Individual differences in child English second language acquisition

Comparing child-internal and child-external factors

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This study investigated how various child-internal and child-external factors predict English L2 children's acquisition outcomes for vocabulary size and accuracy with verb morphology. The children who participated (N=169) were between 4;10 and 7;0 years old (mean = 5;10), had between 3 to 62 months of exposure to English (mean = 20 months), and were from newcomer families to Canada. Results showed that factors such as language aptitude (phonological short term memory and analytic reasoning), age, L1 typology, length of exposure to English, and richness of the child's English environment were significant predictors of variation in children's L2 outcomes. However, on balance, child-internal factors explained more of the variance in outcomes than child-external factors. Relevance of these findings for Usage-Based theory of language acquisition is discussed.

Keywords: English language learners, child second language acquisition, individual differences, language aptitude, usage-based theory, l1 transfer

1. Introduction

Factors accounting for individual differences in acquisition have been studied extensively for monolingual child first language learners and adult second language learners (Dörnyei & Skehan, 2003; Hoff, 2006), but they have been studied much less in child second language (L2) learners. Understanding how child-internal and child-external factors influence the rate of L2 acquisition by children has both applied and theoretical relevance. Awareness of individual difference factors could be useful for educators and clinicians for interpreting evaluations of academic achievement and speech-language assessments based on the L2, or for giving advice to parents regarding language use at home and language of instruction at

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school (Paradis, Genesee & Crago, 2010). In addition, the relative weight of internal versus external factors in predicting acquisition rates is pertinent to constructivist or emergentist approaches to language acquisition, Usage-Based (UB) theory in particular. This is because such approaches strongly emphasize the role of input properties, i.e., external factors, as determinants of the language acquisition process (Bybee, 2001, 2008; Ellis, 2002, 2008; Tomasello, 2003). Therefore, such approaches predict that variations in child-external factors would play a prominent role in explaining individual differences. The present study investigated how child-internal and child-external factors predict English L2 children's acquisition outcomes for vocabulary size and accuracy with verb morphology. This study included a larger number of individual difference factors than most previous studies to date on child L2 learners, and in so doing, the relative impact of each factor, as well as internal factors and external factors as sub-groups, could be examined.

1.1 Child-internal factors

Factors influencing language acquisition rates that vary among individuals can be categorized as internal or external to the learner. Child-internal factors include the following: language aptitude, transfer of morphosyntactic features/constructions from L1 to L2, and cognitive maturity as represented by chronological age. Prior research indicates that each of these factors could potentially influence children's L2 acquisition rates.

Language aptitude is considered to be a kind of intelligence that is inherent to the individual, and measures of language aptitude are related, but not identical to, general intelligence as measured in the form of IQ (Dörnyei & Skehan, 2003; Sawyer & Ranta, 2002). Language aptitude is thought to consist of various components, including verbal memory skills and analytic reasoning or pattern recognition skills, and it is the most consistent predictor of success in adult L2 acquisition, next to motivation (Dörnyei & Skehan, 2003; Sawyer & Ranta, 2002). The few studies that have examined memory and analytic components of language aptitude in L2 children point to the possibility that these internal learning mechanisms are also predictive of L2 outcomes in this population (Genesee & Hamayan, 1980; Harley & Hart, 1997; Masoura & S. Gathercole, 1999; Ranta, 2002). This previous research has focused on older children and adolescents (except Genesee & Hamayan, 1980), and children acquiring a L2 as a foreign language or through immersion schooling; therefore, it would be informative to know if similar results are found for younger children who are minority L1/majority L2 learners.

Research on a variety of structures such as, object scrambling, definite/indefinite articles, auxiliary verbs, and clitic pronouns, has found evidence for the presence of L1 transfer in child L2 acquisition, either in terms of structural patterns

being carried over, or in terms of positive influence on the rates of acquisition when the L1 and L2 share similar grammatical features (Chondrogianni, 2008; Unsworth, 2005; Zdorenko, 2010; Zdorenko & Paradis, 2008; 2011). With respect to verb morphology in particular, Paradis (2005) and Paradis, Rice, Crago & Marquis (2008) found that at the early stages of English L2 acquisition, children's L1 background had little systematic impact on acquisition rates. However, in a longitudinal study with the same English L2 children, Blom, Paradis & Sorenson Duncan (2010; under review) found that whether a child's L1 was a richly inflecting or an isolating language was a significant predictor of how rapidly children acquired English verb inflection over a two-year period. Thus, in the present study, verb morphological characteristics of children's L1s were considered to be a potential source of individual differences. In addition, one pertinent aspect of the above research is that L1 transfer was not examined as an individual difference factor per se (except see Blom et al., 2010; under review); therefore, examining L1 transfer among other potential sources of individual differences would shed light on how prominent a role it plays in determining the rate of children's L2 acquisition.

Differential long-term outcomes for L2 learners with variations in age of acquisition within childhood have been well documented (Hyltenstam & Abrahamsson, 2003). But, what concerned this study was whether there are short-term age effects, or individual differences in children's developmental rates due to variations in age of L2 onset. A middle-childhood L2 onset has been found to be advantageous over an earlier onset for academic English skills, including vocabulary building (Collier, 1987; Roessingh, Kover & Watt, 2005). Golberg, Paradis & Crago (2008) found that children who began to learn English as a L2 older than 5;0 accumulated vocabulary faster in English than children who began to learn English younger than 5;0. In contrast, there is less evidence that older age of onset is advantageous for morphological acquisition. Meisel (2009) argued that early child L2 learners of French struggle with grammatical gender and produce errors unattested in monolingual or bilingual L1 acquisition of French; therefore, he proposed that the language acquisition mechanisms for morphology might begin to diminish as early as age 4;0, making a younger age of acquisition onset more advantageous. However, rate of acquisition was not specifically examined in Meisel's (2009) study. Jia & Fuse (2007) reported steeper growth curves at the initial stages for older L2 learners than for younger learners in their accuracy with English grammatical morphemes, but younger learners were more likely to achieve mastery of the morphemes over a five-year period. Because the older learners in this study were adolescents, it is unknown if this pattern would hold for older versus younger learners who were all children. One aim of this study was to examine the impact of differential age of onset on both morphosyntactic and lexical acquisition

in the L2, in order to understand if it affected both domains of language in a similar way.

1.2 Child-external factors

Child external factors are mainly factors that determine the quantity and the quality of the input the child receives in the target language. A child's quantity of input in the L2 could vary based on overall length of exposure, or differences in exposure time in school, in the community, and at home. Regarding quality of the input, variation in experience with native-speaker input, rich and complex input gained through activities like reading, and interlocutors whose interactive styles foster language development, could all contribute to differences in children's L2 acquisition rates. Previous studies that have examined the impact of child-external factors have touched on both quantity- and quality-oriented factors, and have found both to have an impact on children's development. However, few existing studies have examined both external input factors alongside a set of internal factors to assess the relative contribution of each type of individual difference factor; instead, the tendency has been toward comparing different sources of input factors.

The impact of the languages used at home on children's acquisition outcomes has been studied for both simultaneous bilingual and L2 children. Studies of French-English simultaneous bilingual children have shown that variations in how much of each language children hear and use at home influenced their acquisition rates for both the lexicon and morphosyntax (Paradis, 2009, 2010; Paradis, Nicoladis, Crago & Genesee, in press). Similarly, studies including bilingual children who speak both languages at home and those who speak one at home and one at school (L2 learners), in Wales (UK) and the United States, have revealed these variations in the amount of L2 exposure to have influence on children's speed of acquisition of both the lexicon and morphosyntax (Bohman, Bedore, Peña, Mendez-Perez & Gillam, 2010; Gathercole & Môn Thomas, 2009; Oller & Eilers, 2002). Jia & Aaronson (2003) and Jia & Fuse (2007) found a positive impact of different L2 input sources on Mandarin L1 children's English L2 acquisition in the United States; however, they combined use of English in the home with other input factors, and so whether use of English at home among family members had an independently positive effect on the children's English cannot be determined. Golberg et al. (2008) and Blom et al. (2010) examined growth in vocabulary and accuracy with verb inflection in English L2 children over two years, and found that even though the families varied in how much English was used in the home, this factor was not a significant determinant of children's acquisition rates. These conflicting findings could be rooted in parental proficiency in the languages used at home. In the case of the Welsh-English and French-English bilingual children

in prior research, it is likely that parents were native or proficient speakers of these languages. For example, in Paradis (2009), over 90% of parents reported using primarily their native-language with their children, and thus, in French-English bilingual homes, children usually experienced a one-parent one-language style of presentation from native-speakers of each language. In contrast, many L2 children from newcomer (immigrant and refugee) families might not be exposed to proficient input in the L2 at home if their parents are also in the process of learning the language (see also Bohman et al., 2010). In the present study, language use among family members at home was examined independently of other input factors to understand if the findings of Golberg et al. (2008) and Blom et al. (2010), also based on English L2 children in Canada, would be the same with a larger sample of children.

Turning to quality factors in the input, Jia and colleagues used a measure they referred to as "richness" of the English environment (Jia & Aaronson, 2003; Jia & Fuse, 2007). Part of this measure included whether the child had English native-speaker friends, read books in English, engaged in other media in English; in other words, it included how much native-speaker input, as well as rich L2 input, children received. These components all point more to quality than to quantity of input. However, as mentioned above, Jia and colleagues also included frequency of English use at home, including parents as interlocutors, in their English richness variable, and thus, it is not possible to distinguish between the more quantity-oriented language use at home factor, and the more quality-oriented richness factor, in their studies. Scheele, Leseman & Mayo (2010) examined enriching home language activities, such as reading, story-telling, conversations and educational TV, in the L1 and the L2 among Moroccan-Dutch and Turkish-Dutch families in the Netherlands. Their analyses revealed significant correlations between these quality-oriented activities in the L2 and L2 vocabulary outcomes. In the present study, home language input and richness of the English environment outside school were examined as separate factors in order to understand the relative impact of quality of input.

Family socio-economic status, often measured through maternal education levels, is a robust predictor of language development, vocabulary in particular, in monolinguals (Hoff, 2006). Researchers have also found higher maternal education to be associated with more advanced language development in bilingual and L2 children in the United States, Canada and the Netherlands (Blom et al., 2010; Bohman et al., 2010; Oller & Eilers, 2002; Golberg et al., 2008; Paradis, 2009; Scheele et al., 2010). Whether the quantity or quality aspects of the discourse style of highly-educated mothers is most important to its enhancing effects has been debated (e.g., Hoff, 2003). In Golberg et al.'s (2008) study, the children of mothers with post-secondary education had consistently larger vocabularies than children

of mothers with secondary-only education; however, mothers with post-secondary education reported using more of the L1 with their children than mothers with secondary-only education Similarly, Paradis (2009) found that French-English bilingual children whose mothers had university degrees had larger vocabularies in both languages, and this trend held regardless of whether the language of the vocabulary test matched the language the mother used most often with the child. Therefore, these studies point to the potential for a qualitative element in the impact of maternal education, because if quantity were the only important element, then it would be difficult to explain how hearing more of one language would boost children's vocabulary in the other language. Furthermore, Scheele et al. (2010) found that higher socio-economic status had a significant impact on Moroccan-Dutch children's L2 vocabulary, but did not have an impact on the L2 vocabulary of the Turkish-Dutch children. Their analyses revealed complex relationships between home language activities in L1 and L2 and socio-economic status that were different for the Moroccan-Dutch and Turkish-Dutch families. Thus, Scheele et al.'s (2010) results suggest socio-economic status should be considered as a separate factor from overall quantity of L2 input in the home. Accordingly, maternal education was considered a separate and more quality-oriented external factor in the present study.

1.3 Usage-based theory of language acquisition

Usage-based (UB) theory of language acquisition is part of a family of emergentist theories that assume language learning is the product of the interaction between input properties, sophisticated but largely domain-general perceptual and cognitive learning mechanisms, and social-pragmatic context, without innately-determined language knowledge being a component of the language learning process (O'Grady, 2008). UB theory has two key elements that are relevant to the concerns of the present study: (1) UB theory emphasizes the properties of the input as determinants of acquisition rates for both the lexicon and morphosyntax, and (2) UB theory assumes that the same learning mechanisms underlie development of the lexicon and morphosyntax (Bybee, 2001, 2008; Ellis, 2002, 2008; Lieven & Tomasello, 2008; Tomasello, 2003). According to these researchers, properties of the input that influence acquisition rates of words and morphological constructions include token, type and collocation frequency, salience, semantic complexity and distributional consistency. In this study, the input factors being examined are mainly associated with token frequency because they focus on the quantity and quality of the L2 input each child is exposed to. Variations in how much overall L2 input a child receives, and how much of that input is rich and native-like, could influence the frequency with which a child is exposed to the correct form of a

particular construction and to a diverse vocabulary, and this in turn, should result in variations among children in their lexical and morphosyntactic acquisition rates, following UB theory logic.

In spite of the strong research and theoretical emphasis on the role of input properties in acquisition, as mentioned above, UB theory, and emergentist approaches more generally, assume that domain-general perceptual-cognitive mechanisms also play a role in language acquisition. Examples of such mechanisms are the attention and memory systems, and the cognitive processes of generalization, categorization, and analogical reasoning, (see in particular Ellis, 2008; Gathercole, 2007; MacWhinney, 2008; O'Grady, 2008; Tomasello, 2003). In addition, the influence of existing L1 knowledge is also an internal factor that needs to be taken into account in L2 acquisition. Taking a UB perspective, Gathercole (2007) and Odlin (2008) argue that sharing between the two languages of a bilingual would be expected at the conceptual level, and thus, could facilitate transfer in the domain of lexical semantics, including the semantics of grammatical concepts encoded by functional morphemes, such as tense. Also according to a UB perspective, transfer from the L1 to the L2 in the domain of morphosyntax is possible, but would be constrained by the level of abstractness of the constructions involved. In the UB framework, constructions like inflectional verbal paradigms or periphrastic verb forms develop gradually overtime, beginning as lexically-specific schemas from which more abstract schemas emerge following processes of analogy, categorization and generalization, as well as interaction with the input (Bybee, 2001, 2008; Tomasello, 2003). Clearly, lexically-specific information is unlikely to transfer from one language to the other, but elements of abstract schemas could, in principle, be generalized from the L1 to the L2 (MacWhinney, 2008). Transfer of schemas for verb constructions from the L1 could potentially facilitate the development of analogous constructions in the L2, since there is evidence that even within one language, morphosyntactic constructions can be built on the basis of existing constructions, in what Abbot-Smith and Behrens (2006) label "construction conspiracy" (Zdorenko, 2010). Finally, on a UB perspective, transfer could also be viewed as taking place at the perceptual-attentional level where learners are directed to process or focus on linguistic structures or cues in the L2 based on their L1. For example, learners might attend to inflectional morphology in the L2, or expect agreement relationships to be an important cue for processing in the L2, if both are present in the L1 (Blom et al., under review; MacWhinney, 2008). Regarding the particular morphosyntactic constructions examined in this study, namely verb inflections and auxiliary verbs marking tense and agreement features, it would be expected that children whose L1s include construction schemas for verb inflections or auxiliaries with the features of tense and agreement would have the potential to transfer some of this information to their English L2 via conceptual

sharing, transfer of abstract elements of constructions, and attentional-perceptual processing mechanisms.

One aim of this study was to examine the contribution of child-internal factors on acquisition outcomes, e.g., language aptitude components, general cognitive maturity (age) and L1 structure, and furthermore, to compare their contribution with that of child-external input factors. Such a comparison could be informative to UB theory in terms of the relative weight of external factors in the language acquisition process, and whether this differs for the lexicon and morphosyntax.

1.4 The present study

The overall goal of this study was to examine the impact of individual difference factors on English L2 children's acquisition of vocabulary and verb morphology. The specific research questions asked were:

1. What is the contribution of the following factors to predicting variation in children's English L2 acquisition rates: language aptitude, L1 morphosyntax, child's age, and quantity and quality of English input?
2. What is the contribution of child-internal versus child-external factors as a group to predicting variation in children's L2 acquisition rates?
3. Does the contribution and combination of factors change depending on whether L2 vocabulary or L2 morphsyntax is the outcome variable?

2. Method

2.1 Participants

The 169 children who participated in this study were between the ages of 4;10 and 7;0 (mean = 5;10), had between 3 to 62 months of exposure to English (mean = 20 months), and came from newcomer (immigrant and refugee) families residing in Edmonton and Toronto, Canada (see Table 1). All children who qualified for inclusion in this study had to have been exposed primarily or exclusively to their L1 during the first two to three years of life, and have foreign-born parents who immigrated as adults. The majority of families used mainly the L1 as the language of communication in the home at the time of the study, and on average, children were first exposed to English around 4;2 (see 'AOE' and 'LANGHOME' columns in Table 1). Thus, these children were early L2 learners, since they experienced a sequence in their exposure to their two languages, and were exposed to their

L2 before 6–8 years of age[1], that is, before the period where long-term outcomes could differ from those of monolingual native-speakers.

Children's L1s were the following: (1) Chinese (Mandarin and Cantonese), (2) South Asian (Hindi, Punjabi and Urdu), (3) Spanish, and (4) Arabic. The morphosyntactic outcome variable in this study was verb morphology marking tense/agreement (details below in procedures), and so children's L1s were coded according to whether they mark tense and agreement features on verbs. The Chinese languages do not mark either of these features grammatically (Lin, 2001; Matthews & Yip, 1994), and so these languages were coded as "L1TNS=0". The other languages are all richly inflected for both these features and include auxiliary verbs, and so they were coded as "L1 TNS=1" (Bateson, 1967; Bhatia, 1993; Kachru, 2006; Mackenzie, 2001; Schmidt, 1999). Such coding was for the purposes of the regression analyses.

2.2 Procedures

Parents were given a questionnaire and children were given a battery of tests in English. The form and procedures for the questionnaire and the tests are described below along with the predictor or outcome variables that they yielded for the analyses.

Alberta Language Environment Questionnaire (ALEQ). With the assistance of a cultural broker-interpreter, parents were given a detailed oral questionnaire that included the following topics: parent education and self-rated fluency in English, number of older siblings, child's age at testing and age at onset of English exposure, language use among family members in the home, and the child's experiences with media, organized activities and playmates.[2] Maternal education was measured in years, and in terms of highest diploma/degree awarded. The mean years of maternal education is labeled MOTED in Table 1. Note that the mean is above 12 years, the number that typically coincides with the end of secondary education, which indicates that this sample is skewed toward mothers with higher levels of education. There were 99 mothers who had post-secondary diplomas or degrees, and 70 mothers with secondary level education or lower. Mothers were asked to rate their fluency in English using a 0–4 point rating scale: "no understanding/speaking ability"=0, "some understanding and can say short, simple sentences"=1, "good understanding and can express myself on many topics"=2, "can understand and use English adequately for work and most other situations"=3, and "can understand almost everything/very comfortable expressing myself in English in all situations"=4. The mean response was 2.31, indicating that the mothers, as a group, were not highly fluent English speakers (see MOTFLU in Table 1). The

average number of older siblings was .79, range 0–4, and the variable OLDSIB was included on the grounds that the more older siblings there are in the family, the more English might be brought into the home because they would have had more experience in English school. The child's chronological age is the variable AGE in Table 1. For their age at onset of English exposure (AOE), exposure was defined as "consistent and sustained", so that overhearing some television in the home or English in the community did not count, and for the vast majority of children, onset of English learning began with entry into a daycare, preschool or school program, regardless of whether they were born in Canada or not. (Families who reported using both English and the L1 equally from the child's birth were excluded from the study). Length of exposure to English in months (MOE in Table 1), was calculated from AGE and AOE. For language use in the home, parents were asked a series of questions with rating scale responses about the use of languages from each household member to the child, and the use of languages from the child to each household member. Scales were: "Mother tongue always/English never"=0, "Mother tongue usually/English seldom"=1, "Mother tongue 50%/English 50%"=2, "Mother tongue seldom/English usually"=3, "Mother tongue almost never/English almost always"=4. Rating scale responses were totaled, divided by

Table 1. Predictor variables used for analyses of l2 children's acquisition outcomes

	Factor	Mean	SD	Range
Internal	AGE	69.72	7.2	58–84
	AOE	50.12	11.3	10–76
	CTOPP	90.1	12.6	43–130
	CMMS	106	12	73–136
	L1 TNS	.64[a]	.48	0–1
External	MOE	19.56	11.7	3–62
	LANGHOME	.36	.23	.00–.95
	OLDSIB	.79	.97	0–4
	MOTFLU	2.31	1.1	0–4
	MOTED	14	4	0–22
	ENGRICH	.62	.15	.08–.88

NB: AGE = age at testing in months; AOE = age at onset of English exposure in months, CTOPP = phonological short term memory scores based on digit span and non-word repetition; CMMS = non-verbal IQ scores as a measure of analytic reasoning; L1_TNS = whether the L1 marked tense and agreement on verbs; MOE = months of exposure to English; LANGHOME = proportion of English spoken among family members in the home; OLDSIB = number of older siblings; MOTFLU = mother's self-rated fluency in English on a 0–4 point scale; MOTED = mother's education in years; ENGRICH = richness of the English environment outside school

[a]L1TNS = 0 (N = 60) or L1TNS = 1 (N = 109)

the highest total possible number (i.e., 4 for each scale), and a proportion of English use in the home was derived, LANGHOME in Table 1. Finally, parents were asked about the language and density of children's experiences with media like computer games, television and books, organized activities, and friends within an average week. Points were assigned according to whether the media, activity or playing with friends was in English or the L1 and how often the child engaged in these experiences. Points were totaled and divided by the highest possible score within either English or the L1, deriving an English richness and a L1 richness score. English richness, or ENGRICH, is the variable entered in Table 1. Among the child-external, or input factors, in this study, the more quantity-oriented ones were: MOE, LANGHOME and OLDSIB, and the more quality-oriented ones were: MOTFLU, MOTED, and ENGRICH; however, it is important to recognize the impossibility of completely disentangling quantity and quality elements for most of these factors, which is why the term "oriented" has been used.

Comprehensive Test of Phonological Processing (CTOPP; Wagner, Torgesen & Rashotte, 1999). The phonological memory sub-tests (digit span and non-word repetition) of the CTOPP were administered to the children. Each of these tests included a list of digits or nonwords that increased in length, played to the child from a CD, and the child was asked to repeat each one right after hearing it. Scores from non-word repetition and digit span were combined to yield the phonological memory composite score, a standard score calculated from raw scores according to age. There is much evidence that individual variation in phonological short term memory abilities is predictive of both L1 and L2 acquisition, and is thus a key component of language aptitude (Gathercole, 2006; Masoura & Gathercole, 1999); however, it needs to be acknowledged that children's phonological memory abilities when measured through their L2 could be somewhat depressed (Masoura & Gathercole, 1999; Sorenson Duncan, 2010; Thorn & Gathercole, 1999). This should not interfere with the analyses in this study because even if depressed generally, the children's scores showed a more than adequate range (see CTOPP in Table 1). Standard scores were used for the analyses rather than raw scores because standard scores are controlled for age, and age was another predictor variable.

Columbia Mental Maturity Scales (CMMS; Burgemeister, Hollander Blum & Lorge, 1972). Studies of older L2 learners and language aptitude include an analytic component, typically designed to measure the ability to analyse or detect patterns in a written unfamiliar language (Sawyer & Ranta, 2002). But, this kind of measure cannot be used with young, preliterate children, and so following Genesee & Hamayan (1980), children in this study were administered a non-verbal IQ screen as a measure of analytic abilities. The CMMS consists of diagrams of

pattern sequences that increase in complexity, and children must determine the best members of a sequence, and in so doing, employ skills of generalization, categorization and analogical reasoning. As with phonological memory scores from the CTOPP, standard scores were used from the CMMS to reduce the confound with chronological age as another predictor factor (see CMMS in Table 1).

Peabody Picture Vocabulary Test (PPVT-III, Dunn & Dunn, 1997). The PPVT is a measure of receptive vocabulary size. Children were asked to point to an image out of an array of four images that best matched a word spoken by the experimenter. The children's mean PPVT raw score was 62.88 (SD = 20.29, range = 11–112), and mean PPVT standard score was 87.78 (16.27, range = 40–125). PPVT raw scores were analysed as an outcome variable in the regression modeling.

Test of Early Grammatical Impairment (TEGI, Rice & Wexler, 2001). The TEGI consists of a group of probes, using picture sequences or puppets and toys, designed to elicit children's use of third person singular [-s], *a teacher teach<u>es</u>*, regular past tense [-ed] and irregular past tense, *he rak<u>ed</u>/he <u>dug</u>*, BE (copula and auxiliary), *the bears <u>are</u> soft, <u>is</u> the kitty thirsty?*, and DO (auxiliary), *<u>do</u> the bears want some juice?*. The TEGI yields an overall proportion correct score, the elicited grammar composite, that is calculated from children's accuracy in producing the required morpheme for each probe. The children's mean proportion correct across all probes was .52 (SD = .28, range = .05–1.0).

3. Results

Data were analysed using multiple linear regression. The predictor variables were those in Table 1, and how these accounted for variation in the two outcome variables, vocabulary (PPVT) and verb morphology (TEGI), were analysed using separate models. Before the models were run, correlations between the predictor variables were calculated, to see whether any were moderately-to-strongly correlated (.5–1.0), which could cause collinearity effects in the models. Correlation coefficients between the child-internal factors ranged from -.077 (ns) to -.387 ($p <$ .01), and between the child-external factors from .024 (ns) to .479 ($p <$ .01), and thus none were higher than .5. Correlations between internal and external factors produced one correlation above .5, age of onset of exposure (AOE) and months of exposure (MOE), $r = -.758$ ($p < .01$). The correlation between months of exposure (MOE) and chronological age (AGE) was much weaker, $r = .369$ ($p < .01$). Because of the strong correlations between months of exposure and age of onset of exposure, it was decided to include chronological age, but not age of onset of exposure,

in the regression models. Also, because of the significant small-to-moderate correlations that exist between some of the predictor variables, partial correlations as well as coefficients are reported.

3.1 Regression analyses for vocabulary

For the first analysis, all the factors were entered in the regression model. The model was significant (F(9,158) = 15.082, p = .000), and yielded an R^2 of .462. Factors that had significant coefficients (p < .05) were chronological age (AGE), phonological memory (CTOPP), non-verbal IQ/analytic reasoning (CMMS), and months of exposure (MOE); factors that had marginally significant coefficients (p = .06-.07) were language use in the home (LANGHOME), mother's fluency in English (MOTFLU), mother's level of education (MOTED), and richness of the English environment (ENGRICH); only number of older siblings (OLDSIB) was clearly not significant (p = .251). For the second analysis, stepwise regression procedures were used to find the best fitting model and results are in Table 2. This model accounted for 43% of the variance in vocabulary scores, (F(10,157) = 18.389, p = .000, R^2 = .428), and the predictors included were chronological age (AGE), phonological memory (CTOPP), non-verbal IQ/analytic reasoning (CMMS), months of exposure (MOE) and richness of the English environment (ENGRICH), all significant at less than p = .01. Note that the strongest standardized beta coefficient and partial correlation was for phonological memory from the CTOPP (Beta = .278, partial r = .320), and that three internal and just two external factors were included in the model. To further explore the internal versus external comparison, a third regression analysis was conducted where the internal factors (AGE, CTOPP, CMMS) were entered first as a block, followed by the external factors (MOE and ENGRICH) as a block, and the R^2_{change} was calculated. Results showed that the internal factors alone produced a model predicting 33% of

Table 2. Stepwise Regression Model Results for Vocabulary Scores

Factors	Unstandardized coefficients		Standardized coefficients			Correlations	
	B	St.error	Beta	t	Sig.	Zero-order	partial
(constant)	−66.619	17.769		−3.749	.000		
AGE	.528	.183	.185	2.881	.004	.331	.221
CTOPP	.447	.104	.278	4.302	.000	.463	.320
CMMS	.270	.102	.164	2.634	.009	.302	.203
MOE	.493	.117	.284	4.229	.000	.490	.315
ENGRICH	22.880	8.606	.164	2.659	.009	.303	.204

Note: R = .654, R^2 = .428, F(5,162) = 24.235, p = .000

the variance in vocabulary scores (R^2 = .327), and just 10% of additional variance was explained by entering the external factors (R^2_{change} = .101).

3.2 Regression analyses for verb morphology

As with the vocabulary scores, the first analysis consisted of a full model with all the factors entered. Because the outcome in this analysis was verb morphology, whether the L1 marks tense/agreement (L1_TNS) was added as a predictor to the set. The model was significant (F(10,157) = 18.389, p = .000), with a R^2 of .539. The factors in this model that showed significant coefficients were chronological age (AGE), phonological memory (CTOPP), non-verbal IQ/analytic reasoning (CMMS), whether L1 marks tense/agreement (L1_TNS), months of exposure (MOE) and richness of the English environment (ENGRICH). The other factors did not have significant coefficients (LANGHOME, OLDSIB, MOTFLU and MOTED). A second, stepwise regression analysis was conducted, and the results are in Table 3. This best fitting model explained 52% of the variance in verb morphology scores (F(6,161), = 29.239, p =.000, R^2 = .521). Parallel to the analyses for vocabulary scores, the predictor with the largest standardized beta and partial correlation coefficients was phonological memory (CTOPP) (Beta = .373, partial r = .444), followed closely by whether L1 marks tense/agreement (L1_TNS) (Beta = .343, partial r = .389). Note that the factors included were the same as those in the best-fitting model for vocabulary scores (except for L1_TNS, which was only entered in this model). Also, the model in Table 3 included four internal and just two external factors. To further explore this difference between the contributions of internal versus external factors, a third regression analysis was conducted with the internal factors entered first as block (AGE, CTOPP, CMMS, L1_TNS), then the external factors (MOE, ENGRICH), and the R^2_{change} calculated. Results

Table 3. Stepwise Regression Results for Verb Morphology Scores

Factors	Unstandardized coefficients		Standardized coefficients			Correlations	
	B	St.error	Beta	t	Sig.	Zero-order	partial
(constant)	−1.548	.230		−6.717	.000		
AGE	.007	.002	.172	2.920	.004	.287	.224
CTOPP	.008	.001	.373	6.290	.000	.529	.444
CMMS	.004	.001	.165	2.668	.008	.191	.206
L1 TNS	.197	.037	.343	5.362	.000	.199	.389
MOE	.006	.002	.240	3.730	.000	.372	.282
ENGRICH	.389	.112	.205	3.485	.001	.417	.265

Note. R = .722, R^2 = .521, F(6,161) = 29.239, p = .000

showed that the first set of predictors explained 42% of the variance in scores (R^2 = .424), and the addition of the external block added just 10% to the explanation of variance (R^2_{change} = .098).

3.3 Further exploration of language use at home

Language use at home has been found to predict children's acquisition rates in some other studies, but in the analyses above, language use at home played a marginal role and was not selected in the stepwise regression analyses. Therefore, it was thought that further exploration of this variable was warranted. As mentioned in the *Methods*, LANGHOME is a composite score based on the languages others speak with the child and the languages the child speaks with others — a global measure of the quantity of English in the home. Thus, "input to the child" and "child output to others" are components of the overall LANGHOME score, and can be examined independently. Correlations between input-to-child and child-output and vocabulary and verb morphology in English showed that output scores were more closely associated with larger English vocabulary and better accuracy with verb morphology than input scores (see Table 4). The directionality of this relationship cannot be determined; for example, children who are more proficient in English might be more likely to use more English at home, or using more English at home might make children more proficient. Nevertheless, the results in Table 4 suggest that variations in the English *input* children received at home had limited impact on their English acquisition rates[3].

3.4 Further exploration of maternal education

Like language use in the home, prior research has found that maternal education was a determinant of language acquisition rates. Accordingly, it was thought that additional analyses with this variable were warranted. In the regression models, maternal education in years was entered, but it is possible that the component of this variable that is more meaningful is highest diploma/degree completed.

Table 4. Correlations between input and output scores within the language use at home factor

English Outcome	Input/Output	Coefficient	p-value
Vocabulary	Input to child	.097	.211
	Output from child	.283**	.000
Verb morphology	Input to child	.258**	.001
	Output from child	.423**	.000

Children's vocabulary and verb morphology scores were re-analysed using independent sample t-tests where children whose mothers had secondary school diplomas or less education were compared with those whose mothers had post-secondary diplomas or degrees. For vocabulary, children whose mothers had higher education levels had marginally significantly higher PPVT standard scores than those whose mothers had lower levels of education ($t(167) = -1.903$, $p = .059$, post-secondary group mean = 89.77 and secondary group mean = 84.97). Results for PPVT raw scores were not significant, possibly because standard scores control for age, which the analyses above showed was an important individual difference factor. For the verb morphology scores from the TEGI, children whose mothers had post-secondary degrees were more accurate with verb morphology than those whose mothers had secondary diplomas or less education ($t(167) = -2.344$, $p = .020$, post-secondary group mean = .56 and secondary group mean = .46). Therefore, when examined according to diploma/degree obtained, there is some evidence that maternal education had an influence on these children's L2 acquisition rates, although that influence was not as strong as the other factors that were entered in the best fitting regression models, as shown in Tables 2 and 3[4].

4. Discussion

The goal of the present study was to assess how certain child-internal and child-external factors predicted English L2 children's vocabulary and verb morphology acquisition. Research questions asked about the relationship of each factor to the outcome variables, how internal factors compared to external factors as a group, and whether the factors contributing to vocabulary and verb morphology were the same. One prominent result from this study was that child-internal factors, as a group, predicted more variation in children's acquisition rates than child-external factors (see also Armon-Lotem et al., this volume). This was striking primarily because one of the child-external factors was length of exposure to the L2, and for this group of children, length of exposure to English ranged from 3 to 62 months. While length of exposure was a significant factor in the models, it did not contribute as much to explaining variation as certain child-internal factors. The tendency for internal factors to predict more individual variation was somewhat stronger for verb morphology than for vocabulary. This could be due to the models for verb morphology having an additional internal variable, L1 morphosyntactic characteristics, entered. Alternatively, it could be due to the absence of a variable measuring classroom vocabulary exposure in the models. It is reasonable to assume that classroom input would have an important impact on vocabulary building in particular. A second prominent result of this study was that the best fitting model

consisted of the same factors for both vocabulary and verb morphology (except that L1 was only entered in the verb morphology model). This result suggests that similar learning mechanisms underlie different domains of language, at least, for lexical and morphological acquisition (but see Chondrogianni & Marinis, this volume). We return to this idea in the section on UB theory below.

4.1 Child-internal factors

Among the child-internal factors the strongest predictor for both vocabulary and verb morphology was children's phonological short-term memory abilities. The non-verbal IQ screen, which was considered to be a measure of analytic reasoning, was a significant predictor for both linguistic outcomes as well. Thus, both memory and analytic components of language aptitude were significant predictors, with memory being the more important component for young children, as argued by Hart & Harley (1997). On the whole, these findings show that language aptitude is an important source of individual differences in L1 minority children in an L2 majority context, which complements previous research on other child L2 populations (Genesee & Hamayam, 1980; Hart & Harley, 1997; Masoura & Gathercole, 1999; Ranta, 2002).

In addition to phonological short-term memory, whether children's L1 marked tense and agreement on verbs was a strong predictor of accuracy with English verb morphology; children whose L1s marked tense and agreement had higher scores on the TEGI. This result is in line with other research showing L1 transfer effects to be operative in child L2 acquisition (Blom et al., 2010, under review; Chondrogianni, 2008; Unsworth, 2005; Zdorenko, 2010; Zdorenko & Paradis, 2008, 2011). In contrast to most other research, this study compared the contribution of L1 transfer relative to other individual difference factors. It seems that L1 transfer is an important source of individual differences in acquisition rates, but it is not the only important source. Taken together, the two language aptitude measures contributed more to the variance in verb morphology outcomes. Therefore, a child whose L1 is Mandarin or Cantonese, but who has high language aptitude, might be able to keep pace with his/her Spanish- or Punjabi-speaking L1 peers in acquiring English verb morphology.

The final child-internal factor examined in this study was chronological age. The age range was narrower among the children than their range of exposure to English, 3 to 62 months versus 58 to 84 months. Nevertheless, this variable emerged as a significant predictor of both vocabulary and verb morphology outcomes showing that older children were more advanced in their L2 development than younger children. Thus, these findings are in line with those of Golberg et al. (2008) and Chondrogianni & Marinis (this volume), showing the greater cognitive

and linguistic maturity that comes with age is an advantage for the speed of L2 oral language development, and that this holds for both the lexicon and morphosyntax. Understanding that older children might typically learn the L2 faster is relevant to the issue of when minority L1 children ought to be introduced to the majority L2. In this author's experience, many newcomer parents express a desire to introduce their children as soon as possible to the L2 in order to smooth the transition to full-time schooling when they are five years old, and enable them to achieve academic success earlier. This desire on the part of parents is often supported by educators and policy-makers. However, because early onset of full-time L2 learning could be associated with more precipitous decline or even loss of a minority L1 (Montrul, 2008; Wong Fillmore, 1991), it seems that the desire for early L2 exposure may come at the cost of maintaining the L1. Research has shown that maintenance of the L1 has many cognitive, psycho-social-cultural and educational benefits for minority children (Paradis et al., 2010). If children learn the L2 faster when they are older, it is possible that early exposure in the preschool years might not be highly important for ensuring academic success in elementary school. Additional research is needed to know for certain, but the results of this study indicate that it would be fruitful to explore this possibility further.

4.2 Child-external factors

Of the five external factors that were analysed (see Table 2), just two emerged as significant predictors for vocabulary and verb morphology scores in the best fitting models: length of exposure to English, and richness of the English environment. These results are consistent with other studies that found effects of variations in length or richness of L2 exposure on children's acquisition rates of the lexicon and morphosyntax (Bohman et al., 2010; Jia & Aaronson, 2003; Jia & Fuse, 2007; Oller & Eilers, 2002; Scheele et al., 2010). Note that length of exposure was considered to be a quantity-oriented variable, while richness of the English environment was considered to be a quality-oriented variable. Thus, it appears that both quantity and quality of the input are relevant to determining rate of child L2 acquisition. The contrast between language use at home and richness of the L2 environment in how they predicted the children's L2 abilities point to the importance, for both researchers and clinicians, of obtaining information on richness of the L2 environment, independent of language use at home, when assessing potential sources of individual differences between children (see also Scheele et al., 2010).

The overall lower impact of the external factors was the striking finding of this study, as mentioned above. In particular, two variables that have been found to be significant predictors of individual variation in bilingual/L2 children's outcomes in prior research, language use at home and mother's level of education,

had limited impact on English L2 children's acquisition rates in the present study. We now turn to a discussion of these two variables in particular.

The results of this study are consistent with those of Blom et al. (2010) and Golberg et al. (2008), who also examined English L2 children in Canada, but they are inconsistent with studies of Welsh-English, Spanish-English and French-English bilinguals (Gathercole & Môn Thomas, 2009; Oller & Eilers; Paradis, 2009; 2010, and Paradis et al., in press). The source of these conflicting findings is most likely the proficiency of the speakers of the languages, such that input from non-proficient speakers does little to enhance children's acquisition of the L2. For example, in the present study, mother's self-rated fluency was rather low on average, 2.31 on a 0–4 scale, and mother's fluency had a small significant correlation with richness of the English environment ($r = .224$, $p = .003$). Furthermore, the additional analyses showed that children's L2 output (child's use of English with others) correlated more strongly with vocabulary and morphology outcomes than children's L2 input (other's use of English with the child). Similarly, Bohman et al. (2010) found that variation in children's output made a more important contribution to their L2 development than variations in their input, for morphosyntax in particular. They hypothesized that output might have been more important for morphosyntax than semantic development because practice is possibly more relevant to developing accuracy and automaticity with morphosyntactic constructions. Since the largest correlation coefficient in Table 4 was between output and accuracy with verb morphology, Bohman et al.'s (2010) hypothesis could find support in these results.

Language use at home among family members as an independent factor in the language development of minority children from newcomer families is important to consider not only in the context of L2 acquisition but also in the context of L1 maintenance. Since much research has shown the benefits of L1 maintenance for minority children, numerous researchers have argued that parents should be encouraged to use their L1 with their children as much as possible (Wong Fillmore, 1991; Kohnert, Yim, Nett, Kan & Duran, 2005). However, in this author's experience, parents often admit that they use the L2 with their children at home in order to help their children acquire it faster so that they will do well at school; some teachers and healthcare practitioners also recommend that families switch to using the L2 at home. This situation is parallel to the one discussed above regarding age and the desire for early exposure to English. In this study, use of the L2 in the home had a low impact on L2 acquisition, and moreover, the child's use of English to others in the home was more closely associated with stronger L2 outcomes than use of English to the child. These results, together with evidence that early onset of L2 acquisition and L2 use at home could undermine maintenance of the L1 (Montrul, 2008; Wong Fillmore, 1991), suggest that use of the L2 at home, *by*

non-proficient speakers, might not be particularly helpful for L2 development and could potentially increase the risk of L1 decline and loss. Therefore, the results of this study support the policy of encouraging newcomer families to use the minority L1 at home as much as possible.

Differences in maternal education levels, or family socio-economic status more generally, has been found to influence linguistic outcomes for L2/bilingual children (Armon-Lotem et al., this volume; Bohman et al., 2010; Golberg et al., 2008; Oller & Eilers, 2002; Paradis, 2009; Scheele et al., 2010). What could be the reason why maternal education played a more prominent role in other studies than in this study? One possible explanation could be design of the analyses. Some previous research used a between-group design for comparing differences based on mother's education (Golberg et al., 2008; Oller & Eilers, 2002; Paradis, 2009) and indeed, in the between-group analyses for this study, it was found that maternal education had some influence on children's outcomes, especially verb morphology. But, this impact was not substantial enough for maternal education to be a significant factor in the regression models. However, other studies using regression or related statistical techniques found maternal education/socio-economic status to be a significant predictor (Blom et al., 2010; Bohman et al., 2010; Scheele et al., 2010). Perhaps the role of maternal education is modulated by interactions with other factors. For example, Scheele et al.'s (2010) study revealed complex relationships between socio-economic status, home language activities in L1 and L2, and children's language outcomes (see also Armon-Lotem et al., this volume). Therefore, detailed exploration of maternal education in relation to home input factors in future research with these L2 children is warranted.

4.3 Usage-based theory of language acquisition

UB theory emphasizes the importance of input properties in language acquisition and assumes that similar mechanisms underlie the emergent lexicon and grammar. Overall, these findings support UB theory since factors measuring input properties like length of exposure and richness of the English environment were significant predictors of the children's L2 development, and furthermore, largely the same internal and external factors were the strongest predictors of both lexical and morphosyntactic development, indirectly supporting the assumption that the lexicon and verb morphology are intertwined in representation and development (Bybee, 2001, 2008; Ellis, 2002, 2008; Tomasello, 2003; but see Chondrogianni & Marinis, this volume). Richness of the English environment having an impact is probably more significant than length of exposure, because it is reasonable to assume that any theory of language acquisition would expect exposure time to the target language to make a difference.

Even though external factors had an impact on children's L2 development, the child-internal factors explained more of the variance in individual outcomes than the external factors in this study; is this pattern compatible with UB theoretical predictions? First, it is important to point out that token frequency in the input is just one element of the input properties that are predicted to impact acquisition rates (Lieven & Tomasello, 2008; Bybee 2001), and more fine-grained aspects of the input such as distributional collocation frequency and type frequency among verb paradigms was not explored. Blom et al. (2010, under review) and Zdorenko (2010) found that such fine-grained aspects of input properties influenced L2 children's acquisition of English verb morphology. Thus, additional external factors than the ones examined in this study are likely to be influencing these children's English L2 acquisition. Second, as mentioned in the introduction, emergentist theories, including UB theory, are united in the assumption that language acquisition is the product of numerous perceptual, cognitive, social and pragmatic factors that interact with input properties. However, O'Grady (2008) notes that the bulk of research from this perspective has been perhaps overly oriented toward input properties and statistical learning, at the expense of more thorough consideration of the role of additional cognitive mechanisms whose structure and operation may be less reducible to frequency factors. The results of this study suggest that, for child L2 acquisition, the balance between external factors, like input quality and quantity, and internal factors, like cognitive maturity, verbal working memory, analytic reasoning and the presence of an established linguistic system, might not be as weighted toward the external factors as might be assumed. In short, these results are generally compatible with UB theory, but at the same time, they indicate that domain-general learning mechanisms, and existing L1 knowledge, should not be underestimated as factors in acquisition. Future research with L2 learners in this framework ought to include more of these internal factors in order to arrive at a fully comprehensive view of the L2 acquisition process.

Notes

1. A few children in this group were exposed to English before three years of age, and thus, would technically be considered simultaneous bilinguals by other researchers (Paradis et al., 2010). We have included them in this study regardless because they share many other characteristics with the other children in the study, and do not share characteristics with many simultaneous bilinguals such as, Canadian-born parents and a one-parent-one language style of language use in the home. Furthermore, differentiating between simultaneous and very early sequential bilingualism was not a goal of this study.

2. This questionnaire was developed by the author and her graduate students, with input from the Multicultural Health-Brokers Cooperative in Edmonton (www.mchb.org), for the purposes of conducting research with newcomer families from a variety of cultural/linguistic backgrounds. The ALEQ is available at www.chesl.ualberta.ca .

3. Re-running the model with the child-output variable did not result in this variable being selected in the stepwise regression procedures.

4. Re-doing the models with maternal education as a dichotomous variable did not result in this factor emerging as significant.

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