analyses. The following strategy was used to identify the variables to be included as covariates in impact analyses.

- We verified whether the relationship between the variables under consideration and experimental group membership was significant. The choice of test depended on the type of variable examined: the F-test was used for continuous variables, the Chi-square test for categorical variables.

- We verified whether there was a significant relationship between the variable and at least one outcome observed during the 12-month post-program evaluation period.

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[32] Note that a measured variable can only correct for differences observed between experimental groups. Because the measured variable is imperfect (it contains the measurement error), there may well be an undetected real difference between the groups. A difference that is real but undetected cannot be corrected by including the measured variable in a regression analysis. This is an example of an unobserved difference. Unobserved differences can be cancelled only through random assignment to the experimental groups.

[33] Two sociodemographic variables met the selection criteria for both measuring periods (baseline and +36 months): Younger siblings and Household size. Note that for these two variables, the residual between the two measuring periods was not significantly associated with the outcomes and did not vary significantly according to experimental group. Hence, including these variables at both measuring periods would be redundant.

- Variables that met both of the above criteria are included in the specification for the regression models to correct the potential bias they represent. The results of these preliminary analyses are reported in Appendix A. The variables presented in bold are those retained as covariates. For more details, see the appendix.

In total, 19 covariates were retained for the 12-month post-program impact analyses. These included three variables pertaining to the methodology: Cohort, Community and Change in Experimental Group during the First Year. The following 15 baseline covariates were added to the list: Child's Age in months, Household Size, Single-Parent Families, Younger Siblings, Mother's Age at Birth of First Child, Frequency of Literacy Activities, Language of Literacy Activities, Language Spoken by the Mother to Child, Language Spoken by the Father to Child, Continuum of French Spoken by the Child, Vitality of the Francophone Community, Family Functioning, Depression reported by the respondent, Authoritarian Parenting, and the Child's Score on the ÉPE-AD Communication Scale at baseline.[34] Finally, the last covariate retained for the impact analyses was measured during the 12-month post-program evaluation period (+36 months), namely the Father's Education Level.

In short, a control process was rigorously applied to associate observed variables with experimental groups and child outcomes. The observed variables that were not retained for the impact analyses are distributed similarly across the experimental groups and therefore do not significantly bias the estimate of the tested program's impact (i.e., the groups are matched for these characteristics). The variables that were retained are used to perform a "statistical" matching as part of the impact analyses. We hypothesize that, after statistical matching of the experimental groups, the children's developmental trajectories would progress at the same rate in the absence of the tested program.

4.4 Representativity of the Sample (Readiness to Learn Project Versus SVOLM)

The last section mainly concerned group comparability for impact analysis purposes, a criterion affecting the study's internal validity. This section now focuses on the study's external validity. This topic was addressed previously in Chapter 5 of the *Readiness to Learn in Minority Francophone Communities: Reference Report* (Legault et al., 2014), in which a systematic series of comparisons was carried out to examine the sample of the Readiness to Learn project (first cohort only) and that of the 2006 Survey on the Vitality of Official-Language Minorities (SVOLM; Corbeil, Grenier & Lafrenière, 2007). The same series of analyses was repeated in Chapter 4 of the *First Cohort Findings Report* for a smaller sample: the sample of children from the four communities retained for the impact analyses of the first cohort, and in Chapter 7 of the *Report of Findings from the Preschool Phase* for a sample that included children from both cohorts. This section is an update of the last analysis, this time taking into account the children in both cohorts who were included in the 12-month post-program impact analyses (N = 336).

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[34] A factor was generated to represent family linguistic variables at baseline, including: Language of literacy activities, Language spoken by the mother to the child, Language spoken by the father to the child, Continuum of French Spoken by the Child and Vitality of the Francophone Community. This factor was then used as a single covariate in the regression equation, which enabled us to avoid the issue of multicollinearity.

4.4.1 Issue

The SVOLM sample serves as a benchmark for the Readiness to Learn project sample. The purpose of the current analyses is simply to answer the following question: If the Daycare Program and the Family Literacy component were offered to the entire Francophone minority in the project's participating communities, would the observed effects be similar to those of the Readiness to Learn project? In order to answer this question, it is essential that both samples be drawn from the same Francophone minority population. However, this is not the case.

The interpretation of results must be nuanced by the fact that the SVOLM and the Readiness to Learn project used different sampling strategies; their populations are different, thereby limiting the samples' comparability in several regards. These differences stem in part from how the two projects define the minority Francophone population. As explained in the *Reference Report*, the SVOLM's sampling process is less restrictive. There may be substantial demographic differences between the two samples due solely to a difference in the studies' definitions of the minority Francophone population.

Next, the sampling of the Readiness to Learn project and the SVOLM differ in terms of demographic data. To ensure that a large enough sample was extracted from the SVOLM database, the data for children ages three to five were used in the comparative analyses. This contrasts with the average age of three observed for the study sample when the baseline survey was administered and the average age of 6 observed for the sample used in the 12-month post-program impact analyses. Finally, project participants were selected in a non-probabilistic manner based on daycare attendance, which means that the sample's geographic distribution is located within the communities participating in the project. In contrast, the distribution of the SVOLM sample is more geographically diverse because the survey in question uses random sampling

Note that wherever possible, we used the available data to re-evaluate SVOLM statistics based on the reduced sample of the four communities so as to maximize the validity of the comparison with the Readiness to Learn project sample used in the impact analyses.[35] When this strategy was impossible for practical reasons, we made comparisons with the SVOLM sample gleaned from the six geographic regions (*Reference Report*). These are acknowledged in the body of the text. Further, the project sample data applied in the comparative analyses were collected at the baseline survey although they only included participants who were studied in the 12-month post-program impact analyses. This decision was made to ensure that the data was collected in relatively the same period across both samples.

4.4.2 Immigrant and Linguistic Profile

Sampling procedures for the Readiness to Learn project and the SVOLM were carefully detailed and compared in the *Reference Report*. The following quotation summarizes the conclusions of that analysis:

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[35] SRDC currently has access to frequency data by community, which allows for calculating appropriate estimates for the gross sample including the four communities. However, this calculation was not possible for certain variables where the analysis by community resulted in sample sizes too small to be extracted from Statistics Canada data. The six communities in the SVOLM sample nevertheless represent a worthwhile comparative group for the purposes of establishing the external validity of the Readiness to Learn Project sample for the four communities.

"According to Forgues and Landry (2006), a Francophone population (such as the one used in the Readiness to Learn project) that is defined using the 'ayant droit' criterion would result in a much more restrictive pool whereas a Francophone population (such as the one used in the SVOLM) that is defined using several criteria (e.g., mother tongue, knowledge of official languages and languages spoken at home) would result in a greater number of eligible individuals."

Two predictions were made in light of this analysis: a) the SVOLM sample likely includes a higher proportion of immigrants than the Readiness to Learn project and b) relatively fewer children are likely to report French as their mother tongue in the SVOLM. The next sections present the analysis results for information collected on immigrant status. Comparisons based on the mother tongue of the children and of the parents are also reported.[36] The pattern of results presented here for the analysis by mother tongue is equivalent to that presented in previous reports.

Respondents Born in Canada

The immigrant status of respondents in the Readiness to Learn project and SVOLM samples (four communities) is reported in Table 4.4. The first row reports the frequency of respondents who say they were born in Canada and the second, that of people born outside Canada. As anticipated, an examination of the distribution of responses for both surveys clearly indicates that the Readiness to Learn project has a higher proportion of respondents who were born in Canada. About 92% of the study sample members were born in Canada, while only 75.7% of respondents in the SVOLM sample were born here. This apparent difference was confirmed by applying a statistical Chi-square test that proved to be significant [X^2 (1, N = 1 118) = 36.45, $p < 0.01$].

Table 4.4   Comparison of the Readiness to Learn Project and the SVOLM

Immigrant Status	Readiness to Learn Project	SVOLM	Significant differences between the two samples?
	N (%)	N (%)	*Chi-square*
Born in Canada	300 (91.5)	598 (75.7)	Yes***
Born outside Canada	28 (8.5)	192 (24.3)	

Note: The SVOLM sample is from four regions. The Readiness to Learn project sample includes participants retained for the impact analyses (N = 336). Significance levels set at: *** $p < 0.1\%$; ** $p < 1\%$; * $p < 5\%$.

First Language Learned and Still Understood — Children

Data on the mother tongue of children in the Readiness to Learn project were captured on the consent form filled out by parents. For the SVOLM, a child's mother tongue is deduced from the following question (Statistics Canada, 2006, p. 35): "What is the language that [child's name] first learned at home in childhood and still understands?"

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[36]   FOLS (first official language spoken) was not used here to compare the samples because these data were collected in the SVOLM in such a manner as to invalidate all comparisons (see the *Reference Report*).

Table 4.5 shows that the Readiness to Learn project sample has a greater percentage of Francophones than that of the SVOLM. In fact, a higher percentage of children in the project report French only as their mother tongue (first row of the table). The percentage of children whose mother tongue is English only or English and another language is greater in the SVOLM sample (third row of the table). The representation of children identified as bilingual in the two samples is practically identical (second row of the table).

Application of the statistical Chi-square test confirms that the distribution of the project children (four communities) across the mother-tongue categories is not representative of the Francophone minority population in the six geographic regions based on SVOLM data [X^2 (2, N = 1,097) = 103.81, $p < 0.001$]. These results are not surprising, given the above-mentioned differences in the sampling strategies of the two studies.

Table 4.5   Comparison of the Readiness to Learn Project and the SVOLM — Children Categorized by Mother Tongue

Mother Tongue	Readiness to Learn Project	SVOLM	Significant differences between the two samples?
	N (%)	N (%)	*Chi-square*
French only	244 (72.6)	306 (40.2)	
English and French equally OR French and another language	31 (9.2)	89 (11.7)	Yes***
English only OR English and another language OR other language(s)	61 (18.2)	366 (48.1)	

Note: The SVOLM sample is from six regions. Significance levels set at: *** $p < 0.1\%$; ** $p < 1\%$; * $p < 5\%$.

First Language Learned and Still Understood — Mothers

Table 4.6 indicates that more than half of the mothers in the project (67.3%) and SVOLM (58.3%) samples reported French as their only mother tongue (first row of the table), although the proportion in this regard is slightly higher in the sample of the Readiness to Learn project. Moreover, a smaller proportion of mothers in the project chose the "English only OR English and another language OR other language(s)" category (22.9% in the third row). A Chi-square test indicates that the distribution of the project mothers (four communities) across the mother-tongue categories is not representative of the Francophone minority population in the six geographic regions based on SVOLM data [X^2 (2, N = 1,125) = 10.02, $p < 0.01$].

Table 4.6   Comparison of Mothers in the Readiness to Learn Project and the SVOLM — Mothers Categorized by Mother Tongue

Mother Tongue	Readiness to Learn Project	SVOLM	Significant differences between the two samples?
	N (%)	N (%)	*Chi-square*
French only	226 (67.3)	460 (58.3)	
English and French equally OR French and another language	33 (9.8)	75 (9.5)	Yes**
English only OR English and another language OR other language(s)	77 (22.9)	254 (32.2)	

Note: The SVOLM sample is from six regions. Significance levels set at: *** $p < 0.1$ %; ** $p < 1$%; * $p < 5$%.

First Language Learned and Still Understood — Fathers

Table 4.7 compares the linguistic profile of fathers in the Readiness to Learn project and the SVOLM based on their mother tongue. At first glance, the pattern seems similar to that observed among mothers. The main difference is the substantial number of fathers in the SVOLM who reported "English only OR English and another language OR other language(s)" as their mother tongue. The proportion of fathers in the SVOLM at either end of the distribution in Table 4.7 is virtually identical (46.7% versus 47.7%). However, fathers in the project sample are more massively represented in the "French only" category (55.9% in the first row) than in the "English only OR English and another language OR other language(s)" category (35.8% in the third row).

A Chi-square test confirms that the distribution of the project fathers (four communities) across the mother-tongue categories is not representative of the Francophone minority population in the six geographic regions based on SVOLM data [X^2 (2, N = 1,110) = 13.95, $p < 0.001$].

Table 4.7   Comparison of Fathers in the Readiness to Learn Project and the SVOLM — Fathers Categorized by Mother Tongue

Mother Tongue	Readiness to Learn Project	SVOLM	Significant differences between the two samples?
	N (%)	N (%)	*Chi-square*
French only	181 (55.9)	367 (46.7)	
English and French equally OR French and another language	27 (8.3)	44 (5.6)	Yes***
English only OR English and another language OR other language(s)	116 (35.8)	375 (47.7)	

Note: The SVOLM sample is from six regions. Significance levels set at: *** $p < 0.1$%; ** $p < 1$%; * $p < 5$%.

4.4.3 Sociodemographic Characteristics

In the *Reference Report, First Cohort Findings Report* and *Report of Findings from the Preschool Phase*, the Readiness to Learn project sample was compared with the SVOLM sample based on child gender, family composition (the family's size and structure) and socioeconomic status (parents' education, family income). The reports conclude that the samples of the two surveys are comparable in terms of Child gender (this variable was only reported in the *Reference Report*), Family structure, Family size and Family income. However, the distribution of responses is found to vary between the samples for parents' education (father and mother) and number of siblings. In all cases, the general pattern of these results was reproduced in the analysis of the sample used for 12-month post-program impact analyses. The results are presented below.

Total Family Income

Table 4.8 shows that the families in the Readiness to Learn project and those in the SVOLM are distributed similarly among the income brackets considered here. In both cases, the modal and median category for both samples is $60,000 or more per year. A Chi-square test confirms that the distribution of the project parents (four communities) across the income brackets is statistically equivalent to that observed for the Francophone minority population in the six geographic regions based on SVOLM data [X^2 (5, N = 1,125) = 5.67, $p > 0.05$]. The results suggest that most children in both samples enjoy a good quality and good quantity of physical resources for their development.

Table 4.8 Comparison of the Readiness to Learn Project and the SVOLM — Families by Income Bracket

Income Bracket	Readiness to Learn Project	SVOLM	Significant differences between the two samples?
	N (%)	N (%)	*Chi-square*
$10,000 or less	20 (5.9)	54 (6.9)	
From $20,000 to $29,999	14 (4.2)	23 (2.9)	
From $30,000 to $39,999	19 (5.6)	64 (8.1)	
From $40,000 to $49,999	17 (5.1)	57 (7.2)	No
From $50,000 to $59,999	45 (13.4)	95 (12.0)	
$60,000 and over	221 (65.8)	496 (62.9)	

Note: The SVOLM sample is from six regions. Significance levels set at: *** $p < 0.1\%$; ** $p < 1\%$; * $p < 5\%$.

Mothers' Level of Education

Table 4.9 below shows three main points. First, the mothers in the Readiness to Learn project are, on average, more educated than mothers in the SVOLM sample. In fact, almost 80% of the project mothers have a college diploma (DEC, or diploma of collegial studies, DCS) or a university degree versus about

70% of mothers in the SVOLM. This difference is mainly attributable to the low number of mothers with at least one diploma or one certificate of collegial studies in the SVOLM versus those of the project (second row). Second, there are as many mothers with a college diploma (38.7%) as there are mothers with a university degree (41.1%) in the project. Third, the proportion of SVOLM mothers who attended university (42.7%) is similar to that of the project mothers (41.1 %).

The Chi-square test confirms that the mothers' level of education in the Readiness to Learn project is not representative of the Francophone minority population in the four geographic regions based on SVOLM data [X^2 (2, N = 877) = 22.03, $p < 0.01$].

Table 4.9   Comparison of Mothers' Level of Education in the Readiness to Learn Project and in the SVOLM

Level of Education	Readiness to Learn Project	SVOLM	Significant differences between the two samples?
	N (%)	N (%)	*Chi-square*
High school diploma or less OR a few post-secondary courses	68 (20.2)	172 (31.8)	
College diploma/certificate (e.g., trade school)	130 (38.7)	138 (25.5)	Yes***
University degree (bachelor's, master's or PhD)	138 (41.1)	231 (42.7)	

Note: The SVOLM sample is from four regions. Significance levels set at: *** $p < 0.1\%$; ** $p < 1\%$; * $p < 5\%$.

Fathers' Level of Education

Table 4.10 indicates that a greater number of fathers in the SVOLM attended university (35.9%) compared to those in the Readiness to Learn project (34.7 %). However, the project fathers are generally more educated than fathers in the SVOLM. In fact, two-thirds of them have a college diploma (DEC, or diploma of collegial studies, DCS) or a university degree, while 60% of fathers in the SVOLM have an equivalent level of education. Finally, application of the Chi-square test suggests that fathers' level of education in the Readiness to Learn project is not representative of the Francophone minority population in the four geographic regions based on SVOLM data [X^2 (2, N = 867) = 6.80, $p < 0.05$].

Table 4.10 Comparison of Fathers' Level of Education in the Readiness to Learn Project and in the SVOLM

Level of Education	Readiness to Learn Project	SVOLM	Significant differences between the two samples?
	N (%)	N (%)	*Chi-square*
High school diploma or less OR a few post-secondary courses	109 (33.4)	216 (39.9)	
College diploma/certificate (e.g., trade school)	104 (31.9)	131 (24.2)	Yes**
University degree (bachelor's, master's or PhD)	113 (34.7)	194 (35.9)	

Note: The SVOLM sample is from four regions. Significance levels set at: *** $p< 0.1\%$; ** $p< 1\%$; * $p< 5\%$.

Family Size

According to Table 4.11, the modal and median family size is four for both samples (four communities). In both surveys, families of four represent about half of the sample. The remaining families are distributed fairly equally between families of three or less and families of five or more. A Chi-square test suggests that there is no significant difference in the distribution of family size for families participating in the Readiness to Learn project and families from the four geographic regions of the SVOLM [X^2 (2, N = 874) = 1.83, $p>0.05$].

Table 4.11 Comparison of Family Size in the Readiness to Learn Project and the SVOLM

Number of Family Members	Readiness to Learn Project	SVOLM	Significant differences between the two samples?
	N (%)	N (%)	*Chi-square*
Three or less	78 (23.2)	143 (26.6)	
Four	190 (56.5)	280 (52.0)	No
Five or more	68 (20.2)	115 (21.4)	

Note: The SVOLM sample is from four regions. Significance levels set at: *** $p< 0.1\%$; ** $p< 1\%$; * $p< 5\%$. The number of people in a family refers to the number of parents and children <u>only</u>.

Siblings

Table 4.12 indicates that the modal and median number of children per respondent (family) is two for the Readiness to Learn project and for the SVOLM. However, there are slightly more two-children families in the project (60.1%) than in the SVOLM (50.4%). In addition, there are more families with three or more children in the SVOLM (30.0%) than in the project (20.8%). Conversely, the number of families with a single child, about 20%, is roughly the same for both samples. A Chi-square test confirms that the distribution of the number of children per respondent in the Readiness to Learn

project is not representative of the Francophone minority population in the four geographic regions based on SVOLM data [X^2 (2, N = 1,122) = 11.52, $p < 0.01$].

Table 4.12 Comparison of the Readiness to Learn Project and the SVOLM — Number of Children per Respondent

Number of Children	Readiness to Learn Project	SVOLM	Significant differences between the two samples?
	N (%)	N (%)	*Chi-square*
One child	64 (19.0)	154 (19.6)	
Two children	202 (60.1)	396 (50.4)	Yes**
Three or more children	70 (20.8)	236 (30.0)	

Note: The SVOLM sample is from four regions. Significance levels set at: *** *p*< 0.1%; ** *p*< 1%; * *p*< 5%.

Family Structure

Families in the Readiness to Learn project had to be redefined as either single-parent families or two-parent families in order to compare family structure in the project sample with that in the SVOLM (see Table 4.13). Note that the two-parent category includes intact families and blended families where both parents (or one parent and his or her spouse) live with the child. The single-parent category consists of families where only one parent lives in the home with the child.

Note that a child's father or mother may be either his or her biological or adoptive parent. Finally, same-sex couples were excluded from the analysis as were children raised by a person other than the child's biological or adoptive mother or father. A Chi-square test confirms that children's distribution in single-parent or two-parent homes in the project is representative of the Francophone minority population in the four geographic regions based on SVOLM data [X^2 (1, N = 1,125) = 1.46, $p > 0.05$].

Table 4.13 Comparison of the Readiness to Learn Project and the SVOLM — Number of Single-Parent and Two-Parent Families

Family Structure	Readiness to Learn Project	SVOLM	Significant differences between the two samples?
	N (%)	N (%)	*Chi-square*
Single-parent	29 (8.6)	87 (11.0)	
			No
Two-parent	307 (91.4)	702 (89.0)	

Note: The SVOLM sample is from four regions. Significance levels set at: *** *p*< 0.1%; ** *p*< 1%; * *p* < 5%.

4.5 Summary of the Implications for Impact Analyses

In this chapter, we covered the methodological issues that affect the internal and external validity of the impact analyses to follow. Technical matters related to quality control processes, missing values, imputation of missing data, confounding variables and external validity were examined.

The chapter began by identifying data verification and quality control processes (Section 4.1). These processes were designed to minimize problems caused by the data collection process and to identify and correct problems in the electronic databases. These procedures and the use of a mixed-method approach (or "converging operations") in the research ensured the validity of the results from the impact analyses. For example, they assisted in identifying an executive function assessment tool that was poorly suited for our target group (i.e., the Dots Task).

The chapter continued with an analysis of missing values (Section 4.2) due to attrition or the inability to administer the tools to participants. Overall, the attrition rate was relatively low over the three years of the project. However, analyses indicate that the missing values due to attrition are not distributed equally across the experimental groups, which could bias the internal validity and external validity of the study. Furthermore, the children who withdrew from the study tended to obtain lower scores at baseline that those who continued to participate in the study. This analysis suggests that excluding the children who withdrew would artificially increase the skill level of the children still enrolled in the study. Moreover, there was a low percentage of completely missing data, and these data were not distributed equally across the three experimental groups. Since the missing data were not distributed randomly, it was deemed important to impute the missing data, thereby preserving the characteristics of the gross sample. Finally, the analysis of missing values due to partially missing data indicates that, other than the Family income variable, there was not more than 1% missing data for any variables from the survey or from the direct assessment of the children. Other than the data for the Income variable, the missing values appear to have been produced randomly. These missing values were imputed to maximize the number of participants for impact analyses. For all missing data, we focused on the longitudinal nature of the study to impute data. Specifically, previously collected data was used to estimate the missing values.

This chapter then reported the results of the confounding variables analysis (Section 4.3). The goal of the analysis was to identify variables that allow for statistical adjustments to offset initial differences between the experimental groups and changes to group composition over time. As a result of this analysis, a number of covariates were identified for inclusion in the impact analyses (see Appendix A for an exhaustive list of the variables examined and the detailed results). Introducing these covariates in the impact analyses will maximize the internal validity of this quasi-experimental study with non-equivalent control groups.

Finally, we examined the issue of the study's external validity. In earlier research we concluded that there were more Francophones in the sample of the Readiness to Learn project than in that of the SVOLM. This result is reproduced here with the combined sample from both project cohorts (N = 336). In the *Reference Report*, we hypothesized that this apparent bias would stem from the population of children typically found in French-language daycares. To the extent that this argument is justified, all the results of this study would apply only to a population of Francophone children enrolled in daycare.

First, this limit appears to be self-evident in the sense that this population of children would be affected by a daycare intervention. However, if the differences in mother tongue observed between the Readiness to Learn project and the SVOLM reflect a true lack of representativity - which is tantamount to saying that the project sample is not representative of the target population - then the results of the impact analyses in Chapter 6 of this report may in fact underestimate the magnitude of the program's true effect for a population characterized by greater linguistic diversity. The possibility that linguistic variables may emphasize or mitigate the tested program's effect can be examined by reassessing program effects separately for children who mainly speak French and those who speak it less (see Section 6.4, Analyses by Linguistic Profile). The information resulting from these analyses may help determine whether the intervention would be more effective if it targeted given subpopulations, including that of children who are mainly exposed to languages other than French in their family environment.

The fact that the samples of the Readiness to Learn project and the SVOLM are generally similar with regard to non-linguistic characteristics supports the argument that the project sample is representative of Francophones living in a minority environment. The only difference worth mentioning is the fact that parents in the Readiness to Learn project are slightly more likely to report a level of education beyond high school than parents in the SVOLM sample.

In short, a number of precautions were taken to ensure the internal validity of the program's estimated effects and to estimate its degree of external validity. Other verifications will be discussed as they become relevant to the interpretation of results in the following sections of this report.

5.0 Analysis Strategies

This chapter deals with the logic underlying the analyses described in Chapter 6. The adopted approach factors in the data's longitudinal and multi-level structure and involves verification of the robustness of results (see Section 5.1). The method used to identify the program's effect is suitable for a quasi-experimental study with non-equivalent groups (see Section 5.2). Finally, the impact analyses are accompanied by an indicator of the size of the effect (see Section 5.3).

The general approach described in the next few sections was applied for the specification of several empirical data models, which are presented in Chapter 6. Each of these models represent, through their specification, a different way to conceive of children's exposure to the tested program. For the purposes of this project, exposure to the tested program is designed as a continuum ranging in intensity from low to high. The strongest possible intensity of exposure would be implementation of the program exactly as it was designed and with the highest degree of quality. The additional models considered in this report are introduced in Section 5.4. The chapter ends with an explanation of how the results are organized in Chapter 6.

5.1 Hierarchical Linear Modeling (HLM)

The data were analyzed using linear regression models based on the core assumption that each observation point or data point in the analysis was observed independently. This assumption is not respected when the sample units (e.g., daycares or children) contribute to multiple observations for a set of data. In this case, the observations made by a given sample unit are said to be nested or clustered. In a longitudinal design, observations are grouped by participant (i.e., that each participant contributes to several observations) and sometimes based on another type of analysis unit. The Readiness to Learn project in particular presents data that are nested by daycare and by participant. This multi-level structure, often analyzed using HLM, must be reflected in the analyses to avoid overestimating the statistical significance of results (Hox, 2002; Moulton, 1990). Treatment of the study's longitudinal aspect is detailed later in Section 5.2, whereas treatment of the "daycare" effect will be addressed now.

To maximize the robustness of results, we use the Huber-White heterogeneity-consistent estimator (White, 1980). Two models are specified: 1) a disaggregate model with errors at the individual level; and 2) an aggregate model with errors grouped by daycare. The aggregate model is a modification of the disaggregate model that makes it robust to clustering (Williams, 2000). According to Woodbridge (2002), the properties of this method are satisfactory for analyzing a database like that of the Readiness to Learn project (i.e., the ratio of the number of groups/observations per group) when the number of groups determines the degrees of freedom for the significance tests. The accuracy of the reported effects is then robust to heterogeneity and to clustering by childcare environment.

5.2 Analysis of Covariance (ANCOVA) Estimator

A popular method for estimating the effects of a program or intervention inhumanities literature is the use of an Analysis of Covariance (ANCOVA). This approach is particularly useful in a quasi-experimental study, where group composition is not random (Tabachnick & Fidell, 2006). In such a situation, it is more likely that systematic differences will be found between the members of the Program Daycare

group and those of the comparison groups. The benefit of the ANCOVA procedure is its ability to correct potential biases linked to group composition by statistically controlling the effect of covariates, that is, variables that have an assumed impact on the expected outcomes. Including covariates in the equations provides enhancement of the internal validity of results (see Appendix A for an exhaustive list of the covariates that were retained).

In a quasi-experimental design, internal validity also depends on statistical control of intra-individual factors to correct initial individual differences that might influence outcome values. This statistical control is generally a pre-intervention measure directly linked to outcomes of interest. For the purposes of impact analyses in this report, pre-intervention measures directly linked to skills measured during the 12-month post-program period would ideally provide statistical control.[37] However, a single valid baseline measurement can provide intra-individual control. This measurement is the ÉPE-AD (*Évaluation de la petite enfance – Appréciation directe*, Willms, 2007) Language and communication domain at baseline, which was completed in French by all of the children enrolled in the study. Adding this variable made it possible to more accurately estimate the program's effect by statistically eliminating initial differences in language skills between the experimental groups. Although some of the outcomes measured during the 12-month post-program evaluation period are not directly linked to language skills, they indirectly depend on knowledge of the language of instruction. In other words, intra-individual statistical control is based on a development model which recognizes that knowledge of the language of instruction facilitates acquisition of academic skills, such as those targeted by the measures in the present report, for instance, reading and math skills, as well as executive functions (see Figure 2.1 for the theoretical model of school achievement). This argument was supported by the fact that the instruments used to measure all constructs required a solid understanding of French.

5.3 Size of the Effect

An indicator of the size of the effect accompanies the impact analyses for each experimental group. A "standardized" difference between the groups is the most common method used to express the size of an effect. According to Cohen (1988), we refer to this statistic as *d*. Cohen provides conventional references for interpreting the size of the effects expressed on a standardized scale. A standardized difference of *d* = 0.20 between the groups is considered to be small, while a difference of *d* = 0.50 is considered to be average and a difference of *d* = 0.80 is considered to be large. These points of reference support the results of a meta-analysis examining the distribution of standardized sizes of effect in various intervention studies (Lipsey & Wilson, 1993). However, they must only serve as a general guideline in determining the significance of an effect. An effect may be considered as more or less significant depending on the research context (Kane, 2004; Hill, Bloom, Black & Lipsey, 2008).

According to Kane (2004) and Hill et al. (2008), a useful means of understanding the significance of the effect of an early childhood intervention is to compare it with the effect of normal development, that is, to ask the following question: how does the size of the effect compare with the normal increase

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[37] The differences-in-differences (DinD) estimator applied in the first phase of the Readiness to Learn project cannot be used to estimate program effects in this report since it requires the same pre- and post-intervention measure. Different instruments were used in the 12-month post-program follow-up period to track the children`s development and measure academic performance indicators rather than school readiness indicators.

observed during a year of development? According to Hill et al. (2008; Table 1), the average increase in the development of literacy and numeracy expected for the period from kindergarten to grade one is approximately $d = 1.33$. In other words, a program effect of $d = 1.33$ would represent a year of development and an effect of 0.67 would represent an increase equivalent to approximately six months of development.

5.4 Conceptualization of Treatment and Dosage

The simplest model to capture a treatment effect involves two groups of participants: the "treated" group and the "untreated" group. This type of model is most valid when the distinction between a treated group and an untreated group is absolute, that is, the untreated group receives absolutely no treatment, while all members in the treated group receive the same treatment (e.g., the same dosage or "exposure"). For a study carried out in the field, such clean-cut distinctions are rather rare, and the Readiness to Learn project is no exception to this rule. The intensity of treatment received by participants varied in at least two regards: degree of treatment exposure (dosage) and the fidelity/quality of treatment. These two sources of variations in treatment intensity are detailed in the sections that follow. We will then describe the underlying logic of the program evaluation as it pertains to the child's linguistic profile.

5.4.1 Evaluating the Effect of Dosage/Exposure

The treatment was defined by using hours of exposure to a childcare environment, along with the characteristics of the daycare setting (i.e., the Program Daycare group or the Comparison Daycare group). Hours of exposure was defined as the average number of hours per week a child spent at daycare during the first eight months of program delivery.[38] Including this variable in the analyses enabled us to more specifically define exposure to the Daycare Program. By crossing the hours of exposure variable with our grouping variable (i.e., by specifying an interaction term), we were able to: a) estimate the average treatment effect associated with a given number of hours per week of exposure to daycare; and b) test whether the effect of the degree of exposure to daycare varies as a function of program type. The latter test is simply an extension of our basic research hypothesis, whereby given an equivalent degree of exposure, participants in the Program Daycare group will have an advantage with respect to indicators of academic achievement.

The results reported in Appendix A show that there is no difference in average exposure to the childcare environment for the two daycare groups. One practical effect of this equivalence is that this variable is not an obvious threat to the validity of our estimates of the tested program's effects. Nevertheless, it is worth questioning whether the degree of exposure to a treatment condition is important and whether the program's effects, if any, interact synergistically with the degree of exposure. In other words, to ask specifically: Does spending an hour at a Program Daycare yield better results than spending an hour at a Comparison Daycare? We treated this question by adding variables for the degree of treatment exposure to the impact analyses.

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[38] We excluded data collected during the summer months. The purest measurement of the average effect
of treatment exposure is the information collected during the school year.

5.4.2   Evaluating the Effect of Daycare Program Fidelity/Quality

The mechanisms through which the intervention was supposed to affect the developmental outcomes of children were the quality of the program and the fidelity of its implementation. Thus, experimental group membership can be seen as an approximation proxy for quality and fidelity. The study's internal validity is fundamentally based on the truth of this statement. It follows that one condition required to observe a program effect on the targeted outcomes is that children enrolled at the daycares where the intervention was implemented (the Program Daycare group) have experiences that compare favourably with those of children in the comparison group (the Comparison Daycare group), who are also exposed to a childcare program. Likewise, within each group, the nature of the program offered from one daycare to the next must be as similar as possible, that is, it must be consistent at all daycares in the same group. In other words, the daycares must be grouped in a coherent manner. These conditions were verified and confirmed in the analyses presented in the *Report of Findings from the Preschool Phase* by means of qualitative (Chapter 5) and quantitative (Chapter 9) analyses.

The use of experimental groups to estimate the magnitude of program effects is a useful simplification, where the potentially continuous dimensions (e.g., fidelity and quality) are reduced to categories (i.e., the Program Daycare group and the Comparison Daycare group) for comparative purposes. This simplification is the most appropriate method when members of every group are very similar with regard to continuous dimensions. Of course, the nature of a daycare program always varies somewhat from daycare to daycare, which means that using experimental groups results in a loss of information (i.e., intra-group variability). In fact, the distribution of fidelity/quality scores for both groups may, in principle, overlap.

We verified whether this loss of information, resulting from the use of experimental groups, was significant. To do so, we conducted a series of analyses where the presence of an intermediary (the experimental group) was eliminated and replaced by continuous fidelity and quality indicators as child outcome predictors. This method optimizes the use of the available information and offers a better chance of identifying the program's true effects.

The analyses reported in Section 6.3 are based on a global fidelity index and a global quality index. First, the global fidelity index includes two detailed indicators, i.e. evidence of specific elements relating to the program structure and program content. The global fidelity estimate was calculated simply by taking the average of these two indicators. The global quality index was calculated based on the following three dimensions: structural quality, quality of the educational content and quality of reading.[39] Once again, the global quality index was calculated by taking the average of these three quality indicators.

The global fidelity and quality indices were inserted in the analyses as follows. We began by conducting a series of analyses for which the fidelity and quality indices, rather than membership in an experimental group, were used as indicators for treatment exposure. The goal of this analysis was to

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[39]   The "Educator sensitivity" index was not included in the analyses since distribution of this variable was very dissymetrical and the differentiation between program daycares and comparison daycares was not significant for this quality indicator (see *Report of Findings from the Preschool Phase*, Section 9.2.4).

verify whether: a) the results obtained using the simple definition of the treatment would be reproduced; and b) the more sensitive analysis would show more marked effects.

5.4.3   Evaluating the Program's Effect by Linguistic Profile

Children living in a minority Francophone community are faced with a major challenge in terms of developing the French language. High exposure to French is required to offset their primarily English environment, enabling the children to develop additive rather subtractive bilingualism. With additive bilingualism, children can benefit from what is taught in kindergarten and grade one (see Cummins, 1979; Doherty, 1997; Hindman et al., 2010). The children most vulnerable to develop subtractive bilingualism are those who received limited exposure to French in many settings. The Readiness to Learn preschool project is designed to bridge this gap by exposing the children to French more often at home and at daycare.

In the short term, the program should impact primarily on the language skills of vulnerable children, i.e. those with low exposure to French at home. For children with a well-established base in French, the program should have an impact on the development of skills beyond simply learning French (e.g., literacy and numeracy). The analyses presented in the *Report of Findings from the Preschool Phase* (2014) tend to confirm the hypothesis that the ***short term*** benefits of the tested program would be most noticeable in terms of language outcomes (e.g., vocabulary) in children characterized by a lower exposure to French, while children characterized by a higher exposure to French would primarily benefit from accelerated development of their cognitive skills (e.g., literacy). This hypothesis, verified at the end of program delivery (i.e. at 24 months), is based on a development model which recognizes that knowledge of the language of instruction facilitates acquisition of more complex academic skills.

Following the logic of the development model, ***in the medium term*** (12 months post-program), we expect to observe a different pattern of results. For children from homes with low exposure to French, the program's effect should continue to be seen in terms of linguistic variables. If the dual-component program is successful in bridging children's linguistic gaps during the first phase of the project (by increasing the children's exposure to French at home and in a daycare setting), then the program's effect on so-called "vulnerable" children should also be seen in terms of executive functions, reading skills and mathematics skills. In other words, giving a linguistic boost to children in the Program Daycare group who had received low exposure to French should provide them with an advantage over the vulnerable children in the comparison groups for all predictors of academic achievement. Hence, in general, ***in the medium term***, the program should have a more pronounced effect on children from homes with a low exposure to French. For the sub-group of children who initially benefited from a high exposure to French at home, we should now expect to see less significant differences between the children in the Program Daycare group and those in the comparison groups. For these children, a preschool program effect should appear in terms of indicators of cultural identification, reflected in the child's choice to use French.

In this report, we adopted the same definition for linguistic profile as that used in the *Report of Findings from the Preschool Phase*, i.e. a dichotomous indicator calculated by crossing the language spoken to the child by the mother and that spoken to the child by the father. This indicator, called Household type, has two categories: high exposure and low exposure. The hypothesis that the program would have a

distinct effect in relation to the children's school readiness was tested by juxtaposing experimental group factors with household type to determine whether their interaction is significant (using the ANCOVA estimator). This enables us to estimate the program's effects on academic achievement indicators independently for children from a family with high exposure and those from a family with low exposure.

5.5 Outline for the Next Chapter

An evaluation of the tested program's impact on the children is presented in Chapter 6. That chapter presents a comparison between the experimental groups (Section 6.1) and a series of more in-depth analyses. The analysis strategy adopted for this report is based on many secondary analyses. We are testing whether the program had an impact, but also whether this impact depends on the dosage (Section 6.2), quality/fidelity (Section 6.3) and linguistic profile (Section 6.4). The value of each analysis is limited by the rather small sample size, but overall, if they produce a pattern of consistent results, then they can help to eliminate several alternative explanations for the results. They can also validate that the mechanism used to generate the results obtained was well understood, enabling us to anticipate contingencies in achieving the program's effect. Chapter 6 also includes impact analyses for parents' behaviour within the dual-component program (Section 6.5).

6.0 Impacts of the Tested Program

The preschool program being tested by this project has two components. A daycare component developed specifically to meet the needs of Francophone children in minority settings has been combined with a family literacy component targeting the parents of these children. The main goal of the first component is to *directly* influence child outcomes, while that of the second component is to *indirectly* influence child outcomes by modifying parents' attitudes and behaviours. The analyses reported in this chapter cannot clearly distinguish the effect of one component from that of the other. A more complex experimental design would have been necessary to allow for that distinction. As such, the main analyses comparing the experimental groups test the *combined effect* of the program's two components on children's academic achievement. The situation is different for parent outcomes. The analyses reported in Section 6.5 can evaluate the impact of the Family Literacy component on the parents. Furthermore, mediation analyses allow us to examine the indirect impact of Family Literacy component on children.

This report focuses on the results of analysis of differences observed between children in the Program Daycare group and those in the two comparison groups on the predictors of academic achievement. Additional analyses on dosage, quality/fidelity of program delivery and linguistic profile enable us to quantify the significance of their respective contributions to the program's effects. Child outcomes include two measures of executive functions (Forward Digit Span and Backward Digit Span), four measures of language skills (Word Reasoning, Verbal Fluency, Ability to Communicate in French and Continuum of French Spoken by the Child), three measures of reading skills (Knowledge of Letter Names, Knowledge of Letter Sounds and Reading Simple Words) and one measure of mathematics skills (Knowledge of Numbers). Moreover, the effect of the Family Literacy component is evaluated by examining the impact of the program on parents' behaviour using group analyses. Assessed parent outcomes include: Frequency of Literacy Activities, Language of Literacy Activities, Language Spoken by Mother to Child and Language Spoken by Father to Child. These measures are further detailed in sections 3.5.2 and 3.5.3 of this report.

The chapter begins with a comparison of the three experimental groups for the predictors of academic achievement (see Section 6.1). We then present analyses evaluating whether the program's effect varies in function of the dosage (see Section 6.2). The chapter continues with analyses that test the effect of the program's fidelity and quality on predictors of academic achievement of children attending a daycare (see Section 6.3). Next, we present analyses by linguistic profile wherein we re-examine the differences between the experimental groups, for children with high initial exposure to French, and for those with low initial exposure (see Section 6.4). These analyses aim to determine whether the impact of the tested preschool program varies across sub-populations. Finally, the program's impact on parent outcomes and its indirect impact on child outcomes are presented in Section 6.5.

6.1 Impact on Children – Analyses by Group

This section presents the results of the 12-month post-program impact analyses by experimental group. Estimates of the program effect are based on the specification used for the data modelling. The general strategy adopted is to present two alternate specifications for each analysis: a "disaggregate"

model with standard errors at the individual level, and an "aggregate" model with standard errors grouped by daycare. The two models include group membership and the 19 covariates (see Appendix A for a complete list of covariates). Note that the Communication variable measured at baseline is among the covariates. It is being used as a pre-test measurement (intra-individual covariate) for measures drawn from direct assessments of the children. The two specifications produce results which, when compared, permit us to nuance our interpretation of findings. The aggregate model is considered to be more conservative than the disaggregate model, as it is not only more robust in terms of heterogeneity, it also considers clustering by daycare.

In both models, the "group" factor is represented by two dummy variables designed to compare the comparison groups with the Program Daycare group. In other words, the Program Daycare group is set up as the "reference" group. *It is important to note that the decision to place the Program Daycare group in reference means that* **negative values in the ANCOVA estimates for all group comparisons represent a positive effect of the program** *(i.e., an advantage for the Program Daycare group).*

The results are presented according to the four following target skills: executive functions, language skills, reading skills and mathematics skills.

6.1.1 Executive Functions

(Forward) Digit Span

The mean scores presented in Table 6.1 show that Program Daycare group children perform similarly to those in the two comparison groups on the Forward Digit Span test. Indeed, the comparisons between the Program Daycare group and the comparison groups are not significant and the effects are close to nil (d= -0.01 and 0.08).

Backward Digit Span

Note that the Backward Digit Span test involves two dimensions of executive functions, i.e. it refers to the working memory and mental flexibility. As observed in Table 6.1, children in the Program Daycare group score significantly higher than those in the Comparison Daycare group (aggregate model only). The size of the effect is d= -0.21. The comparison with the Informal Care group reveals no significant difference. The results of additional analyses (e.g., quality/fidelity and linguistic profile) presented in the following sections further clarify the program's impact on executive functions.

Table 6.1   Program Impact on Executive Functions at 12 Months Post-Program – Measures Obtained from Direct Assessment of Children

Measure	Program Group adjusted MEAN	Comparison Groups adjusted MEAN	Program Effect Difference	Effect Size Cohen's *d*	Standard Error S.E.$_1$	Standard Error S.E.$_2$
Forward Digit Span						
G1 vs. G2	6.51	6.50	-0.01	-0.01	0.22	0.14
G1 vs. G3	6.51	6.64	0.12	0.08	0.24	0.13
Backward Digit Span						
G1 vs. G2	3.82	3.48	-0.34	-0.21	0.24	0.12**
G1 vs. G3	3.82	3.95	0.13	0.08	0.25	0.11

Note: G1 = Program Daycare group; G2 = Comparison Daycare group; G3 = Informal Care group; S.E.$_1$ corresponds to disaggregate standard error at individual level; S.E.$_2$ corresponds to aggregate standard error with clustering by daycare. Standard errors are estimated using the robust Huber-White heterogeneity estimator. *Negative values of ANCOVA estimates for all group comparisons represent a positive effect of the program (i.e., an advantage for the Program Daycare group); *$p<0.10$, **$p<0.05$, ***$p<0.01$.*

6.1.2   Language Skills

This sub-section presents findings of impact analyses on language skills by experimental group. Language skill indicators drawn from child assessments include Word Reasoning and Verbal Fluency. In addition, two language skill measures are drawn from the parent survey — the Continuum of French Spoken by the Child and the Ability to Communicate in French. Results of analyses on child assessment indicators are presented in Table 6.2 and those drawn from the parent survey are found in Table 6.3.

Word Reasoning

As shown in Table 6.2, the results for the Word Reasoning variable are similar regardless of the model specification. We can observe a significant advantage for the Program Daycare group compared to the Comparison Daycare group, and this effect is significant. The effect size is *d* = -0.03 in favour of the Program Daycare group. The results indicate that the scores for the Informal Care group are no different from those of the Program Daycare group, as demonstrated by the lack of significant difference and an effect size close to nil (*d* = -0.04).

Verbal Fluency

As presented in Table 6.2, the ANCOVA estimates for the Verbal Fluency variable clearly show a pattern in favour of the program Daycare group compared to the two comparison groups. The difference between the Program Daycare group and the Comparison Daycare group is significant in both models, with a small to medium effect size of *d* = -0.39. The comparison with the Informal Care group was also

significant, but only for the aggregate model with clustering of the error at the daycare level. A small effect size of d = -0.21 is observed in favour of the Program Daycare group.

Table 6.2   Program Impact on Language Skills at 12 Months Post-Program – Measures Obtained from Direct Assessment of Children

	Program Group	Comparison Groups	Program Effect	Effect Size	Standard Error	
Measure	adjusted MEAN	adjusted MEAN	Difference	Cohen's d	S.E.$_1$	S.E.$_2$
Word Reasoning						
G1 vs. G2	6.03	5.41	-0.63	-0.30	0.32*	0.31*
G1 vs. G3	6.03	5.95	-0.09	-0.04	0.31	0.20
Verbal Fluency						
G1 vs. G2	24.68	22.17	-2.51	-0.39	0.93***	0.70***
G1 vs. G3	24.68	23.34	-1.34	-0.21	0.98	0.31***

Note: G1 = Program Daycare group; G2 = Comparison Daycare group; G3 = Informal Care group; S.E.$_1$ corresponds to disaggregate standard error at individual level; S.E.$_2$ corresponds to aggregate standard error with clustering by daycare. Standard errors are estimated using the robust Huber-White heterogeneity estimator. *Negative values in ANCOVA estimates for all comparisons between groups represent a positive effect of the program (i.e., an advantage for the Program Daycare group);* *p<0.10, **p<0.05, ***p<0.01.

Continuum of French Spoken by the Child

ANCOVA estimates for both models can be observed in Table 6.3, suggesting an advantage for the Program Daycare group compared to the two comparison groups. The difference between the Program Daycare group and the Comparison Daycare group is significant in both models with almost a medium effect size of d = -0.45 observed. The comparison with the Informal Care group is also significant in both models with a small to medium effect size of d = -0.30 observed.

Ability to Communicate in French

The results of the Ability to Communicate in French variable reveal an advantage for the Program Daycare group compared to the two comparison groups (see Table 6.3). The comparison with the Comparison Daycare group was significant, and the effect size was d = -0.28. ANCOVA estimates calculated using both models also indicate a significant effect for the comparison with the Informal Care group, in favour of the Program Daycare group, with a medium effect size of d = -0.48. Overall, these results are consistent with those emerging for the Continuum of French Spoken by the Child variable.

Table 6.3   Program Impact on Language Skills at 12 Months Post-Program – Measures Obtained from Parent Surveys

Measure	Program Group adjusted MEAN	Comparison Groups adjusted MEAN	Program Effect Difference	Effect Size Cohen's *d*	Standard Error S.E.₁	Standard Error S.E.₂
Continuum of French spoken by Child						
G1 vs. G2	2.34	2.17	-0.18	-0.45	0.06***	0.05***
G1 vs. G3	2.34	2.23	-0.11	-0.30	0.06*	0.04***
Ability to Communicate in French						
G1 vs. G2	2.89	2.84	-0.05	-0.28	0.03*	0.03*
G1 vs. G3	2.89	2.79	-0.10	-0.48	0.03***	0.03**

Note: G1 = Program Daycare group; G2 = Comparison Daycare group; G3 = Informal Care group; S.E.₁ corresponds to disaggregate standard error at individual level; S.E.₂ corresponds to aggregate standard error with clustering by daycare. Standard errors are estimated using the robust Huber-White heterogeneity estimator. *Negative values in ANCOVA estimates for all comparisons between groups represent a positive effect of the program (i.e., an advantage for the Program Daycare group);* *p<0.10, **p<0.05, ***p<0.01.

6.1.3   Reading Skills

Knowledge of Letters

Results found in Table 6.4 show no significant difference between the Program Daycare group and the comparison groups for the Knowledge of Letters variable regardless of the model specification.

Letter Sounds

Examination of the estimates in Table 6.4 fail to reveal significant difference between the Program Daycare group and the Informal Care group. However, children in the Program Daycare group scored higher than children in the Comparison Daycare group, and this effect is significant in the aggregate model. The size of this effect is considered to be small (d = -0.19)

Reading Simple Words

The results presented in Table 6.4 show that in reading children in the Program Daycare group scored at the same level as those in the Comparison Daycare group, but significantly lower than those in the Informal Care group. However, the difference in favour of the Informal Care group is solely significant in the aggregate model specified with errors at the daycare level, and the size of this effect is considered small (*d* = 0.21).

Table 6.4   Program Impact on Reading Skills at 12 Months Post-Program – Measures Obtained from Direct Assessment of Children

Measure	Program Group adjusted MEAN	Comparison Groups adjusted MEAN	Program Effect Difference	Effect Size Cohen's *d*	Standard Error S.E.$_1$	S.E.$_2$
Knowledge of Letters						
G1 vs. G2	3.57	3.54	-0.03	-0.04	0.11	0.10
G1 vs. G3	3.57	3.70	0.13	0.17	0.12	0.10
Letter Sounds						
G1 vs. G2	3.44	3.27	-0.17	-0.19	0.14	0.09*
G1 vs. G3	3.44	3.53	0.09	0.09	0.15	0.08
Reading Simple Words						
G1 vs. G2	17.87	16.60	-1.28	-0.14	1.33	1.32
G1 vs. G3	17.87	19.74	1.86	0.21	1.45	0.73**

Note: G1 = Program Daycare group; G2 = Comparison Daycare group; G3 = Informal Care group; S.E.$_1$ corresponds to disaggregate standard error at individual level; S.E.$_2$ corresponds to aggregate standard error with clustering by daycare. Standard errors are estimated using the robust Huber-White heterogeneity estimator. *Negative values in ANCOVA estimates for all comparisons between groups represent a positive effec t of the program (i.e., an advantage for the Program Daycare group); *p<0.10, **p<0.05, ***p<0.01.*

6.1.4   Mathematics Skills

Knowledge of Numbers

The results presented in Table 6.5 indicate that the children in the Program Daycare group scored higher in mathematics than those in the Comparison Daycare group. This difference is significant in both models and the size of the effect is considered small at *d* = -0.26. Moreover, the results fail to reveal significant difference between the Program Daycare group and the Informal Care group.

Table 6.5   Program Impact on Mathematics Skills at 12 Months Post-Program – Measures Obtained from Direct Assessment of Children

Measure	Program Group adjusted MEAN	Comparison Groups adjusted MEAN	Program Effect Difference	Effect Size Cohen's *d*	Standard Error S.E.$_1$	Standard Error S.E.$_2$
Knowledge of Numbers						
G1 vs. G2	20.83	19.66	-1.17	-0.26	0.61*	0.50**
G1 vs. G3	20.83	20.27	-0.56	-0.13	0.70	0.49

Note: G1 = Program Daycare group; G2 = Comparison Daycare group; G3 = Informal Care group; S.E.$_1$ corresponds to disaggregate standard error at individual level; S.E.$_2$ corresponds to aggregate standard error with clustering by daycare. Standard errors are estimated using the robust Huber-White heterogeneity estimator. *Negative values in ANCOVA estimates for all comparisons between groups represent a positive effect of the program (i.e., an advantage for the Program Daycare group);* *$p<0.10$, **$p<0.05$, ***$p<0.01$.

6.1.5   Summary: Analyses by Group

The results of the analyses by experimental group indicate that the tested program had a positive effect on some of the outcomes associated with academic achievement in an environment where French is the language of instruction. Figure 6.1 presents a summary of the program effects (Cohen's *d*) for all outcomes. The blue and grey bars represent the effect size for comparisons with the Comparison Daycare group (G2) and the Informal Care group (G3) respectively. A bar above zero represents an effect in favour of the Program Daycare group.

As shown in Figure 6.1, the results indicate that the program effect is more pronounced in relation to the Comparison Daycare group (blue bars above zero) than it is in relation to the Informal Care group (grey bars below zero). Specifically, significant differences were observed between the children of the Program Daycare group and the Comparison Daycare group on all skills related to academic success, that is to say, executive functions, language skills, and skills in reading and mathematics. Furthermore, compared to the Informal Care group, the effect is more pronounced in terms of language skills.

A more mixed pattern of findings can be observed in results for executive functions. The Program Daycare group appears to have an advantage over the Comparison Daycare group in the development of their executive functions though only on the more complex measure of executive functions (i.e. Backward Digit Span). In contrast, children in the Program Daycare group perform similarly to those in the Informal Care group on both measures of executive functions. The effect of the tested program on executive functions remains to be verified through additional impact analyses found in this report and during the 24-month post-program evaluation period, when these skills are fully developing.

Figure 6.1 Program Effect on Child Outcomes Represented by Standardized Differences (Cohen's d)
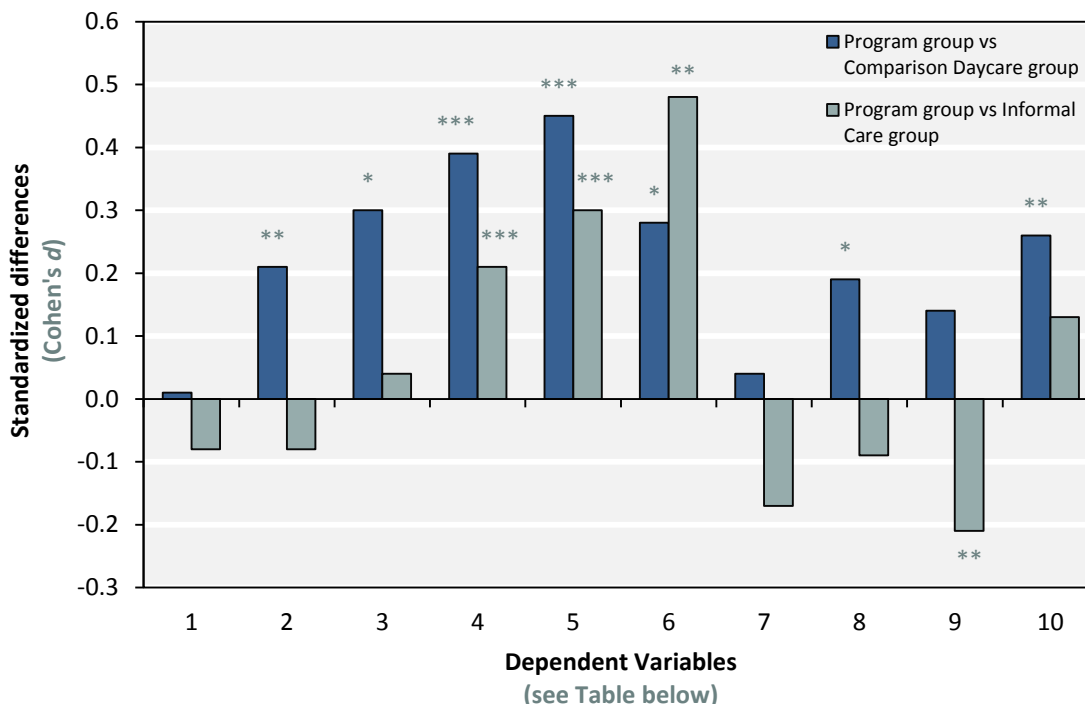
1	Forward Digit Span	6	Ability to Communicate in French
2	Backward Digit Span	7	Knowledge of Letters
3	Word Reasoning	8	Letter Sounds
4	Verbal Fluency	9	Reading Simple Words
5	Continuum of French Spoken by the Child	10	Knowledge of Numbers

Note: *$p<0,10$, **$p<0,05$, ***$p<0,01$ (Robust model with aggregate standard errors clustered by daycare)

Next, a clear pattern emerges in favour of the Program Daycare group on linguistic variables. The results show that children in the Program Daycare group have greater French language skills compared to children in the Comparison Daycare group. Significant differences were observed for all four variables (Word Reasoning, Verbal Fluency, Continuum of French Spoken by the Child, and Ability to Communicate in French), for both specified models. This effect is more credible given the consistency of the results across two sources, the direct assessment of children and the parents' survey. Overall, the pattern of results is reproduced when the Program Daycare group is compared to the Informal Care group. Indeed, children in the Program Daycare group obtain higher scores than children in the Informal Care group on the linguistic variables, and these differences are all significant except for the Word Reasoning outcomes. The program impact on language skills has been present since the beginning of project and appears to continue at 12 months post-program. One possible explanation is the fact that Program Daycare group parents provide their children with a higher exposure to French. Analyses of the program impact on parents, in Section 6.5, assist us in verifying this hypothesis.

Language skills are important precursors to the acquisition of reading skills, particularly during grade one, at time when children learn to read. At 12 months post-program, children in the Program Daycare group scored similarly or higher than those in the Comparison Daycare group for the three literacy tests. In contrast, the children in the Informal Care group scored significantly higher on Reading Simple Words than the children in the Program Daycare group. The superior language skills of the children in the Program Daycare group could possibly reverse this effect in grade one. It remains to be seen whether this hypothesis will be supported during the 24-month post-program evaluation period.

Finally, the children in the Program Daycare group tended to score higher in mathematics than the children in the two comparison groups, and the effect was significant when comparing with the children in the Comparison Daycare group. In short, the program appears to primarily have an impact on children's language skills. In comparing the Program Daycare group to the Comparison Daycare group, the effect of the program is also observed in terms of executive functions, reading skills and mathematics skills. The effect of the program will be further verified through additional analyses presented in the next few sections of this report and after the 24-month post-program evaluation period.

6.2 Impact on Children – Analyses by Dosage

This section presents analyses of the medium term effect of dosage. Note that these analyses concern only the experimental groups attending daycare (N = 235). The dosage variable (average number of hours spent at daycare per week for the first eight months of program delivery, M = 27.24, S.E. = 8.91)) was standardized for analysis purposes. Thus, a value of zero represents the sample mean. The reported models include only the linear effect of dosage.[40]

The pattern of results presented in Table 6.6 shows that, overall, the dosage is positively linked to 12-month post-program outcomes. The effect is significant only for the variables Ability to Communicate in French and Knowledge of Letters variables. These latter findings suggest that the number of hours spent in daycare can predict success at these outcomes. The findings of the moderation analysis (Dosage by Group) suggest that, with the exception of Knowledge of Letters, the dosage effect does not vary significantly as a function of experimental group. In short, the dosage effect does not appear to persist at 12 months post-program.

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[40] The relationship between the dosage and development may be linear or non-linear. A linear relationship is established when the dosage effect is consistent regardless of the degree of exposure to a child care setting (e.g., 10 hours per week versus 40 hours per week). In previous reports (*First Cohort Findings Report* and *Report of Findings from the Preschool Phase*), preliminary analyses (e.g., using quadratic terms; inspecting residuals) did not reveal a non-linear relationship in the adjusted model. The conclusion drawn from these finding is that the linear effect of the dosage is sufficient for the purposes of the analyses reported in this document, which is consistent with literature indicating that dosage effects are linear (National Institute of Child Health and Human Development Early Child Care Research Network & Duncan, 2003).

Table 6.6 Impact of the Daycare Component 7 Dosage on Child Outcomes

	Dosage			Dosage by Group (G1 vs. G2)		
	Estimate	Standard Error		Estimate	Standard Error	
Measure		S.E.[1]	S.E.[2]		S.E.[1]	S.E.[2]
Executive functions						
Forward Digit Span	0.01	0.02	0.02	0.01	0.03	0.03
Backward Digit Span	0.01	0.03	0.02	0.02	0.03	0.02
Language Skills						
Continuum of French Spoken by the Child	0.00	0.01	0.01	0.00	0.01	0.01
Ability to Communicate in French	0.00	0.00	0.00**	0.00	0.00	0.00
Word Reasoning	0.02	0.03	0.04	-0.05	0.04	0.04
Verbal Fluency	0.05	0.09	0.05	-0.06	0.11	0.07
Reading Skills						
Knowledge of Letters	0.01	0.01	0.01*	-0.02	0.01	0.01*
Letter Sounds	0.01	0.01	0.01	-0.01	0.02	0.01
Reading Simple Words	-0.02	0.13	0.09	0.07	0.15	0.11
Mathematics skills						
Knowledge of Numbers	0.04	0.07	0.04	0.04	0.08	0.07

Note: G1 = Program Daycare group; G2 = Comparison Daycare group; S.E.[1] corresponds to disaggregate standard error at individual level; S.E.[2] corresponds to aggregate standard error with clustering by daycare. Standard errors are estimated using the robust Huber-White heterogeneity estimator. *Positive values in ANCOVA dosage estimates represent a positive dosage effect. Incidentally, negative values in ANCOVA estimates for comparisons between G1 and G2 (Dosage by Group) represent a positive effect of the program (i.e., an advantage for the Program Daycare group).* Significance levels set at *p<0.10, **p<0.05, ***p<0.01.

6.3 Impact on Children – Analyses by Daycare Program Quality and Fidelity

This section presents analyses examining the medium term effect of the daycare program quality and fidelity on precursors to academic achievement at 12 months post-program. The analysis results enable us to verify the predictive value of key dimensions of the tested program in terms of quality and fidelity of implementation. Note that, as was the case for the dosage analyses, the results only apply to the experimental groups that spent time in daycare (N = 235).

6.3.1 Quality and fidelity

The implementation study provided us with information on the daycare programs being offered when the children were finishing the first year of the project. This information was used to calculate program quality and fidelity indices for daycares in the Program Daycare group and the Comparison Daycare group. The program delivered at each daycare was assigned two global scores based on a number of quality and fidelity indices.

The ***global quality*** index includes three dimensions that describe the quality of the program and the environment in which it is delivered: 1) Structural Quality measures the overall quality of the environment in childcare settings; 2) Quality of Educational Content gives special attention to activities that encourage children to communicate and broaden their vocabulary; and 3) Reading Quality measures the quantity and accessibility of books in the classroom, as well as the quality of literacy activities led by the educators. The global quality index represents the average of the three quality indicators.

The ***global fidelity*** index includes two dimensions, one addressing the structural fidelity of the implementation and the other, content fidelity. Both fidelity indicators express the proportion of the tested program's elements that were implemented at each daycare. Structural Fidelity reflects the presence of elements in the environment, such as cards displaying a picture and word or routine charts. Content Fidelity, on the other hand, indicates the extent to which program elements have been added to the childcare programming (e.g., story time may include reading or reasoning activities). The global fidelity index is generated by calculating the average of these two fidelity indicators.

Differentiation analyses of the programs offered at program daycares and comparison daycares reveal that program daycares stand out from comparison daycares in the dimensions found within the global quality and fidelity indices (see Section 9.2.4 of the *Report of Findings from the Preschool Phase* for a description of the differentiation analysis results).

6.3.2 Results of Analyses by Program Quality and Fidelity

Table 6.7 presents analysis results based on global program quality and fidelity indices. Note that ANCOVA estimates consider the effect of quality and fidelity on child outcomes beyond the effect of the 19 covariates. The results reveal that there is a positive (or null) relationship between the global quality and all child outcomes. Moreover, this relationship is significant for the Backward Digit Span (aggregate model only), the Continuum of French Spoken by the Child (both models), Verbal Fluency (aggregate model only), and Mathematics (both models).

Hence, daycares with a better overall quality program tend to promote the development of executive functions, especially the "mental flexibility" component. This result is consistent with findings from impact analyses by experimental group which suggest that children in the Program Daycare group score higher on the Backward Digit Span measure than children in the Comparison Daycare group. The results also indicate that the global quality of the program is positively associated with the Continuum of French Spoken by the Child and with the Verbal Fluency. These results support the findings of analyses by experimental group, that is, children in the Program Daycare group make greater use of French and show better Verbal Fluency than the children in the Comparison Daycare group (significant

effect in the analyses by experimental group discussed in Section 6.1). Finally, the global quality seems to favour the development of mathematics skills. This result supports the findings of the analyses by experimental group, which indicate that the children in the Program Daycare group score higher on the Knowledge of Numbers measure.

As demonstrated in Table 6.7, the pattern of results is similar for global fidelity. We observe a positive correlation between the global fidelity index and all child outcomes (with the exception of the Knowledge of Letters variable) with four of these correlations significant. Specifically, high program fidelity is correlated to higher scores for the Backward Digit Span measure (aggregate model only), the Continuum of French Spoken by the Child (both models), Verbal Fluency (both models), and Knowledge of Numbers (both models). This consistent pattern of results in the quality impact and fidelity impact gives further credibility to the results.

Table 6.7   Effect of the Daycare Program Fidelity and Quality on Child Outcomes

	Global Quality			Global Fidelity		
	Effect	Standard Error		Effect	Standard Error	
Measure	ANCOVA Estimate	S.E.[1]	S.E.[2]	ANCOVA Estimate.	S.E.[1]	S.E.[2]
Executive Functions						
Forward Digit Span	0.02	0.13	0,09	0.10	1.00	0.92
Backward Digit Span	0.15	0.12	0.07**	1.14	0.92	0.21*
Language Skills						
Continuum of French Spoken by the Child	0.08	0.03***	0.03***	0.44	0.20**	0.03*
Ability to Communicate in French	0.02	0.02	0.01	0.07	0.11	0.50
Word Reasoning	0.13	0.18	0.17	0.96	1.29	0.46
Verbal Fluency	0.84	0.52	0.41*	6.98	3.69*	0.06**
Reading Skills						
Knowledge of Letters	0.00	0.05	0.04	-0.19	0.39	0.64
Letter Sounds	0.01	0.07	0.05	0.06	0.53	0.91
Reading Simple Words	0.36	0.67	0.56	1.04	4.87	0.83
Mathematics Skills						
Knowledge of Numbers	0.73	0.35**	0.31**	5.03	2.50**	0.05**

Note: S.E.[1] corresponds to disaggregate standard error at individual level; S.E.[2] corresponds to aggregate standard error with clustering by daycare. Standard errors are estimated using the robust Huber-White heterogeneity estimator. *Contrary to the analyses by group, positive values in the ANCOVA estimates (A. E.) represent a positive relationship between the quality or fidelity index and the outcome.* *$p<0.10$; **$p<0.05$; ***$p<0.01$.

In sum, the quality and fidelity of the daycare component of the tested program appear to have a medium term effect on children's executive functions (especially mental flexibility), use of French and mathematics skills. The program's significant effect on the Verbal Fluency variable, observed in the findings of the analyses by experimental group, remain to be explained (see results in Section 6.1), since neither the dosage nor the daycare program fidelity/quality appear to be responsible for this effect. It is possible that the program's impact on this variable is being experienced through the program's effect on parents. Analyses of the program's impact on parents, discussed in Section 6.5, will allow us to verify this hypothesis.

6.4 Impact on Children – Analyses by Linguistic Profile

The objective of the analysis by linguistic profile is to estimate the program's medium term effect independently for children who were initially (before program implementation) from families with high exposure to French at home and those from families with low exposure to French at home. Note that these analyses were conducted on the entire sample across the three experimental groups. The variable Household type with high/low exposure is a dichotomous indicator calculated by crossing the Language spoken to the child by the mother and those spoken to the child by the father, measured at baseline.

We anticipated a greater medium term program impact on the language skills of children who were initially from a home with low exposure to French. In contrast, the impact of the preschool program on children with high exposure to French at home (Francophone endogamous families) should be primarily observed on the more complex skills linked to academic success such as reading and mathematics skills, as well as the development of executive functions. This hypothesis is based on a developmental model which recognizes that knowledge of the language of instruction facilitates the acquisition of complex academic skills.

Table 6.8 reports the results of ANCOVA estimates (model which includes covariates) testing the moderating effect of the Household Type on the impact of the tested program at 12 months post-program (interaction between the Household Type and the Experimental group). It also presents the ANCOVA estimates for the program effect calculated separately for the two types of households.

6.4.1 Executive Functions

Forward Digit Span

For the Forward Digit Span measure, the results indicate that among children from a home with low exposure, those in the Program Daycare group do less well than children in the comparison groups. Moreover, a non-significant trend is observed in favour of the Program Daycare group for children with high exposure to French at home, and this effect is observed relative to both comparison groups.

Backward Digit Span

An examination of the program effects by Household Type presents a similar pattern of results as with the Forward Digit Span, but specifically when comparing to the Comparison Daycare group. While children from the Program Daycare group with low exposure to French at home do not perform as well

as their counterparts in the Informal Care Group on this measure, Program Daycare group children tend to perform better when they come from homes with high exposure to French.

Moreover, Program Daycare group children from homes with high exposure to French perform significantly better on this measure compared to their counterparts in the Comparison Daycare group. These findings suggest that the program enhances the executive functions involved in the Backward Digit Span measure (i.e., working memory and mental flexibility) for children who initially have a high exposure to French at home.

6.4.2 Language Skills

Note that the analyses by experimental group show a significant effect in favour of the Program Daycare group for all language variables (see Section 6.1). The following results for the four language variables are however mixed though all non-significant comparisons for language variables (other than Word Reasoning) are in favour of the Program Daycare group.

Continuum of French Spoken by the Child

When comparing with the Comparison Daycare group on the Continuum of French Spoken by the Child measure, the effect of the program seems more pronounced for children with low exposure to French at home, although a significant effect is also observed in the disaggregate model for children with high exposure to French at home. No significant effect is observed between the Program Daycare group and the Informal Care group.

Ability to Communicate in French

A significant effect is found in the comparison with the Informal Care group, although only for Program Daycare group children with low exposure (significant effect with both models). The tested preschool program therefore appears to strengthen language skills (expressive and receptive) of children with initial limited exposure to French

Word Reasoning

For the Word Reasoning measure, the program appears to have a stronger effect for children with high exposure at home, but only when compared to the Comparison Daycare group.

Verbal Fluency

For the Verbal Fluency measure, a significant effect is observed in favour of the Program Daycare group when compared with both comparison groups, but only for children with high exposure to French at home. This result indicates that a quality program such as the one offered in the Readiness to Learn project enhances expressive vocabulary to a greater extent for children from Francophone endogamous homes.

6.4.3 Reading Skills

Knowledge of Letters

An examination of the analysis by Household Type suggests that children in the Program Daycare group with low exposure have a lower Knowledge of Letters than their counterparts in the Informal Care group (only significant in the aggregate model). No difference was observed between the Program Daycare group and the Comparison Daycare group.

Letter Sounds

The results by Household Type show a significant effect in favour of children in the Program Daycare group with high exposure compared to their counterparts in the Comparison Daycare group. It is interesting to note that the trend in favour of the Program Daycare group observed in the main experimental group analyses with the Comparison Daycare group (Section 6.1), becomes significant once the Household Type variable is taken into consideration.

Reading Simple Words

For the variable Reading Simple words, we observed a significant effect in favour of children in the Program Daycare group with high exposure compared to their counterparts in the Comparison Daycare group. Note that the trend in favour of the Program Daycare group in comparison with the Comparison Daycare group observed in the results of the analyses by experimental group (Section 6.1) becomes significant once the Household Type variable is taken into consideration. In contrast, the results indicate that children in the Program Daycare group with low exposure in the home scored lower in reading than their counterparts in the Informal Care group.

6.4.4 Mathematics Skills

Knowledge of Numbers

For this variable, the results reveal that the tested program has a significant positive effect, but only for children with high exposure. Once again, by targeting the sub-group that benefits the most from the program in terms of mathematics skills, the analyses by Household Type yield significant results between the Program Daycare group and the Informal Care group that are not observed when strictly analyzing the effects by experimental group.

Table 6.8   Impact of the Tested Program by Household Type: Low/High Exposure to French

Measure	Comparison	Household with low exposure to French			Household with high exposure to French		
		Estimate	Standard Error		Estimate	Standard Error	
			S.E.$_1$	S.E.$_2$		S.E.$_1$	S.E.$_2$
Executive Functions							
Forward Digit Span	G1 vs. G2	0.33	0.28	0.19*	-0.39	0.35	0.26
	G1 vs. G3	0.50	0.30	0.21**	-0.22	0.37	0.15
Backward Digit Span	G1 vs. G2	-0.05	0.30	0.16	-0.69	0.35*	0.22***
	G1 vs. G3	0.49	0.34	0.21**	-0.24	0.33	0.19
Language Skills							
Continuum of French Spoken by the Child	G1 vs. G2	-0.21	0.08***	0.06***	-0.14	0.08*	0.09
	G1 vs. G3	-0.10	0.08	0.07	-0.09	0.08	0.06
Ability to Communicate in French	G1 vs. G2	-0.06	0.04	0.04	-0.04	0.04	0.03
	G1 vs. G3	-0.12	0.05**	0.02***	-0.08	0.04*	0.05
Word Reasoning	G1 vs. G2	-0.39	0.42	0.33	-0.83	0.47*	0.43*
	G1 vs. G3	-0.33	0.42	0.28	0.08	0.46	0.42
Verbal Fluency	G1 vs. G2	-1.66	1.25	1.12	-3.39	1.33**	0.96***
	G1 vs. G3	-0.96	1.36	0.79	-1.74	1.37	0.83**

Measure	Comparison	Household with low exposure to French			Household with high exposure to French		
		Estimate	Standard Error		Estimate	Standard Error	
			S.E.$_1$	S.E.$_2$		S.E.$_1$	S.E.$_2$
Reading skills							
Knowledge of Letters	G1 vs. G2	0.04	0.15	0.10	-0.11	0.14	0.16
	G1 vs. G3	0.22	0.16	0.09**	0.04	0.15	0.13
Letter Sounds	G1 vs. G2	-0.11	0.18	0.12	-0.24	0.20	0.12*
	G1 vs. G3	0.13	0.20	0.15	0.03	0.20	0.09
Reading Simple Words	G1 vs. G2	-0.22	1.84	1.94	-2.25	1.79	1.16*
	G1 vs. G3	2.80	2.04	1.35**	1.40	1.89	1.30
Mathematics Skills							
Knowledge of Numbers	G1 vs. G2	-0.01	0.78	0.69	-2.35	0.93**	0.73***
	G1 vs. G3	0.25	0.91	0.62	-1.21	0.96	0.58**

Note: S.E.$_1$ corresponds to disaggregate standard error at individual level; S.E.$_2$ corresponds to aggregate standard error with clustering by daycare. Standard errors are estimated using the robust Huber-White heterogeneity estimator. *Negative values in the ANCOVA estimates for all comparisons between groups represent a positive program effect (i.e., an advantage for the Program Daycare group).* F$_1$ represents Wald's F calculated with disaggregate standard error at individual level; F$_2$ represents Wald's F calculated with aggregate standard errors clustered by daycare. Significance levels set at *p*<0.10, **p*<0.05, ***p*<0.01.

6.4.5   Summary of Results by Linguistic Profile

In short, the results of analyses by linguistic profile indicate that, overall, the program has had a more noticeable effect on children who were initially from homes with high exposure to French, particularly compared to the Comparison Daycare group.

First, regarding executive functions, the program seems to be having a favourable impact, compared to the Comparison Daycare group, for the sample with high exposure (significant for the Backward Digit Span). However, results suggest that children in the Program Daycare group with low exposure score lower on executive functions measures than their counterparts in the Informal Care group.

Next, the pattern of results for language skills varies depending on the variable being analyzed. The results of the Continuum of French Spoken by the Child indicate that the program is more effective for children from homes with low exposure to French compared to their counterparts in the Comparison Daycare group. This result suggests that a high quality French preschool program can promote the use of French by children with limited exposure to French. Note that the program also seems to promote, to a lesser extent, the use of French in children with high exposure to French at home (disaggregate model only).

For the Ability to Communicate in French variable, the comparison with the Informal Care group seems to indicate that the program is more effective for children with low exposure. This variable involves a linguistic ability that is both expressive and receptive. This result suggests that the preschool program enables to compensate to some extent for the limited exposure to French in the home. Next, according to the results of the Word Reasoning variable, the program seems to have an impact on children's ability to understand sentences in French, but especially for children with high exposure to French at home. Finally, with respect to Verbal Fluency, the results clearly indicate that it is the children with high exposure who benefit more from the program. This latter refers to skills associated with a child's ease in accessing linguistic information.

For reading and mathematics skills, the results of Letter Sounds, Reading Simple Words and Knowledge of Numbers suggest that the program is only having a significant impact on children from homes with high exposure compared to their counterparts in the Comparison Daycare group.

6.5   Impact on Parents – Analyses by Group

Analyses by group include the following four outcomes: Languages Spoken to the Child by the Mother, Languages Spoken to the Child by the Father, Frequency of Literacy Activities and Language of Literacy Activities.

6.5.1   Languages Spoken to the Child by the Mother/Father[41]

The results reported in Table 6.9 indicate that the program had an effect on Languages spoken by the mother and father to the child, but only in comparison to the Comparison Daycare group. Note that the

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[41]   Note that five children were excluded from analyses for the variable Languages Spoken by the Mother to the Child since these children are from single-parent families headed by the father. Likewise, 43 children

measure consists of a three-point scale corresponding to a language continuum where "1" signifies that the parent does not speak French to the child and "3" signifies that the parent only speaks French to the child. Indeed, the results suggest that parents in the Program Daycare group are more likely to speak to their child in French than parents in the Comparison Daycare group. The effect sizes are small to average (d =-0.40 and -0.20 for mother and fathers respectively). Note also that for the Language Spoken to the Child by the Father, only the aggregate model with errors clustered by daycare was significant.

6.5.2   Language of Literacy Activities

The results for the analyses reported in Table 6.9 show that the program has a significant effect on the Language of Literacy Activities, in comparison to both comparison groups. The size of these effects is considered to medium for the comparison with the Comparison Daycare group (d = -0.53) and small to medium for the comparison with the Informal Care group (d = -0.32)

6.5.3   Frequency of Literacy Activities

According to the results presented in Table 6.9, the program does not have a significant effect on the Frequency of Literacy Activities. The size of the effect is considered small regardless of the comparison group at d = -0.22 for the comparison with the Comparison Daycare group and d = -0.25 for the comparison with the Informal Care group.

were excluded from analyses for the variable Languages Spoken by the Father to the Child since these children are from single-parent families headed by the mother.

Table 6.9   Program Impact on Parents at 12 Months Post-Program – Measures Obtained from Parent Surveys

Measure	Program Group	Comparison Groups	Program Effect	Effect Size	Standard Error	
	adjusted Mean	adjusted Mean	Difference	Cohen's *d*	S.E.1	S.E.2
Languages Spoken by the Mother to the Child						
G1 vs. G2	2.59	2.45	-0.14	-0.40	0.05***	0.06**
G1 vs. G3	2.59	2.55	-0.04	-0.13	0.05	0.04
Languages Spoken by the Father to the Child						
G1 vs. G2	2.36	2.27	-0.09	-0.20	0.06	0.04*
G1 vs. G3	2.36	2.32	-0.03	-0.08	0.06	0.04
Language of Literacy Activities						
G1 vs. G2	4.66	4.39	-0.27	-0.53	0.08***	0.08***
G1 vs. G3	4.66	4.50	-0.16	-0.32	0.08*	0.06**
Frequency of Literacy Activities						
G1 vs. G2	4.52	4.40	-0.12	-0.22	0.08	0.08
G1 vs. G3	4.52	4.39	-0.13	-0.25	0.08	0.08

Note: S.E.1 corresponds to disaggregate standard error at individual level; S.E.2 corresponds to aggregate standard error with clustering by daycare. Standard errors are estimated using the robust Huber-White heterogeneity estimator.*$p<0.10$, **$p<0.05$, ***$p<0.01$.

6.5.4   Summary of Impact on Parents Analyses

Analysis results for the program impact on parents show that, overall, the program's effect on parents is continuing at 12 months post-program. Figure 6.2 presents a summary of the program effects (Cohen's *d*) for the four parent outcomes. The blue and grey bars represent the effect size for comparisons with the Comparison Daycare group (G2) and the Informal Care group (G3) respectively. A bar above zero represents an effect in favour of the Program Daycare group.

Figure 6.2 Program Effect on Parent Outcomes Represented by Standardized Differences (Cohen's *d*)
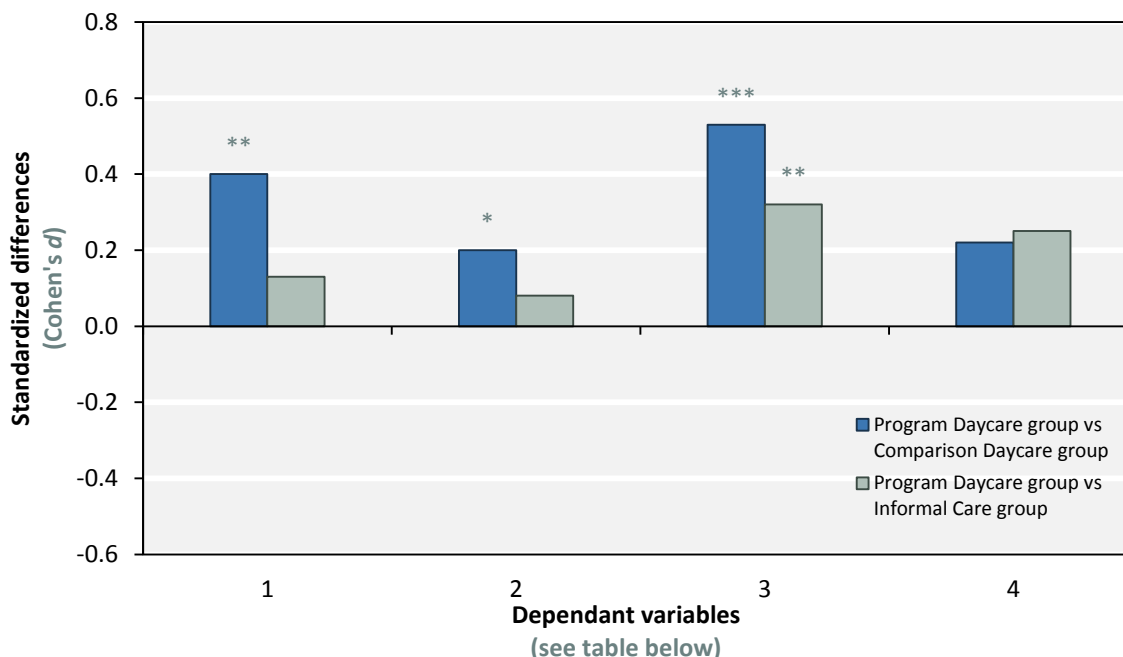
Note: *p<0,10, **p<0,05, ***p<0,01 (Robust model with aggregate standard errors clustered by daycare)

1	Languages Spoken by the Mother to the Child	3	Language of Literacy Activities
2	Languages Spoken by the Father to the Child	4	Frequency of Literacy Activities

Specifically, the results suggest that the program has an impact on the mother's and father's use of French in communications with the child (compared to the Comparison Daycare group only) and as preferred language of literacy activities. Note that the impact on the parents is consistent with the results obtained for the children, that is, a clear pattern is emerging for language skills at 12 months post-program, according to program impact analyses by experimental group (Section 6.1).

The program's impact on parents is promising. Now that the children are no longer participating in the program, the indirect effect of the program on parents is acting as an important support in the children's ongoing exposure to the French language. This support is an indispensable precursor to ongoing progress and development of the basic skills children need for academic achievement.

6.5.5 Mediation Effect of the Family Literacy Component on Children

According to impact analysis results, the tested program appears to be having a significant impact on children's language skills (see Section 6.1), and on the parent's use of French at home (see Table 6.9). This section presents the results for a mediation analysis; the objective was to determine the degree to which the program's impact on parents is responsible for the program's effects on children's language

skills. Specifically, the analyses examined whether the program's effect on the children's linguistic outcomes could be partially or fully explained by the parents' linguistic variables.

We tested this idea, estimating the effects of the experimental group after statistically controlling for parent outcomes. If the role of the parent outcomes is responsible for the effects observed in the children, then the adjusted effects in the experimental group should not prove to be statistically significant. The logic of this analysis is based on a mediation test (Cohen et al., 2003, p. 457) where the effect of experimental group membership on child outcomes is assumed to be indirectly influenced by parent outcomes.

We are using the experimental group variable as an exogenous (X) explanatory factor, a parental linguistic factor as a mediating endogenous (M) variable and the children's language skills as the outcomes (Y). The linguistic factor consists of three variables, Languages Spoken by the Mother to the Child, Languages Spoken by the Father to the Child, and Languages of Literacy Activities with the child. The outcomes of interest are those in which the program has an impact in analyses by experimental group (see Section 6.1); these include the Continuum of French Spoken by the Child, the child's Ability to Communicate in French and Verbal Fluency. The mediation analysis is based on three parameters and their standard errors: coefficient a captured the relationship between X and M, coefficient b captured the relationship between M and Y and coefficient c captured the residual effect of X on Y after eliminating the variance associated with variable M. A diagram illustrating the underlying logic of this analysis is presented in Figure 6.3 (see also Krull & MacKinnon, 1999).

Figure 6.3 Diagram illustrating the two paths through which the program is having an effect on children's language skills: the path attributable to parental linguistic factors (a, b) and the path directly attributable to the tested preschool program (c')
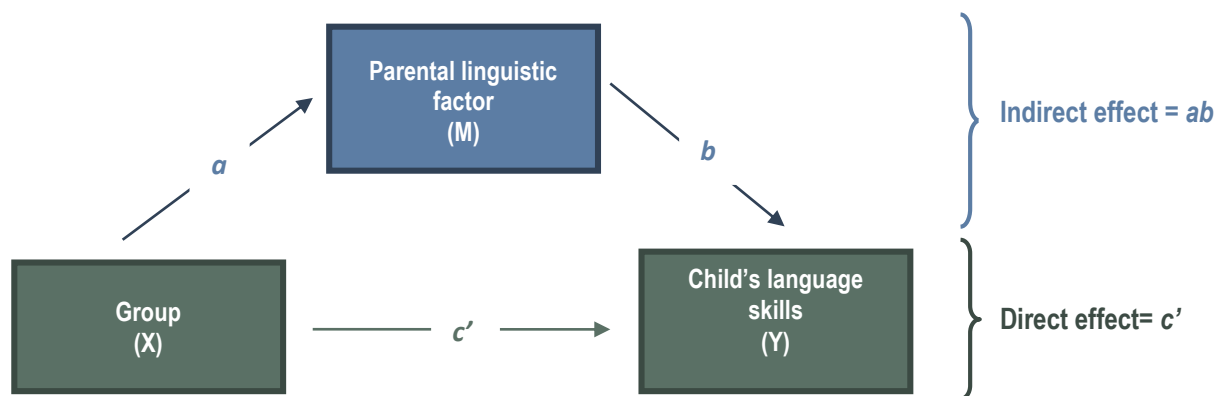
Two effects of interest are illustrated in Figure 6.3. The *indirect effect* of the program is the part of the tested program's effect that is attributable to the parental linguistic factor. This effect is estimated by introducing the 'parental linguistic' factor into the regression model. The part of the group effect that is eliminated in the adjusted model through the inclusion of the parental linguistic factor is attributed to this element (Indirect effect = *ab*). The residual group effect is the *direct effect* (*c'*) of the program, i.e. the part of the effect attributable to other aspects of the program. If this latter effect is non-significant, we assume that the entire program effect has been experienced through the mediating variable (i.e., the parental linguistic factor). On the other hand, if the effect is significant, we then

assume that there is a part of the effect that has yet to be explained (e.g., dosage, program quality/fidelity).

The results are reported in Table 6.10. In the table, the program impact is represented by the total effect. This is then broken down into an indirect effect (through the mediating factor) and a direct effect (residual effect of the experimental group not explained by the mediating factor). As shown in Table 6.10, significant indirect effects are observed for the three of the four child outcomes, Continuum of French Spoken by the Child, Ability to Communicate in French, and Verbal Fluency [42]. Results from the Sobel test are significant for these three language outcomes in comparison to the Comparison Daycare group and are significant for the Continuum of French Spoken by the Child and Verbal Fluency in comparison with the Informal Care group. Since the direct effect is significant for the Continuum of French Spoken by the Child and Verbal Fluency, the mediating effect is considered incomplete. Incidentally, the mediating effect is complete in terms of the Ability to Communicate in French, but only in comparison with the Comparison Daycare group.

In short, the results suggest the presence of an indirect medium term program impact on child outcomes through the program's impact on the parents. The results of the mediation analyses support the hypothesis that the impact of the Family Literacy component on the parents is partly responsible for the program's effect on the children's language skills. These results are further corroborated by the short term results of the tested program. As mentioned in the *Report of Findings from the Preschool Phase*, the mediation effect of the quality and fidelity do not fully explain the effect of the program on variables linked to language skills (communication). This result suggests that the impact of the Family Literacy component on the parents is likely a residual effect that is not explained by the program fidelity/quality.

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[42]   The coefficient b for Word Reasoning is not significant.

Table 6.10 Mediation Test with Parental Linguistic Factor as Mediator of the Program Effect at 12 Months Post-Program

Measure	Total Effect			Direct Effect			Indirect Effect							
	Effect	S.E.$_1$	S.E.$_2$	c'	S.E.$_1$	S.E.$_2$	a	S.E.$_1$	S.E.$_2$	b	S.E.$_1$	S.E.$_2$	Sobel$_1$	Sobel$_2$
Word Reasoning														
G1 vs. G2	-0.63	0.32**	0.31*	-0.57	0.33*	0.32*	-0.28	0.07***	0.09***	0.21	0.22	0.18	-0.93	-1.09
G1 vs. G3	-0.09	0.31	0.20	-0.06	0.31	0.21	-0.12	0.08	0.05**	0.21	0.22	0.18	-0.81	-1.05
Verbal Fluency														
G1 vs. G2	-2.51***	0.93***	0.70***	-1.92	0.93**	0.68**	-0.28	0.07***	0.09***	2.13	0.63***	0.72***	-2.58***	-2.14**
G1 vs. G3	-1.34	0.98	0.32***	-1.08	0.96	0.32***	-0.12	0.08	0.05**	2.13	0.63***	0.72***	-1.37	-1.86*
Continuum of French Spoken by the Child														
G1 vs. G2	-0.18	0.06***	0.05***	-0.08	0.05	0.04*	-0.28	0.07***	0.09***	0.36	0.03***	0.02***	-3.79***	-3.07***
G1 vs. G3	-0.11	0.06*	0.04***	-0.07	0.05	0.04*	-0.12	0.08	0.05**	0.36	0.03***	0.02***	-1.49	-2.38**
Ability to Communicate in French														
G1 vs. G2	-0.05	0.03*	0.03*	-0.04	0.03	0.03	-0.28	0.07***	0.09***	0.06	0.02**	0.03	-2.40**	-1.68*
G1 vs. G3	-0.10	0.03***	0.04**	-0.09	0.03***	0.04**	-0.12	0.08	0.05**	0.06	0.02**	0.03	-1.34	-1.54

Note: c' = Coefficient c'; a = Coefficient a; S.E.$_1$ corresponds to disaggregate standard error at individual level; S.E.$_2$ corresponds to aggregate standard errors with clustering by daycare. Sobel$_1$ = Sobel test calculated with S.E.$_1$; Sobel$_2$ = Sobel test calculated with S.E.$_2$. Standard errors are estimated using the robust Huber-White heterogeneity estimator. *Negative values in effect estimates for all comparisons between groups represent a positive effect of the program (i.e., an advantage for the Program Daycare group).* *p <0.10, **p<0.05, ***p<0.01.

7.0 Discussion

The purpose of this report was to document the medium term impact of the Readiness to Learn project on both the children and the parents. The main objective was to verify whether the new dual-component preschool program enables Francophone children being raised in a minority community to be better equipped to successfully complete tasks that are vital to academic achievement, such as reading and mathematics. The program impact presented in this report focuses on data collected from children and parents in both cohorts, 12 months after the intervention ended, as the children were beginning grade one. Data was obtained primarily from children's assessments and the parents' follow-up survey for the 12-month post-program evaluation period. Baseline measurements were also retained as covariates for analyses so that the program impact could be estimated more accurately.

7.1 The Dual-Component Preschool Program

The tested program was intended to promote the development of language skills and school readiness of Francophone children living in a minority language context, which ultimately fosters academic achievement. Theorists have proposed that the driving force behind the acquisition of such competencies is a child's interaction with his or her environment (Bronfenbrenner & Morris, 1998). Drawing upon Bronfenbrenner's (1979) ecological theory of child development, we conceived a child's environment as a set of partially overlapping spheres of influence, which include the home, the daycare setting, the school, and the community. As discussed in the introduction, the majority language can influence speakers of the minority language within each of these spheres, including the two primary settings: home and daycare. Accordingly, a dual-component preschool program was offered to maximize its effect on child outcomes (Reese et al., 2010): a) a high-quality Francophone daycare program (Daycare Program) designed to influence the children more directly, and b) family literacy workshops (Family Literacy Program) to positively influence the home environment through the parents.

Daycare Program

The Daycare Program is innovative in several regards. Detailed implementation analysis results presented in a previous report (*Report of Findings from the Preschool Phase*) indicate that the tested program contributes new elements in terms of its quality and content. The integrity of the Daycare Program was examined based on indicators of quality (e.g. quality of educational content) and fidelity, i.e. the degree to which program elements have been implemented. This series of analyses has shown a differentiation between the tested program and the programs offered in other daycare facilities. The results of the differentiation analysis in the *Report of Findings from the Preschool Phase* indicate that the tested Daycare Program distinguishes itself from Comparison Daycares through its fidelity and quality, showing a differentiation with respect to existing programs in the community.

Family Literacy Program

The individual attention that a childcare educator can provide to a child is limited (Wasik, 2008), which is why some researchers have emphasized that parents are an important resource for any intervention

targeted at children (Reese et al., 2010). The workshops for the parents were designed to take advantage of this resource in developing children's language and Francophone culture. The evaluation of the integrity of the Family Literacy program, also reported in the *Report of Findings from the Preschool Phase,* shows that it has been consistent with the planned program and the quality of leadership is considered to be good. The perceived impacts of the Family Literacy program include parent awareness of their parental role, adoption of new parenting practices and awareness of the importance of the French language in a minority Francophone community. This latter impact can be seen in the increased use of French in literacy activities at home.

The next few sections present, respectively, the results of impact analyses for the children (Section 7.2) and the parents (Section 7.3). Next, we dedicate section 7.4 to interpreting the program impact in relation to the initial linguistic profile of the household (moderator effect) and the consequences for the children, families and community. That is followed by a presentation of the limits and the strategies used to offset them (Section 7.5). Finally, the report conclusion is presented in Section 7.6.

7.2 Impact of the Tested Program on the Children

This dual-component program is evaluated using a quasi-experimental methodology with non-equivalent control groups. The methodology involves three experimental groups: the Program Daycare group, consisting of children enrolled in a French-language daycare that offers the new preschool program; the Comparison Daycare group, consisting of children enrolled in a French language daycare that does not offer the new program; and the Informal Care group, consisting of children whose daytime care is provided at home or at an unregulated family daycare. The purpose of the Comparison Daycare group is to take into account how formal daycare affects child development, which is a treatment in itself. The purpose of the Informal Care group is to factor in how an informal childcare environment affects child development. The main goal of the daycare component is to *directly* influence child outcomes, while the goal of the second component is to *indirectly* influence child outcomes by modifying their parents' attitudes and behaviour.

The results of the main impact analyses (by experimental group) and complementary analyses (by dosage, quality, fidelity and initial linguistic profile of the household) are presented in tables 7.1 and 7.2. The consistent pattern of results emerging from this series of analyses helps to build the credibility of the results as real effects of the tested program. The program's impact on the children is evaluated by comparing the Program Daycare group to the Comparison Daycare group (see Table 7.1) and the Informal Care group (see Table 7.2). Overall, the results show that the tested program has a positive effect on many predictors of academic achievement for Francophones living in a minority community. This program effect is more noticeable in relation to the Comparison Daycare group. Since the program impact varies considerably depending on the experimental group with which the Program Daycare group is being compared, we are presenting the comparison results separately for each of the comparison groups.

7.2.1 Comparison with the Comparison Daycare group

Table 7.1 shows that the program impact is experienced through better scores on the most complex test of the executive functions, the Backward Digit Span. This impact is more noticeable in children

from homes with high initial exposure to French. The "Backward Digit Span" tool measures both working memory and mental flexibility. However, the results indicate that the children in the Program Daycare group do not score significantly higher than the children in the Comparison Daycare group on the Forward Digit Span test, which primarily measures working memory. An examination of the results of complementary analyses (i.e. by quality/fidelity and by initial household linguistic profile) reveals a consist pattern of results. Combined, these results suggest that the program effect is mostly seen in the mental flexibility of children from households that are Francophone endogamous.

Next, the program's medium term effects are clearly being seen in the development of children's language skills. Specifically, the average effects we have observed vary from -0.28 to 0.45 on four measures, Word Reasoning, Verbal Fluency, Continuum of French Spoken by the Child and Ability to Communicate in French. According to research done by Hill et al. (2008), the size of these effects corresponds to approximately three to five and half months of accelerated growth. The results of the analyses by linguistic profile vary by language outcome which means that the program seems to be beneficial all children in terms of language skills, independently of their initial level of exposure to French.

The results also indicate that the program promotes the development of reading skills. First, there is a significant effect in favour of the Program Daycare group in terms of Letter Sounds. Furthermore, although the positive impact of the program is not significant in the main analyses by experimental group for the Reading Simple Words measure, the analyses by linguistic profile serve to highlight a significant effect for children whose home is Francophone endogamous. The effect size for variables that measure reading skills is smaller than that observed for language skills, from -0.04 to -0.19. According to Hill et al. (2008), the size of these effects equals approximately 0.5 to 2.3 months in the development of reading skills.

Finally, the program seems to support the children in the development of mathematics skills. Once again, a consistent pattern can be seen in favour of the Program Daycare group in the series of analyses. Analyses by experimental group indicate a positive and significant program effect on the development of children's mathematics skills. The results of complementary analyses have contributed significantly to the interpretation of the program's effect on the children. The program quality and fidelity significantly predict mathematics skills and the analysis by linguistic profile suggests that children with a higher exposure to French at home benefit from the program. The effect size is 0.26, which represents approximately 3.1 months in the development of mathematics skills (Hill et al., 2008).

In short, the program has a significant effect on various dimensions of both expressive and receptive language skills, and on language behaviour. According to the theoretical model of academic achievement for young Francophone (see Figure 2.1), knowledge of the language of instruction is essential to the development of more complex academic skills (e.g. reading and mathematics). Note that performance of all of the tasks administered to the children, including Knowledge of Numbers, requires a good understanding of the French language. The program's significant impact on language skills is therefore likely to play a role in the performance of more complex reading and mathematics tasks and to promote the development of executive functions.

Complementary analyses suggest that the dosage effect no longer appears to be contributing to the program's medium term effects. The advantage in favour of the Program Daycare group observed for

executive functions, language skills, and mathematics skills may be explained by the quality and fidelity of program implementation. Finally, analyses by linguistic profile enabled us to further fine tune the results, showing that overall, the program effect is more noticeable in children who have had higher exposure to French at home.

Table 7.1   Summary of 12-Month Post-Program Impact Analyses on Child Outcomes – Comparison with the Comparison Daycare group

	Effect at 12 months post-program?	Effect directly related to dosage?	Explained by quality?	Explained by fidelity?	Greater benefit for a sub-group?	Explained by effect on parents?
G1 vs. G2						
Executive Functions						
Forward Digit Span	*ns*	*ns*	*ns*	*ns*	●G2/Lo	N/A
Backward Digit Span	▲	*ns*	▲	▲	▲ /Hi	N/A
Language Skills						
Word Reasoning	▲	*ns*	*ns*	*ns*	▲ /Hi	*ns*
Verbal Fluency	▲	*ns*	▲	▲	▲ /Hi	▲
Continuum of French Spoken by the Child	▲	*ns*	▲	▲	▲ /Lo	▲
Ability to Communicate in French	▲	*ns*	*ns*	*ns*	*ns*	▲
Reading Skills						
Knowledge of Letters	*ns*	▲	*ns*	*ns*	*ns*	N/A
Letter Sounds	▲	*ns*	*ns*	*ns*	▲ /Hi	N/A
Reading Simple Words	*ns*	*ns*	*ns*	*ns*	▲ /Hi	N/A
Mathematics Skills						
Knowledge of Numbers	▲	*ns*	▲	▲	▲ /Hi	N/A

Note: G1 = Program Daycare group; G2 = Comparison Daycare group; ▲ = Significant results in favour of the Program Daycare group (p <0.10); ●G2 = Significant results in favour of the Comparison Daycare group (p <0.10); *ns* = No significant difference; Lo = Low exposure to French; Hi = High exposure to French; N/A= Not applicable.

7.2.2   Comparison with the Informal Care group

Table 7.2 indicates a lack of significant program impact on the children's executive functions. The results of the analyses by linguistic profile indicate that children in the Informal Care group with low exposure to French at home scored higher than children in the Program Daycare group on forward and Backward Digit Span measures.

On the other hand, the program's contribution is clearly seen in terms of language skills. The effect size varies considerably depending on the variable, i.e. -0.21, -0.30 and -0.48 for Verbal Fluency, Continuum of French Spoken by the Child and Ability to Communicate in French, respectively. These effects are equal to an acceleration of 2.5 to 3.6 months for Verbal Fluency and the Continuum of French Spoken by the Child, and approximately 5.8 months for the Ability to Communicate in French (Hill et al., 2008). The overall pattern of the program effect on the development of language skills is noticeable regardless of the comparison group used to compare with the Program Daycare group. These reported effect are of practical importance in strengthening the understanding and use of French, which in turn has a positive influence on academic achievement in a setting where French is the language of instruction.

Next, the program does not appear to give children in the Program Daycare group an advantage in terms of reading skills. Instead, the results of the main analyses by experimental group indicate that children in the Informal Care group score higher than children from the Program Daycare group in terms of reading skills, and these results are corroborated by the analyses by linguistic profile. Moreover, a significant effect in favour of the Program Daycare group is emerging for mathematics skills, but only for children with a high exposure to French at home.

In short, in the medium term, the program only appears to benefit children in terms of language skills and mathematics skills compared to children in the Informal Care group. The results of comparisons between the Program Daycare group and the Informal Care group are more difficult to fine tune and interpret because in this context, the childcare environment may be more heterogeneous. Differentiation analyses are not possible due to the heterogeneity of the informal childcare settings. Consequently, it is difficult to determine how the childcare environment to which the children in the Informal Care group are exposed differs from that of the program daycares in terms of quality and fidelity of implemented elements. Data collected in the next wave (24-month post-program evaluation period) will enable us to determine whether the program's effect on children's language skills leads to better academic achievement in the long term.

Table 7.2   Summary of 12-Month Post-Program Impact Analyses on Child Outcomes – Comparison with the Informal Care group

	Effect at 12 months post-program?	Effect directly related to dosage?	Explained by quality?	Explained by fidelity?	Greater benefit for a sub-group?	Explained by effect on parents?
G1 vs. G3						
Executive Functions						
Forward Digit Span	*ns*	N/A	N/A	N/A	●G3/Lo	N/A
Backward Digit Span Inverse	*ns*	N/A	N/A	N/A	●G3/Lo	N/A
Language Skills						
Word Reasoning	*ns*	N/A	N/A	N/A	*ns*	*ns*
Verbal Fluency	▲	N/A	N/A	N/A	▲ /Hi	▲
Continuum of French Spoken by the Child	▲	N/A	N/A	N/A	*ns*	▲
Ability to Communicate in French	▲	N/A	N/A	N/A	▲ /Lo	*ns*
Reading Skills						
Knowledge of Letters	*ns*	N/A	N/A	N/A	●G3/Lo	N/A
Letter Sounds	*ns*	N/A	N/A	N/A	*ns*	N/A
Reading Simple Words	●G3	N/A	N/A	N/A	●G3/Lo	N/A
Mathematics Skills						
Knowledge of Numbers	*ns*	N/A	N/A	N/A	▲ /Hi	N/A

Note: G1 = Program Daycare group; G3 = Informal Care group; ▲ = Significant results in favour of the Program Daycare group (*p* <0.10); ●G3 = Significant results in favour of the Informal Care group (*p* <0,10); *ns* = No significant difference; Lo = Low exposure to French; Hi = High exposure to French, N/A = Not applicable.

7.3 Impact on Parents and Role of this Impact on Children

The effect of the Family Literacy component was evaluated through program impact analyses on parent outcomes. Mediation analyses then enabled us to evaluate the role of an indirect impact on the children through the Family Literacy component. Overall, the analyses by experimental group suggest that the Family Literacy component has brought about positive changes in the parents. Specifically, it was noted that mothers and fathers in the Program Daycare group are more likely to communicate with their child in French than those in the Comparison Daycare group. No significant effect emerged in terms of the

language spoken by the parents relative to the Informal Care group. Furthermore, it was observed that parents in the Program Daycare group prefer to use French when doing literacy activities. This result is interesting because according to studies on bilingualism in a minority community (e.g., Landry & Allard, 1997; Landry et al., 2006), a strong French influence in the family and school environments is required to foster the development of a Francophone cultural identity and the use of French. Landry & Allard (1997) claim that it is the language dynamic chosen by the family, and not the exogamy itself, that plays a key role in passing on the French language. Indeed, the impact in the parents suggests a significant linguistic change at home and raises an interesting question regarding its indirect role on the children. In other words, is the Family Literacy component playing an indirect role on child outcomes?

Main analyses comparing the experimental groups tested the *combined effect* of both program components on child development. Nevertheless, analyses can be conducted to give an idea of each component's relative contribution to the program impact. When the children begin grade one, they will not have been exposed to the program for a year or two,[43] so we can assume that the program impact is continuing to be felt through observed changes in the parents, at least in part. In fact, a change in the degree to which the language is used by the parent at home translates into corresponding benefits in child development, in other words, effect of the program on children's language skills. A formal mediation test (Cohen et al., 2003) was therefore conducted to test the hypothesis that the impact of the Family literacy component on the parents is partially or fully responsible for the program's effect on children's language skills. To do this, the mediator we used was a parental linguistic factor created by crossing the Language Spoken by the Mother, Language Spoken by the Father, with the Language used during Literacy Activities with the child. Of course, we assumed that any observed differences in the parents' linguistic behaviour, compared to those in the comparison groups, were a result of the Family Literacy component.

The results of this mediation test suggest that the parental linguistic factor might partly explain the program effect on the Continuum of French Spoken by the Child and Verbal Fluency regardless of the experimental group being used as the comparison group. In other words, the results suggest that the impact of the Family Literacy component on the parents is continuing in the medium term, and that this change is responsible for some of the children's language skills, such as the child's use of French and French expressive vocabulary (i.e. Verbal Fluency). Moreover, the effect of the program for the variable Ability to Communicate in French is completely explained by the parents' indirect effect, but only relative to the Comparison Daycare group.

It is interesting to note that, according to analysis results, during the two years of program implementation, the quality and fidelity of the tested preschool program were largely responsible for the effects on the children attributed to the program (see the *Report of Findings from the Preschool Phase*). This marked effect of the direct impact of the Daycare component on child development is not surprising given the number of hours spent at daycare (i.e. approximately 28 hours per week on average during the first year of program implementation). In the same report, it was noted that the

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[43] Some children only participated in the program for one year because they enrolled in junior kindergarten on a part-time or full-time basis, which involved a change in child care, while other children continued to attend program daycares during the second year of implementation.

mediator effect of the quality and fidelity does not fully explain the effect of the program on variables linked to language skills (Communication scale). It was difficult to establish the *short term* effect of the Family Literacy component on children's language skills through the impact on the parents.[44] The effect of the Family Literacy component on the children's development and use of the French language seems to be getting clearer in the medium term, as the children are growing and the influence of the daycare setting on the child's development is fading with time. At this stage, the home remains an important influential setting, where the child can benefit from ongoing exposure to the French language and culture. This reinforcement of exposure to French at home is particularly important for children living in a minority-language setting to offset the primarily Anglophone environment in which they live. Healthy exposure to French must be maintained in order to translate the child development gains observed during the first phase of the study into academic achievement. This is where the role of the Family Literacy component becomes important. The long term direct impact of the Family Literacy component on the parents, and its indirect effect on the children, will be evaluated in the next wave of data collected at 24 months post-program, as the children begin grade two.

In short, the portrait depicted by the series of results supports the conclusion that the two daycare components play a complementary role in school readiness in the *short term* (see the *Report of Findings from the Preschool Phase*) and in the development of predictors of academic achievement in the *medium term* (this report*). This finding is corroborated by studies showing that the effect of a program targeted at both parents and children is greater than the effect of a program targeted at only one or the either of these two groups (Brooks-Gunn, Berlin & Fuligni, 2000; Reese, et al., 2010).

7.4 The Moderator Effect of the Family Linguistic Profile

As mentioned in the introduction, literature on bilingualism makes a clear distinction between cases where the acquisition of a second language benefits a child's general development and cases where the development is affected (e.g., Landry et al., 2009). The research identifies two types of bilingualism: additive and subtractive. While additive bilingualism is associated with the development of executive functions (e.g. Adesope et al., 2010), and in turn to academic success (e.g. Duncan et al., 2007), subtractive bilingualism is linked to a delay in the development of the child's cognitive skills or language skills in the mother tongue (Ball, 2010; Landry et al., 2009). Several young Francophones living in minority communities are at risk of developing a subtractive bilingualism because their level of exposure or use of the minority language does not reach the required minimum threshold of exposure or use of the French language.

It is in this context in which we examined the possibility that children exposed to languages other than French (usually English) benefit most from the tested preschool program. This research question was examined in the two previous reports (the *First Cohort Findings Report* and the *Report of Findings from the Preschool Phase*) and is repeated in this report. Here we refer explicitly to the combined effect of both components of the tested program (the Daycare program and the Family Literacy program) as a source of environmental influence on children's language development. Thus, we anticipated

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[44] In the *Report of Findings from the Preschool Phase*, although findings indicated that the family workshops contributed to the positive effects on the parents, it was more difficult to establish a systematic link between this indirect effect and child development.

differentiated effects based on the children's linguistic profile. Children with low exposure to French at home are more likely to develop subtractive bilingualism. The risk is even greater with low exposure to French outside the home, which is characteristic in minority linguistic settings.

Two series of hypotheses were put forward. Specifically, during the first phase of the project, when the program was implemented (*short term)*, the program was assumed to primarily have an effect on the language skills of vulnerable children, i.e. those with low initial exposure to French at home. For children with a high exposure to French, it was assumed that the program would have an impact on the development of skills beyond simply learning French (e.g. reading and mathematics skills). The analyses presented in the *Report of Findings from the Preschool Phase* (2014) tend to confirm these hypotheses.

Recognizing the fact that understanding the language of instruction facilitates acquisition of more complex academic skills (Bialystok, 2009; Cummins, 1979; Doherty, 1997; Hindman et al., 2010), we anticipated that in the *medium term* (12 months post-program) the program effect would continue to be more pronounced in the language skills of children with low exposure to French at home and in more complex skills in children with high exposure to French at home. These hypotheses were investigated in a series of analyses where the program's effects were estimated for children with low exposure to French at home versus those with high exposure, as measured at the beginning of program delivery (baseline evaluation period).

Results of Comparisons by Linguistic Profile with the Comparison Daycare group

As expected, the impact of the program on more complex skills is generally more significant for children who initially had a high exposure to French. This hypothesis was confirmed for several variables targeting skills required for academic achievement, including Backward Digit Span (executive function that requires working memory and mental flexibility), Letter Sounds (precursor to reading), Reading Simple Words (reading skills) and Knowledge of Numbers (mathematics skills). In terms of language skills, the program seems to have a beneficial effect on all children, but this effect varies by the measure in question. Specifically, children with low exposure to French at home seem to benefit more from the program in terms of the level of use of French, while it is those from homes with high exposure to French who seem to benefit more in terms of Word Reasoning and Verbal Fluency.

Results of Comparisons by Linguistic Profile with the Informal Care group

When the Program Daycare group is compared to the Informal Care group, the pattern of results is less clear. Table 7.2 indicates a better performance by children in Informal Care for two measures of reading skills, i.e. Knowledge of Letters and Reading Simple Words compared to the children in the Program Daycare group, and for two measures of executive functions, but only for children from homes with low exposure.

For language skills, two significant effects emerged in favour of the Program Daycare group. First, a more pronounced program effect was observed for children from homes with low exposure to French on the Ability to Communicate in French. In contrast, it is the children from homes with high exposure who seem to benefit from the program in terms of Verbal Fluency. Finally, with regard to mathematics

skills, there is a greater impact of the program for children from Francophone endogamous families in terms of mathematics skills.

In short, all of the results further substantiate the empirical support of our hypotheses when the Program Daycare group is compared to the Comparison Daycare group. The results suggest that the gains in language skills in children with low exposure do not enable the children in the Program Daycare group to score higher than their counterparts in the Comparison Daycare group on more complex tasks that are essential to academic achievement (e.g., reading and mathematics skills, executive functions). On the contrary, it is the children from Francophone endogamous homes who seem to benefit more from the program. This explanation is consistent with models recognizing the important role that command of a language plays in academic achievement (Cummins, 1979; Doherty, 1997; Hindman et al., 2010). Furthermore, the analyses by linguistic profile highlight the significant differences in favour of the Informal Care group for children from the subgroup of families with low exposure to French, particularly in regard to reading skills and executive functions. Future studies should be conducted to see if the results can be replicated with another sample of participants and to better understand what aspects of the environment of Informal Care supports the development of children.

Implications for the Generalization of Findings

The results of comparative analyses show that the study sample differs from the SVOLM sample mainly with respect to linguistic characteristics. However, we believe that the gap between the linguistic profile of this sample and that of the general population of minority Francophones is not an obstacle to the generalization of results. If the population is comparatively more exposed to French at home, then the *short term* impact will be observed primarily in terms of cognitive development, and in the *medium term*, on all skills needed for academic achievement (e.g. executive functions, readings skills and mathematics skills). If, on the other hand, the population is comparatively less exposed to French, a greater *short and medium term* impact on language skills is expected (e.g., vocabulary, use of French). If there is doubt regarding the validity of the analyses indicating a differentiation based on linguistic profile, then a generalized positive effect on school readiness is expected (in the short term) and the development of skills predictive of strong academic achievement is expected (in the medium term), based on key findings comparing the experimental groups. As such, there is no reason to believe the program impact would not be reproduced with a different sample of minority Francophone children.

7.5 Limitations of the Study and Strategies Used to Offset Them

The use of a quasi-experimental design with non-equivalent groups is generally accompanied by a number of concerns in regards to the validity of findings from such a study. Several strategies were applied to ensure valid results. Among the greatest threats to internal validity is that findings may result from a bias linked to group composition rather than from the program effect. This source of bias is diminished by the special attention given to recruiting participants in the comparison groups with a socio-demographic profile similar to that of the Program Daycare group (e.g., socioeconomic level) and living in the same neighbourhood, thereby ensuring that they have access to the same French-language

resources and services as the Program Daycare group.[45] Thus, group composition was first controlled for when families signed up for the project, particularly as regards household location for potential members of the comparison groups. A second control was the use of pre-intervention measures which were used as covariates to offset the bias associated with the initial differences in the experimental group composition. For the purposes of this study, we also used the Communication scale from the Early Years Evaluation: Direct Assessment as an intra-individual control measured in the children at baseline.

A second threat to the study's internal validity is that the evaluators, educators and parents were aware of who was receiving the treatment and who was not. This source of bias is inevitable when daycare status is known in the community (daycare offering the program, daycare not offering the program) and, by association, the status of children attending those daycares. This is less of a threat than one might first believe, since the daycares, rather than the children, were recruited and assigned to the experimental groups. The children who were already enrolled at these daycares (program or comparison) and their families found themselves as implicit members of an experimental group. It is nevertheless difficult to respond to criticisms that the results are due to a bias tied to this knowledge. However, it is difficult to imagine that these potential sources of bias would have, separately or combined, produced the pattern of results obtained. No one knew the relative level of program fidelity and quality available at program or comparison daycares. No one knew the hypotheses on the effect of linguistic profile. As such, it is unlikely that any bias (e.g., in group composition, from evaluators) would have given responses consistent with our research hypotheses.

One possible research limitation is the modest size of the sample on which the findings are based (N ≈ 330), since statistical analyses are most robust with very large samples (N > 1000). Several strategies were used to verify the robustness of findings, particularly with respect to the analyses. The analyses by experimental group were accompanied by complementary analyses (e.g., analysis by dosage, quality/fidelity of program delivery, linguistic profile). This series of complementary analyses enabled us to verify the findings using different conceptualizations of the program (dosage, quality, fidelity, linguistic profile) and different sources (e.g. observation notes, parent surveys, child assessments). Upon examination of this series of analyses, we favoured an interpretation of findings based on all results, not just one result in particular. At the community level, it is important to note that the findings may be generalized only to the communities studied or to similar communities.[46]

In the next report, we will be examining the long term impact of the new preschool program on other measures of language skills, as well as on reading and mathematics skills, predicting the children's academic achievement. These analyses will assist in evaluating the contribution of the preschool program to the lives of these children and will enable us to trace its impact from the time of program implementation to the beginning of grade two.

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45   For more information, refer to the Revised Work Plan and Methodology Report submitted to HRSDC on March 30, 2007.

46   The "community" factor was considered a fixed factor in the impact analyses due to the small number of communities.

7.6 Conclusion

The purpose of this research was to evaluate the *medium term* impact of a new preschool program on young minority Francophone children and their parents. The main findings of the impact study revealed positive program effects for both child and parent outcomes. The positive effects on child outcomes appeared in the form of better scores on some of the measures that predict academic achievement, including executive functions, language skills, and mathematic skills. Overall, the program effects are more noticeable and have a greater impact on the outcomes when the children in the Program Daycare group are compared to those in the Comparison Daycare group than when they are compared to those in the Informal Care group. Furthermore, the nature of the gains depends on the child's exposure to French at the beginning of the project. Overall, children from a home with high initial exposure to French benefited more from the program in the development of skills needed for academic achievement (e.g. language skills, executive functions, reading, mathematics), while children from homes with low exposure to French benefited more in terms of the Ability to Communicate in French and on the use of French.

The daycare component primarily influenced child development through the fidelity and quality of elements put in place. However, in the medium term, the program intensity, measured through the dosage, does not appear to significantly predict child outcomes. The program component targeted at parents also had a positive influence. The parents experienced positive changes in terms of the language chosen for literacy activities and the French language used by the mother and father to communicate with their child. The results of mediation analyses suggest that the Family Literacy component effect on the parents indirectly influenced child development, particularly with respect to language skills. At this stage, the pattern of results suggests that the Family Literacy component is an important source of program effect on the children.

We can therefore conclude that the tested program had a modest impact on the predictors of academic achievement for minority Francophone children. The effect size observed equals a gain of a few months in the development of executive functions, as well as language skills, reading skills and mathematics, with greater effects observed in comparisons with the Comparison Daycare group. It must be stated that it was difficult to interpret comparisons with the Informal Care group due to the wide diversity of childcare settings in this group— diversity which made it impossible to obtain accurate measures of the linguistic environment and quality indicators. The reported effects have a practical importance, not only in promoting the children's academic achievement, but also in strengthening the vitality of Francophone communities in minority settings. In the next report, we will be examining the same research questions once again, when the children are aged 7 and beginning grade two. We will also be further examining the notion of Francophone cultural identity with items added to the children's direct assessment measures. Together, these analyses will enable us to establish whether better school readiness and greater understanding of the French language increase the chances of greater academic achievement in the long term and the development of predictors of the Francophone cultural identity.

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Appendix A: Result of the Confounding Variables Analysis

This appendix reports the results of a preliminary analysis designed to identify the relevant covariates for the impact analyses. The results concern a sample that combines both cohorts and excludes withdrawals from the first phase of the study (N = 336).

Variables that meet the two inclusion criteria are retained as covariates in the impact analysis. The two criteria are: i) a significant association with at least one dependant variable, and ii) a significant association with experimental group membership. The following tables report the significance tests for both criteria for each potential covariate.

The results are presented as follows. The examined variables are categorized in tables as follows: demographic and family composition variables, socioeconomic variables, linguistic variables, Francophonie engagement (sociolinguistic) variables, parenting style variables, characteristics of the daycare environment, a series of methodological factors, and academic variables. In the tables that follow, variables that were selected as covariates are in boldface.

Table A1 Relevance of Demographic and Family Composition Variables

Covariate	Significant Correlations (p < .10) with Dependent Variables at +36 months											Association Tests with Experimental group Membership				
	Freq. Lit.	Language Lit.	Child's Language	Ability to Communicate in French	Fwd Digit Span	Bkwd Digit Span	Letter Sounds	Verbal Fluency	Word Reasoning	Reading	Know. Numbers	Sample Parameter % or M (SD)	Group Association Test	Program Daycare group % or M (SD)	Comparison Daycare group % or M (SD)	Informal Care group % or M (SD)
Gender (+Girl) [a]	0.14	-	-	-	-	-	-	-	-	0.11	-0.09	50.9%	X² (2) = 1.09	46.4%	52.7%	52.6%
Child's Age (in months) [b]	**-**	**-**	**-0.09**	**-**	**0.1**	**0.24**	**0.44**	**0.21**	**0.22**	**0.35**	**0.33**	**38.42 (3.66)**	**F(2, 339) = 0.29**	**38.52 (3.79)**	**38.54 (3.55)**	**38.21 (3.70)**
Older Siblings Baseline	-0.11	-	-	-	-	-	-	-0.15	-	-	-	52.0%	X² (2) = 2.73	46.4%	57.3%	50.9%
Older Siblings +36 months [c]	-0.15	-	-	-	-	-	-	-0.17	-	-	-	53.2%	X² (2) = 5.16*	44.2%	60.0%	52.4%
Younger Siblings Baseline	**-0.10**	**-**	**-**	**-**	**-**	**-**	**0.12**	**-**	**-**	**-**	**-**	**34.5%**	**X² (2) = 16.62*****	**24.7%**	**29.0%**	**49.1%**
Younger Siblings +36 months	-	-	-	-	-	-	-	0.10	-	-	-	46.2%	X² (2) = 7.64**	41.9%	40.0%	57.1%
Single-Parent Home (+single-parent) [a]Baseline	**-0.12**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-0.1**	**8.5%**	**X² (2) = 6.08****	**7.2%**	**13.0%**	**4.4%**
Single-Parent Home (+single-parent) [a] +36 months	-0.11	0.09	-	-	0.11	-	-	0.11	-	-	-	15.2%	X² (2) = 0.53	15.1%	16.8%	13.3%
Household Size Baseline	**-0.11**	**-**	**-0.16**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**3.99 (0.88)**	**F(2, 339) = 5.24*****	**3.81 (0.79)**	**3.95 (0.93)**	**4.19 (0.85)**
Household Size +36 months	-	-0.11	-0.17	-	-	-	-	-	-	-	-	4.16 (0.93)%	F(2, 313) = 3.90**	3.94 (0.82)	4.18 (0.98)	4.31 (0.93)

Note: Variables retained as covariates for the impact analyses are in boldface. [a]All categorical variables are binary (codes 0, 1) and the reported percentages are for category "1" indicated between parentheses and preceded by the (+) symbol. M = mean; SD = standard deviation; N=338; Significance levels set at: *** $p< 1\%$; ** $p< 5\%$; * $p< 10\%$. Freq. Lit. = Frequency of Literacy Activities, Language Lit. = Language of Literacy Activities, Child's Language = Language Spoken by the Child, Reading = Reading Simple Words, Know. Numbers = Knowledge of Numbers. [b]Exceptionally, this variable was retained as a covariate even though it is not associated with membership in the treatment conditions. This decision is justified by its very strong association with several of the dependent variables. [c]This variable was redundant given the inclusion of the variables Household Size and Younger Siblings.

Table A2 Relevance of Socioeconomic Variables

Covariate	Significant Correlations (p < .10) with Dependent Variables at +36 months												Association Tests with Experimental group Membership				
	Freq. Lit.	Language Lit.	Child's Language	Ability to Communicate in French	Fwd Digit Span	Bkwd Digit Span	Know. Letters	Letter Sounds	Verbal Fluency	Word Reasoning	Reading	Know. Numbers	Sample parameter % or M (SD)	Group Association Test	Program Daycare group % or M (SD)	Comparison Daycare group % or M (SD)	Informal Care group % or M (SD)
Mother's Age at First Birth	**-**	**-0.11**	**-**	**-**	**-**	**0.17**	**0.14**	**0.11**	**-**	**0.20**	**0.13**	**0.22**	**2.45 (0.91)**	**$F_{(2, 338)}$ = 4.38****	**2.65 (1.02)**	**2.45 (0.85)**	**2.28 (0.85)**
Income Baseline		-0.13		0.16		0.11				0.15	0.17	0.27	7.24 (2.60)	$F_{(2,30)}$ = 2.27	7.30 (2.75)	7.54 (2.51)	6.84 (2.54)
Income +36 months	-	-	-	0.11	-	0.10	0.14	0.14	0.14	0.15	0.23	0.33	7.30 (2.72)	$F_{(2, 286)}$ = 0.69	7.47 (2.74)	7.40 (2.72)	7.03 (2.70)
Mother Ed. Baseline (+min. college dip.) [a]	-	-	0.16	0.14	0.15	0.10	0.13	0.20	0.20	0.27	0.24	0.27	79.8%	X^2 (2) = 0.38	81.4%	80.2%	78.1%
Mother Ed. + 36 months (+min. college dip.) [a]	0.14	0.11	0.24	0.14	-	-	0.17	0.15	0.21	0.17	0.16	0.21	82.6%	X^2 (2) = 1.10	82.1%	85.2%	80.0%
Father Ed. Baseline (+min. college dip.) [a]	-	-	-	-	-	-	0.14	0.14	0.20	0.22	0.11	0.15	66.9%	X^2 (2) = 2.76	71.3%	68.8%	61.1%
Father Ed. + 36 months (+min. college dip.) [a]	**-**	**-**	**-**	**0.11**	**0.14**	**-**	**0.10**	**-**	**0.15**	**0.17**	**-**	**0.13**	**80.2%**	**X^2 (2) = 6.99****	**86.7%**	**83.2%**	**71.4%**
Immigrant Status	-	-	-0.12	-	-	-	-	-	-	-	-	0.09	4.7%	X^2 (2) = 0.36	5.2%	3.8%	5.3%
Social Capital	-	-	-	-	-	-	-	-	-	-	-	-	15.43 (3.91)	$F_{(2, 338)}$ = 1.08	15.74 (3.90)	15.57 (3.93)	15.00 (3.87)

Note: Variables retained as covariates for the impact analyses are in boldface. [a]All categorical variables are binary (codes 0, 1) and the reported percentages are for category "1" indicated between parentheses and preceded by the (+) symbol. M = mean; SD = standard deviation; N=338; Significance levels set at: *** p< 1%; ** p< 5%; * p< 10%. Freq. Lit. = Frequency of Literacy Activities, Language Lit. = Language of Literacy Activities, Child's Language = Language Spoken by the Child, Know. Letters = Knowledge of Letters, Reading = Reading Simple Words, Know. Numbers = Knowledge of Numbers, Ed. = Education, min. college dip. = at least a college diploma.

Table A3 Relevance of Linguistic Variables

Covariate	Significant Correlations (p < .10) with Dependent Variables at +36 months												Association Tests with Experimental group Membership				
	Freq. Lit.	Language Lit.	Child's Language	Ability to Communicate in	Fwd Digit Span	Bkwd Digit Span	Know. Letters	Letter Sounds	Verbal Fluency	Word Reasoning	Reading	Know. Numbers	Sample parameter % or M (SD)	Group Association Test	Program Daycare group % or M (SD)	Comparison Daycare group % or M (SD)	Informal Care group % or M (SD)
Frequency of Literacy Activities (Baseline)	**0.30**	**-0.20**	**-0.12**	**-**	**-**	**-**	**-**	**0.16**	**-**	**-**	**0.16**	**0.10**	**15.12 (2.94)**	**$F(2, 339) = 4.60^{**}$**	**15.33 (2.58)**	**14.53 (3.01)**	**15.62 (3.06)**
Language of Literacy Activities (Baseline)	**-**	**0.68**	**0.78**	**0.13**	**-**	**-**	**-**	**-**	**0.33**	**0.26**	**-**	**-**	**19.96 (5.97)**	**$F(2, 339) = 2.17$**	**18.97 (6.44)**	**20.08 (5.59)**	**20.66 (5.92)**
Language Spoken to Child by Mother	**-**	**0.62**	**0.74**	**0.13**	**-**	**-**	**-**	**-**	**0.27**	**0.26**	**-**	**-**	**4.06 (1.36)**	**$F(2, 336) = 2.42^{*}$**	**3.85 (1.45)**	**4.05 (1.36)**	**4.27 (1.25)**
Language Spoken to Child by Father	**-**	**0.56**	**0.78**	**0.14**	**0.14**	**-**	**-**	**-**	**0.29**	**0.30**	**0.10**	**-**	**3.69 (1.65)**	**$F(2, 324) = 3.97^{**}$**	**3.37 (1.75)**	**3.64 (1.66)**	**4.01 (1.49)**
Continuum of French Spoken by the Child	**-**	**0.65**	**0.87**	**0.20**	**0.12**	**-**	**-**	**-**	**0.33**	**0.33**	**0.09**	**-**	**3.79 (1.47)**	**$F(2, 339) = 3.20^{**}$**	**3.48 (1.57)**	**3.87 (1.43)**	**3.96 (1.42)**
Language of Care (0-12)	-	0.25	0.34	-	-	-	-	-0.12	-	0.14	-0.10		2.25 (0.87)	$F(2, 337) = 0.22$	2.24 (0.86)	2.22 (0.89)	2.29 (0.88)
Language of Care (13-24)	-	0.20	0.27	-	-	-0.10	-	-0.13	-	0.10	-0.10	-0.13	2.25 (0.86)	$F(2, 337) = 0.81$	2.18 (0.85)	2.23 (0.89)	2.32 (0.83)
Language of Care (25-36)	-	0.10	0.17	-	-	-0.14	-0.15	-0.17	-	-	-0.13	-0.18	2.33 (0.85)	$F(2, 337) = 0.04$	2.31 (0.85)	2.35 (0.88)	2.33 (0.85)
Household Type Based on FOLS (+Endogamous -French) [a]	-	0.48	0.60	0.11	0.13	-	-	-	0.27	0.24	-	-	50.1%	$X^2(2) = 1.41$	46.4%	49.2%	54.4%
Household Type Based on Language Spoken to the Child (+Endogamous-French) [a]	-	0.56	0.75	0.10	-	-	-	-	0.28	0.24	-	-	52.2%	$X^2(2) = 2.92$	45.4%	53.1%	57,0%

Note: Variables retained as covariates for the impact analyses are in boldface. [a]All categorical variables are binary (codes 0, 1) and the reported percentages are for category "1" indicated between parentheses and preceded by the (+) symbol. M = mean; SD = standard deviation; N=338; Significance levels set at: *** $p< 1\%$; ** $p< 5\%$; * $p< 10\%$. Freq. Lit. = Frequency of Literacy Activities, Language Lit. = Language of Literacy Activities, Child's Language = Language Spoken by the Child, Know. Letters = Knowledge of Letters, Reading = Reading Simple Words, Know. Numbers = Knowledge of Numbers. [b]Exceptionally, this variable was retained as a covariate since it was assessed as a dependent variable during the +36 months evaluation period.

Table A4   Relevance of Sociolinguistic Variables

| Covariate | Significant Correlations (p < .10) with Dependent Variables at +36 months | | | | | | | | | | | | Association Tests with Experimental group Membership | | | |
	Freq. Lit.	Language Lit.	Child's Language	Ability to Communicate in French	Fwd Digit Span	Bkwd Digit Span	Know. Letters	Letter Sounds	Verbal Fluency	Word Reasoning	Reading	Know. Numbers	Sample parameter % or M (SD)	Group Association Test	Program Daycare group % or M (SD)	Comparison Daycare group % or M (SD)	Informal Care group % or M (SD)
Vitality [b]	**0.22**	**0.45**	**0.65**	-	-	-	-	-	**0.21**	**0.22**	-	-	**15.61 (5.34)**	**F(2, 288) = 2.19**	**15.13 (5.11)**	**15.23 (5.40)**	**16.61 (5.41)**
Engagement in Francophone Culture	0.16	0.19	0.21	-	0.17	-0.12	-	-	0.18	0.18	-	-	15.92 (3.20)	F(2, 308) = 0.04	16.00 (3.04)	15.89 (3.16)	15.90 (3.38)
Sense of Belonging	-	0.51	0.64	0.14	-	-	0.12	-	0.29	0.32	-	-	2.42 (0.75)	F(2, 337) = 2.24	2.29 (0.83)	2.45 (0.73)	2.50 (0.70)

Note: Variables retained as covariates for the impact analyses are in boldface. [a]All categorical variables are binary (codes 0, 1) and the reported percentages are for category "1" indicated between parentheses and preceded by the (+) symbol. M = mean; SD = standard deviation; N=338; Significance levels set at: *** $p< 1\%$; ** $p< 5\%$; * $p< 10\%$. Freq. Lit. = Frequency of Literacy Activities, Language Lit. = Language of Literacy Activities, Child's Language = Language Spoken by the Child, Know. Letters = Knowledge of Letters, Reading = Reading Simple Words, Know. Numbers = Knowledge of Numbers. [b]Exceptionally, this variable was retained as a covariate even though it is not associated with membership in the treatment conditions.

Table A5   Relevance of Parenting Variables

Covariate	Significant Correlations (p < .10) with Dependent Variables at +36 months													Association Tests with Experimental group Membership			
	Freq. Lit.	Language Lit.	Child's Language	Ability to Communicate in French	Fwd Digit Span	Bkwd Digit Span	Know. Letters	Letter Sounds	Verbal Fluency	Word Reasoning	Reading	Know. Numbers	Sample parameter % or M (SD)	Group Association Test	Program Daycare group % or M (SD)	Comparison Daycare group % or M (SD)	Informal Care group % or M (SD)
Family Functioning	**0.11**	**0.12**	**0.14**	-	-	-	-	-	-	-	-	-	**29.75 (3.16)**	**F(2, 337) = 3.56****	**29.03 (4.18)**	**30.02 (2.59)**	**30.05 (2.63)**
Depression	-	-	**-0.09**	**-0.15**	-	-	-	-	-	**-0.11**	-	-	**10.41 (3.22)**	**F(2, 337) = 3.83****	**10.78 (3.49)**	**9.81 (2.53)**	**10.81 (3.60)**
Positive Parenting Practices	0.30	-	0.10	0.14	-	-	-	-	-	-	-	-	23.09 (1.90)	F(2, 336) = 1.98	22.91 (2.01)	22.98 (1.97)	23.38 (1.69)
Authoritarian Parenting Practices	**0.13**	-	**0.11**	**0.12**	-	-	-	-	-	-	**0.17**	**0.11**	**12.97 (2.10)**	**F(2, 336) = 10.76*****	**12.18 (2.29)**	**13.40 (1.96)**	**13.14 (1.89)**
Empowerment	0.12	-	-0.11	-	-0.10	-	-	0.13	-0.12	-	-	-	16.64 (2.31)	F(2, 289) = 1.02	16.37 (2.33)	16.66 (2.21)	16.86 (2.41)

Note: Variables retained as covariates for the impact analyses are in boldface. [a]All categorical variables are binary (codes 0, 1) and the reported percentages are for category "1" indicated between parentheses and preceded by the (+) symbol. M = mean; SD = standard deviation; N=338; Significance levels set at: *** $p< 1\%$; ** $p< 5\%$; * $p< 10\%$. Freq. Lit. = Frequency of Literacy Activities, Language Lit. = Language of Literacy Activities, Child's Language = Language Spoken by the Child, Know. Letters = Knowledge of Letters, Reading = Reading Simple Words, Know. Numbers = Knowledge of Numbers.

Table A6   Relevance of Methodological Factors

Covariate	Significant Correlations (p < .10) with Dependent Variables at +36 months													Association Tests with Experimental group Membership			
	Freq. Lit.	Language Lit.	Child's Language	Ability to Communicate in French	Fwd Digit Span	Bkwd Digit Span	Know. Letters	Letter Sounds	Verbal Fluency	Word Reasoning	Reading	Know. Numbers	Sample parameter % or M (SD)	Group Association Test	Program Daycare group% or M (SD)	Comparison Daycare group% or M (SD)	Informal Care group% or M (SD)
Change in Group During First Year (+change) [a]	-	-	-	-	-	-	-	-	-	-	-	-	4.1%	X^2 (2) = 9.76***	1.0%	2.3%	8.8%
Cohort [a] **(+ 1st)** [b]	-	-	**-0.10**	-	-	**0.13**	**0.14**	**0.13**	-	-	**0.10**	**0.12**	28.7%	X^2 (2) = 0.35	27.8%	27.5%	30.7%
Community [b]	-	**0.17**	**0.19**	-	-	**0.16**	**0.19**	**0.15**	**0.14**	-	**0.14**	**0.16**	N/A	X^2 (6) = 7.38	N/A	N/A	N/A
Orleans	-	0.12	0.26	0.12	-0.14	0.18	0.21	0.16	0.12	0.09	0.19	0.19	31.0%	X^2 (2) = 0.85	28.9%	29.8%	34.2%
Cornwall	-	-0.28	-0.51	-0.16	-	-0.14	-0.11	-	-0.15	-0.30	-0.12	-0.12	33.6%	X^2 (2) = 1.92	39.2%	32.1%	30.7%
Durham	-	-0.21	-0.29	-	-	-	-	-	-	0.11	-	-	10.8%	X^2 (2) = 3.08	14.4%	11.5%	7.0%
Edmundston	0.15	0.32	0.50	-	0.17	-	-0.13	-0.16	-	0.15	-0.10	-0.14	24.6%	X^2 (2) = 3.68	17.5%	26.7%	28.1%

Note: Variables retained as covariates for the impact analyses are in boldface. [a]All categorical variables are binary (codes 0, 1) and the reported percentages are for category "1" indicated between parentheses and preceded by the (+) symbol. M = mean; SD = standard deviation; N=338; Significance levels set at: *** $p< 1\%$; ** $p< 5\%$; * $p< 10\%$. Freq. Lit. = Frequency of Literacy Activities, Language Lit. = Language of Literacy Activities, Child's Language = Language Spoken by the Child, Know. Letters = Knowledge of Letters, Reading = Reading Simple Words, Know. Numbers = Knowledge of Numbers. [b]Exceptionally, this variable was retained as a covariate.

Table A7   Relevance of School Variables

Covariate	Significant Correlations (p < .10) with Dependent Variables at +36 months													Association Tests with Experimental group Membership			
	Freq. Lit.	Language Lit.	Child's Language	Ability to Communicate in French	Fwd Digit Span	Bkwd Digit Span	Know. Letters	Letter Sounds	Verbal Fluency	Word Reasoning	Reading	Know. Numbers	Sample parameter % or M (SD)	Group Association Test	Program Daycare group % or M (SD)	Comparison Daycare group% or M	Informal Care group% or M (SD)
School Enrolment (Year 2) [b]	-0.15	-0.15	-0.33	-	-0.12	0.12	0.26	0.29	-	-	0.21	0.23	N/A	$X^2(4) = 2.26$	N/A	N/A	N/A
Full-Time (+Full-time) [a]	-0.12	-	0.10	0.10	-	0.20	0.28	0.24	0.11	0.17	0.28	0.27	36.0%	$X^2(2) = 0.32$	37.2%	36.9%	33.9%
Part-Time (+Part-time) [a]	-	-0.21	-0.45	-0.11	-	-	-	-	-0.10	-0.25	-	-	29.2%	$X^2(2) = 1.00$	33.0%	28.5%	26.8%
French Program +36 months (+French Program) [b]	-0.10	-0.37	-0.45	-0.12	-	-	-	-	-0.27	-0.15	-	-	16.2%	$X^2(2) = 2.67$	21.2%	16.1%	12.4%
Tutoring +36 months (+Tutoring)	-	-	-0.16	-0.19	-0.10	-0.22	-0.10	-0.12	-0.13	-	-0.12	-0.19	9.2%	$X^2(2) = 0.42$	9.3%	8.0%	10.5%
Homework Frequency +36 months (+Every day)	0.14	-	-	-	-	-	0.16	0.25	-	-	0.13	-	72.5%	$X^2(2) = 0.61$	70.9%	71.2%	75.2%
Internet +36 months (+Internet)	-	-	-	-	-	0.10	-	0.11	-	-	-	-	63.3%	$X^2(2) = 1.48$	67.4%	64.0%	59.0%
Perception of the School (+36 months)	0.12	-	-	-	-	-	-	-	-	-	-	-	17.40 (2.18)	$F(2, 312) = 1.29$	17.30 (2.15)	17.59 (2.33)	17.13 (1.85)
Perception of the Teacher+36 months	0.21	-	0.11	-	-0.11	-	-	-	-	-	-	-	10.13 (1.82)	$F(2, 313) = 2.27$	10.34 (1.82)	10.25 (1.89)	9.83 (1.73)

Note: Variables retained as covariates for the impact analyses are in boldface. [a]All categorical variables are binary (codes 0, 1) and the reported percentages are for category "1" indicated between parentheses and preceded by the (+) symbol. M = mean; SD = standard deviation; N=338; Significance levels set at: *** $p < 1\%$; ** $p < 5\%$; * $p < 10\%$. Freq. Lit. = Frequency of Literacy Activities, Language Lit. = Language of Literacy Activities, Child's Language = Language Spoken by the Child, Know. Letters = Knowledge of Letters, Reading = Reading Simple Words, Know. Numbers = Knowledge of Numbers. [b]Analyses revealed that this variable was redundant for covariates already included in the model.

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