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LANGUAGE APTITUDE AND SECOND LANGUAGE PROFICIENCY IN CLASSROOM LEARNERS OF DIFFERENT STARTING AGES

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This empirical study investigates the relationship between language aptitude components and second language (L2) outcomes among learners whose intensive L2 exposure began at different ages. The learners in this study are 65 11th-grade students in continuing early and late French immersion programs. Evidence is found to support the main hypothesis that in late immersion starting in adolescence there will be a positive relationship between L2 outcomes and an analytical dimension of language aptitude, whereas in early immersion beginning in grade 1 a positive relationship will hold between L2 outcomes and memory ability. A further hypothesis that early immersion students will have higher language aptitude as a result of their early L2 exposure is not supported by the findings.

Language aptitude has been described as "one of the central individual differences in language learning" and "consistently the most successful predictor of language learning success" (Skehan, 1989, pp. 25, 38). These observations are supported by robust findings from a variety of classroom language learning contexts showing substantial positive correlations between measures of language aptitude and second

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language (L2) outcomes (for review, see, e.g., Carroll, 1981; Skehan, 1989).[1] Language aptitude is not a unitary concept, but it is seen to consist of several cognitive abilities. Individuals may have different relative strengths and weaknesses on the various component abilities (Skehan, 1986; Wesche, 1981). In this paper, we are concerned with an age-related question: Are different components of aptitude associated with L2 success when school-aged learners begin an intensive L2 program at an early primary grade as opposed to an intermediate grade level? We describe a study examining the relationship between aptitude components and L2 outcomes among secondary school students who are all at the same grade level but who have had different entry points for a French immersion program, some having begun early immersion as children in grade 1 and others having entered late immersion as adolescents in grade 7.

BACKGROUND AND RATIONALE

The hypothesis of a critical period for language acquisition in childhood carries with it the idea that postpubertal L2 learners have to work harder than children to learn a second language and that the learning process may be a different one, with older learners applying a more studious approach to the L2 learning enterprise (Lenneberg, 1967, p.176). This idea is reflected in more recent theorizing about the characteristics of adult, as opposed to child, language acquisition—for example, in Krashen's notion of a Monitor and the learning or acquisition distinction (e.g., Krashen, 1982); in Schwartz's (1993) related conception of *learned* linguistic knowledge and behavior; and in what Felix (1985) has called problem-solving cognitive structures (seen in adult L2 learning to compete with the language-specific cognitive structures employed by children). For these authors, intellectual, analytical procedures are not viewed as promoting L2 success but, if anything, as interfering with it. This controversial point of view appears inconsistent with research on language aptitude that reveals a positive relationship between analytical language abilities and L2 learning outcomes. However, the hypothesis that a later start for L2 learning will nonetheless be more closely associated with a reliance on analytical procedures is an issue that deserves closer investigation from the perspective of language aptitude. We note that other approaches to investigating the possibility of L2 processing differences between younger and older learners, such as comparing developmental sequences (e.g., Wode, 1981), error types (e.g., Cook, 1973; Harley, 1986), or use of cues to sentence interpretation (e.g., Harley, Howard, & Hart, 1995), have not to date succeeded in establishing any clear age-related differences. In what follows we begin by examining the language aptitude concept and some relevant empirical findings.

The concept of language aptitude is most often associated with the name of J. B. Carroll, who, in pioneering work with Stanley Sapon in the 1950s, developed the Modern Language Aptitude Test (MLAT) (Carroll & Sapon, 1959) as a predictive measure of success in classroom L2 learning. According to Carroll (1981), L2 aptitude predicts the rate of L2 learning and can be defined as "the individual's initial state of readiness and capacity for learning a foreign language, and probable facility in doing

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so" given the presence of motivation and opportunity (p. 86).[2] From the many studies of language aptitude conducted over a period of 25 years by himself and others, Carroll (1981) concluded (a) that language aptitude is a stable learner characteristic, (b) that it is a composite of several relatively independent cognitive abilities, and (c) that it is not the same as verbal intelligence or academic ability although it overlaps to some extent with these domains. We consider briefly some research relevant to each of these conclusions and implications for the present study among French immersion students.

Stability of Language Aptitude

Initial evidence for the stability of language aptitude came from a study by Politzer and Weiss (1969), who found that giving adults specific training on relevant cognitive tasks did not in general lead to improvement in their language aptitude scores or their L2 proficiency. More recently, Skehan (1988) has provided further evidence of aptitudinal stability in a study showing significant relationships between a number of measures of first language development in the preschool years and language aptitude scores in early adolescence. The apparent stability of language aptitude does not mean that it is necessarily innate, although individual differences in preschool children's rate of first language acquisition (Wells, 1985) and in children's ability for classroom L2 learning (Humes-Bartlo, 1989) suggest that aptitude differences are already present at a young age. Individual case studies of exceptionally talented adult L2 learners have also led some researchers to argue that these outstanding learners may have a genetically determined talent for languages that is associated with various family traits (e.g., Ioup, Boustagui, Tigi, & Moselle, 1994; Novoa, Fein, & Obler, 1988; Obler, 1989; Schneiderman & Desmarais, 1988). The relevance of these case studies for a wider population of L2 learners is unclear, however. Carroll himself appears to have maintained an open mind on the innateness issue. In a 1973 article, he indicated that he was prepared to accept the notion of innate language acquisition abilities, but later he commented that he could see no evidence to justify rejecting the idea that aptitude may be "crucially dependent upon past learning experiences" (Carroll, 1981, p.86; cf. also Skehan, 1989, p.39).

McLaughlin (1990) has taken a stronger stand in favor of the view that prior L2 learning experience can have the effect of enhancing language aptitude. According to McLaughlin, "aptitude should not be viewed as a static personality trait; novices can become experts with experience" (p. 173). In support of this claim in the domain of language learning, McLaughlin refers to a study by Nation and McLaughlin (1986) in which multilinguals (i.e., those with the most language learning experience) were more successful than bilinguals or monolinguals at learning a miniature artificial language system under implicit learning conditions in which there were no instructions to learn any rules. In another study (Nayak, Hansen, Krueger, & McLaughlin, 1990), more experienced language learners did not prove to be better at learning a minilanguage system, but they did demonstrate greater flexibility in the use of learning strategies. In contrast to Carroll, McLaughlin (1990, p. 172) expressed the

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belief that "aptitude has a teachable component—novices can become experts by learning appropriate strategies."

It is possible that experience gained specifically in childhood is a key factor in developing language learning aptitude. Eisenstein (1980), for example, found that childhood bilingualism, and particularly formal education in more than one language before age 10, was associated with enhanced language aptitude in adulthood. Further indirect evidence of the role of childhood language experience in developing language learning aptitude comes from Mayberry's (1993) study of the learning of American Sign Language (ASL) by deaf children. One of the findings of that study was that when ASL was learned as a second language by those who had become deaf between the ages of 9 and 15, a higher level of success was achieved than when ASL was learned at a similar age by congenitally deaf children as their first full language of communication.

These studies thus suggest that although language aptitude appears to be a relatively stable individual characteristic over time (Skehan, 1988), it may be influenced by prior language experience, particularly in childhood. This experience hypothesis is one that we explore in the present study, namely, that intensive L2 exposure in an early immersion classroom beginning in kindergarten or grade 1 will be associated with higher eventual language aptitude scores than a later start at the grade 7 level, owing to the greater opportunity that the early start in childhood affords to develop language learning strategies. However, in that students entering late immersion are self-selected and tend to have been previously successful in a regular core French program (see Wesche, 1993, for discussion), a finding of higher aptitude scores on their part would not necessarily lead to rejection of the experience hypothesis because higher eventual language aptitude scores could be a reflection of higher initial aptitude.

Components of Language Aptitude

Carroll (1981) outlines four components of language aptitude emerging from the research: phonetic coding ability (an ability to form and retain associations between sounds and symbols), grammatical sensitivity (the ability to recognize the grammatical functions of words in the context of sentences), rote-learning ability for L2 materials (the ability to make rapid and efficient associations between sounds and meanings and retain them), and inductive language learning ability (the ability to infer rules from samples of language). This conception of language aptitude as a composite of several relatively independent cognitive abilities has been sustained (Carroll, 1990, 1993). In some instances, subsequent research has suggested ways in which the original four-component model might be refined. Wesche (1981), for example, reported that in addition to the components of phonetic coding ability, grammatical sensitivity, and rote memory measured by the MLAT, auditory ability assessed by two subtests from Pimsleur's (1966) Language Aptitude Battery (PLAB) was diagnostically important in choosing appropriate instruction for adult L2 learners in the Canadian Public Service. Carroll (1990) cited further research concerning individual differences in auditory abilities that might add predictive value to existing

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language aptitude tests. In the area of memory abilities, Carroll (1990) also recognized that rote-learning ability as measured by a paired associates subtest in the MLAT is only one aspect of memory and that other more recently studied memory abilities could well be involved in language aptitude. Research among adults by Skehan (1980; see also Skehan, 1989) has in fact already shown substantial correlations between L2 achievement and two additional aspects of memory: response integration and memory for text (correlations of .55 and .57, respectively). Response integration in Skehan's research was measured by a task requiring recall of a set of words in an unknown language (without being given word associates in the L1), and memory for text was assessed by a task involving recall of the rules of a game.

The componential view of language aptitude has led to productive research on individual differences in "learner types" (Skehan, 1989, p. 34 et seq.). In the Canadian Public Service, according to Wesche (1981), most learners of French L2 were assigned to a core audiovisual teaching approach, but alternative approaches were designed for two specific types of learners identified from scores on the MLAT and the two PLAB subtests. One group of learners had relatively high analytical language ability, reflected in a high level of grammatical sensitivity measured by the MLAT-IV Words in Sentences subtest. This group of learners, some of whom also had poor memory and auditory abilities, was matched with a traditional analytical teaching approach involving grammatical explanations and abundant written input. Another group with relatively low analytical ability but compensatory abilities in the memory, auditory, and phonetic coding domains was matched with a functional, situational approach emphasizing language use in interpersonal situations. Matching was observed to lead to improved results in both attitudes and L2 achievement. A study of British army personnel learning colloquial Arabic in an intensive 10-week course (Skehan, 1986) also revealed two specific learner types that appeared similar to those described by Wesche. In Skehan's research, both types were associated with successful L2 outcomes. One group consisted of young adult learners who stood out as having good memories and the other of older learners who had high scores on grammatical sensitivity. Skehan (1989) interpreted the research on aptitude as suggesting two different orientations to language development: "One type of learner seems to have a language learning orientation which stresses the analysability of language while the other, perhaps more expression-oriented, is more apt to rely on chunks of language and efficient memory" (p. 37).

A key question in the context of this article is whether one of these suggested orientations is more likely to be associated with successful L2 learning in an early immersion program, and the other orientation more closely related to L2 success in a late immersion program and, if so, which orientation would apply to which program. In favor of a holistic memory orientation in early immersion, there is evidence from case studies in both first and second language acquisition that some children, initially at least, adopt a holistic, memory-oriented approach to language processing (e.g., Hakuta, 1974; Peters, 1983), extracting and using meaningful chunks of memorized language that are not internally analyzed. By some accounts, this may remain a characteristic of fluent native-speaker language use in adulthood as well (e.g., Pawley & Syder, 1983). More generally, some developmental psychologists have

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argued that a holistic mode of processing information is developmentally prior to analytic processing in cognitive growth (e.g., Kemler Nelson & Smith, 1989; see also Lautrey [1993] on analogical vs. symbolic modes of processing and Nelson [1983] on the precedence of event representations in conceptual development). These theoretical perspectives lead us to predict, therefore, that L2 proficiency outcomes from early immersion that begins in childhood will at an older age still be more positively associated with memory abilities than with analytical abilities. In the next section, dealing with the relationship between language aptitude and general academic ability, we examine the companion issue of whether an analytical orientation is more likely to be related to L2 outcomes in a late immersion program beginning in adolescence.

Language Aptitude and Academic Ability

According to Carroll (1981), a measure of language aptitude such as the MLAT is a better predictor of L2 proficiency than a more general measure of academic ability, and the two kinds of abilities are relatively independent. Nevertheless, it appears from factor analytic studies using measures of both language aptitude and general intelligence that there can be substantial overlap between the two kinds of measures (e.g., Wesche, Edwards, & Wells, 1982) and that some components of language aptitude are more closely associated with academic ability than others. Relevant components of language aptitude appear to be those that characterize an analytical orientation toward L2 learning. Carroll (1990), for example, reported that in one of his earlier studies among college students a grammatical sensitivity factor on which the MLAT-IV Words in Sentences subtest loaded most highly also had relatively high loadings from two subtests of the Scholastic Aptitude Test (SAT). From this, he inferred that the MLAT subtest in question represents "a fairly good test of general intelligence" (p. 20). Skehan (1980) and Wesche et al. (1982) have similarly shown relative high loadings from this MLAT test of grammatical sensitivity on factors of verbal and general intelligence, respectively. In addition, Carroll (1990) has speculated that another component of language aptitude, inductive language learning ability, seen as best measured by the PLAB Linguistic Analysis subtest, is "probably substantially correlated with the inductive factor that has appeared in numerous factor-analytic studies of cognitive ability" (p. 22). Evidence for the contribution of this PLAB subtest to a general cognitive ability factor is provided by Sasaki (1993).

The preceding studies, all conducted with adult L2 learners, do not tell us whether analytical language abilities are likely to be associated with L2 proficiency when intensive L2 exposure begins in adolescence. However, assuming that there is a relatively strong relationship between analytical language ability and general cognitive ability, we can look for indirect support for this hypothesis in research carried out on the relationship between general cognitive ability and L2 proficiency. Among adults, Sasaki (1993), for example, has shown a substantial correlation between two such general factors. Among adolescents, relevant findings were reported by Genesee (1978/1979) and Harley (1986). In different samples of late immersion students at the grade 7 and 10 levels, both studies revealed a significant relationship between oral L2 proficiency and scores on intelligence tests. The same relationship did not

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hold for early immersion students at comparable grade levels. In short, research among later learners relating analytical aspects of language aptitude to intelligence test scores, on the one hand, and intelligence test scores to communicative L2 outcomes, on the other, brings us back to the critical period hypothesis and the prediction that analytical abilities will be more heavily involved when L2 learning begins after childhood. In the present study, then, our main hypothesis is stated as follows: In late immersion beginning in adolescence there will be a positive relationship between L2 outcomes and an analytical dimension of language aptitude, whereas in early immersion beginning in grade 1, a positive relationship will hold between L2 outcomes and memory abilities.

METHOD

The Sample

The sample for this empirical study of the relationship between aptitude components and L2 proficiency in early and late French immersion consisted of 65 11th-grade students in four different classes and schools in a southern Ontario regional school board. Students in two of the four classes were continuing an early partial French immersion program in which exposure to French began for most students in grade 1 ($n = 36$).[3] At each grade level from grade 1 on, including the current grade, the students in early partial immersion had been receiving 50% of their daily instruction via the medium of their second language, French, and the other 50% in English. Students in the other two classes ($n = 29$) were continuing a late immersion program that had begun in grade 7 with a similar 50% French and 50% English instructional pattern. These late immersion students were likewise still receiving 50% of their curriculum in French at grade 11. Prior to the beginning of their immersion program, the late immersion students had received some nonintensive instruction in French, having attended the board's regular "core French" program of 40 minutes per day from grade 4 to grade 6.[4] It was not until grade 7, however, that their intensive L2 exposure began. The total sample of 65 included most of the students attending the four immersion classes.[5] In each group, there were three students who reported speaking a third language at least sometimes at home. In the early immersion group, there were two students who spoke Polish at home, one of them "sometimes" and the other "about half the time," and one student who spoke Chinese at home "most or all of the time." In the late immersion group, one student spoke Turkish and another Croatian for "about half the time" at home, and a third student "sometimes" spoke Gujarati at home. There was a similar distribution of male and female students in the early and late immersion groups, with approximately 60% female and 40% male students in each group.

Aptitude Measures

Measures of memory and analytical language ability were obtained via three group-administered tests given in a single class period. The tests are described here in their order of administration, which was the same for the early and late immersion groups.

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Associative Memory. The first memory measure was the MLAT-IV Word Pairs subtest, used as a test of associative memory. In this test, students first had to study a list of 24 Kurdish–English word pairs for 2 minutes. Next, they had 2 more minutes to practice writing English meanings for the Kurdish words, referring to the initial list if they wished. Their recall of the word pairs was then tested on 24 multiple-choice items each consisting of a Kurdish stimulus word and five potential translation equivalents in English, only one of which was the correct answer. Four minutes were provided for this recall phase of the test.

Memory for Text. A second memory measure was selected to extend coverage in the memory domain to memory for text, in accordance with Skehan's findings indicating that this aspect of memory ability—described as the ability "to analyse text, to extract its propositional content, and remember such content" (Skehan, 1989, p. 31)—was significantly correlated with L2 learning success. The memory-for-text measure used in the present study was based on a subtest in Wechsler's (1972) Memory Scale, Form 1, adapted for group administration. Two short narrative texts in English, the contents of which were revised to suit the Canadian context, were prerecorded on audiotape. Immediately after listening once to the first text, the students were given 3 minutes to write down as much as they could remember of the narrative on a blank sheet provided. The procedure was then repeated with the second text. For scoring purposes, each text was deemed to contain 24 information bits. A student score consisted of the average of the number of information bits included in each written version.

Analytical Ability. To assess the ability to analyze language structure, we considered both the MLAT-IV Words in Sentences subtest and the PLAB-IV Language Analysis subtest, and we decided on the latter. This decision was made in light of suggestions (Carroll, 1990; Skehan, 1980) that formal training in grammar might have a moderating effect on grammatical sensitivity measured by the MLAT subtest. Because we anticipated that late immersion students would have had more initial emphasis on grammar instruction in their program than the early immersion students, the Words in Sentences subtest could have biased our results in favor of the hypothesis that success in late immersion would be more closely related to analytical ability. The PLAB-IV Language Analysis subtest, seen as measuring inductive language learning ability, was therefore our preferred choice. In this test, students are given a small corpus of language data in an unknown language together with English glosses. From this information, they have to infer how the new language system works and, for each of 15 multiple-choice items, select the correct way of expressing in the new language a stimulus statement provided in English. Students in the present study were given 10 minutes to do this test.

L2 Proficiency Measures

Proficiency measures in French were designed to assess various dimensions of L2 knowledge and use, including vocabulary recognition, listening and reading comprehension, and oral and written production. Apart from the oral production tasks that

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were administered individually to a subsample of 9–10 students in each class, the proficiency tests were administered on a group basis to each of the four classes during a single class period.

Vocabulary Recognition. This yes or no test of vocabulary recognition knowledge (based on work by Meara, 1994; see also Meara & Buxton, 1987) consisted of a list of 66 real French words interspersed with 34 pseudowords that conform to the phonological and orthographic conventions of French. Students had 8 minutes to look through the word list and cross out any words that they did not know well enough to say what they mean. In scoring, a formula (Meara & Buxton, 1987) was used to correct for guessing; that is, correcting for when students fail to cross out pseudowords, thus erroneously claiming to know what they mean. In the present test, the real words were taken from a utility index of French words (Savard & Richards, 1970), whereas the pseudowords were derived from Meara's (1994) database.

Listening Comprehension. In this test, consisting of selected items from an existing listening comprehension test designed for immersion students by the Second Language Institute, University of Ottawa, and the Modern Language Centre, Ontario Institute for Studies in Education (1988), students listened to five tape-recorded excerpts from oral discourses in French such as an interview with a French-speaking teenager and radio broadcasts. Topics ranged from sports to industrial pollution. Following each segment, which they heard once, students responded to several multiple-choice comprehension questions written in their test booklet. Prior piloting of the original test with a class of late immersion students in the present study had revealed that it was too long and that some items on the test were too difficult for these students. These items were therefore dropped from the test for this study. The maximum score on the final 13-minute test was 17.

Cloze Test and Written Production Task. The cloze test was based on a written French passage of three short paragraphs extracted from an authentic essay on the evils of money and materialism. Twenty-five words were deleted from the text and replaced with blanks. Deletion was carried out on a rational rather than a random basis to focus on items that represented various parts of speech and would be readily inferable from context by native speakers. The students' task was to fill in the missing words. Once they had completed this cloze task or when 15 minutes were up, the students were given 5 more minutes to respond in writing to the following open-ended question related to the reading passage: *Est-ce que l'argent est un élément indispensable au bonheur à ton avis? Pourquoi ou pourquoi pas?* ("Is money indispensable to happiness in your opinion? Why or why not?"). The 25 items in the cloze passage were scored by the acceptable method, based on the way in which three native speakers of French filled in the blanks. These native speakers were generally consistent in their responses, with a few variations in, for example, adjectives. The judgments of two native speakers were also obtained with respect to any other potentially acceptable responses produced by the immersion students.

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The written responses to the open-ended question were scored in two ways: (a) for task fulfillment—that is, for the ideas the student was able to get across—and (b) for linguistic accuracy. Task fulfillment was scored on a 5-point scale according to criteria developed for a similar writing task in the Senior Secondary French Proficiency Test Package for French Immersion (Second Language Institute, University of Ottawa, and Modern Language Centre, Ontario Institute for Studies in Education, 1988). Points ranged from a minimum of 0 for no answer attempted in French or an incomprehensible answer to a maximum of 4 points depending on the amount of explanation and examples given to justify the stated opinion. The score for linguistic accuracy consisted of a count of the number of error-free T-units produced.

Individual Oral Test. The first part of this test was an elicited imitation task from the Senior Secondary French Proficiency Test Package for French Immersion. The student listened to a short tape-recorded broadcast in French advertising the evening programs for the day. The broadcast was then replayed sentence by sentence. The student's task was to repeat each one of the 14 sentences in turn after it was heard. Two kinds of scores were based on the student's tape-recorded responses: In an exact scoring method, 1 point was awarded for each sentence repeated exactly as produced on the tape, and in an equivalent scoring method, 1 point was awarded for each sentence that was semantically equivalent to the taped sentence but that may have contained some grammatical errors or may have been missing one content word. By either scoring method, the maximum score was 14. The second part of the oral test consisted of a cartoon description task (based on Harley, 1986). The student was shown four cartoon strips and asked to say what was happening in each. The descriptions were recorded, and scoring from the tape focused on variety of verb vocabulary in French, that is, total number of lexically appropriate verb types used in describing the four cartoons. Grammatical errors were ignored, and there was no maximum score on this task.

Procedures

Testing took place in the four schools during the months of October and November. Researchers made three visits to each class during 75-minute immersion class periods. The first occasion was devoted to the administration of the three language aptitude tests and a background questionnaire concerning students' prior language experience and French program history. On the second visit, we gave the group tests of French proficiency and began individual oral testing. The oral testing was then completed at the time of a third visit.

ANALYSIS AND FINDINGS

For random subsamples of students, interrater reliabilities were calculated on language aptitude and L2 proficiency measures for which subjectivity in scoring could have affected results. Satisfactorily high reliabilities were obtained. On the memory for text measure of aptitude, nine students' versions of the two narratives were

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Table 1. Language aptitude by immersion program

	Early Immersion (n = 36)		Late Immersion (n = 29)		Significance Level (Two-Tailed t Test)
	M	*SD*	*M*	*SD*	
Word pairs[a]	15.4	4.5	16.8	5.3	.261
Memory for text[a]	11.2	3.7	12.8	2.5	.063
Language analysis[b]	7.4	3.0	9.1	3.7	.045

[a]Maximum score = 24. [b]Maximum score = 15.

Table 2. French proficiency by program

	Early Immersion (n = 36)		Late Immersion (n = 29)		Significance Level (Two-Tailed t Test)
	M	*SD*	*M*	*SD*	
Vocabulary recognition[a]	0.66	0.12	0.44	0.14	.000
Listening comprehension[b]	8.9	3.3	7.8	2.8	.130
Cloze[c]	10.1	3.5	10.0	3.4	.949
Written task fulfillment[d]	2.3	1.0	3.0	0.8	.003
Written accuracy[e]	0.91	1.16	1.38	1.21	.123
Sentence repetition—exact[f]	1.1	1.1	0.9	1.1	.577
Sentence repetition—equivalent[f]	9.3	2.7	7.3	3.1	.038
Oral verb vocabulary[e]	17.9	4.0	17.2	3.7	.556

Note: n = 18 for early immersion and n = 20 for late immersion for sentence repetition and cartoon description (oral verb vocabulary measure) in each program; for the written grammar (accuracy) measure, n = 33 for early immersion, and n = 29 for late immersion; for all other measures, n = 36 for early immersion and n = 29 for late immersion.
[a]Maximum = 1. [b]Maximum = 17. [c]Maximum = 25. [d]Maximum = 4. [e]No maximum. [f]Maximum = 14.

rescored by a second rater; 89.5% level of agreement was found with the scores of the first rater. On the oral sentence repetition task in French, 95% level of agreement was found when eight students' performances were rescored by the equivalent method. On the open-ended question following the cloze passage, agreement levels of 80% and 90% were obtained for task fulfillment and linguistic accuracy, respectively, on subsamples of 10 written responses.

To test the hypothesis that an early start to an immersion program beginning in grade 1 or kindergarten would be associated with higher eventual language aptitude scores than the later start in grade 7, two-tailed t tests were used to compare the aptitude scores of the grade 11 early and late immersion students. As Table 1 shows, the early immersion students' language aptitude scores were on average not significantly higher than those of the late immersion students. On the contrary, the latter scored significantly higher on one of the aptitude measures, namely, Language Analysis (9.1 vs. 7.4, $p < .05$).[6] In terms of L2 proficiency, where there were differences, they tended to be in the opposite direction (see Table 2). On two proficiency measures, vocabulary recognition and sentence repetition (equivalent method of scoring), the early immersion students performed significantly better than the late immersion students ($p < .001$ and $p < .038$, respectively). In particular, the early

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Table 3. Pearson correlations of language aptitude and French proficiency measures for early immersion students

French Proficiency	Language Aptitude		
	Word Pairs	Memory for Text	Language Analysis
Vocabulary recognition	.37*	.53**	.22
Listening comprehension	.49*	.50**	.48**
Cloze	.03	.40*	.30
Written task fulfillment	.17	.13	<.01
Written accuracy	.17	.27	.01
Sentence repetition—exact	.26	.43	.16
Sentence repetition—equivalent	.28	.16	.17
Oral verb vocabulary	.14	−.25	−.13

Note: Pairwise deletion of missing cases. n = 18 for early immersion for sentence repetition and oral verb vocabulary; for all other measures, n = 33–36 for early immersion.
*$p < .05$. **$p < .01$.

immersion average score of 66% on vocabulary recognition was substantially higher than that of the late immersion students at 44%. The late immersion students, however, scored significantly higher on written task fulfillment.

The hypothesis that the relationship between components of language aptitude and L2 proficiency would differ for the two immersion groups was tested via correlations and regression analysis. As an initial step, we ran Pearson product-moment correlations between aptitude and proficiency measures within each group. Among early immersion students, significant correlations ranging from .40 to .53 emerged between memory for text and three group-administered tests of L2 proficiency: vocabulary recognition, listening comprehension, and cloze (see Table 3). The MLAT-V Word Pairs test also correlated significantly at .37 with vocabulary recognition and at .49 with listening comprehension. The PLAB-1V Language Analysis test correlated significantly at .48 with listening comprehension only. For the subsample of 18 orally tested early immersion students, there were no significant correlations between aptitude and oral proficiency measures, although a near-significant correlation of .43 (p = .073) was registered between memory for text and sentence repetition, exact score. Among late immersion students, a different pattern of correlations was obtained (see Table 4). In this instance, significant correlations were found between language analysis and several L2 proficiency measures. Language analysis correlated significantly with vocabulary recognition at .41, with cloze at .41, with task fulfillment in writing at .43, and with written accuracy at .44. There was only one significant correlation between a memory measure and an L2 proficiency measure for the late immersion group: Word pairs correlated with written accuracy at .39. As was the case for the early immersion students, there were no significant correlations between language aptitude measures and oral L2 measures for the subsample of 20 late immersion students, although a near-significant relationship between word pairs and sentence repetition, exact score (.42, p = .068) may be noted.

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Table 4. Pearson correlations of language aptitude and French proficiency measures for late immersion students

	Language Aptitude		
French Proficiency	Word Pairs	Memory for Text	Language Analysis
Vocabulary recognition	.15	.09	.41*
Listening comprehension	−.34	.34	−.07
Cloze	.32	.14	.41*
Written task fulfillment	.23	−.09	.43*
Written accuracy	.39*	−.04	.44*
Sentence repetition—exact	.42	−.03	.10
Sentence repetition—equivalent	.25	.20	.31
Oral verb vocabulary	.18	−.14	.27

Note: Pairwise deletion of missing cases. $n = 20$ for late immersion for sentence repetition and oral verb vocabulary; for all other measures, $n = 29$ for late immersion.
*$p < .05$.

Table 5. Pearson correlations among language aptitude measures by immersion program

	Early Immersion ($n = 36$)		Late Immersion ($n = 29$)	
	Word Pairs	Memory for Text	Word Pairs	Memory for Text
Memory for text	.25		.30	
Language analysis	.38*	.21	.54**	.31

*$p < .05$. **$p < .01$.

As a prelude to the regression analyses designed to provide a more stringent test of the hypothesis that different memory and analytical language abilities would predict L2 proficiency in the two groups of immersion students, additional correlational analyses were conducted to examine relationships among the three aptitude measures. Table 5 presents correlations among these measures for the early and late immersion groups separately. Language analysis was significantly correlated in both the early and late immersion samples with word pairs (at .38 and .54, respectively) but not with memory for text. At the same time, there was no significant relationship between word pairs and memory for text in either immersion group. This suggests that memory for text is providing a measure of memory ability that is more distinct from analytical language ability than the word pairs measure and that word pairs and memory for text may be measuring substantially different abilities.

Correlations among proficiency measures revealed different patterns of relationships in the early and late immersion groups (see Tables 6–7). For early immersion, significant positive relationships ranging from .40 to .70 emerged among all the group-administered measures of proficiency, except for task fulfillment in writing,

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Table 6. Pearson correlations among French proficiency measures for early immersion

	Vocabulary Recognition	Listening Comprehension	Cloze	Written Task Fulfillment	Written Accuracy	Sentence Repetition Exact	Sentence Repetition Equivalent
Listening comprehension	.58***						
Cloze	.47**	.70***					
Written task fulfillment	.28	.20	.29				
Written accuracy	.27	.40*	.51**	.58***			
Sentence repetition—exact	−.30	.44	.19	.15	.12		
Sentence repetition—equivalent	.06	.34	−.10	.14	−.29	.27	
Oral verb vocabulary	−.16	.23	−.03	.45	.25	.03	.43

Note: Pairwise deletion of missing cases. $n = 18$ for early immersion for sentence repetition and oral verb vocabulary; for all other measures, $n = 36$ for early immersion.
*$p < .05$. **$p < .01$. ***$p < .001$.

Table 7. Pearson correlations among French proficiency measures for late immersion

	Vocabulary Recognition	Listening Comprehension	Cloze	Written Task Fulfillment	Written Accuracy	Sentence Repetition Exact	Sentence Repetition Equivalent
Listening comprehension	−.02						
Cloze	.19	.27					
Written task fulfillment	.49**	−.16	.30				
Written accuracy	.31	.07	.41*	.27			
Sentence repetition—exact	.01	−.01	.42	.19	.49*		
Sentence repetition—equivalent	.24	.09	.29	.35	.23	.57**	
Oral verb vocabulary	.38	.02	.32	.29	.44	.17	.43

Note: Pairwise deletion of missing cases. $n = 20$ for late immersion for sentence repetition and oral verb vocabulary; for all other measures, $n = 29$ for late immersion.
*$p < .05$. **$p < .01$.

Table 8. Stepwise regression: Predicting French proficiency in early immersion from dimensions of language aptitude

Dependent Variables (French Proficiency)		Predictor	Adjusted R^2	F Value[a]	Significance Level of F Value
Vocabulary recognition	Step 1	Memory for text	.26	12.05	.002
Listening comprehension	Step 1	Memory for text	.23	10.56	.003
	Step 2	Language analysis	.38	10.75	.000
Cloze	Step 1	Memory for text	.14	6.00	.020
Written task fulfillment	Step 1	No entry			
Written accuracy	Step 1	No entry			
Sentence repetition—exact	Step 1	No entry			
Sentence repetition—equivalent	Step 1	No entry			
Oral verb vocabulary	Step 1	No entry			

Note: Probability for inclusion = .05; probability for exclusion = .10. Language aptitude variables: associative memory, memory for text, and language analysis.
[a]For equation.

which correlated only with the written accuracy measure (.58). For the orally tested subsample of early immersion students, listening comprehension was near-significantly correlated with oral sentence repetition exact (.44, $p = .065$). For late immersion, there were altogether fewer significant correlations among proficiency measures. Cloze was significantly related to written accuracy, and vocabulary recognition to written task fulfillment; listening comprehension did not correlate with any other proficiency measure. In the subsample of 20 orally tested late immersion students, the two sentence repetition measures were, however, significantly correlated at .57, and written accuracy also correlated significantly with sentence repetition exact (.49) and near-significantly with oral vocabulary (.44, $p = .053$). Based on these findings, we concluded that the correlations among proficiency measures, even among early immersion students, were insufficiently strong to justify constructing a consolidated set of proficiency measures, based on additive scales or factor analytic methods.

Stepwise regression analyses using the three aptitude measures as predictor variables and each of the L2 proficiency measures in turn as the dependent variable were then conducted separately for the early and late immersion groups. Results are presented in Tables 8 and 9.

Early Immersion. For the early immersion group, memory for text was the main predictor of proficiency scores on the vocabulary recognition, cloze, and listening comprehension measures. As shown on Table 8, stepwise regression analysis revealed memory for text as the only statistically significant predictor of vocabulary recognition and cloze scores for the early immersion group. In the case of listening comprehension, memory for text was the strongest predictor variable, entering the equation at Step 1; language analysis, however, was also a significant predictor and entered the equation at Step 2, increasing the adjusted R^2 from .23 at Step 1 to .38 at Step 2. Apart from its role in predicting listening comprehension, language analysis

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Table 9. Stepwise regression: Predicting French proficiency in late immersion from dimensions of language aptitude

Dependent Variables (French Proficiency)	Predictor		Adjusted R^2	F Value[a]	Significance Level of F Value
Vocabulary recognition	Step 1	Language analysis	.13	5.36	.028
Listening comprehension	Step 1	No entry			
Cloze	Step 1	Language analysis	.14	5.53	.026
Written task fulfillment	Step 1	Language analysis	.15	6.12	.020
Written accuracy	Step 1	Language analysis	.16	6.53	.017
Sentence repetition—exact	Step 1	No entry			
Sentence repetition—equivalent	Step 1	No entry			
Oral verb vocabulary	Step 1	No entry			

Note: Probability for inclusion = .05; probability for exclusion = .10. Language aptitude variables: associative memory, memory for text, and language analysis.
[a]For equation.

did not enter any other regression equation, and word pairs, the measure of associative memory, did not emerge as a statistically significant predictor of any of the proficiency measures for the early immersion students. None of the aptitude measures was predictive of early immersion scores on written task fulfillment or written accuracy, nor on any of the oral measures administered to the subsample of 18 early immersion students.

Late Immersion. For the late immersion students, unlike the early immersion students, language analysis was the only statistically significant predictor of L2 proficiency scores (see Table 9). It accounted in general for less variance in late immersion scores than memory for text did in early immersion scores. Specifically, language analysis was a significant predictor of late immersion scores on vocabulary recognition, the cloze test, written task fulfillment, and written accuracy. No aptitude measure emerged as a significant predictor of scores on the listening comprehension test or on the three oral measures administered to the subsample of 20 late immersion students.

DISCUSSION

The main question investigated in this study was whether different components of language aptitude would be positively associated with L2 outcomes in early and late immersion. Results were generally in line with the predictions made. Before discussing these findings, we first consider the evidence relating to the hypothesis that the early immersion students would have higher aptitude scores than the late immersion students owing to the greater opportunity available in early immersion to develop language learning strategies in childhood. This hypothesis was not supported by the aptitude test results. We are hesitant to conclude from these findings that, in contrast to the students in Eisenstein's (1980) research, the early immersion students' intensive L2 exposure in childhood did not make a difference to their language aptitude.

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This interpretation would be compatible with the notion of language aptitude as a stable individual attribute that is relatively impervious to environmental influences. A problem, however, is that we cannot rule out the possibility that the late immersion students were a more select group of higher aptitude learners in the first place and that this continued to be reflected in their grade 11 aptitude scores, especially in their significantly higher performance on the PLAB-IV Language Analysis test. Indeed, the problem of ascertaining initial comparability of groups is one that also arises in prior aptitude studies in which advantages have instead been found for those with more prior language learning experience (e.g., Eisenstein, 1980; Nation & McLaughlin, 1986; Nayak et al., 1990). In the present study, a different finding of greater language aptitude among early immersion students relative to late immersion students would have provided more convincing evidence with respect to the experience hypothesis.

With respect to our main research question, findings from the correlational and regression analyses provide support for the hypothesis that different components of language aptitude would be associated with L2 proficiency among the early and late immersion students. For those proficiency measures for which aptitude measures were significant predictors, early immersion students' L2 outcomes were much more likely to be associated with a memory measure than with a measure of analytical language ability, whereas the opposite was the case for the late immersion students, for whom analytical language ability was the only significant predictor of L2 proficiency. One interpretation of these findings, in keeping with the notion of a maturationally determined critical period for language acquisition in childhood, is that when intensive L2 exposure begins around adolescence, language learning will tend to depend on different cognitive abilities from those that early learners rely on, with analytical language ability being more intimately involved in L2 success for later learners. Experience in the two programs could, however, also be a factor, with initial instruction in early immersion oriented toward incidental learning and holistic processing of meaning in context, and in late immersion involving a heavier initial focus on the second language as a code to be taken apart and intentionally mastered. Dicks (1992), for example, observed such program differences in grade 8 early and late immersion classes in the Ottawa Board of Education. To the extent that these two orientations are in fact characteristic instructional differences between the two programs involved in the present study (which was carried out in a different region of Ontario), they could have affected the learning strategies that students employed. At the same time, however, such different instructional orientations could be regarded primarily as responses to age differences in maturation of early and late immersion students at the initial phase of their respective programs. Whether adolescent L2 experience outside a classroom context would produce a similar association between analytical language ability and L2 outcomes, or whether it would, as in early immersion, be more closely associated with a memory dimension is an issue that needs to be examined in further research. Kemler Nelson and Smith (1989), for example, have argued that, compared to analytic processing, "holistic processing may constitute a less resource-intensive, fallback mode of cognition that is especially associated with the lack of a deliberate, strategic approach" (p. 132). Children, in

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their view, "are especially likely to manifest holistic processing, perhaps because they typically function in such a nonstrategic cognitive mode" (p. 132), but this mode is also available for adults to fall back on when learning conditions are not conducive to their "normally deliberate, resource-intensive, problem-solving bent" (p. 133). One implication of this view might be that a memory dimension of language aptitude is more likely to be associated with L2 proficiency in adolescent beginners when L2 exposure occurs largely outside the L2 classroom setting. Perhaps significant is that several case studies of exceptionally talented adult L2 learners have found them to have strong memory abilities, which may have been a factor in their success (e.g., Ioup, 1989; Novoa, Fein, & Obler, 1988; Schneiderman & Desmarais, 1988).

The results of this study do not support the argument that the analytical, problem-solving abilities of older learners will actively interfere with their L2 learning success as Felix (1985) predicted, because the PLAB Language Analysis test of inductive language learning ability was positively associated with L2 outcomes in the late immersion group, and among early immersion students as well, language analysis made some contribution to L2 listening comprehension scores. The fact that the L2 proficiency results achieved by the analytically oriented late immersion students were not substantially different from those of the early immersion students, who had had much more exposure to the L2, also points to the positive influence of analytical language ability on the L2 learning of the late immersion students. It is likely, however, that over time the heavy investment of cognitive resources entailed by an analytical orientation toward L2 learning is hard for older learners to maintain in the face of competing demands on their time and energies, especially when they are outside a sustaining academic environment. Strong memory abilities to fall back on may then be one of the components of language aptitude that serves as a necessary accompaniment to analytical abilities in promoting a high level of long-term L2 success among older learners.

In the present study, we note that relative success on some tests of L2 proficiency was not significantly associated with any of the aptitude measures we used and that there were some differences between early and late immersion students as to which L2 measures were significantly related to aptitude scores. The relatively small number of orally tested students in each group may have been a factor in the general lack of aptitude–proficiency relationships found on the oral production tasks. These tasks may also not have produced sufficient variability among students for clear relationships with aptitude to emerge. The sentence repetition task proved generally difficult for early as well as late immersion students (see Table 2), and there are indications from other research (Laufer & Shahaf, 1995) that in spontaneous production learners may fall back on a relatively undifferentiated set of familiar vocabulary items that do not necessarily reflect the range of vocabulary knowledge displayed on more controlled tasks. As Table 2 shows, early immersion students did much better than late immersion students on the vocabulary recognition test, but the variety of oral verb vocabulary used by early immersion students in the cartoon description task was not significantly greater than that of the late immersion students. Furthermore, we see in Table 6 that there is no positive correlation (−.16) between vocabulary recognition and oral verb vocabulary for the early immersion

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subsample and even among late immersion students with a smaller overall recognition vocabulary there is still a nonsignificant relationship between the two vocabulary measures of .38 (see Table 7).

Only three aptitude measures were used in the present study, and it is likely that the addition of other components of language aptitude, such as phonetic coding ability and auditory ability, would have added predictive value, especially to oral measures and listening comprehension. It is surprising that for the early immersion students there was no relationship between any aptitude measure and the L2-writing measures (written task fulfillment and accuracy). Successful performance on this context-reduced, academic task may have required more dependence on a strategic analytical mode of processing (cf. late immersion results on Tables 2 and 4) than appears typically to have characterized the L2 use of the early immersion students.

In the regression analysis, the MLAT Word Pairs test of associative memory was a nonsignificant predictor of L2 proficiency scores not only among late immersion students (as anticipated) but also among the early immersion students for whom a significant relationship with L2 proficiency was expected. The fact that this aptitude test was significantly correlated with the PLAB Language Analysis test for both early and late immersion students, and not significantly correlated with memory for text (Table 5), raises questions about the interpretation of scores on the word pairs test. In fact, Carroll (1990, p. 20) himself has expressed some doubts about the validity of this test, indicating that he has never been as confident about its validity as about some other MLAT subtests.

CONCLUSIONS

Through an examination of relationships between components of language aptitude and L2 proficiency measures, this study has presented some initial evidence in support of the view that different cognitive abilities will tend to be associated with relative L2 success in an early and late immersion program, with eventual L2 proficiency outcomes from early immersion being more closely associated with memory ability and late immersion outcomes with analytical language ability. The findings should not be construed, however, as evidence that across age-of-onset groups one of these abilities is more predictive of long-term L2 success than the other. One interpretation in line with Lenneberg's (1967) predictions for postpubertal L2 learners is that successful L2 acquisition resulting from a later start will, for maturational reasons, be more heavily reliant on analytical language ability than successful L2 acquisition resulting from an early start. But we cannot rule out the alternative interpretation that the differences found in this study are an artifact of the particular programs involved. More research is therefore now needed to determine whether the findings of this study are generalizable to other learning contexts and other L1–L2 combinations and to delve deeper into the questions of how different processing modes relate to long-term L2 success in learners of different onset ages and of how maturational and environmental factors interact in prompting the use of different L2 processing modes.

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NOTES

1. Most studies of language aptitude–proficiency relationships have been carried out in L2 classroom contexts. However, Reves (1983) also found measures of aptitude to be predictive of L2 outcomes when acquisition was taking place largely in the L2 environment outside the classroom.

2. As McLaughlin (1990, p. 164) has pointed out, the association of Carroll's model of language aptitude with variance in classroom foreign language learning may account for the neglect of this model in recent research focused on universal aspects of naturalistic second language acquisition. Both McLaughlin (1990, p. 165) and Skehan (1989, pp. 40–42) have argued that the various components of language aptitude are logically just as relevant to informal as to formal language learning contexts.

3. Grade 1 was the starting point for early immersion in this particular school board; however, 8 of these 36 students had joined the program after having attended an early total French immersion program in another school board for some portion of their elementary schooling. These eight students' French immersion experience had started in kindergarten.

4. Four of the late immersion students had started core French at other grade levels: two of them at grade 2, 1 at grade 5, and 1 at grade 6.

5. Excluded from the early immersion sample were five students whose French proficiency could not be attributed to an early start to French immersion in the primary grades, either because they had attended French language schools at the elementary level and spoke French with family at home (four students) or because in one case the student had entered the early immersion program only at grade 5. In the late immersion classes, three students were excluded from the late immersion sample because they had also attended an early immersion program or a French language school at the elementary level.

6. No change in this pattern of findings occurred when we reran the analysis having removed from the late immersion sample the three students who spoke a third language at least sometimes at home and who may have had exposure to more than one language in early childhood.

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