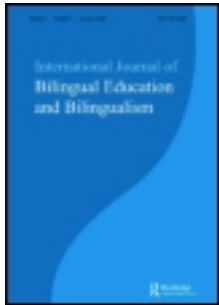


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Bilingual education in an Aboriginal context: examining the transfer of language skills from Inuktitut to English or French

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Bilingual education is thought to be one of the principal means of simultaneously revitalizing threatened language and preparing students for success in mainstream society. However, little research has examined, in a comprehensive and longitudinal fashion, bilingual programs in Aboriginal contexts. Hierarchical linear modeling was used to conduct a longitudinal analysis of the language skills of 110 Inuit students participating in an Inuktitut–English/French program in a remote Arctic community. Students' skills in English or French improved from Grades 4–6, after a switch to second language instruction; whereas, their skills in Inuktitut showed no significant improvement across these grades. Baseline heritage language skills in Grade 3 were found to be predictive of later success in both the heritage and mainstream languages, providing evidence for cross-language transfer and pointing to the pivotal importance of heritage language instruction for Aboriginal students.

Keywords: Aboriginal people; bilingual education; heritage language; language transfer; hierarchical linear modeling

Language is more than a vehicle for communication. Languages express identity, are repositories of history, and contribute to the sum of human knowledge (Baker 2006). When a language dies, a culture dies, and thus history and vast knowledge are lost. Such a tragedy is nowhere more apparent than in the case of Aboriginal languages, many of which have been extinguished and replaced by a more dominant colonial language (Foster 1982; Priest 1985). In Canada, only one-in-four Aboriginal people¹ speak even a small amount of an Aboriginal language (Norris 2007). Such statistics are particularly troubling because, in contrast to other minority language groups, Aboriginal language groups have no homeland to turn to for support when acquiring or maintaining their ancestral language. Therefore, the loss of an Aboriginal language by any individual is the true death of an entire language, and its embedded history and knowledge.

Today, Aboriginal people are fighting for the survival of their language in the context of a globalizing world. While seeking to maintain and strengthen their Aboriginal heritage language, they are also striving to master the dominant language, as it is this powerful language that will allow them to be full participants in mainstream society. Aboriginal people then face the challenge of simultaneously meeting two essential goals: (1) strengthening, or in some cases re-building their

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heritage language and ensuring its continued survival; and (2) becoming expert users of the mainstream language.

Although these goals were once believed to be mutually exclusive, it is now thought that they can be simultaneously achieved. Researchers have argued that, in the case of threatened languages, bilingual education is one of the principal means of producing more heritage language speakers (Baker 2003; McCarty 2002). When supported by parents and the community, bilingual programs may be a vehicle through which children can be simultaneously prepared for success in mainstream society and for becoming active participants in the learning and perpetuation of their minority language and culture (Fishman 1991).

Much empirical research has explored the success of minority language speakers in bilingual programs (for reviews see Cummins 1983; Lindholm-Leary 2001; Rolstad, Mahoney, and Glass 2005; Thomas and Collier 1997). However, there is a paucity of research that has examined, in a comprehensive and longitudinal fashion, bilingual programs in varied and complex Aboriginal contexts where the threat of language loss is most serious (McCarty 2003). The present study represents a 12-year program of research examining students in an Inuktitut–English/French bilingual program in a small, remote Inuit community in Nunavik, Arctic Québec, Canada. This examination will address the extent to which a bilingual program shows some promise toward achieving both the maintenance of the Aboriginal language, in this case Inuktitut, and the acquisition of a mainstream language, either English or French.

During the course of the research, we, the authors, have spent much time living and working in the small Inuit community where our research was conducted and have witnessed the growing intrusion of English and to a lesser extent French into the community. The present research is a response to worries expressed to us by the community members, in particular by Inuit elders, who were concerned about the survival of their language. These community members look to the only school in the community and its bilingual program to help educate Inuit who are strong in both their heritage language and a mainstream language. Indeed, the school is a central focus of the community and acts as more than merely an educational facility, but also a gathering place and employer of many respected community members, making it a place where the community's language and culture is meant to be transmitted to younger generations. The school is thus a natural choice of venue for us to measure the strength of the community's languages.

Bilingual education

Bilingual education can take an array of forms ranging from transitional to two-way bilingual programs. On one end of the spectrum, transitional bilingual programs, also known as 'weak' forms of bilingual education, have potential assimilationist overtones, aiming to shift the child from the heritage minority language to the dominant, majority language as quickly as possible. On the other hand, two-way, or 'strong' bilingual programs aim to extend the use of the heritage language leading to cultural and linguistic diversity. Based on an extensive review, Baker (2006) documents the positive effects for children attending such 'strong' heritage language programs including findings indicating that students in heritage language programs learn the mainstream language, English, at a level comparable to their peers in English-only programs (Cummins 2000). These findings sound somewhat

counterintuitive, as logic might dictate that if a student is exposed to instruction in one language, his or her skills in another language would necessarily suffer. In contrast, Cummins (1986, 20) argues for what he terms the *interdependence hypothesis*: 'To the extent that instruction through a minority language is effective in developing academic proficiency in the minority language, *transfer* of this proficiency to the majority language will occur, given adequate exposure to and motivation to learn the language.'

Cross-language transfer

Cummins' interdependence hypothesis is supported by research exploring the transfer of skills from one language to another. Specifically, there is an evidence for cross-language transfer in specific literacy processes. Durgunoğlu (2002) reviews research demonstrating that phonological awareness, syntactic awareness, and even functional awareness are correlated across languages. These findings imply that a common metalinguistic awareness is used across tasks in different languages. Even skills in languages with two very distinct writing systems, such as Chinese and English have been found to be related. For example, Wang, Cheng, and Chen (2006) found that English morphological awareness contributed to character reading and reading comprehension in Chinese, suggesting that awareness of the smallest units of meaning in one language, can be transferred to another very different language.

Beyond the transfer of specific language skills, researchers argue that education in a heritage language may be particularly important in empowering the minority students' cultural identity. Cummins (1986, 2000) posits that this empowerment results in a boost to self-confidence and self-esteem, thus improving students' abilities in both the heritage and mainstream language. Support for Cummins' assertion comes from a study by Wright and Taylor (1995), who found that Aboriginal students educated in their heritage language actually showed increased self and collective esteem compared to those educated in a second language (English or French).

Bilingual education in an Aboriginal context

The exploration of bilingual education in Aboriginal contexts is of the utmost importance. In some Aboriginal communities, the school is the only place where students will hear or use the heritage language. In communities where the heritage language is more widely used, the language is still under serious threat from the predominantly English mainstream culture. Bilingual programs in such contexts face a substantial challenge, and research examining their efficacy is needed.

McCarty (2002) conducted a rare review of heritage language – English bilingual programs in Aboriginal communities across the USA. She points to the success of such programs, where bilingual education both promoted students' proficiency in English and contributed to heritage language recovery. Comparable results were documented in Canada by Wright, Taylor, and Macarthur (2000) who compared Inuit students in an Inuktitut-immersion program with Inuit students in a second language-only program. Beyond demonstrating that Inuktitut immersion students benefited from the program in terms of their mastery of both the heritage and mainstream languages, the researchers found that students educated only in a second language were comparatively weak in both of these languages. These findings point

to the primary importance of heritage language instruction for the development of overall higher language skills. Within a similar research program, Louis and Taylor (2001) found, more specifically, that a strong foundation in Inuktitut in Grade 3 was the best predictor of second language success in Grade 4, pointing to the possibility that Aboriginal language skills might transfer to skills in a mainstream language.

In summary, heritage language programs have proven successful, at least in the short term, in their development of language skills both in an Aboriginal and a mainstream language. However, much about the potential power of heritage language education and its sustained effects remains to be investigated (see McCarty 2002).

The majority of current research on cross-language transfer in minority students has been limited in scope, because it often relies on simple bivariate correlation, focuses on one particular point in time, and examines only very specific language skills, such as morphological or syntactic awareness. From such a narrow snapshot, it is impossible to examine the transfer of language skills over several years in order to gauge whether early skills in a heritage language are actually predictive of later skills in a dominant language. The credibility of this 'transfer' argument in an Aboriginal context, or indeed in any minority language context, cannot be made until a comprehensive longitudinal analysis of language abilities is conducted.

The present research attempts to address these limitations by exploring in a longitudinal fashion: (1) students' skills in their Aboriginal and second languages after their transition to a mainstream language classroom; and (2) the transfer of language abilities from the heritage language to the mainstream language and vice versa. These aims are pivotal since the entire rationale for bilingual education in Inuit communities rests with the assumption that skills in the heritage language transfer to the dominant, mainstream language. Without this transfer, students in a heritage language bilingual program would be seriously compromised. As well, the strength of their threatened language might be at risk. The present research thus examines language development and transfer in a real-life school setting using pedagogically sound tests and a longitudinal analysis.

Research context

The present research was conducted in a remote Inuit community in Nunavik, Québec. A 1975 political agreement (the James Bay Agreement) gave the Inuit of Nunavik considerable power over their education system. A new school board was created with a substantial Inuit presence and a real effort was made to reflect Inuit culture in the education process. The new school board implemented a form of bilingual education that was designed to foster expertise in Inuktitut and prepare students to participate in higher education in either French² or English. The result was a program whereby students in Kindergarten, Grades 1–3 receive instruction exclusively in Inuktitut. From Grade 4 through to the end of the secondary school, parents choose either French or English stream of education for their children. It is important to note that the school board does not have an assimilationist agenda with this transitional type of bilingual education. Most educators in Nunavik would prefer to have Inuktitut instruction continue well beyond Grade 3. However, it is extremely difficult to generate Inuktitut curriculum materials and to find and hire enough trained Inuit teachers, a very common concern facing heritage language programs in Aboriginal contexts, which limits the school's ability to offer Inuktitut instruction beyond Grade 3.

In the community where our research was conducted, more than 90% of the approximately 550 residents are Inuit. Almost all the children at the only school in the community are Inuit in origin and use Inuktitut in the home. Furthermore, most Inuit children have had very little direct interpersonal contact with White southerners prior to entering school. The majority of them were born and raised in the community and had little opportunity to travel, given that all neighboring communities are accessible only by air. Although Inuktitut is used extensively and appears to be relatively strong in the community, there is an evidence for the growing intrusion of the societally dominant languages, French and English into community life. Taylor and Wright (2002) conducted a comprehensive language-use survey of five Inuit villages in Nunavik. They found evidence for the rise of subtractive bilingualism, meaning that Inuit community members, especially those under the age of 25, were learning the dominant languages at the expense of Inuktitut. Furthermore, Inuktitut was primarily being used in the home and during traditional activities such as hunting and fishing. However, the dominant language in the workplace was most often English and/or French. In follow-up questions, Taylor and Wright asked Inuit villagers about the future of their language. There were concerns among respondents about the survival of Inuktitut and a clear consensus that it was the responsibility of both parents and the school to ensure the continued vitality of the language.

There are a number of advantages to the present research context in terms of the scientific credibility of the results. First, the heritage language, Inuktitut, is spoken by virtually all Inuit in the community. Second, the isolation and relative homogeneity of the community minimizes the impact of variables, beyond language, that might influence the results. There is only one school in the community, family composition is culturally homogenous, social class differences are minimal and access to the media is common. Thus, all participants in our research come from a very similar linguistic and social context. Finally, there is a very high rate of teacher turnover at the school. All the teachers in the French/English stream are White teachers from the South, and most stay for only one or two years. A high rate of teacher turnover across a 12-year period creates an unstable environment for the students, but means that any characteristics and/or style of a particular teacher that might affect our results would not have a serious influence.

The present research tracks students across the transition from Inuktitut instruction (Grade 3) to dominant (English or French) language instruction (Grades 4–6). The education system in this community is designed to foster the maintenance and even the strengthening of heritage language skills while allowing students to gain a mastery of the mainstream language. We seek to explore if such a program is in fact successful in developing and sustaining such skills. Specifically, over a 12-year period, we investigate if language skills in Grade 3, the last year of Inuktitut instruction, are predictive of students' abilities in both the heritage and mainstream languages in Grades 4–6.

Data analysis: hierarchical linear modeling (HLM)

The objectives of this study were to evaluate heritage and second language skills across time for each cohort of students. We therefore elected to use Hierarchical Linear Modeling (HLM; Raudenbush and Bryk 2002) for the data analyses. HLM is a relatively new, but already highly respected statistical technique, that is

advantageous for studying longitudinal change, as it can be used to calculate each student's trajectory of scores across time. It avoids some limiting factors of traditional methods of assessing participants' scores across time such as repeated measures analysis of variance (ANOVA). Repeated measures ANOVA focus on the fixed effects of age or time and treat individual differences as error variance. In contrast, HLM takes into account and examines the nature of individual differences among students as they progress across time. Moreover, for repeated measures ANOVA, students must be tested at fixed time intervals with no missing data. When students are tested multiple times across a variety of different ages, and where missing data are common, HLM is considered to be the most comprehensive and desirable technique (see Tate and Hokanson 1993).

In an Aboriginal context, where there are frequent absences, failures, and even drop-outs in the early years of schooling, data analyses are particularly challenging. HLM is thus especially powerful for our research as it does not require the same number of participants at set points in time and can accommodate missing data. It computes each individual's trajectory on the basis of all available data points. Measurements at different times are viewed as nested within the individual, allowing us to include individuals who have not participated at all times of testing and to combine data from individuals tested at different ages. We were thus successful in incorporating not only those students who were at school for all four years of testing, but also those who were absent on certain occasions. Our analysis then included more of an unbiased sample of students, as it did not just focus on the children who were always at school and were thus presumably the stronger students in the community.

In the current analysis, we have operationalized language and language ability to be the results of a battery of language skills tests, conducted at the school with students in Grades 3–6 (for a complete description of the tests see Louis and Taylor 2001). Although administered at school, the battery of tests was designed to be a broad test of academic as well as conversational, everyday language skills, and was developed by a team of Inuit, Anglophone and Francophone researchers, teachers, community members, and School Board employees.

Hypotheses

- (1) *Language growth*: We expect that after the transition from Inuktitut instruction to either English or French, students will experience significant improvements in the mainstream languages. Students may also experience improvements in their heritage language skills given the widespread use of this language in the community. However, we expect that gains in the heritage language will be less dramatic than improvements made in the mainstream languages. In the context of the present research, students have only very little Inuktitut instruction after they switch to second language instruction.
- (2) *Predicting second language skills*: We expect that Inuktitut language skills in Grade 3 will transfer to second language skills in Grades 4–6. Based on Cummins' (1986) interdependence hypothesis and supporting literature pertaining to cross-language transfer, we predict that skills developed in the heritage language transfer to a second language. Naturally, we also expect baseline second language skills in Grade 3 to be predictive of second language

skills in subsequent grades. Any knowledge of a second language that students begin with should facilitate their later second language ability.

- (3) *Predicting Inuktitut skills*: In terms of Inuktitut skills, we do not expect that second language skills in Grade 3 will transfer to or be predictive of Inuktitut skills in Grades 4–6. Because no second language instruction occurs prior to Grade 3, academic proficiency in this language would not have developed to a sufficient extent for transfer to occur to another language (Cummins 1986). However, we do predict that baseline Inuktitut in Grade 3 will be predictive of Inuktitut in later years. A higher baseline Inuktitut should lead to a higher skill in Inuktitut in later years, again pointing to the primary importance of heritage language education.

Method

Participants

The study was conducted over a 12-year period, from 1995 to 2007.³ Students were tested in Grade 3 and tracked across Grades 4–6. Because Grade 3 was our baseline measure of language ability used to predict subsequent language skills, all students who were not tested in Grade 3 were deleted from the analysis. Six students of mixed heritage were removed from the analyses in order to ensure a culturally homogenous Inuit sample. A further 11 students were deleted as their age data were missing. The final sample retained for HLM analysis involved 110 students, 61 boys and 49 girls. Forty-nine students were in the French language stream, and 63 were in the English language stream. Inuktitut was the first language for all students and they all spoke this language at home.

Materials and procedure

The study used a longitudinal design including four test occasions: at the end of Grade 3 (the last year of Inuktitut language instruction), and at the ends of Grades 4–6, respectively (the first three years of second language instruction). Each year of the research, every child was assessed in Inuktitut, English, and in French on three separate occasions. Children were taken individually from their classes during regular instruction and assessed in a quiet location. Testers were trained researchers or educators from the school. Each assessment took approximately 45 minutes, was administered in random order; and children did not receive more than one language assessment per half a day of school. The assessment was demanding for the young students but was an experience that they appeared to thoroughly enjoy.

Each language assessment involved a battery of 14 tests (see Louis and Taylor 2001) designed to assess general language competencies and specific language skills appropriate for the children's ages and grade levels, and to assess the fundamental language needs defined by community members. In addition to the usual concerns for adequately testing children's language abilities, all the materials had to be suitable for the culture and context of the community. For example, the majority of children being assessed would have never before seen a tree, as there are no trees in the harsh, arctic environment. Such specific contextual details were taken into account when developing the testing materials. In addition, the language tests also had to be flexible enough to measure language development over a developmentally rich period of the

children's education. The need for such culturally appropriate tests that could be translated across three languages mandated the development of new testing materials (Wright, Taylor, and Macarthur 2000). The materials were developed and translated by Inuit, Francophone, and Anglophone teachers, researchers, community members, and educators from the School Board in Nunavik. For the purposes of the present study, only those tests that were exactly the same across grades and across languages were retained for analyses. We wanted to limit confounding factors such that students' scores for each grade and each language were obtained from tests that were identical. The tasks retained for the present analyses were: (1) identifying colors, where children were asked to name the colors of eight different circles; (2) identifying numbers, where children were asked to name 40 different numbers, ranging from one to numbers in the thousands; (3) identifying body parts, where children were asked to name body parts shown to them by the tester; (4) naming letters in the alphabet, where children were asked to identify the Inuit syllabics or letters from the English/French alphabet; and finally (5) filling in missing words in a list of sentences, where children read an incomplete sentence describing a common activity in their community, and selected a word from four alternatives that completed the sentence correctly. These tasks combined provided an index of general language skills where the colors, numbers, letters, and body parts tasks measured vocabulary, and where the sentence completion task was a measure of sentence reading and comprehension. This index was computed as percentage scores. The gender of the child, their language of instruction (English or French), their age, and the year in which they were tested were also recorded.

Results

Inuktitut and second language scores: descriptive statistics

We begin by reporting descriptive information associated with participants' ages across Grades 3–6. We report students' mean scores in Inuktitut and mean scores in their second language as they increase in age (see Table 1). Our main analyses focus on age rather than grade level, as students often repeated grades, making grade level an unreliable predictor.

From Table 1, students' mean Inuktitut scores appear somewhat stable as they age. They begin relatively high in Grade 3, which is consistent with past research showing that children instructed in Inuktitut in Grades 1–3 exhibit substantial improvement in this language until Grade 3 (Wright, Taylor, and Macarthur 2000). However, they show little improvement in later grades. On the other hand, students' mean scores in their second language increase as they increase in age. Their second language skills are initially low relatively, but almost catch up to their skills in Inuktitut after only three years in their second language program. In order to more

Table 1. Mean ages and language scores for students in Grades 3–6. (Standard deviations in parentheses).

	Grade 3	Grade 4	Grade 5	Grade 6
Age (months)	110.65 (7.74)	123.83 (8.22)	137.39 (9.21)	151.67 (10.57)
Inuktitut score (%)	87.90 (7.35)	88.07 (7.27)	89.82 (5.52)	88.29 (6.91)
Second language (%)	28.08 (17.47)	71.27 (13.05)	82.96 (8.51)	87.43 (7.40)

comprehensively test these observations, linear models of change across age for each participant were constructed and tested using HLM.

Hierarchical linear modeling (HLM): model construction

HLMs are hierarchical in that they may be thought of as involving first an assessment of individual level change (level 1; change in language skills within an individual over Grades 4–6) and second, an assessment of individual differences in change (level 2; factors that vary among individuals, such as gender or language of instruction). First, each person's growth across time is estimated at level 1 by a linear model containing an intercept and a slope term. Once a model of an individual level change (level 1) is determined, level 2 variables assessing individual differences, such as gender or language of instruction, are added. The final model contains both levels where the predictive power of individual difference variables (e.g., gender) on individual level change (growth across time) is assessed.

In the present research, we constructed two final models, the first to predict second language scores across Grades 4–6, and the second to predict Inuktitut scores across Grades 4–6. The full set of predictors for these models included age, gender, language of instruction (English or French), year of initial test (1995–2007), baseline levels of Inuktitut (Grade 3 Inuktitut score), and baseline levels of a second language (Grade 3 second language score). In creating our models we followed the procedure outlined by Raudenbush and Bryk (2002, 160–9) in which they describe HLM applications in the study of individual change (See Appendix 1 for a description of our model construction and estimation of explained variance).

Assessment of individual level change

Before building our final models, we first estimated how participants' language scores evolved as they aged in two preliminary models. These models assessed: (1) second language growth; and (2) Inuktitut growth, before any individual difference (level 2) variables were taken into account. Second language scores across Grades 4–6 and Inuktitut scores across Grades 4–6 were expressed as linear functions of age, yielding an estimate of intercept (grand mean) and slope (growth) across time. At this stage, the level 2 model was left empty or unconditional, as individual difference variables were not yet examined (see Appendix 2 for a detailed description of the second language and Inuktitut unconditional models).

Analysis of the preliminary second language model showed significant variability depending on age, $t(109) = 12.18, p < 0.001$ (see Table 2 for fixed and random effects) such that as age increased, so did performance in a second language across Grades 4–6. Estimated average second language performance was 79.46% with participants gaining an average of 0.51% points per month in age. Not surprisingly, as students aged and spent more time in a second language program, their skills in this language improved.

Analysis of the random effects of the model showed significant variability in both intercepts (means) and slopes (growth) across participants (see Table 2). The significant effects here mean that not only did children vary significantly in their mean second language skills, but also that there was significant variation in their rates of progression from Grades 4–6. In other words, there were individual

Table 2. Fixed effects and random effects for second language unconditional model.

<i>Fixed effects</i>	<i>Coefficient</i>	<i>Standard error</i>
Second language intercept	79.46*	1.15
Second language growth rate	0.51*	0.04
<i>Random effects</i>	<i>Variance component</i>	<i>Standard deviation</i>
Second language intercept	126.00*	11.22
Second language growth rate	0.07*	0.27
Level 1 residual variance	38.05	6.16

* $p < 0.001$.

Table 3. Fixed effects and random effects for the Inuktitut unconditional model.

<i>Fixed effects</i>	<i>Coefficient</i>	<i>Standard error</i>
Inuktitut intercept	88.87*	0.54
Inuktitut growth rate	-0.03	0.03
<i>Random effects</i>	<i>Variance component</i>	<i>Standard deviation</i>
Inuktitut intercept	23.91*	4.89
Inuktitut growth rate	0.05*	0.23
Level-1 residual variance	15.39	3.92

* $p < 0.001$.

differences among children and they were changing at different rates. These findings point to the need for the inclusion of individual difference variables in a final model.

Analysis of the preliminary Inuktitut model showed no significant variability depending on age, $t(109) = -0.56$, $p > 0.05$ (see Table 3 for fixed and random effects). As students aged, their Inuktitut did not show any significant change. The average predicted Inuktitut score was 88.89% with participants gaining an average of -0.03% points per month of age.

Analysis of the random effects of the model showed significant variability in both intercepts (means) and slopes (growth) among children (see Table 4). Again, this meant that children varied significantly in their average Inuktitut skill and their growth in Inuktitut, indicating a need for the inclusion of individual difference variables in a final model.

Building the final models

In order to assess individual differences in language scores across age, we added level 2 predictors, trimming predictors that did not reach significance (Raudenbush and Bryk 2002). Level 2 predictors included gender, language of instruction (French or English), year of initial test (1995–2006), baseline (Grade 3) levels of a second language, and baseline (Grade 3) levels of Inuktitut. In a stepwise fashion, Level 2 predictors were added one at a time. All variables were grand-mean centered. For the final models, all predictors that remained significant at $p < 0.05$ were retained.

Best hierarchical linear model of second language scores

The best fitting model of second language scores included the baseline Inuktitut scores in Grade 3 and baseline second language scores in Grade 3 as significant predictors of participants' mean second language scores. No significant predictors of

Table 4. Fixed and random effects for best second language conditional model.

<i>Fixed effects</i>	<i>Coefficient</i>	<i>Standard error</i>
For second language intercept		
Average	79.65*	0.97
Baseline Inuktitut intercept	0.45*	0.12
Baseline Second Language intercept	0.23*	0.05
For linear slope as a function of age		
Average	0.50*	0.05
Baseline Inuktitut	0.0015	0.01
Baseline second language	-0.003	0.003
<i>Random effects</i>	<i>Variance components</i>	<i>Standard deviation</i>
Intercept	84.54*	9.19
Age slope	0.10*	0.31
Level-1 residual variance	38.16	6.18

* $p \leq 0.001$.

slope were found. This means that, baseline second language and baseline Inuktitut scores explained some of the variance in participants' mean second language scores, but none of the predictor variables explained individual differences in growth rate across age (see Table 4 for fixed and random effects, estimates, and standard errors). Other predictors including gender, language of instruction and year of initial test did not contribute significantly to the best model.

These results indicate that for every one point increase in baseline Inuktitut, second language scores across subsequent years increased by 0.45 points when all other predictors were held constant. The better a student was in the heritage language in Grade 3, the better he or she was in a second language across Grades 4–6. Furthermore, for every one point increase in baseline second language scores, second language scores across subsequent years increased by 0.23 points, when all other predictors were held constant. The better a student was in a second language in Grade 3, the better he or she was in this language across Grades 4–6 (See Appendix 3 for the proportion of variance explained by the best model).

The differences predicted by baseline Inuktitut with other predictors held constant at their average can be seen in Figure 1 for baseline Inuktitut scores in the 25th, 50th, and 75th percentiles. In support of our language transfer hypothesis, Grade 3 Inuktitut scores were predictive of success in a second language across subsequent years.

The difference predicted by baseline second language scores, with all other predictors held constant at their mean can be seen in Figure 2 for baseline second language scores in the 25th, 50th, and 75th percentile. Here, Grade 3 second language scores are also shown to be predictive of success in a second language across subsequent years.

In summary, the best predictors of second language scores across age were baseline (Grade 3) Inuktitut and baseline (Grade 3) second language scores. Higher scores on the Grade 3 Inuktitut and second language tests were independently associated with stronger performance in a second language across subsequent grades, pointing to the importance of early skill in both languages for strength in later years.

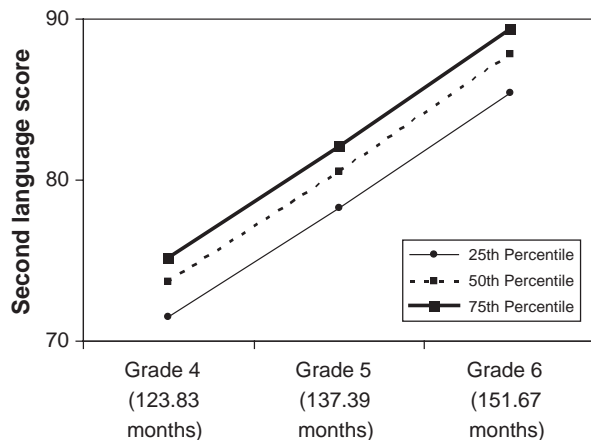


Figure 1. Best model of second language scores: predicted performance for students scoring in the 25th, 50th, and 75th percentile for baseline (Grade 3) Inuktitut.

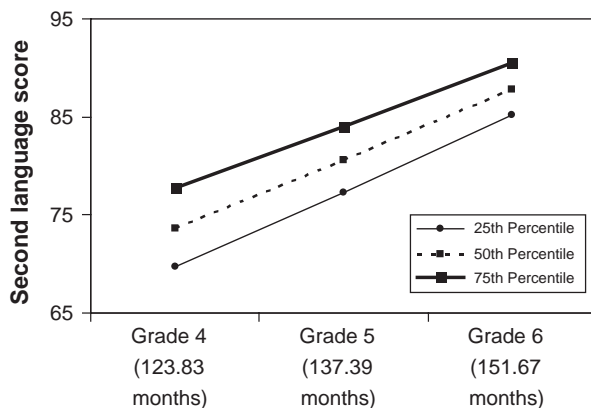


Figure 2. Best model of second language scores: predicted performance for students scoring in the 25th, 50th, and 75th percentile for baseline (Grade 3) second language.

Best hierarchical linear model of Inuktitut scores

The best fitting model of Inuktitut scores across age included only baseline Inuktitut scores in Grade 3 as a significant predictor of participant's mean Inuktitut scores. No significant predictors of slope were found. That is, baseline Inuktitut scores explained some of the variance in students' average Inuktitut scores across Grades 4–6, but none of the predictor variables explained individual differences in growth rate across age (see Table 5 for fixed and random effects estimates). Other predictors including year of initial test, language of instruction, gender, and baseline second language in Grade 3 did not contribute significantly to the best model.

These results indicate that for every one point increase in baseline Inuktitut, Inuktitut scores across subsequent years increased by 0.45 points when all other predictors were held constant. The difference predicted by baseline Inuktitut can be seen in Figure 3 for baseline Inuktitut scores in the 25th, 50th, and 75th percentiles. The better a student was in their heritage language in Grade 3, the better he or she

Table 5. Fixed and random effects for best Inuktitut conditional model.

<i>Fixed effects</i>	<i>Coefficient</i>	<i>Standard error</i>
For Inuktitut intercept		
Average	89.10*	0.43
Baseline Inuktitut intercept	0.45*	0.06
For linear slope as a function of age		
Average	-0.01	0.03
Baseline Inuktitut	0.002	0.004
<i>Random effects</i>	<i>Variance components</i>	<i>Standard deviation</i>
Initial status	12.82*	3.58
Age slope	0.07*	0.26
Level-1 residual variance	14.99	3.87

* $p < 0.001$.

was in this language across Grades 4–6 (See Appendix 3 for the proportion of variance explained by the best model).

In summary, the best predictor of Inuktitut scores across age was baseline (Grade 3) Inuktitut. The better a student was in Inuktitut in Grade 3, the better he or she was in that language across subsequent years. This finding again points to the importance of early skill in the heritage language, as it is skill in this language that is especially diagnostic of heritage language skill in later years.

Our finding that Inuktitut scores did not improve as students aged could have been due to the possibility that our tests were subject to a ceiling effect. Inuktitut scores in Grade 4 were already quite high ($M = 88.07\%$), potentially leaving little room for improvement in subsequent grades. However, we did find significant variability in Inuktitut scores when it came to our best model predicting Inuktitut scores across age, such that higher Inuktitut in Grade 3 predicted higher Inuktitut in later years. Thus, not all students were simply scoring at the top of the scale, some were scoring higher than others, and these differences were predictable in that they could be at least partially explained by their baseline Inuktitut score.

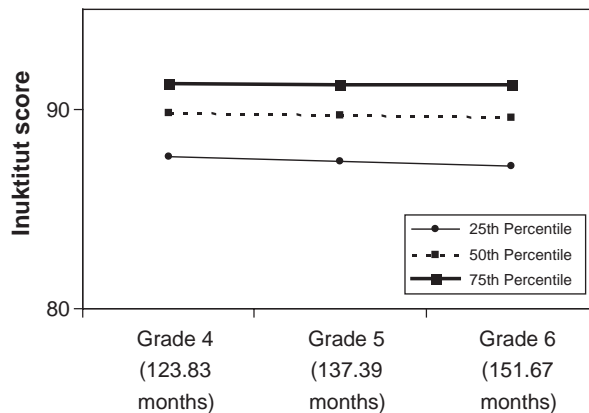


Figure 3. Best model of Inuktitut scores: predicted performance for students scoring in the 25th, 50th, and 75th percentile for baseline (Grade 3) Inuktitut.

Discussion

Summary of results

Our first hypothesis examining the growth of both second language and Inuktitut skills across years was fully supported. Age significantly predicted participants' second language growth, indicating that as students aged and had more second language instruction, their skills in this language improved. In contrast, age was a non-significant predictor of Inuktitut skills. As students aged, their skills in their heritage language remained constant. Furthermore, the fact that age was a non-significant predictor of Inuktitut skills allows us to be more certain that it was students' second language improvement, and not simply their normal cognitive development, that accounted for the observed age effects on second language scores.

Our second prediction pertaining to second language skills across Grades 4–6 was also supported. Baseline second language skills in Grade 3 predicted second language performance across subsequent grades. More importantly, baseline heritage language skills in Grade 3 were predictive of second language skills across subsequent grades. That is, not only were English and French skills in Grade 3 associated with skills in English and French in later grades, but also, more importantly, Inuktitut skills in Grade 3 transferred to English and French skills in later grades.

Finally, our third prediction pertaining to Inuktitut skills across Grades 4–6 was supported. Heritage language skill in Grade 3 was the only significant predictor of Inuktitut performance in later grades, making it especially diagnostic of success in the heritage language. As expected, second language skills in Grade 3 were not predictive of Inuktitut skills in later grades.

In addition, gender, language of instruction, and year of test were all non-significant predictors of language skills in both the heritage and second languages. Interestingly, whether the child was a girl or a boy, or being educated in English or in French, he or she had similar language skills and a similar rate of growth. In addition, skills in both the heritage and second languages did not change significantly from 1995 to 2007.

Support for cross-language transfer

The present research lends support to Cummins' (1986) interdependence hypothesis and by extension to the whole rationale for bilingual education. We demonstrate that early skill in the heritage language is related to skill in a second, societally dominant language in later years. Rather than setting the child back in his or her second language learning, as intuition might suggest, having a strong basis in Inuktitut is predictive of later strength rather than weakness in a second language. Furthermore, even though students were learning entirely in Inuktitut for the first three years of their education, skill in their second language actually catches up to similar level of skill in Inuktitut after only three years of second language instruction.

Importantly, using a longitudinal analysis, we found that the transfer of language skills is not bidirectional. That is, transfer appears to proceed from the heritage language to the second language, but not the reverse. Skill in a second language in Grade 3 was not predictive of Inuktitut skills in later years. This may be because students were not instructed in a second language in the early grades, meaning that they had not reached the higher level of academic proficiency in this language that is necessary for transfer to occur (Cummins 1986).

Implications for bilingual education in an Aboriginal context

As is the case in many Aboriginal contexts, it is very difficult to design and implement a bilingual program that includes the heritage language as a meaningful and continuous component in the curriculum. Indeed, in the Inuit community that is the site for our research, it is challenging for the school board to generate materials beyond Grade 3 in Inuktitut and even more difficult to find trained Inuit teachers to continue teaching after Grade 3. These constraints make a transitional or more 'weak' form of bilingual education a necessary reality in this community, where students only receive a small amount of Inuktitut instruction after they switch to dominant language education. Consistent with research examining different forms of bilingual education (Baker 2006), it appears that a transitional program may not be adequate to ensure the survival of the language. Inuktitut scores reach a plateau after Grade 3 and there was no significant improvement in Inuktitut scores over the 12 years of the study. Such a transitional program may send the potentially dangerous implicit message that one's own heritage language is only functional in the early grades and it is the second language that is needed for high school and beyond.

Based on our results, heritage language education would seem to be essential in the Aboriginal context. However, in order for a bilingual program to maintain and strengthen an Aboriginal language, the bilingual program needs to be a 'strong' one. Perhaps with continued inclusion of the heritage language as a meaningful component in the curriculum throughout all years of schooling, a community will be able to achieve the dual goal of strengthening and expanding their mother tongue while at the same time preparing their young people for success in mainstream society.

Future directions

Although we were able to demonstrate a longitudinal relationship between baseline skills in a heritage language and later skills in a second language, it would be interesting to know more about the mechanism of this relationship. Are there particular language skills that are being transferred from one language to another, or is it the cultural empowerment (Cummins 1986, 2000) embedded in the heritage language that is then translated into better second language skills? Knowing whether to focus on specific language skills, on instilling cultural pride, or on both of these might better guide educators and improve the success of heritage language programs.

Again, in order to further improve the effectiveness of such a program, future research might need to take more predictors of participants' language trajectories into account. Although our HLM models provided us with information about certain key predictors of participants' language trajectories, our models did not account for all the variance in these trajectories and were unable to account for any variance in the growth rate of participants. Other individual difference variables that this study failed to examine such as parental involvement in school, nutrition, overall physical and psychological well-being, might account for more variance, and give us a greater ability to predict a child's success and growth rate in both Inuktitut and a second language across years.

Furthermore, future research should include more ecologically or ethnographically informed notions of community-based uses of language and literacy in order to achieve a broader and more comprehensive gauge of language. According to Scribner

and Cole (1981), proficiency in a language is not always synonymous with education, or skills learned in school. Furthermore, literacy is not simply knowing how to read and write a particular script, but applying this knowledge for purposes in specific contexts of use (Scribner and Cole). Inuktitut learned in the home or while engaged in the traditional practices of Inuit community members may not have been entirely reflected in our school-based tests. Even though our operationalization of language skills was informed by Inuit community members, future research might investigate language outside of the school, in a more contextualized fashion.

Our research set out to examine the extent to which bilingual education in an Aboriginal context was successful in its achievement of the dual goals of strengthening the Aboriginal language and preparing children for success in a dominant language. It was novel in its examination of language transfer in an Aboriginal context using a comprehensive longitudinal methodology and a powerful statistical tool, HLM. Although we were successful in predicting language trajectories across three years of schooling, further longitudinal research would be useful. Research examining the use and level of Inuktitut and second languages in adulthood, in a variety of contexts, might provide us with a more accurate picture of whether or not the language is surviving and whether or not students are indeed successful in a future second language environment.

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Notes

1. We have chosen the label 'Aboriginal people' to use throughout the paper as it is more inclusive than the more common term 'Native American'. The term 'Aboriginal people' refers to First Nations (Native North Americans), Inuit, and in the Canadian context, Métis.
2. In the present research context, both French and English are considered mainstream languages. Québec, while situated in largely English-speaking North America, is a Francophone province where both work and home life are conducted for the most part in French.
3. Preliminary data from a small subset of these participants were published in Louis and Taylor (2001). Data from participants finishing Grade 3 in 1995, 1996, and 1997 and participants finishing Grade 4 in 1995 and 1999 were described. The present research represents a more comprehensive analysis of these data by including them in a much larger, 12-year longitudinal analysis.

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Appendix 1. Model construction and estimating variance explained

Following Raudenbush and Bryk (2002), we begin by modeling individual level change trajectories across time (age) for each outcome variable. We estimate a mean growth curve and the extent of individual variation around it. We then proceed to add level 2 predictors one at a time. All variables were grand-mean centered. Variables were retained for the best models if they were significant predictors of individual differences in the initial status or growth rate (slope). The best-fitting model was the simplest model for which the deviance from lower-order models was significantly different ($p < 0.05$) as indicated by a chi-square test.

In estimating variance explained by our final models, we have followed the procedure outlined by Raudenbush and Bryk (2002, 64–79). The approach that we used first approximates explained variance at level 1 given the level 2 model. Then, at level 2, it estimates the proportion of level-1 intercept and slope variance explained by the final model. It is important to note that no single approach to estimating explained variance in HLM as been agreed upon. We have followed Raudenbush and Bryk's technique because of the widespread use of this technique, its intuitive appeal, and its relative simplicity. However, this approach is not without problems (see Snijders and Bosker 1999), but problems are more likely to occur when models become complex. Our models are simple and include few predictor variables, therefore we elected to use the technique proposed by Raudenbush and Bryk.

Appendix 2. Second language and Inuktitut unconditional models

Level 1: Second language = $P_0 + P_1 \times \text{age} + E$

Level 2: $P_0 = B_{00} + R_0$

$$P_1 = B_{10} + R_1 \quad (1)$$

Level 1: Inuktitut = $P_0 + P_1 \times \text{age} + E$

Level 2: $P_0 = B_{00} + R_0$

$$P_1 = B_{10} + R_1 \quad (2)$$

P_0 is the intercept term representing participants' average language score, P_1 is the slope term representing participants' growth rate in language score and E represents random error as it varies by age. The level 1 models thus directly represent individuals' change trajectories for both second language (Eq. (1)) and Inuktitut (Eq. (2)) scores across age. At this stage, the level 2 models are left unconditional thus they simply represent individuals' intercept (P_0) and growth terms (P_1) as the sample average measured with some error (R).

Appendix 3. Proportion of variance accounted for by the best models

The best model of second language scores accounted for approximately 70% of the variance in level 1 parameters compared to an unconstrained model containing no predictors. At level 2, approximately 33% of the level-1 intercept variance was explained by the best model, while none of the slope variance was explained. The differential effects of baseline Inuktitut versus baseline second language were also calculated. The addition of the baseline second language predictor to the model accounted for 22% of the level-1 intercept variance; whereas, the addition of the baseline Inuktitut predictor accounted for 10% of the level-1 intercept variance.

The best model of Inuktitut scores accounted for approximately 36% of the variance in level 1 parameters compared to an unconstrained model containing no predictors. At level 2, approximately 46% of the level-1 intercept variance was explained by the best model, while none of the slope variance was explained.