Article

The Role of Environmental Factors on Grammatical Development in French–English Bilinguals Attending a Dual Language Programme in France

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Abstract: This mixed methods study explores the effects of cumulative exposure, age of onset of acquisition (AO), parent proficiency and richness of the language environment on the grammatical development in French and English of 49 French–English bilingual children who were acquiring the languages either simultaneously (2L1) or successively (cL2). Participants (24 girls) were in 1st grade (M = 6;4, *n* = 20) or 5th grade (M = 10;4, *n* = 29), attending a state school in France, in a French–English bilingual programme. Production data come from a narrative task in each language. Parent questionnaires were used to explore environmental factors. Results show, first, that children's age and parent proficiency were positive predictors of grammatical accuracy in English, while in French only cumulative exposure was a positive predictor. Secondly, exposure showed a stronger relationship with grammatical accuracy in cL2 children; however, only in French, the language in which children made more errors overall. Finally, we found that both 2L1 and cL2 children made gender errors, an early-acquired structure in French. A qualitative analysis of errors with gender highlights, first, the importance of language output for grammatical development, even for children receiving substantial language input and, second, the role of home factors which play a more important role than community language use in shaping grammatical development. This study underscores the complex, interconnected nature of experiential effects on bilingual grammatical development in each language.

Keywords: child bilingualism; age of onset of acquisition; cumulative exposure; parent proficiency; grammatical development; French; English

1. Introduction

Questions remain regarding how bilingual children's experiences and environment influence their grammatical development. For example, the relative contributions of quantity of exposure and the age at which children start learning a language (age of onset, henceforth AO) are not fully understood. Some studies find that cumulative exposure to languages is a more robust and consistent predictor of grammatical development than AO (Thordardottir, 2019); however, exposure's impact may diminish as bilingual children move into adolescence (Cohen et al., 2024; Gathercole, 2007). Some report that later AO results in slower grammatical development and qualitative differences in children's errors (Meisel, 2008). Other studies report that it facilitates grammatical development (e.g., Blom & Paradis,

2015) or shows no relationship with it at all (Hopp, 2011). Adding to this complexity, parent proficiency (Paradis & Jia, 2017) and the richness of the language environment (Jia & Fuse, 2007; Paradis, 2011) may also contribute to bilingual grammatical development. The current mixed methods study investigates the contribution of different environmental factors to the development of grammatical skills in French–English bilingual children with varied levels of experience with these languages.

In the following sections, we first discuss the role of cumulative exposure on grammatical development. Next, we consider how AO relates to grammatical development, and then, more specifically, how AO and exposure effects may differ across simultaneous (2L1) and successive (cL2) bilingual contexts. Then, having summarised work that points to differences in exposure and AO effects across grammatical structures, we discuss grammatical gender in French, the source of the highest number of errors in the current study and the focus of our qualitative analysis. Finally, we discuss research on parent proficiency and the richness of the language environment as predictors of grammatical development.

1.1. Cumulative Exposure and Grammatical Development

The quantity of exposure that bilinguals have to each language can be measured at a particular moment in the present or cumulatively from birth. Since exposure quantity often varies considerably over time, measures of cumulative exposure are useful as they take into account children's age and exposure differences (Unsworth, 2013a). Longer cumulative exposure has been found to correlate with higher proficiency in morphosyntactic and lexical skills in both simultaneous (2L1) and successive (cL2) bilinguals (e.g., Chondrogianni & Marinis, 2011; Cohen, 2016; Paradis, 2011). While, in some studies, exposure predicts grammatical development in both of bilinguals' languages (e.g., Thordardottir, 2015), others find that exposure effects differ across bilinguals' languages (Gathercole & Thomas, 2009) and, within a language, across different grammatical structures (Unsworth, 2013a). For example, in a study of simultaneous English–Dutch bilingual children aged 3 to 17 in the Netherlands, cumulative exposure was a significant predictor for Dutch gender marking on determiners but not on adjectives, which was attributed to differences in the rule-based acquisition of the latter but not the former (Unsworth, 2013a). The relative transparency and saliency of a grammatical structure has also been found to moderate the effect of exposure on its development (Gathercole, 2007).

Another feature of exposure effects in grammatical development is their tendency to diminish over time (Gathercole, 2002). In particular, in older children and adolescents, the role of exposure may diminish and other factors such as daily use may become more important (Beauchamp & MacLeod, 2022; Cohen et al., 2024). Gathercole (2007) hypothesised that this occurs because bilinguals who have sufficient and regular exposure reach a critical mass of exposure enabling them to extract the rules for each given structure, thus, diminishing the link between exposure and grammatical abilities as children get older.

1.2. Age of Onset and Grammatical Development

The relationship between AO and grammatical development is not yet well understood. There is some evidence that the ability to acquire certain grammatical features declines with age. Meisel (2008), for example, reported that children who began acquiring French after age four made more and different grammatical errors from children acquiring French from birth. However, studies of the relationship between AO and grammatical development have produced mixed results. While some, like Meisel, have found that earlier AO is associated with better outcomes in that language (Jia & Fuse, 2007; Thordardottir & Juliusdottir, 2013), others find the inverse or no relationship at all (e.g., Hopp, 2011). These mixed results may reflect the difficulty of disentangling the effect of AO from other

correlated factors such as length of exposure and quantity and quality of exposure (Jia & Fuse, 2007). It may also derive from differences in the learning contexts examined. For example, later AO may be facilitative for child L2 learners (cL2) but have the opposite or no effect on children acquiring two languages from an early age (2L1). In the following section, we summarise certain studies which address these issues.

1.3. Age of Onset and Exposure Effects in 2L1 and cL2

AO is a variable that often entails other differences in the quality and quantity of exposure, so it is important to consider both in studies of bilingual grammatical development. In the context of cL2, later AO has been found to have a positive effect on the rate of grammatical development independent of exposure, with some exceptions. In one study, children acquiring L2 English in an immersion school in Columbia were matched for cumulative exposure to English but differed in the age that they began acquiring English (late 6;0–7;0 years vs. early 3;0–4;0 years) (Rothman et al., 2016). Children were followed for three years. Children who started acquiring English late showed higher accuracy and faster mastery of the target structure, the English passive, than children who started early. An advantage for a later start in cL2 was also found in a study of 5- to 6-year-old children who began acquiring L2 English through exposure at preschool (~4 years of age) in an English-dominant region of Canada (Blom & Paradis, 2015). In these children, later AO was associated with higher accuracy with tense inflection. Paradis (2011) found that later AO in 4- to 7-year-old children acquiring L2 English was associated with higher accuracy with verb morphology, even when length of exposure was controlled for. However, no effect of AO was found on the development of case and gender marking on determiner phrases once the effect of exposure quantity was accounted for in a study of cL2 (3;5 to 7;0 years) learners of German (Hopp, 2011). In this study, length of exposure was the more relevant predictor, in line with other reports that exposure quantity is more influential than AO in cL2 acquisition (Thordardottir, 2019).

When cL2 and 2L1 learners are compared, in other words, when AO is treated categorically, using what we call "learner groups" in our analyses, later AO has been shown to have a negative effect on language development: cL2 perform worse than 2L1 children. As noted above, Meisel (2008) found that for children whose AO to French was between 4 and 8 (cL2), development of bound morphology was qualitatively different from in 2L1 children and similar to adult second language acquisition. In a study on Swedish–French bilinguals acquiring French at a French school in Sweden, cL2 learners whose AO was as young as 3;5 differed from 2L1 and L1 children and showed developmental patterns similar to adults acquiring French as L2 (Granfeldt, 2018). We return to this study in more detail in Section 1.5. Note that, in both studies, (continuous) AO effects on grammatical development were absent in children who acquired two languages before the age of 4 and 3;5, respectively.

To sum up, when AO is treated categorically, that is, by grouping children into learner groups (2L1 and cL2), there is some evidence that grammatical development is slower and different for children whose AO is beyond age 3 to 4 (cL2) compared to children with earlier AO (2L1). When AO is treated as a continuous measure, up until approximately 3 years of age, later AO does not appear to negatively affect grammatical development. However, in cL2 children, later AO has been linked to faster grammatical development in some studies (e.g., Blom & Paradis, 2015) but not all (e.g., Hopp, 2011).

1.4. AO and Exposure Effects Across Grammatical Structures

The effect that AO and exposure have on grammatical development may also differ across grammatical structures. For example, in the study mentioned above by Rothman

and colleagues (2016), the authors speculate that later AO may facilitate development of late-acquired structures such as the passive, which recruit cognitive resources that are more developed in older children. In a theory specifically targeting AO and cumulative exposure effects in 2L1 and cL2 learners, based on findings from a range of prior studies, Tsimpli (2014) hypothesised that these effects are mediated by structures' timing in L1 acquisition (early, late, and very late). Under this theory, early-acquired structures rely on innate learning mechanisms specific to syntactic phenomena, which are more impacted by AO, while late-acquired structures rely on broader (semantic and pragmatic) and non-linguistic cues, and thus, their development is linked to variation in exposure in both 2L1 and cL2 children. This theory predicts that 2L1 children will show greater mastery than cL2 children of early-acquired phenomena due to AO effects. On the other hand, these groups should similarly find late-acquired phenomena difficult, since both have diminished exposure to their languages relative to monolinguals. Similar to the theory put forward by Meisel (2008), AO effects in this theory are thought to be driven by maturational constraints.

Another possibility is that AO effects arise because cross-linguistic transfer becomes stronger as children age and master aspects of their L1 grammar, resulting in particular difficulties for structures that diverge in the dominant and non-dominant language. For example, Unsworth found that differences in accuracy of gender concord in Dutch between monolinguals and English–Dutch bilingual children with different AOs were more likely due to their transfer of the English system, which lacks grammatical gender (Unsworth, 2013b). Different from maturational accounts of AO effects, under this view, 2L1 and cL2 grammatical errors (within a language pair) should be quantitatively but not qualitatively different. Like Dutch, French has grammatical gender. Grammatical gender is of particular interest because errors on this structure in French were the most frequent of those made by the French–English bilinguals in the current study, motivating a qualitative analysis of these errors. We, thus, summarise the features of grammatical gender in French below.

1.5. Development of Gender in French

Nouns in French are either feminine or masculine, although some can have both genders (e.g., *ministre*). French distinguishes between feminine and masculine in singular definite (*la*/*le*) and indefinite (*une*/*un*) articles. When a noun begins with a vowel, gender is lost on the definite article because of elision (e.g., *l'île*). Gender marking also appears on singular possessive pronouns (e.g., *ma*/*mon*), demonstrative pronouns (*cette*/*ce*), and some indefinite pronouns (*certaine/certain*). There is no gender agreement on plural articles (*les/des*) or on possessive (e.g., *mes/ses*) or demonstrative pronouns (*ces*). In the developmental literature, this part of the French gender system is called "*gender assignment*" (Dewaele & Véronique, 2001; Granfeldt, 2018; Kupisch et al., 2013). Gender is also marked on singular and plural adjectives (e.g., *petite*/*petit*). In the same literature, this aspect of grammatical gender is called "*gender concord*".

With the exception of certain nouns which reference beings with a biological gender (e.g., *chat*, *chatte*), noun gender cannot easily be predicted from a word's meaning (Nelson, 2005). While it has been suggested that orthographic or phonetic noun endings frequently give an indication of gender (e.g., certain suffixes, such as *-age* or *-isme*, typically mark masculine gender, while others, such as *-tion* or *-tié*, typically mark feminine gender) (Lyster, 2006; Tucker et al., 1977), the grammatical gender system in French is considered quite opaque (Corbett, 1991) and even "quite arbitrary and unsystematic in the case of inanimate nouns" (Lyster, 2004, p. 330). Nonetheless, research on L1 French monolingual acquisition shows that gender develops in the first three years of life, with low error rates in gender assignment and only small individual differences (Clark, 1985). Research has shown that gender assignment and concord in French develop in a similar way in L1 and simultaneous

bilingual children, up to age 3, if French is their dominant language (Granfeldt, 2003; Müller, 1994).

In his study of the acquisition of French in children attending a French school in Sweden, Granfeldt (2018) investigated the effect of AO and input on gender assignment and concord. He focused on a similar age range to the children in the current study: age 3;5 to 10. The data were spontaneous and elicited speech samples, including narratives. Children with two French-speaking parents (*L1 French*), children with one French-speaking and one Swedish-speaking parent (*2L1*), and children with two Swedish-speaking parents (*cL2*) were included. Different from the children in our study, the L1 French-speaking children had very little exposure and knowledge of Swedish; thus, the two other groups are more relevant.

Input was a composite score based on several criteria: French input quality and quantity outside school; parents' French proficiency; proportion of French at home; number of weeks spent in French-speaking countries annually; contact with other French native speakers; access to French television and computer games; and reading habits in French.

Granfeldt's findings showed that gender assignment in French depended largely on input. Children with higher French input outside school were more likely to assign gender correctly. So, the L1 French children outperformed the 2L1 children who outperformed the cL2 children. However, quantitative differences between the 2L1 and the L1 French children disappeared by age 9. Furthermore, input predicted correct gender assignment in 2L1 children but not in cL2 children, which Granfeldt argued was due to greater inter-individual differences in acquisition in the cL2 group. Also, in the cL2 group, there were children with earlier (AO = 3;5) and later (AO = 6;5) AO in French. These two AO groups did not differ in gender assignment; however, there was an initial advantage in the acquisition rate in the cL2 group relative to the 2L1 group, which disappeared after two years of exposure. Different from assignment, gender concord was related to AO (Granfeldt, 2018). While both L1 French and 2L1 children were near ceiling in accuracy, the cL2 children differed quantitatively and qualitatively from the other groups and found gender concord more difficult than gender assignment. Similar findings have been reported for adults (e.g., Edmonds, 2019). Thus, in these children, input played a stronger role in the development of gender assignment while AO played a stronger role in the development of gender concord.

1.6. Parent Proficiency and Richness of the Langauge Environment as Predictors of Grammatical Development

One factor that may moderate the link between home language exposure and children's grammatical development is the proficiency of those providing the exposure, specifically, parents' language proficiency. Exposure provided by parents with low proficiency in the language may have little effect on children's development of skill in that language. This possibility was suggested by Paradis (2011) to explain findings from studies indicating no link between home L2 language use and vocabulary and verbal morphological development in children from immigrant backgrounds in primarily English-speaking parts of Canada (Blom et al., 2012; Goldberg et al., 2008). Unsworth et al. (2019) directly tested this possibility in a study of preschoolers acquiring Dutch and another language in the Netherlands. They found that the degree of non-nativeness (proficiency) in parental input in the majority language, Dutch, was a negative significant predictor of bilingual preschoolers' morphosyntactic and lexical skills in Dutch. An important point in common for all these studies is the focus on parental language use of a majority language with their children in which they have low proficiency. To our knowledge, a similar phenomenon has not been reported for minority languages, that is, a language not widely spoken outside the home.

Another factor that has been linked to grammatical development, and which has been hypothesised to mediate the effect of AO on development, is the "richness" of children's

language environment (Jia & Fuse, 2007). "Richness" measures index a range of features of the language environment, including literacy activities, playing with friends, and children's own use of the language (output). The range of (early) literacy-related activities in the language, for example, shows a positive relationship with bilingual children's oral language skills (Quiroz et al., 2010), including grammar skills (Grøver et al., 2020). Children's own output, another aspect of richness, has also been found to support their grammatical development in that language. As Bohman and colleagues explained, "using a language forces the learner to process the language in a way that only hearing it does not" (Bohman et al., 2010, p. 339). Bilingual children should feel the communicative need for each language with interlocutors of different ages in diverse social networks (Pearson, 2008) and in monolingual domains that oblige and motivate them to speak each language (Fishman, 2001). This idea is not new: in the context of L2 development, nearly four decades ago, Swain (1985) hypothesised that output draws learners' attention to gaps in their knowledge, allows them to test hypotheses, and enables discussions that raise metalinguistic awareness. However, empirical support has been mixed. Some have found a relationship between output and the development of language skills (Bohman et al., 2010; Cohen, 2016; Quirk, 2021; Ribot et al., 2018), yet others have found no contribution of output to development, once the effect of input has been accounted for (Babatsouli & Nicoladis, 2019; De Cat, 2020). Others hypothesise that any link between output and development of language skills in fact reflects the (positive) effect that children's output has on the input that they receive (Pearson, 2007).

1.7. Research Questions and Hypotheses

In this study, we investigate grammatical development in children acquiring French and English through an examination of a range of grammatical structures in children's narrative productions. In a second, qualitative analysis, we focus on their production of grammatical gender. These analyses address the following research questions:

1. What is the relative contribution of cumulative exposure, age of onset, parent proficiency, and richness of the language environment on children's grammatical skill?
2. How do cumulative exposure and age of onset relate to grammatical skill in two learner groups: 2L1 vs. cL2 children (children who get regular exposure to a language before or from age 3)?
3. What grammatical errors do 2L1 and cL2 children frequently make in French and English?
4. Qualitative analysis: Which language environmental variables might account for children's development of gender in French?

With respect to RQ1, we expected that, in the group overall, cumulative exposure to a language and richness of the language environment would be the strongest predictors of grammatical development of that language and that age of onset would play a lesser role, given that the majority of our participants (N = 39 of 49 total) were exposed to both languages before age 3. We also predicted that parental proficiency would make a contribution to grammatical abilities, although to a lesser extent than exposure and richness of the environment.

With respect to RQ2, first, we expected that because cL2 children would be more likely to have not reached a critical mass of exposure to their late-acquired language, cumulative exposure would be more closely linked to grammatical accuracy in these children than in 2L1 children. Second, we expected that AO would relate differently to grammatical ability in these groups, in light of research reviewed above showing the absence of AO effects in 2L1 children but a positive relation in cL2 children.

RQ3 was a descriptive question, thus, we made no prediction. However, as noted above, under maturational accounts of AO effects, we would expect some qualitative differences in frequent error types across the two groups while, under the view the effect of AO as driven by language transfer, we would expect quantitative differences primarily.

RQ4 was an exploratory analysis which was added in order to add nuance to our understanding of the most frequent error type which emerged from the quantitative analyses. Therefore, no hypothesis or predictions were made for this question.

2. Materials and Methods

2.1. Context

This study took place in a French state school (henceforth, the School) in the southeast of France, which goes from 1st to 12th grade, with a bilingual programme, called *Sections Internationales* (International Sections, henceforth ISs). ISs which can go from preschool through secondary school are found in few schools across France, known for its "monolingual habitus" (Hélot, 2008, p. 205). Although schools usually propose several language options, over 75% of pupils attend an English section (RERS, 2022). To attend the English section, children require high-level English proficiency, enabling them to follow English-medium content classes. High-level French proficiency is not mandatory, since support is offered if necessary.

ISs follow the standard French national curriculum, taught in French over three quarters of the week. The remaining quarter is dedicated to the language and literature components of the British national curriculum taught in English. Since all participants attended the same school, the quantity and quality of French and English exposure in class were similar, although the language(s) spoken with friends varied.

2.2. Participants

All families of 1st grade (24 families) and 5th grade (50 families) children in the School's English section were contacted at the start of the school year to request consent for their child's participation in the five-year longitudinal INEXDEB project (Cohen, 2015). Twenty-one 1st grade and thirty-three 5th grade families gave consent. Data from one 1st grader were omitted as she spoke no French. Data from four 5th graders were also omitted because they spoke a third language at home. In the current study, participants were 49 French–English bilinguals (1st grade: *n* = 20, mean age = 6;4, *SD* = 0.26; 5th grade: *n* = 29, mean age = 10;4, *SD* = 0.35). Data come from the first year of the INEXDEB project (Cohen, 2015).

Families had mid to high socio-economic status (SES), based on parents' years in education provided in the parent questionnaires (see Section 2.3.1) (mean maternal education = 16.8 years, range 14–20 years, *SD* = 1.5; mean paternal education = 16.4 years, range 14–20 years, *SD* = 1.6). Parents were identified as L1 French or L1 English speakers from information in the questionnaire requesting their language acquisition order.

The breakdown of children in 2L1 and cL2 groups by grade is shown in Table 1. In the current study, to be conservative, we adopt age 3 as the lower AO limit. We classify children as: *2L1* if AO of both languages was under age 3; *cL2E* if English AO was from age 3; *cL2F* if French AO was from age 3. Children's biographical data are provided in Appendix A. Additional parent and child characteristics are summarised in Appendix B.

Table 1. Distribution of children in 2L1 and cL2 per grade level.

	1st Grade	5th Grade
2L1 [a]	14	15
cL2E [b]	2	8
cL2F [c]	4	6

Note: [a] English and French AO under age 3; [b] English AO from age 3; [c] French AO from age 3.

2.3. Materials

We report on data collected through a parent language background questionnaire on children's language exposure from birth and on an oral narrative task in each language assessing children's grammatical accuracy.

2.3.1. Language Background Questionnaire

The parent questionnaire provided quantitative information on children's language exposure, family language practices, and linguistic environments from birth to the study onset. Parents indicated their child's age and *age group* (1st or 5th grade) and their *age of first regular exposure* to French and English (AO). Parents self-assessed their own French and English speaking proficiency from 1 (no knowledge) to 7 (native-like). *Parent proficiency* was calculated by taking the average of the self-estimated proficiency speaking scores given for the mother and father. Parents' English proficiency ($M = 6.1$, $SD = 1.3$) and French proficiency ($M = 6.1$, $SD = 1.4$) were very similar.

Cumulative exposure to each language was estimated using information about the languages used in various contexts by the child (with each close family member, with the child-minder, at daycare, preschool, and elementary school), on a yearly basis from birth. An estimation of the percentage of exposure[1] to each language for each year of the child's life was then converted to a ratio. For example, if a child was estimated to have had 80% English exposure and 20% French exposure in a particular year, the readings would be .8 and .2, respectively (calculation method adapted from Unsworth, 2013a). If yearly exposure to each language remained stable for a six-year-old child, cumulative exposure would be 4.8 years for English and 1.2 years for French. Children's average English cumulative exposure was slightly higher ($M = 51\%$, $SD = 22\%$) than their French cumulative exposure ($M = 45\%$, $SD = 21\%$).

Richness of the language environment was a composite measure comprising quantitative information from the questionnaire. This included frequency of reading (shared or independent), borrowing library books, and speaking with friends in that language, using a scale for each variable from 1 (never) to 6 (usually daily). It also included children's output frequency to each parent and siblings (if any), assessed on a 5-point Likert scale (Only French; Mostly French; French and English equally; Mostly English; Only English). These six measures were first converted to proportions (e.g., a frequency of borrowing books estimated to be 2 out of 6 would be converted to .33). Then, the proportions were averaged to yield one measure of richness of each language environment. The mean richness score for English was .63 ($SD = .17$) while the mean richness score for French was .46 ($SD = .17$). This difference is significant (paired *t*-test: $t(48) = -3.69$, $p < .001$).

2.3.2. Oral Narratives

Spontaneous oral narratives in French and English were elicited using the wordless picture book *Frog, where are you?* (Mayer, 1969). The book has been used regularly in research both in typically developing monolingual (Berman & Slobin, 1994) and bilingual children (Akinci & Jisa, 2001; El Abed Gravouil & David, 2016; Montanari, 2004; Pearson, 2002). Following Berman and Slobin's (1994) instructions, the following introduction was

given: *This is the story about a boy, a dog and a frog. First you're going to look through the pictures. Then you're going to tell me the story as you look through the pictures again.* The same introduction was given in French.

Children's narratives comprised on average 275 words in English (*SD* = 105) and 278 words in French (*SD* = 113).

The narratives were transcribed and coded in the CLAN software (MacWhinney, 2000) by a near-native French and English researcher. All transcriptions and coding were checked by the first author and another trained researcher until 100% agreement was reached. In this article, we focus on grammatical accuracy. Grammatical errors were coded in broad categories (in italics below). These categories provide insight into the locus of errors across grammatical categories. We chose to use these categories for their ability to capture all errors in the corpus. Our hypotheses were correspondingly broad, which is why we did not choose to home in on specific error types within these categories, such as regular vs. irregular verb morphology, however, this is certainly a possible future direction. Furthermore, since our corpus was quite small and specific structures were not elicited, we did not have a critical mass of any particular type of grammatical structure, hence our choice of a global measure looking across grammatical catetories.

Within these broad categories, errors were then coded according to the particular error type, using a coding manual created for the INEXDEB project (Soroli, 2017): *Determiners*—incorrect determiner (in terms of definiteness), too many determiners, missing determiner; *Gender*—agreement and concord on determiners and adjectives; *Pronouns*—incorrect pronoun, too many pronouns, missing pronoun; *Prepositions*—incorrect preposition, too many prepositions, missing preposition; *Verb morphology*—irregular verb errors, inflexion errors (marking of tense, number, and agreement on regular verbs), reflexive verb errors, auxiliary verb errors, missing auxiliary verb, missing verb, missing reflexive verb; *Adverbs*—substitution; *Lexical substitutions*; *Conjunctions*—incorrect conjunction, too many conjunctions, missing conjunction; *Number on nouns*; *Missing complements*. Examples of error types are shown in Appendix C. *Grammatical accuracy* for each child was calculated by counting all errors per error type and then dividing by the number of clauses in the narrative. Number of clauses is a standard method of relativising error frequencies in our field (see, for example, Reilly et al., 2004). It allowed us to relativise the frequencies across multiple error types in a way that facilitates interpretation and accounts for opportunity for error. In English, children produced on average 5.61 errors (*SD* = 7.4) over 46.4 clauses (*SD* = 18.9). In French, they produced on average 9.33 errors (*SD* = 10.8) over 43.8 clauses (*SD* = 18.5). The English narratives were on average 3 min 7 s long (*SD* = 1 min 1 s) and the French narratives were on average 3 min 14 s long (*SD* = 59 s).

2.4. Procedures

Ethical approval was obtained from the *Service Protection des Données* at the *Centre National de la Recherche Scientifique* in France. Parents gave written informed consent, having asked their child if they wished to participate. To preserve anonymity, children were given a pseudonym. Data collection sessions were recorded using a high-performance digital audio recorder. Children were tested individually in a quiet classroom by the first author who is a highly proficient English–French bilingual. The sessions were separated by at least three weeks to avoid children remembering details of their first narration. Testing order was counterbalanced, with half of participants randomly selected to start in French and the other half in English. No significant group differences were found between order of testing groups for any variables in either language. Children received a book each year thanking them for their participation.

2.5. Analyses

To address RQ1, we ran linear regression models predicting the global measure of accuracy in each language described above from the child's age group (older or younger)—a control variable—total cumulative exposure to each language, age of onset, parents' proficiency score for each language, and richness of the language environment scores in that language. We also conducted hierarchical regression analyses with the same predictors and outcome variables to see if any relationships were obscured or altered by the presence of other variables. We began with the predictors that have been most widely studied and linked to grammatical development, namely age, cumulative exposure, age of onset, and then added the less well-studied predictors, parent proficiency and richness of the language environment.

To address RQ2, we ran the same linear regression models as above but with an additional interaction term representing the learner group (2L1 or cL2E/F).

To address RQ3, we calculated and ranked mean error frequencies, which had been relativised to the number of clauses produced by each child, for each error type in 2L1, cL2E, and cL2F children. Note that due to the small number of errors per error type, linear regression modelling was not feasible.

To address RQ4, we conducted a qualitative analysis of gender, the most frequent French error in the narratives. We compared how errors varied across three factors: (1) *learner groups* (2L1, cL2E, cL2F), (2) *countries lived in* (i.e., the status of the languages outside the home), and (3) *input–output profiles*.

3. Results

3.1. Quantitative Results

Research question 1 asked about the relative contribution of cumulative exposure, AO, parent proficiency, and richness of the language environment to grammatical development. Results from the model predicting children's grammatical accuracy in narrative production from environmental and individual factors are shown in Tables 2 and 3.

Our results show that in English (Table 2), parent proficiency showed a significant and positive relationship with grammatical accuracy ($B = 0.06$, CI = [0.02, 0.10], $p < .01$), as well as children's age group, with older children (coded as 2, younger coded as 1) being more accurate than younger children ($B = 0.11$, CI = [0.04, 0.19], $p < .01$). Cumulative exposure, AO, and richness of the language environment were not significant predictors.

The relationships reported in the final model (Table 2) were stable across hierarchical regressions. Tables with all model coefficients can be found in Appendix D.

Table 2. Coefficient estimates from a linear regression model predicting global accuracy in English narratives.

Predictors	Estimates	Conf. Int.	*p*
(Intercept)	0.33	0.01–0.66	.045
Age group	0.11	0.04–0.19	.005
Cumulative exposure	−0.16	−0.48–0.16	.330
Age of onset	−0.01	−0.03–0.01	.350
Richness of the language environment	0.18	−0.23–0.58	.386
Parent proficiency	0.06	0.02−0.10	.005
Observations		49	
R2/R2 adjusted		.30/.22	

Table 3. Coefficient estimates from a linear regression model predicting global accuracy in French narratives.

Predictors	Estimates	Conf. Int.	*p*
(Intercept)	0.29	−0.13–0.70	.173
Age group	0.02	−0.09–0.13	.767
Cumulative exposure	0.63	0.03–1.24	.042
Age of onset	−0.01	−0.05–0.03	.739
Richness of the language environment	0.32	−0.18–0.81	.207
Parent proficiency	0.00	−0.07–0.07	.977
Observations		49	
R2/R2 adjusted		.60/.55	

In French (Table 3), only cumulative exposure to French was positively related to grammatical accuracy ($B = 0.63$, CI = [0.03, 1.24], $p < .05$). As was the case in English, hierarchical regression analyses revealed no changes to the relationships in the final model. Coefficients from all steps can be seen in Appendix E. Age group, AO, parent proficiency, and richness of the language environment were not significant predictors.

Research question 2 investigated how cumulative exposure and AO related to grammatical skill in 2L1 and cL2 learner groups. Given that cumulative exposure was not a significant predictor of English grammatical accuracy, and that AO did not significantly predict English or French grammatical accuracy, we examined this question only with respect to cumulative exposure and French grammatical accuracy. In this model, there was a significant interaction of learner group and cumulative exposure to French ($B = 4.10$, CI = [1.55, 6.82], $p < .01$) indicating a stronger link between exposure and accuracy in cL2F than 2L1 children (Appendix E).

To aid interpretation of the interaction in the French model, we plotted the two learner groups' accuracy in French by exposure to French (Figure 1). This figure shows (1) that learner groups differed in their cumulative exposure, as expected, and (2) the gains for added exposure are bigger in cL2F than in the 2L1 group, but both show gains with increased exposure, with gains leveling out with balanced or more French than English exposure.
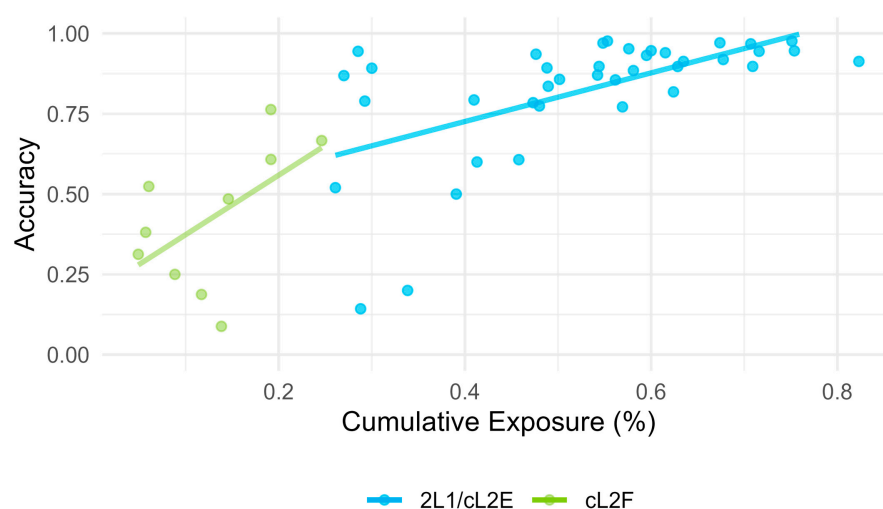

Figure 1. The effect of cumulative exposure to French on grammatical accuracy in narrative production across learner groups (2L1/cL2E, cL2F).

Research question 3 explored how frequent error types differed across learner groups. Results are shown in Table 4 below. The top three most frequent error types per learner group are highlighted in grey. In English, there are similar frequencies in the learner groups and only a minor (but statistically significant, $t(46.89) = 2.51$, $p < .05$) difference in the frequency of determiner errors. Determiner errors were the third most frequent (but still rare) error for 2L1 children, while preposition errors were third most frequent for both 2L1 groups.

Table 4. Means and standard deviations for error frequencies (errors per 100 clauses) divided by 2L1 and cL2 groups and narrative language.

	English Narratives			French Narratives		
	2L1	**cL2E**	**cL2F**	**2L1**	**cL2E**	**cL2F**
Error Type	**Mean (*SD*)**	**Mean (*SD*)**	**Mean (*SD*)**	**Mean (*SD*)**	**Mean (*SD*)**	**Mean (*SD*)**
Adverbs	2.5 (8.2)	2.3 (3.2)	5.7 (14.7)	0.1 (0.3)	0 (0)	0 (0)
Missing Complements	0.4 (1.4)	0.2 (0.8)	0.3 (1)	0.4 (1.6)	0.1 (0.4)	0.3 (0.8)
Conjunctions	0 (0.3)	0.5 (1)	0.3 (0.9)	0.4 (1.3)	0.4 (0.9)	0.3 (0.7)
Determiners	1.8 (3.3)	0.4 (0.8)	1.8 (3)	1 (1.8)	1 (1.4)	1 (1.9)
Gender (total)	0 (0)	0 (0)	0 (0)	8.3 (17.2)	1.5 (2.3)	26.4 (17.8)
Gender (assignment)	*0 (0)*	*0 (0)*	*0 (0)*	*7.3 (15.1)*	*1.5 (2.3)*	*25.0 (17.1)*
Gender (concord)	*0 (0)*	*0 (0)*	*0 (0)*	*1 (2.6)*	*0 (0)*	*1.4 (2.1)*
Lexemes	0.5 (1.1)	0.6 (1)	0.3 (1)	0.4 (1)	0 (0)	1 (2)
Number	0.2 (0.6)	0.9 (1.6)	0 (0)	0.2 (0.8)	0 (0)	2.7 (3.1)
Prepositions	1.2 (1.7)	3.8 (4.5)	1.9 (3.6)	1.9 (2)	1.6 (2.2)	10.6 (7.6)
Pronouns	0.7 (1.5)	1 (1.7)	0.7 (1.2)	2.2 (3.2)	0.3 (0.7)	4.1 (3.4)
Verb morphology	4.0 (5.6)	3.2 (3.7)	2.7 (2.4)	4.8 (5.7)	3.4 (4.9)	10.4 (7.3)

Note: The learner groups represented in the table are children exposed to both languages by the age of 3 (2L1), children exposed to English after age 3 (cL2E), and children exposed to French after age 3 (cL2F).

In French, the three most frequent error types were identical for the 2L1 and cL2 children, but the frequencies were significantly higher in cL2F, particularly for errors with gender ($t(12.55) = -3.24$, $p < .01$), but also for prepositions ($t(9.32) = -3.64$, $p < .01$) and marginally so for verbs ($t(13.46) = -2.12$, $p = .05$). The most frequent error type overall was gender errors in French.

Verbs and prepositions were problematic for both languages and learner groups, while adverbs were only problematic in English.

In Table 4, the frequency of overall gender errors is shown. We also show whether the error involved gender assignment or concord (in italics). Assignment errors were more frequent than concord errors; however, this was likely due to the relatively few adjectives showing concord used by children (see discussion below).

3.2. Qualitative Analysis of Gender Errors

Gender errors in French were the most frequent error type in our corpus. Thus, we look more closely at these with a qualitative analysis that, in particular, views how errors vary across three factors: (1) *learner groups* (2L1, cL2E, cL2F), (2) *countries lived in* (i.e., the status of the languages outside the home), and (3) *input–output profiles*. We chose to examine learner groups because the quantitative analyses indicated a stronger link with exposure among cL2 than 2L1 children. We also consider the status of the language(s) in the country/countries where the children had lived, as this may also impact their grammatical development (Pearson et al., 1997). Finally, we examined input and output in the home and at school because these have been shown to be key environmental predictors of bilingual

development ([Cohen, 2016](); [De Houwer, 2006](); [Ghimenton et al., 2023](); [Hoff, 2006]()). We classify number of errors into frequency bands to simplify the discussion of the results, as shown in Table [5]().

Table 5. Error frequency bands.

Number of Errors	Error Frequency
7 and above	Very frequent
Between 3 and 6	Fairly frequent
1 or 2	Very infrequent
Zero	Never

Appendix [A]() provides information on the total number of gender errors per child (also subdivided to show the number of agreement and concord errors), and whether or not they had lived in an English-speaking country. The most frequent gender error in this study related to "*grenouille*" (frog), a feminine noun in French, whether the frog is male or female.

3.2.1. Learner Groups (2L1, cL2E, cL2F)

2L1 Children

The frequency of gender errors varied considerably within the group of 2L1 children. While some children made very frequent errors, others made none.

The 1st graders, Jacob and Thomas, and the 5th graders, Alice and Oscar, made very frequent errors. For Jacob, while definite and indefinite article gender assignment was always correct on "*grenouille*", subject and object pronouns were always masculine and gender concord was systematically incorrect ("*des *petits* (petites) *grenouilles*", "*une/la *petit* (petite) *grenouille*"). Other high-frequency nouns were also systematically assigned the wrong gender (e.g., "*garçon*" (boy); "*chien*" (dog)). Thomas' gender assignment on "*grenouille*" was generally correct but the subject pronoun for the feminine "*abeilles*" (bees) was systematically masculine. Alice's gender assignment was systematically incorrect on "*grenouille*", "*fenêtre*" (window), "*maison*" (house), and "*rivière*" (river), while it was variable on "*un/*une vase*" (vase) and "*le/*une tronc*" (trunk). Oscar's gender assignment on "*grenouille*" was systematically incorrect on definite and indefinite articles, direct object pronouns, and possessive pronouns. Gender assignment was also incorrect on possessive pronouns, such as "**son* (sa) *bouteille*" (bottle). Ava (1st grade) made fairly frequent errors, but only on "*grenouille*", systematically marking the definite and indefinite articles as masculine. Alexander, Charles, Felix, Isabella, Jessica, Oliver, and Sarah (1st grade) and Gabriel, Laura, and Sophia (5th grade) made very infrequent gender-related errors, while Fanny and Mia (1st grade) and Max (5th grade) made no errors.

cL2E Children

The narrations of eight of the ten 1st and 5th grade cL2E children were error free. The remaining two children, Arthur and Camille (5th grade), made very infrequent errors.

cL2F Children

The four 1st graders, Edward, Eliza, Kevin, and Olivia, and four of the six 5th grade cL2F children, Elin, Ethan, Jack, and Maya, made very frequent or fairly frequent gender-related errors.

The gender of "*grenouille*" was problematical for these children, to varying degrees, with numerous, but not necessarily systematic, errors on definite and indefinite articles and on subject and direct object pronouns. For example, the 1st graders Edward and Eliza systematically chose the incorrect gender on the definite article, while Olivia correctly assigned

the definite article but incorrectly assigned the subject pronoun. Gender assignment errors on other nouns were variable. While Kevin made no other errors, others assigned incorrect gender on certain high-frequency words. For example, gender on "*garçon*" (boy) was generally correct for Eliza on the definite article but, following a dislocation, she produced incorrect gender concord on the subject pronoun in "*le garçon, *elle* (il) *était pas très *contente* (content)".

The 5th graders Elin and Jack consistently assigned the incorrect definite article to "*grenouille*". While the feminine indefinite article and possessive pronoun were generally correct for Jack, they were largely incorrect for Elin. While Maya assigned the incorrect indefinite article to "*grenouille*", she generally self-corrected to the correct definite article. However, she made a gender concord error in "*des *petits* (petites) *grenouilles*". There were also errors on the gender of certain high-frequency nouns. For example, Elin systematically assigned the wrong definite and indefinite article to "*maison*" (house). Jack's gender assignment and concord in the noun group "*le petit garçon*" was always correct but gender assignment when using the genitive was incorrect, "*de *la* (du) *petit garçon*". Maya sometimes assigned a feminine definite article to "*garçon*" but gender concord between the noun and adjective was always correct, "**la* (le) *petit garçon*". She also systematically assigned the incorrect definite article to "*Maman*" (mummy). Ethan assigned the correct gender in "*une *grand roche*" (a big rock), but gender concord was incorrect.

Samuel (5th grade) made very infrequent gender-related errors, while Nicky (5th grade) made none.

3.2.2. Countries Lived in

Of the 2L1 and cL2F children who made very frequent errors, most had lived in an English-speaking country where they had attended English-medium schools before arriving at the School.

The 2L1 children Jacob and Thomas (1st grade) were born and raised in England, until they joined the School in 1st grade. Alice and Oscar were born and raised in the USA. Alice moved to France when she was 9, while Oscar arrived when he was 8.

The cL2F children Eliza (1st grade) and Maya (5th grade) were born and raised in England until they moved to France aged 4 and 9, respectively. Elin (5th grade) was born and raised in England before attending the School, aged 9, while Jack (5th grade) arrived in France, aged 8, from the USA.

The remaining children, who had lived in an English-speaking country, attending English-medium or French–English bilingual schools, made either very infrequent or no gender errors: 2L1 1st graders—Alexander, Amelia, and Fanny; 2L1 5th graders—Ella, Hugo, Luna, Poppy, and Sebastian; cL2E 1st graders—Laurène and Victor; cL2E 5th graders—Arthur, Camille, Léo, Lucie, Manon, Nathan, Thibault, and Tom; cL2F—Samuel. Only Ethan (cL2F 5th grade) made fairly frequent errors.

3.2.3. Input–Output Profiles
2L1 Children

The frequency of gender errors in the 2L1 children discussed in Section 3.2.2 was higher compared to the other 2L1 children in this study. A closer look at home language use, in particular, French output, enables us to gain a finer understanding of the possible reasons accounting for this.

Jacob's L1 English father and L1 French mother followed the one person, one language (OPOL) approach. However, Jacob's output with his parents was almost exclusively English. While Thomas had been exposed exclusively to French from his L1 French parents from birth, his own output with his parents and elder sister was almost exclusively English.

Similarly, Alice's L1 French parents' input at home was French and English but Alice produced English output only with her parents and elder sister until the family returned to France. Input from Oscar's L1 French mother was largely French. However, Oscar's output with his mother, his L1 English father, and his older and younger siblings was exclusively English.

It is interesting here to compare input and output patterns of the above-mentioned children to the other 2L1 children who had lived in an English-speaking country at some point prior to the start of the study and who made very infrequent or no gender errors. Alexander (1st grade) had one L1 French and one L1 English parent. He lived in the USA from age 1 to 5. He and his parents followed the OPOL approach while living in the USA and in France. Amelia (1st grade) had two L1 English parents. She moved to France from the UK aged 4 but had been exposed to some French from both her parents from age 2. She attended French daycare and a year of French immersion preschool in the UK before attending French-medium preschool in France. The remaining 2L1 children (Fanny, Ella, Hugo, Luna, Poppy, and Sebastian) had two L1 French parents. When the family was living in an English-speaking country, the children's input and output in the home were either French dominant or more balanced French and English.

The remaining 2L1 children had lived only in a French-speaking country. Gender errors were very infrequent, or absent, for Charles, Felix, Isabella, Jessica, Mia, Oliver, and Sarah (1st grade) and for Adam, Benjamin, Emily, Gabriel, George, Laura, and Sophia (5th grade). These children had one L1 French and one L1 English parent. The parents and children largely followed the OPOL approach at home. Outside the home, while only certain children went to French-medium daycare, all the children attended French-medium preschool for three years before attending the School (or, in the case of certain 5th graders, perhaps a French-medium primary school before joining the School). So, in all cases, the children's French input and output were abundant, inside and outside the home.

Certain 2L1 children who were born and raised in France had two L1 English parents. Gender errors were very infrequent for Charlotte (1st grade) and absent for Max (5th grade). Both had attended French-medium daycare, then French-medium preschool, before joining the School. Interactions between Charlotte and her mother regularly included some French until Charlotte was three. In contrast, Max had very little French input and output at home because English was the family language. However, he had been exposed to French for over eight years outside the home. In comparison to Charlotte and Max, Ava (1st grade) made fairly frequent gender-related errors. Input and output at home with her L1 English parents and elder sister were in English only. French input and output came principally from occasional daycare, then preschool, before she joined the School.

cL2E Children

All the cL2E children had lived in an English-speaking country at some point before the study onset. With one exception (Lucie, 5th grade) the cL2E children had two L1 French parents, with dominant French input and output at home with close family members, although English was also present, to varying degrees, in certain families, particularly when the family was living in an English-speaking country.

Lucie had one L1 English and one L1 French parent. French was the only home language until Lucie was three, when the family moved to the USA. English was then introduced progressively to family language practices, which gradually became balanced French and English.

cL2F Children

All the cL2F children had two L1 English parents. The cL2F children mentioned in Section 3.2.2 who made very frequent gender-related errors were first exposed to French when they moved to France. All four had only English input and output at home while French input and output were outside the home, principally at the School. Edward, Kevin, and Olivia (1st grade) and Ethan (5th grade), who made very frequent or fairly frequent gender errors, also had English as their home language. French input and output were mainly outside the home, in preschool, then at the School. Edward, Kevin, and Olivia had never lived in an English-speaking country. Ethan arrived in France, aged 8, from English-speaking Canada.

Only one cL2F child, Nicky (5th grade), made no gender-related errors. Compared to the other cL2F children, Nicky and her mother sometimes spoke French together at home. Furthermore, Nicky had lived in France for seven years when the study began where she had attended a French-medium preschool for two years before joining the School.

3.2.4. Synthesis

Summarising the qualitative findings, the study has shown that gender error frequency varied in 2L1 children. The amount of French output the children produced distinguished those making very frequent errors from those who made infrequent or no errors. This was particularly striking for certain children with one L1 English and one L1 French parent who, before joining the School, had spent several years in an English-speaking country, where their output was principally in English, despite having plentiful French input at home.

Gender errors for cL2E children were very infrequent or absent. These children had abundant French input and output at home from birth, regardless of periods spent in an English-speaking country.

The cL2F children making the most gender errors had been in France for a limited period. However, most cL2F children who had been in France either from birth or from a young age also made some errors, despite attending French-medium schools for several years. These children came from English dominant homes where French input and output with family members were either extremely limited or absent.

4. Discussion

4.1. Environmental and Experiential Predictors of Grammatical Skill (RQ1 and RQ4)

Our first research question asked about the relative contribution of different environmental and experiential predictors to grammatical abilities in bilingual children. Our results for these analyses were only partially in line with our predictions, which were that cumulative exposure and richness of the language environment would be the most closely linked to grammatical accuracy, followed by proficiency of parents in the language, which in turn would show a stronger link than AO with grammatical accuracy.

In English, we found that a continuous measure of parent proficiency was the only variable to significantly predict English grammatical accuracy. This is consistent with prior work finding that parent proficiency positively predicts bilingual children's grammatical development (e.g., Unsworth et al., 2019). Parents' French proficiency, however, did not predict grammatical accuracy in French. This is intriguing. Parents' English proficiency ($M = 6.1$, $SD = 1.3$) was not lower and/or more variable than French proficiency ($M = 6.1$, $SD = 1.4$). Findings from a recent study which explored bilingual habitus and socialisation in the same families as those in the current study provide a feasible explanation (Ghimenton et al., 2023). That study revealed that L1 English-speaking parents largely used English only with their children, despite many having high proficiency in French. They expressed the belief that they were responsible for supporting their children's English development,

since English was not widely spoken in the community. In contrast, families with two L1 French-speaking parents were more likely to speak both languages with their children, often following the move to English-speaking countries (see Ghimenton et al., 2023 for details). Once the families returned to France, parents often continued to speak some English at home, to support their children's English development, even when they did not self-assess as having high English proficiency. Thus, children with two L1 French parents were often exposed to non-native English input from their parents.

The more prominent role for proficiency in developing English skill could therefore be explained by the fact that, among these children, the proficiency of *input-providing parents* for English was more variable than for French. The mechanism by which this relationship works requires further exploration, but one possibility, as suggested by Unsworth and colleagues (2019), is that speakers with lower proficiency in the language provide input that is less diverse in terms of morphosyntactic structures, a factor that has been found to predict the rate of grammatical development in monolingual children (Huttenlocher et al., 2002). Indeed, qualitative differences in parental input in a heritage language have been linked to corresponding differences in the phonetic and grammatical properties of children's speech (Daskalaki et al., 2020; Stoehr et al., 2018).

Another not mutually exclusive possibility is that the stronger role of parent proficiency in English compared to French is a reflection of the stronger role of parental input in children's development of a language not spoken widely in the community (a heritage language). The measure for cumulative exposure includes multiple sources of input including school, daycare, extra-curricular activities, and use with friends while parent proficiency may be an indirect measure of their use of the language with children, with higher English proficiency parents being likely to use English more with children. Both possibilities point to an important role for parental language use in children's grammatical development in a heritage language even into elementary school years.

With respect to the effects of exposure and AO on grammatical skill, we found that cumulative exposure significantly predicted French grammatical skill only, while AO was not a significant predictor of grammatical accuracy in either language. Disentangling exposure and AO is difficult in these children, as is often the case (Stevens, 2006), given that cL2 children also had lower cumulative exposure on average than 2L1 children. However, the qualitative findings for our fourth research question also showed a limited role for AO in grammatical development in these children. Specifically, children in both learner groups—2L1 and cL2—made errors with gender. Instead, factors related to the amount of time spent in each language—cumulative exposure, input, and output—in combination with social factors such as the status of the language in the society where children lived predicted variation in accuracy with grammatical gender. With respect to the non-significant relationship between cumulative exposure and English grammatical accuracy, this may reflect the fact that these children were required to have high English proficiency to be admitted to the school's English section. Consequently, proficiency levels were higher overall and more homogeneous for English than for French. Thus, in English, more children likely had accumulated the "critical mass" of exposure needed to master English grammar, resulting in a lesser role for exposure in distinguishing grammatical abilities in this language.

It is important to note that while AO had a large range in these children, from 0 to 9 years of age, the distribution of AO was not at all even—the majority of children had exposure to both languages at birth or shortly after, likely limiting our ability to view AO effects. Thus, these results provide tentative evidence that should be confirmed through future studies with children exhibiting more diversity in AO and a larger sample.

Finally, children's age was included in models as a control variable given the wide age range of our participants. We found that accuracy was higher in older children, as expected, but age was only a statistically significant predictor of English grammatical accuracy. One possibility is that the effect of age was diminished in French because of the high frequency of one error type—gender assignment/concord—which is a structure susceptible to cross-linguistic transfer. Given that cross-linguistic transfer has been found to increase with age and increasing dominance (Quirk & Cohen, 2022; Unsworth, 2013a), this may have obscured age-related growth in accuracy in French, especially in cL2F children.

4.2. Exposure and Age of Onset Effects Across Learner Groups (RQ2)

With respect to our second research question which examined how the relationships between cumulative exposure and AO on the one hand and grammatical accuracy on the other compared across learner groups (2L1 and cL2 children), we predicted that exposure would have a stronger positive association with grammatical accuracy in cL2 than 2L1 children and that AO would show a positive link to accuracy in cL2 children only. Our predictions were only partially borne out. While, in French, accuracy did show a closer relationship with exposure in cL2 than in 2L1, this was not the case for English because, as noted above, cumulative exposure was not a significant predictor of English grammatical accuracy at all in these children. Thus, these findings are in line with a stronger role for exposure in shaping cL2 than 2L1 grammatical development.

4.3. Grammatical Errors in 2L1 and cL2 of English and French (RQ3 and RQ4)

With respect to our third research question, the most frequent error types made by 2L1 and cL2 children were largely the same while the number of errors made by these groups differed, with 2L1 children making markedly fewer errors than cL2 children.

The most frequent error types in English were errors on adverbs, determiners, prepositions, and verb conjugations. In French, the frequent error types were, like English, errors on prepositions and verb conjugations, while the most frequent error type involved gender (particularly gender assignment). The most frequent error types in French were also similar in the two learner groups, but they were higher overall than in English, and the difference between the frequency of gender errors between 2L1 and cL2 groups was notable.

With respect to the nature of gender errors, like Meisel (2018), we found that certain children from both learner groups were not yet sensitive to semantic cues, as evidenced by errors of gender assignment and concord, such as "*la garçon*" and "*le maman*", as emphasised in the qualitative findings in research question four. Because we did not set out to systematically test the various accounts of AO effects (e.g., cross-linguistic transfer, universal grammar) our results do not provide strong evidence for or against any account; however, the large gap in accuracy for gender between cL2F and 2L1 groups is consistent with both views of AO effects involving differential access to UG and increasing language dominance with later AO, given that gender is both an early-acquired feature of French, and an occasion for negative transfer from English—a language without grammatical gender—to French. However, as seen in both the quantitative and qualitative analyses (RQ2 and RQ4), 2L1 children also made gender errors, which suggests gradient rather than categorical differences between these two learner groups. Further research which compares, for example, groups with similar AO profiles from different language pairs (e.g., including other languages with grammatical gender) might clarify the sources of differences between learner groups in the gender development.

4.4. The Importance of Output (RQ4)

The qualitative analysis in our fourth research question highlights, first, the importance of language output for grammatical development, even for children receiving substantial

language input, and, second, the role of home factors, which play a more important role than community language use in shaping grammatical development. Our findings show that while most of the cL2F children made gender-related errors, so did certain 2L1 children. These children often had little French input outside school and they produced limited French output. In contrast, the children receiving consistent French input at home and producing substantial French output made very few or no errors.

Why is it that certain children who had lived in France for several years and had often attended French-medium preschool before joining the School were still making gender-related errors? Findings from an earlier study conducted in the same school setting (Cohen, 2016) showed that children in families with English as a home language often had little exposure to French, the dominant community language, outside school. Furthermore, despite French covering three quarters of the School curriculum, time spent using French productively could be minimal. Once children attended the School, they could choose English friendship groups, reducing considerably their contact with French at school. In addition, lessons in France tend to be more teacher-centred than in English-speaking countries (Osborn, 2009), limiting further opportunities for producing French output. This, in turn, may limit the amount of interactional feedback children get in French, a feature of cL2 environments that has been linked to facilitated acquisition of grammatical structures such as English questions (Mackey & Oliver, 2002).

The longitudinal study of data from the five-year INEXDEB project (Cohen, 2015) will enable us to explore if the gender-related and other morphosyntactic errors reported in the first year of the study diminish over time as a critical mass of exposure is reached and children produce more and more output (Binks & Thomas, 2019; Gathercole, 2007). Future studies might also target the role of output and specifically interactional feedback with tasks involving specific grammatical structures on bilingual children's development of those structures.

4.5. Limitations of the Study

This study has limitations. The data analysed come from children's spontaneous production during a narrative task. While the spontaneous nature of the data boosts the ecological validity of the study, it is at the cost of experimental control. One potential pitfall of this type of data collection method is that children may simply avoid using structures that they are not comfortable with. For example, certain children may have opted to narrate in the present tense to avoid using the *passé compose* which requires the selection of an auxiliary verb (*avoir* or *être*) which is dependent on the main verb. Certain cL2F children who narrated in the *passé compose* made numerous errors on this structure, choosing the wrong auxiliary verb. Thus, future experimental studies of cL2 and 2L1 children's grammatical errors could strengthen our confidence in these findings.

Second, we focused exclusively on grammatical development, but it is possible that other domains of language are differentially affected by children's environment (e.g., Chondrogianni & Marinis, 2011). In future work within the INEXDEB project (Cohen, 2015), we will address this gap with investigations of other language skills, such as vocabulary and phonology, in these same children over time.

Third, as with any elicitation task, it is possible that the characteristics of the task influenced the resulting data. For example, the story used, "*Frog, where are you?*", may have influenced children's use of certain forms. Indeed, the word "*grenouille*" or *frog* in French is a word whose gender was problematic for many children in this study as well as older L2 learners in prior research (e.g., De Clercq & Housen, 2019). An experimental task which targets structures using a variety of lexical items may provide a more accurate assessment of, for example, children's mastery of grammatical gender.

Fourth, because of the longitudinal nature of the larger project, our sample size is relatively small for a cross-sectional study. A larger sample size would strengthen our statistical analyses, especially those involving comparisons of 2L1 and cL2 groups, given the small size of our cL2 group. While it was not possible to balance our samples given that the data were collected as part of a larger project with more general goals, the smaller sample size made it feasible to perform a fine-grained qualitative analysis, strengthening the study's findings. Mixed methods are rarely applied in studies of child bilingualism, despite their potential to provide more comprehensive and nuanced perspectives on language phenomena generally (Hawkey & Kircher, 2022).

Finally, while the context and participants made the study unusual and enabled us to gain new insights into bilingual development, all participants came from mid- to high-SES families, spoke two socially valued languages, and were privileged to receive instruction in their two languages. Many bilingual children in France (and elsewhere) do not have such advantages and the challenges they face, to maintain and develop their bilingualism, are clearly immense. It is important to investigate different language combinations and to include children from a broader range of SES backgrounds.

5. Conclusions

In this study, we explored the effects of different environmental factors on the development of grammatical skills in French–English bilingual children attending a bilingual programme in France. These children's profiles were diverse: they came from different home language backgrounds, some acquired both languages from birth while others began acquiring one language in childhood, and many had experienced international mobility. In neither language did age of onset relate to children's grammatical skill. Instead, factors related to home language use—parental language proficiency and children's output in a language with family members—and cumulative exposure in and outside of the home emerged as the most important predictors. There were differences in these relationships across languages, with parent proficiency being predictive of English grammatical skill— the heritage language in this context—and cumulative exposure from a range of sources predicting French grammatical skill—the societal language. This is consistent with other research which finds a stronger role for parental language use in development of languages not spoken widely in the surrounding community. Finally, we found that an early-acquired structure, grammatical gender, was problematic for children with varying AO and exposure profiles. With respect to this error, home language use also played an important role, especially children's output. These findings provide interesting future directions, such as the exploration of the mechanism by which parent proficiency is linked to grammatical development, perhaps through qualitative input differences, such as more reading in the language, and more diverse social networks in the language.

Taken together, our findings underscore the importance of investigating sources of variation in grammatical skill in both of bilingual children's languages and highlight the need for children to both hear and speak their languages in a variety of contexts, not just school or in the community, but also at home.

Appendix A. Participants' Biographical Data; Total Gender Errors and Number of Gender Agreement and Gender Concord Errors; Residence in an English-Speaking Country

Appendix A.1. 1st Grade Students

Child	English AO	French AO	2L1	cL2E	cL2F	Total Gender Errors	Total Gender Agreement	Total Gender Concord	Residence in an English-Speaking Country
Alexander	Birth	Birth	X			1	1	0	YES
Amelia	Birth	2	X			1	1	0	YES
Ava	Birth	1	X			5	5	0	NO
Charles	Birth	Birth	X			2	2	0	NO
Charlotte	Birth	1	X			2	1	1	NO
Edward	Birth	3			X	7	7	0	NO
Eliza	Birth	4			X	41	40	1	YES
Fanny	Birth	Birth	X			0	0	0	YES
Felix	Birth	Birth	X			1	0	1	NO
Isabella	Birth	Birth	X			1	1	0	NO
Jacob	Birth	Birth	X			15	12	3	YES
Jessica	Birth	Birth	X			2	2	0	NO
Kevin	Birth	3			X	5	5	0	NO
Laurène	4	Birth		X		0	0	0	YES
Mia	Birth	Birth	X			0	0	0	NO
Oliver	Birth	Birth	X			2	2	0	NO
Olivia	Birth	3			X	6	6	0	NO
Sarah	Birth	1	X			2	1	1	NO
Thomas	Birth	Birth	X			7	7	0	YES
Victor	3	Birth		X		0	0	0	YES

Appendix A.2. 5th Grade Students

Child	English AO	French AO	2L1	cL2E	cL2F	Total Gender Errors	Total Gender Agreement	Total Gender Concord	Residence in an English-Speaking Country
Adam	Birth	Birth	X			0	0	0	NO
Alice	Birth	Birth	X			7	7	0	YES
Arthur	3	Birth		X		2	2	0	YES
Benjamin	Birth	Birth	X			0	0	0	NO
Camille	6	Birth		X		1	1	0	YES
Elin	Birth	9			X	14	14	0	YES
Ella	Birth	Birth	X			0	0	0	YES
Emily	Birth	Birth	X			0	0	0	NO
Ethan	Birth	3			X	5	4	1	YES
Gabriel	Birth	Birth	X			1	1	0	NO
George	Birth	Birth	X			0	0	0	NO
Hugo	2	Birth	X			1	1	0	YES
Jack	Birth	8			X	12	11	1	YES
Laura	Birth	Birth	X			2	1	1	NO
Léo	3	Birth		X		0	0	0	YES
Lucie	4	Birth		X		2	2	0	YES
Luna	2	Birth	X			1	1	0	YES
Manon	8	Birth		X		0	0	0	YES
Max	Birth	1	X			0	0	0	NO
Maya	Birth	9			X	21	19	2	YES
Nathan	3	Birth		X		0	0	0	YES
Nicky	Birth	4			X	0	0	0	NO
Oscar	Birth	Birth	X			10	9	1	YES
Poppy	Birth	Birth	X			0	0	0	YES
Samuel	Birth	7			X	2	2	0	YES
Sebastian	Birth	Birth	X			0	0	0	YES
Sophia	Birth	Birth	X			1	1	0	NO
Thibault	6	Birth		X		0	0	0	YES
Tom	7	Birth		X		1	1	0	YES

Appendix B. Participant Characteristics

	M	**SD**
Child age (years; months)—younger/older group	6;4/10; 4	0.26/0.35
Parental education (years)—maternal/paternal	16.8/16.4	1.5/1.6
Age of onset—French (years)	1.20	2.42
Age of onset—English (years)	1.04	2.08
Parent proficiency—French (1 to 7 scale)	6.1	1.4
Parent proficiency—English (1 to 7 scale)	6.1	1.3
Cumulative exposure to French	45%	21%
Cumulative exposure to English	51%	22%
Richness of the French environment (proportion)	.46	.17
Richness of the English environment (proportion)	.63	.17

Appendix C. Grammatical Error Types in *"Frog, Where Are You?"* Coded Using a Coding Manual (Soroli, 2017)

Error Category	Examples of Error Types
DETERMINERS	INCORRECT DETERMINER They're calling to *a frog (the frog)
	TOO MANY DETERMINERS It is *the morning (it is morning) Un petit peu *de l'eau (un petit peu d'eau)
	MISSING DETERMINER *Boy called out for the frog (The boy called out)
GENDER	GENDER ERRORS *Le grenouille n'est pas là (La grenouille) *Toutes les moustiques (Tous les moustiques) Des *petits grenouilles (Des petites grenouilles)
PRONOUNS	INCORRECT PRONOUN He stares at the boy *which is shouting out (who)
	TOO MANY PRONOUNS Ils *l'ont oublié de fermer (Ils ont oublié)
	MISSING PRONOUN Il * avait un petit garçon (Il y avait)
PREPOSITIONS	INCORRECT PREPOSITION Il est tombé *de la fenêtre (Il est tombé par la fenêtre) The jar is *in his head (on his head)
	TOO MANY PREPOSITIONS They fell in the lake *down (They fell in the lake) Il a cherché *pour la grenouille (Il a cherché la grenouille)
	MISSING PREPOSITION He searched him (He searched for him)
VERB MORPHOLOGY	IRREGULAR VERB ERROR He *comed (came) The frog has *fleed (fled)
	INFLEXION ERROR Ils *atterrit (atterrissent) The boy and the dog *is (are)
	REFLEXIVE VERB ERROR Ils sont *se fait mal (Ils se sont fait mal)
	AUXILIARY VERB ERROR Il *a tombé (Il est tombé)
	MISSING AUXILIARY VERB The boy *running (The boy is running)
	MISSING VERB Il *vers le lac (Il va vers le lac)
	MISSING REFLEXIVE VERB Il *lève le matin (Il se lève le matin)
ADVERBS	Il cherche *tout part (partout) It is *always night time (It is still night time) *After they look in the woods (Then they look in the woods)
LEXICAL SUBSTITUTIONS	Il a *enterri (atterri)
CONJUNCTION	INCORRECT CONJUNCTION *When he was sleeping (While)
	TOO MANY CONJUNCTIONS Elle sauta *et sur une branche (Elle sauta sur une branche)
	MISSING CONJUNCTION Il a vu *la grenouille s'est échappée (Il a vu que la grenouille s'est échappée)
NUMBER ON NOUNS	There are different *animal (animals) Lots of different *type of trees (types of trees) Un *animaux (Un animal)
MISSING COMPLEMENT	Il *a appelé (Il l'a appelé) He touched * (He touched him)

Appendix D. Coefficient Estimates from Hierarchical Linear Regression Models Predicting Global Accuracy in English Narratives. Estimates Are Given Above the Standard Error

	RQ1.1	RQ1.2	RQ1.3	RQ1.4	RQ1.5
(Intercept)	0.75 ***	0.70 ***	0.73 ***	0.68 ***	0.33 *
	0.06	0.08	0.09	0.12	0.16
Age group	**0.09 ****	**0.09 ****	**0.10 ****	**0.11 ****	**0.11 ****
	0.04	0.04	0.04	0.04	0.04
Cumulative exposure		0.09	0.02	−0.06	−0.16
		0.08	0.10	0.17	0.16
Age of onset			−0.01	−0.01	−0.01
			0.01	0.01	0.01
Richness of the language environment				0.13	0.18
				0.22	0.20
Parent proficiency					**0.06 ****
					0.02
Num.Obs.	49	49	49	49	49
R2	.09	.12	.14	.15	.30
R2 Adj.	.07	.07	.09	.07	.22

$+ p < .1, * p < .05, ** p < .01, *** p < .001.$

Appendix E. Coefficient Estimates from Hierarchical Linear Regression Models Predicting Global Accuracy in French Narratives. Estimates Are Given Above the Standard Error

	RQ1.1	RQ1.2	RQ1.3	RQ1.4	RQ1.5	RQ2
(Intercept)	**0.64 ****	**0.33 ****	**0.34 ****	**0.29 ****	0.30	0.52
	0.12	0.09	0.11	0.12	0.21	0.05
Age group	0.07	0.00	0.01	0.02	0.02	0.05
	0.07	0.05	0.05	0.05	0.05	0.05
Cumulative exposure		**0.92 ****	**0.88 ****	**0.64 ***	**0.63 ***	**0.69 ***
		0.12	0.20	0.27	0.30	0.27
Age of onset			0.00	−0.01	−0.01	**0.07 ***
			0.01	0.02	0.02	0.03
Richness of the language environment				0.32	0.32	0.38
				0.24	0.25	0.22
Parent proficiency					0.00	−0.05
					0.04	0.04
Age of onset (late)						**−1.08 ****
						0.33
Cumulative exposure X learner group						**4.10 ****
						1.30
Num.Obs.	49	49	49	49	49	49
R2	0.02	0.58	0.58	0.60	0.60	0.68
R2 Adj.	0.00	0.56	0.55	0.56	0.55	0.62

$+ p < .1, * p < .05, ** p < .01, *** p < .001.$

Appendix F. Coefficient Estimates from Linear Regression Models Predicting Global Accuracy in English Narratives Divided by Learner Group. Estimates Are Given Above the Standard Error

	2L1/cL2F	cL2E
(Intercept)	0.33	0.72
	0.22	0.65
Age group	**0.12 ***	0.09
	0.05	0.12
Cumulative exposure	−0.15	0.61
	0.19	1.79
Age of onset	−0.02	−0.00
	0.06	0.06
Richness of the language environment	0.16	0.15
	0.28	0.88
Parent proficiency	**0.06 ****	−0.04
	0.02	0.17
Num.Obs.	39	10
R2	0.29	0.45
R2 Adj.	0.18	−0.25

$+ p < .1, * p < .05, ** p < .01, *** p < .001.$

Appendix G. Coefficient Estimates from Linear Regression Models Predicting Global Accuracy in French Narratives Divided by Learner Group. Estimates Are Given Above the Standard Error

	2L1/cL2E	cL2F
(Intercept)	−0.05	−0.45
	0.30	0.43
Age group	0.05	0.11
	0.05	0.15
Cumulative exposure	**0.95 ****	**4.5 +**
	0.28	1.81
Age of onset	**0.26 *****	0.05
	0.69	0.04
Richness of the language environment	0.19	0.76
	0.24	0.50
Parent proficiency	0.22	−0.09
	0.05	0.08
Num.Obs.	39	10
R2	0.54	0.77
R2 Adj.	0.47	0.47

$+ p < .1, * p < .05, ** p < .01, *** p < .001.$

Note

[1] This estimate included the amount of input the child received and their own output in the languages.

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