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# Bilingual acquisition during school years: predictors of achievement in the societal and heritage language

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There are vast individual differences in heritage bilinguals' linguistic skills. It is not clear, however, to what extent this variation can be attributed to experience, cognitive ability or motivation. This study investigates factors influencing the acquisition of both Polish (HL = Heritage Language) and English (SocL = Societal Language) of school-age children, examining the role of motivation, linguistic experience, and language aptitude. We collected and analyzed speech samples from 7- to 12-year-old participants ( $n = 78$ ) residing in the UK to derive linguistic measures of fluency, syntactic complexity and lexical diversity in both languages. Additionally, a receptive grammar test was administered. Independent variables were obtained via parental questionnaires, a motivation survey and a language aptitude test. To identify predictors of heritage bilingual acquisition, we conducted least squares linear regression analyses for each language area and applied backward stepwise selection to reduce the models. Results show that predictors differ between languages and linguistic areas. Our findings highlight the role of language aptitude in bilingual development, challenge assumptions that motivation to use HL might detract from SocL development, and suggest that HL acquisition can support, rather than hinder, societal language development, as bilingual children draw on their metalinguistic awareness and cognitive skills across both languages.

## KEYWORDS

bilingualism, heritage language acquisition, predictors of linguistic outcome, aptitude, motivation, input

## 1 Introduction

Heritage bilinguals are speakers who are exposed to a minority language (or heritage language) at home, usually from birth, and acquire a community language (or societal language) outside home during childhood (Rothman, 2009; Montrul, 2016). The population is highly heterogeneous, and their linguistic skills vary greatly, especially in the heritage language (HL) (Prela et al., 2024). Later development of heritage language bilinguals did not receive as much focus as early stages of the process until recently. This group has now become of interest to scholars as it provides a new insight into language acquisition. This is because HL speakers often show differential acquisition patterns and outcomes compared to monolinguals, due to different exposure patterns caused by the onset of bilingualism. It is the divergent trajectory of development that has recently been extensively studied and documented (see e.g., Montrul and Polinsky, 2021; Montrul, 2016), and attracted theoretical linguists to this population. Language acquisition in early bilinguals is influenced by a number of variables including environmental predictors

(e.g., language experience, socioeconomic status), cognitive differences (e.g., language aptitude, working memory, and neurotype), as well as affective factors (e.g., motivation and attitude). Discerning these factors, their weight and the relationships between them, however, is not a straightforward task as their role is dynamic and depends on the stage of language acquisition and the context in which it occurs. Therefore, studying different age groups and populations whose linguistic experiences vary can give us a better insight and add to our understanding of the complex process of language development. Investigating language development in school age children is especially important as later language acquisition in bilinguals received considerably less attention than early language development.

Researchers in the field of heritage language acquisition (HLA) traditionally focused on the minority language only and mainly centered on identifying structures that have not been acquired. However, as the two languages are acquired side by side, the development of heritage bilingualism should be investigated holistically and a gradual move toward adopting pluralistic approaches (i.e., approaches that take account of both linguistic systems as well as the cultural/societal context in which acquisition takes place) has slowly been taking place in the field. At the same time, the importance of not approaching bilinguals as simply two *monolinguals in one*, as well as the need to apply methodologies that focus on how different factors interact dynamically across developmental stages and different contexts, has been emphasized. An example of an application of such a perspective is the Individual Differences (ID) approach, which focuses on examining the factors that account for variation in bilinguals and recognizing that bilingual development is not uniform. While moving away from centring on deficits or deviations from monolingual norms, this methodology provides a more nuanced, dynamic, and context-sensitive framework for studying bilingualism (see [Paradis, 2023](#)).

Research into ID and bilingual development highlights that variation in bilingual children arises from an interplay of child-internal and child-external factors. The former include age of onset of L2 acquisition (AoA), cognitive abilities (e.g., verbal memory and analytic reasoning), and socioemotional wellbeing. Older AoA is associated with better HL outcomes ([Montrul, 2016](#)) and it often provides short-term advantages for L2 acquisition (e.g., [Golberg et al., 2008](#)) but this advantage is not sustained long-term (e.g., [Jia and Fuse, 2007](#)). [Paradis et al. \(2022\)](#) longitudinal studies on Arabic-English refugees highlight the contrasting effects of AoA on L2 and HL development. While the advantage of late AoA on L2 diminished over time, for HL it remained consistent long term. Cognitive capacities predict variance in both L2 and HL outcomes, independent of input factors ([Pham and Tipton, 2018](#)), and socioemotional difficulties hinder learning ([Soto-Corominas et al., 2020](#)).

Child-external factors include the quantity and quality of linguistic input, as well as broader environmental influences like socioeconomic status (SES). Higher input quantity supports linguistic development, and so does richness in the language environment (see below). SES, especially maternal education, influences both HL and L2 development, though effects often vary between languages ([De Cat, 2020](#); [Hoff et al., 2018](#)).

For a review of how child-internal and child-external factors influence bilingual acquisition, see [Paradis \(2023\)](#), who provide

a review and synthesis of research on the sources of individual differences in L2 and HL development of child bilinguals.

## 1.1 Exposure

The quantity and quality of language input children receive significantly influence their language development. This includes the type of input they are exposed to and the nature of their interactions with others (e.g., [Bergelson et al., 2023](#); [Huttenlocher et al., 1991](#)). The term *input* here encompasses all spoken language that the child is exposed to and is used interchangeably with *exposure*, as is common in other research (e.g., [Orena et al., 2019](#); [Unsworth, 2016](#) but see [Carroll, 2017](#) for a different perspective on the distinction between these two terms). Indeed, the fact that the presence of input is a prerequisite for language acquisition is unquestionable. It has, in fact, been shown to be one of the main predictors of the rate of linguistic development both in monolinguals and bilinguals (e.g., [Huttenlocher et al., 1991](#); [Pearson, 2007](#)). However, its exact role in the process is far from clear, which fuels the nature vs. nurture controversy. Despite researchers' continuous efforts to address this uncertainty, questions related to the amount of input required for successful acquisition or the relationship between exposure and individual differences—including cognitive or affective factors—remain unanswered. What makes heritage bilinguals a population worth exploring in this context is that they learn both languages in different circumstances to monolinguals, as their input is divided between two languages and the onset of bilingualism varies between individuals. Looking into heritage bilinguals, therefore, allows researchers to better control confounding factors, such as the quantity of input, and thus studying early bilinguals might aid our understanding of how languages are acquired and stored in speakers' minds.

It has been demonstrated that the rate of language acquisition is influenced not only by the quantity but also by the quality of input, which is also the case for bilingual acquisition (for an overview see [Unsworth, 2016](#)). Factors relating to the quantity and quality of input that have been identified in the field as having a critical role include age of onset of bilingualism, (e.g. [Montrul, 2016](#); [Meir and Janssen, 2021](#); [Armon-Lotem et al., 2021](#); [Vorobyeva and Bel, 2021](#)), family language use (e.g., [Vorobyeva and Bel, 2021](#)), as well as the number of speakers the acquiring child interacts with regularly (e.g., [Gollan et al., 2015](#)). However, the relationship between exposure to HL and proficiency was previously mostly explored in young children and adults with much less focus on school-age populations. The role of exposure and achievement in school-age children has mainly been studied in the context of societal language (SocL) acquisition in sequential bilinguals. These studies demonstrate consistently that children acquire the societal language with time and their proficiency advances with the number of years of schooling.

Studies into bilingual development in younger schoolchildren have also consistently shown that the use of SocL at school has a crucial role in SocL development. Focusing on 5–7-year-old bilinguals, for example, [De Cat \(2020\)](#) identified cumulative exposure to the school language as the best predictor of SocL

achievement. Similar findings for this age group were reported by [Golberg et al. \(2008\)](#), who studied recent arrivals in Canada with exposure to English (SocL) in the school settings. They observed that 34 months post arrival, their participants' vocabulary met monolingual norms. The authors also reported that home language policy had no significant effects on the acquisition of SocL lexis. Studies by [Sorenson Duncan and Paradis \(2018, 2019\)](#) also show that the use of the SocL at home has minimal or no impact on proficiency in that language, while providing evidence that HL use at home is crucial for the development of that language. Further evidence for the critical role of language use at home in the development of HL comes from [Rodina and Westergaard \(2017\)](#), who investigated the effect of family type (two parents speaking HL as their first language or mixed) on the acquisition of grammatical gender. Their findings indicate a significant effect of the family type on HL but not on SocL. Similarly, [Vorobyeva and Bel \(2021\)](#), who studied Russian as a HL in a slightly older population (7 to 11-year-olds), reported that family language use was a significant factor predicting performance in the HL (measured through the accuracy of narrative speech samples) and explained 33% of the variance in their sample. However, in a recent study, [Paradis et al. \(2020\)](#), who investigated how language environment, age and cognitive capacity support the bilingual development in Syrian children (mean age = 9) in Canada, reported that language use at home and richness accounted for more variance in SocL than HL. [Rose et al. \(2023\)](#), who explored the relationship between family language policy and vocabulary in Hebrew (HL)—English (SocL) bilinguals of different ages (5–14), reported a complex relationship. Their analysis revealed that speaking English with close family members predicted English vocabulary while using English with friends had a negative impact of Hebrew.

The role of input in bilingual development is not yet fully understood. To gain a deeper insight into the complex relationships between input-related factors and linguistic achievement across different stages of language acquisition, further research is essential especially during school age as this stage has received relatively less attention.

## 1.2 Motivation

The role of motivation has been researched mainly in the field of foreign language (or L2) acquisition and demonstrated to be a crucial element predicting success (e.g., [Dörnyei and Ushioda, 2011](#)). According to [Dörnyei \(1998, p. 117\)](#), motivation “provides the primary impetus to initiate learning the L2 and later the driving force to sustain the long and often tedious learning process; indeed, all the other factors involved in L2 acquisition presuppose motivation to some extent.” Studies into the motivation of HS have mainly focused on adults enrolled into heritage or foreign language programmes. Results show that this population is driven by both *integrative motivation*, i.e., to improve communication with their family members or integrate with the HL community, and *instrumental motivation*, i.e., to gain new professional skills or fulfill academic requirements (e.g., [Cho et al., 1997](#); [Mazzocco, 1996](#); [Campbell and Rosenthal, 2000](#)). The effects of motivation and HL achievement was also mainly studied in adult heritage learners

(e.g., [de Oliveira and Gubitosi, 2021](#); [Jee, 2017](#); [Te Huia, 2017](#)) and the results confirm that it plays a crucial role. It has also been established that the level of HL achievement in this population is related to a strong ethnic identity, a connection to the ethnic community and acceptance of its culture and values (e.g., [Kondo-Brown, 2000](#); [Cho, 2000](#); [Kondo, 1997](#)). In school-age heritage bilinguals, motivation has been reported to be an important factor in HL development (e.g., [Jee, 2017](#); [Mori and Calder, 2015](#)) as well.

As to the question whether strong motivation toward HL could not affect SocL acquisition negatively, the answer is not entirely clear. Many studies show that performance in HL and SocL are correlated positively (e.g., [Bylund et al., 2012](#); [Grose-Hodge et al., 2024](#)), suggesting perhaps that this is not the case. However, [Mori and Calder \(2015\)](#), who studied teenage heritage Japanese speakers in the United States have reported a negative correlation between one of the investigated motivational factors for HL—*Preference for the heritage culture* and SocL vocabulary in teenage bilinguals. A similar effect of was also reported by [Mori and Calder \(2017\)](#) in a subsequent study into the same population: a strong interest in Japanese (HL) pop culture negatively predicted English (SocL) vocabulary. However, to our knowledge, the relationship between motivation and achievement in adolescent heritage speakers has not really been explored beyond this.

## 1.3 Language aptitude

Language aptitude is broadly defined as a talent for learning a foreign or a second language (L2) ([Carroll, 1981](#); [Skehan, 2002](#)) and is considered one of the most important individual difference variables in second language learning ([Cochran et al., 2010](#)). According to the most prominent theory of language aptitude, it involves four subcomponents: phonetic coding ability, grammatical sensitivity, inductive language learning ability, and associative memory ([Carroll, 1981](#); [Skehan, 2012](#)). The standard assessments that measure these abilities (e.g., the Modern Language Aptitude Test or the Pimsleur Language Aptitude Battery) use tasks that rely on explicit memory and reasoning, since these abilities are assumed to be most relevant to the outcome of foreign language learning in instructional settings.

First investigated mainly in the context of L2 instructed settings in the fields of applied linguistics and education, language aptitude has recently become of interest to cognitive scientists ([Wen et al., 2017](#)). Language Aptitude has been proved to predict L2 achievement, in adults and older children (see [Paradis, 2023](#) for an overview). For example, [Sparks et al. \(2009\)](#) found that for the 54 school-age children they tested over 10 years, the Modern Language Aptitude Test result predicted overall L2 proficiency best and was the best predictor of individual proficiency subtests. However, the controversy lies in its predictive power in relation to early bilinguals. While [DeKeyser \(2000\)](#) and [DeKeyser et al. \(2010\)](#) found a correlation between aptitude and morphosyntactic attainment (grammatical proficiency) for adult arrivals, but not for younger arrivals, [Abrahamsson and Hyltenstam \(2008\)](#)'s results were different. In their study, language aptitude predicted grammatical proficiency in the younger group but not in older participants in their SocL (or L2). Furthermore, [Bylund et al.](#)

(2012) also reported the effect of language aptitude in children who started learning SocL (L2) before the age of 12. Moreover, while Granena and Long (2013) did not find any relationship between morphosyntactic proficiency and aptitude in any age group, a study conducted by the same researcher (Granena, 2014) reports an interaction between aptitude and structures in a GJT task, especially those testing grammatical agreement.

Furthermore, studies have also reported a relationship between aptitude and performance in the native language (or L1). Dabrowska (2018) and Llompert and Dabrowska (2023) found correlations between foreign language aptitude and native grammatical proficiency. Interestingly, Prela et al. (2022), who studied Greek-English bilinguals, not only found a robust effect of language aptitude on HL (L1), but also reported it was stronger than for SocL. These findings challenge the view that child and adult language acquisition depend on distinct and fundamentally different systems, suggesting that explicit learning mechanisms may also be involved in L1 (i.e., HL) development. Paradis (2023) also reports HL studies that investigated components of language aptitude (verbal memory and non-verbal analytic reasoning) in children that found associations with HL lexis (in Arabic and Vietnamese), morphosyntax (in Arabic), and syntax (in Mandarin). She concludes that cognitive factors are understudied in research focusing on individual differences in heritage bilinguals and deserve more attention.

Looking at the relationship between language aptitude and language achievement in children is interesting for theoretical linguists as it could provide an opportunity to test the Bley-Vroman (1989)'s Fundamental Difference Hypothesis, which postulates that children generally learn a language implicitly relying on domain-specific mechanism whereas adults draw from domain general processes and rely mainly on explicit learning. If this were the case, language aptitude would not be predictive in our sample for English as participants have all started learning the language early in their childhood so they should be relying on implicit learning. Additionally, if Fundamental Difference Hypothesis is true, language aptitude should show no predictive power in the acquisition of Polish, i.e., the participants' first language. For the purpose of this investigation, we have used only part 2 of eMLAT (Modern Language Aptitude Test Elementary), Matching Words, which tests *the ability to "handle grammar" and discern the functions of words in various contexts* (Carroll, 1962, p. 129) and to notice and generalize patterns, which relies on domain general processes.

## 1.4 The present study

To sum up, studies into bilingual acquisition in schoolchildren are less common than studies on early bilingual acquisition and traditionally examined one language only. Many studies in the field of Heritage Language Acquisition still take the deficit approach by assessing proficiency by comparisons to monolingual norms, which disadvantages bilinguals and may produce a distorted picture of their linguistic abilities (see Rothman et al., 2022). The present study looks into both languages of heritage bilinguals and avoids probing for deficits by comparing bilingual children's language to monolinguals or over focusing on accuracy.

In order to investigate predictors of heritage bilingual acquisition, we have posed the following research questions:

- What role does motivation to maintain HL play and, in particular, does strong motivation to acquire HL hamper the development of SocL?
- What role does input have in HL and SocL acquisition?
- What role does aptitude have in HL and SocL acquisition?

## 2 Method

### 2.1 Participants

All children participating in the study were being raised in Polish families residing in the UK for at least 3 years prior to the study and their overall daily linguistic input was divided into two languages: English and Polish.

Initially, 100 bilingual school-age children acquiring Polish (HL) and English (SocL) in the United Kingdom were recruited to participate in the study. However, we were not able to collect data from all as shortly after the recruitment stage, there was an outbreak of the coronavirus pandemic. This resulted in some families moving back to Poland, taking children out of the Polish school or withdrawing their participation from the study. We, therefore, collected and analyzed data from 78 participants (37 F and 41 M) aged 7.25 to 12.33. Sixty seven of them were born in the UK, 11 in Poland (2 of them arrived in the UK just after they were born, and the remaining 9 left Poland at or before the age of 5). All participants were exposed to Polish from birth and an average age of onset of exposure to English was 2.2 years. The average mean of cumulative exposure was 2.7 years to English and 6.13 years to Polish. Finally, their average ratio of current exposure to Polish and English was close to 50%, meaning they spent similar time during the day or week speaking each language.

All participants attended monolingual British schools and received some academic support of the minority language at a Saturday community-based school. This included 3–4 h a week of instruction focusing on literacy in the Heritage Language, as well as aspects of the Polish culture, history, literature and geography. Apart from weekend schooling, no children had any formal education in the L1. Further demographic information about the participants is presented in Table 1.

### 2.2 Tasks and measures

Independent variables included *exposure*, *motivation*, and *language aptitude*, and dependent variables constituted of measures of proficiency that tapped into grammar (receptive and productive), phonology and lexis: *receptive grammar*, *fluency*, *syntactic complexity*, and *lexical diversity*. All proficiency measures except from receptive grammar were derived from speech samples, which were transcribed in CLAN (MacWhinney, 2000). For more information on how samples were collected, recorded, coded and analyzed, see Grose-Hodge et al. (2024). Table 2 summarizes all measures and tasks used in the present study.

TABLE 1 Demographic information about the participants.

	Mean	SD	Range
Age	9.15	1.28	7.3–12.3
% current exposure to Polish	0.49	0.13	0.21–0.75
% current exposure to English	0.51	0.13	0.25–0.79
Cumulative exposure to Polish (years)	6.13	1.81	2.1–8.9
Cumulative exposure to English (years)	2.7	1.67	0.8–8
Motivation for Polish (max 40)	29.9	3.95	19–40
Onset of Exposure to English (years)	2.2	1.5	0–5.2
SES (ISCED 2011)	4.4	1.5	2.5–7

TABLE 2 A summary of measures and tasks.

Independent variables	Tasks	Dependent variables	Tasks
Exposure	BILEC	Lexical diversity	Narrative
Motivation	Motivation survey	Syntactic complexity	Narrative
Language aptitude	eMLAT, part 2	Fluency	Narrative
Age	BILEC	Receptive Grammar	TROG2

### 2.2.1 Exposure

To quantify bilingual experience and obtain information regarding language exposure, a parental questionnaire (BILEC, Bilingual Language Experience Calculator; Unsworth, 2013) was used. This comprises a detailed parental questionnaire and an Excel spreadsheet, which automatically calculates composite measures of input quantity and quality (for more information regarding the algorithms used, see Unsworth, 2013). In order to help parents become more aware of the patterns of exposure children receive, they were asked to fill in a journal for 2 weeks prior to the interview. They recorded the time their child spent at school/home/with friends and which language they spoke in these environments. This encouraged reflection and careful observation. The questionnaire allowed us to obtain two measures, which we combined: the proportion of current exposure to Polish vs. English, and cumulative length of exposure. The former was estimated through a quantitative analysis of the child's average input throughout the week, and the latter was derived through an analysis of earlier patterns of exposure focusing on the family's prior routines (more information on how the scores were computed is available [here](#)). We were not able to obtain a reliable measure of the quality of exposure as data was collected during the

pandemic, where most additional classes and activities, which would contribute to richness were canceled and children had much fewer opportunities to interact with others. The number of hours participants spent attending extra-curricular activities and interacting with other speakers was dependent on temporary restrictions in place, therefore responses given during the interview could not be representative of the child's more permanent situation. We have incorporated richness into a correlation matrix (see [OSF | Predictors of Heritage Language Acquisition DC1](#)) but decided against including it in the final analysis for the reasons stated above.

### 2.2.2 Motivation survey for children

A motivation survey for children was designed to gain a better understanding of other factors that may be correlated with ultimate attainment in HL, namely motivation, as well as attitude and identity, which are strongly correlated with motivation. This tool was designed to test the participants' motivation to use/learn their HL. The first 3 items asked participants about their Polish friend network and their use of Polish. These included:

- *Do you have any friends who speak Polish? If yes - how many?*
- *How often do you speak Polish with your Polish friends?*

They were then instructed to indicate to what extent they agreed with some statements using a 5-point rate scale. In order to ensure clarity and make the tool more appropriate for the age group, a smiley-face scale was used similar to the one [Ambridge et al. \(2008\)](#) used to elicit ratings for grammatical acceptability of argument-structure from children. Using smiley faces on point-scales is an established method in research into first language acquisition ([Ambridge and Rowland, 2013](#)), and it was adapted in this study in order to ensure that the questions are understood, and the responses are straightforward and clear. The statements included: *I enjoy speaking Polish; I want to know more about Polish culture; Speaking Polish is not cool; Speaking Polish will be useful for my career; I plan to live in Poland in the future; Being Polish matters to me.*

The answers to the first two questions were also converted to a 1–5 scale. The highest possible score on the questionnaire was thus 40. The interviews were conducted either face to face or using a video conferencing platform and the interlocutor encouraged children to ask for clarification in case they needed help with understanding the items. The children's answers were recorded by the experimenter. This method of administration was chosen over an online questionnaire in order to ensure questions were understood fully and answers input in a similar way.

After the survey was completed in a one-to-one session with each participant, items were first examined separately in order to visualize how they contribute to the overall results. A correlation matrix confirmed all items were positively correlated (see [Figure 1](#)). To explore the relationships between all motivation items, check which items have the most predictive power and represent the overall direction of the influence of motivation on linguistic outcomes, a Principal Component Analysis (PCA) was performed, and a correlation circle of the principal components and all variables was plotted (see [Figure 2](#)). PCA is a dimensionality

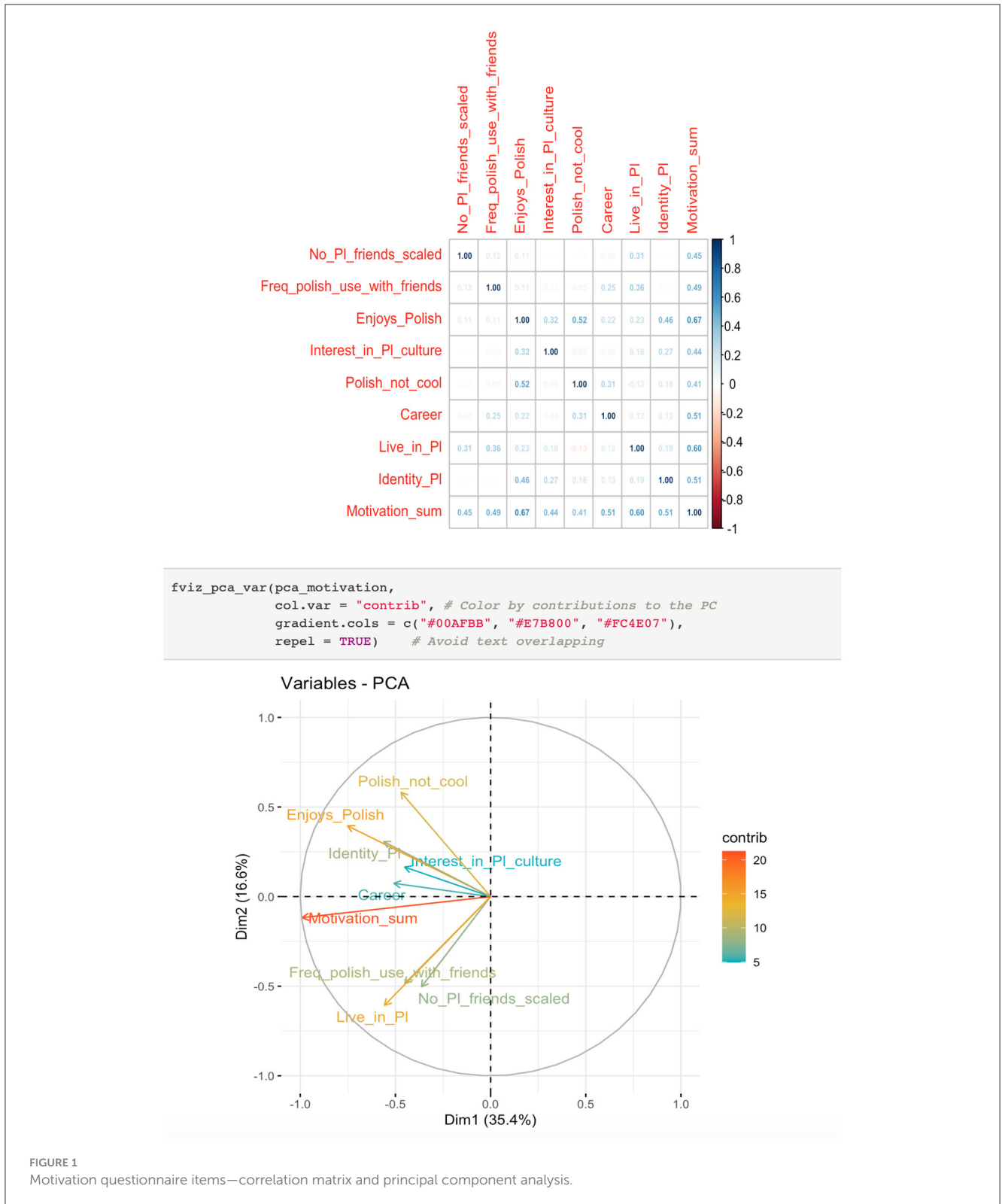


FIGURE 1 Motivation questionnaire items—correlation matrix and principal component analysis.

reduction statistical method, used when multiple measures are available for a variable of interest. It can also be used as a data visualization tool to inform decisions regarding the choice of final measures as the coordinates of the correlation variable plot visualize the overall contribution and correlational directions of each of

the items. The variable that contributed the most and represented the directionality of the data was the overall result, therefore, we decided that a measure that reflects the variable in the population best should include all items and used the total score. Means and standard deviations for each item are presented in Table 3.

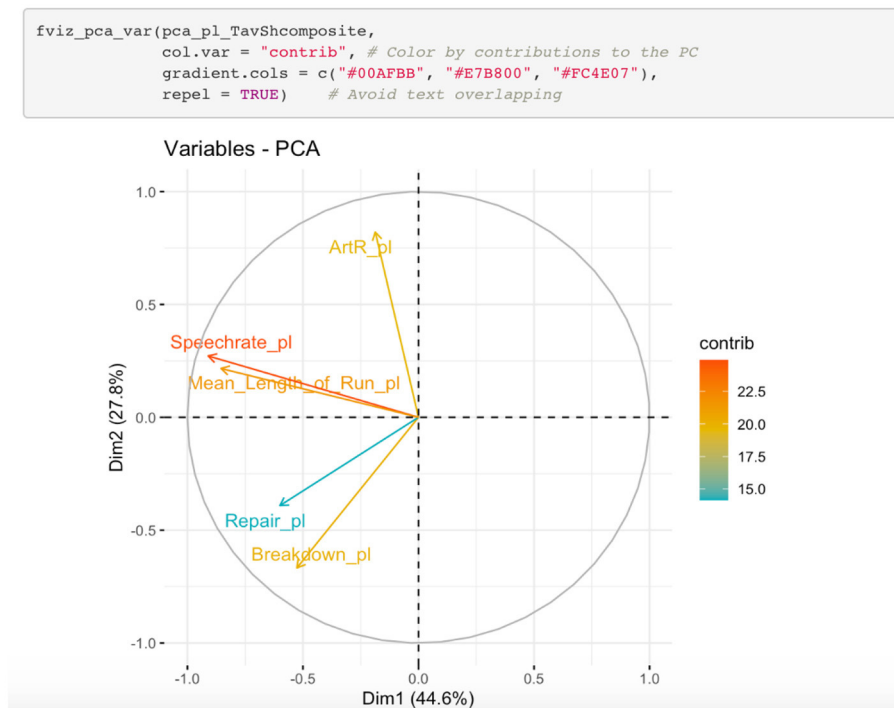


FIGURE 2 Fluency measures—principal component analysis for Polish.

TABLE 3 Means and standard deviations of motivational sub-factors.

Item	Mean (5 max)	SD
1. Number of Polish friends	2.1	1.2
2. Frequency of L1 use with Polish friends	3.2	1.02
3. Enjoys using Polish	4.1	0.85
4. Interest in the Polish culture	4.1	0.92
5. Pride in using Polish (Speaking Polish is cool)	4.6	0.75
6. Career orientation	4	1.03
7. Intention to live in Poland	3.4	1.14
8. Importance of Polish identity	4.4	0.92

\*All Items rated on a scale 1–5. Number of friends was adjusted to 1–5 scale as well.

### 2.2.3 Language aptitude

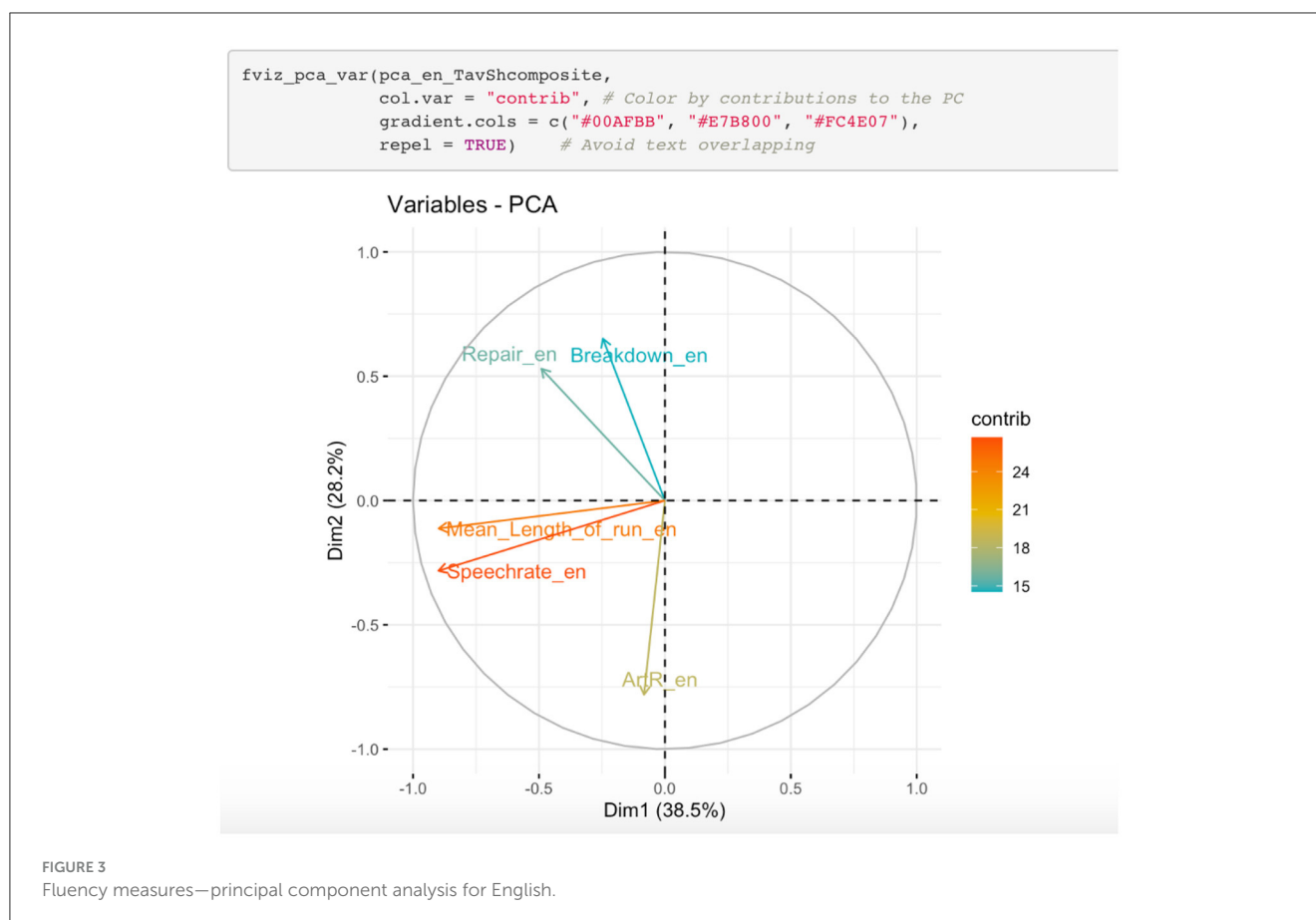
Grammatical sensitivity, the aspect of language aptitude that is most relevant for grammar, was measured using a subtest of the Modern Language Aptitude Test Elementary (eMLAT, Carroll and Sapon, 2002), namely part 2 (Matching Words). The children are presented with a key sentence, where one word is underlined and printed in capital letters (e.g., *Yesterday, Mary caught a FISH at the lake*). They are then shown a new sentence and asked to identify the word that plays a similar grammatical role in the sentence to the underlined word from the key sentence (e.g., *Cindy cut a*

*cake with a knife*—where cake is the analogous word). Participants first listened to recorded instructions and were briefly trained in identifying keywords, then completed a practice item before embarking on the actual test. Matching Words effectively measures the ability to explicitly reason about grammatical categories and relations, which is considered irrelevant to child language learning unlike associative memory or phonological abilities tested in other parts of eMLAT. This subtest was also chosen as we were most interested in grammatical development, and grammatical sensitivity has been found to predict grammatical attainment as well as composite aptitude scores (see Li, 2015 for a meta-analysis). Language Aptitude was tested in English only and raw results were used for the analysis (max 30). Li (2015) conducted a meta-analysis of studies of L2 grammar learning and found that measures of language analytic ability (such as the Matching Words subtest of eMLAT) predicted grammar as well as full aptitude scores.

### 2.2.4 Narrative production

The task was conducted in both languages and allowed us to derive the measures of three linguistic outcomes, namely *Fluency, Syntactic Complexity, and Lexical Diversity*. For detailed information on data processing and procedures applied, see Grose-Hodge et al. (2024).

Eliciting narratives is recommended as one of the most effective tools to measure language proficiency (see Polinsky, 2018; Montrul, 2016). This approach makes it possible to avoid testing bilinguals using tools designed for monolinguals and to explore different areas of language without overfocusing on accuracy,



or measuring bilingual achievement in relation to monolingual standards. Therefore, in order to tap into participants' syntactic and lexical proficiency, as well as utterance fluency in both languages, *narrative production samples* were elicited with the help of a picture story commonly used in language acquisition research, which is based on a book "Frog, Where Are You" (Mayer, 1969). We followed the protocol described by Berman and Slobin (1994), a summary of which is available on The Frog Story Corpora within CHILDES, the language component of the TalkBank system (MacWhinney, 2000). During individual sessions, participants were shown the illustrations and asked to tell the story, Their output was recorded for later analysis (see below). Three research associates were recruited to help with the transcription of the samples. The files were then edited by one of the authors, who then coded them and checked for accuracy before a random sample was scrutinized by the second author.

#### 2.2.4.1 Fluency

Following Tavakoli and Skehan (2005)'s three-dimensional model of fluency, a number of measures were derived from the speech samples. These included *Articulation Rate* (speed), *Breakdown Ratio*, i.e., number of silent and filled pauses per time unit (breakdown), and *Repair ratio*, i.e., number of repetitions and retractions per time unit (repair). These were derived manually from coded transcripts (see Grose-Hodge et al., 2024 for more details on the process). Additionally, two standard composite measures used in fluency analyses were derived automatically using

the Syllable Nuclei v2 script (de Jong and Wempe, 2009) in the PRAAT software (Boersma and van Heuven, 2001). These were *Mean Length of Run*, i.e., the number of silent pauses divided by the number of syllables, and *Speech Rate*, i.e., the number of syllables divided by time. As this approach yielded a number of measures, we performed a Principal Component Analysis (PCA) in order to reduce dimensionality and better understand how the measures relate to one another and how much weight they have on the principal components. The coordinates of the correlation variable plot of PCA show that *Speech Rates* and *Mean Length of Run* had the greatest contribution to the principal components and represented the directionality of all variables. Based on this data exploration, we decided to average these two composite measures instead of using principal components (see plots in Figures 2, 3).

#### 2.2.4.2 Syntactic complexity

To derive a measure of syntactic complexity, we calculated Mean Length of T-Unit (a main clause and all subordinate clauses attached to it) in words, and Subordination Index (a ratio of the total number of clauses to the number of T-units) from the transcripts using the CLAN analysis tools. These are standard syntactic complexity measures commonly applied in productive language analyses, and calculating these allowed us to steer away from using tests designed for monolinguals. Both have also been shown to increase throughout adolescence (e.g., Nippold et al., 2005; Loban, 1963). The variables were strongly correlated ( $r = 0.63$ ,  $p < 0.001$ ) in Polish; ( $r = 0.77$ ,  $p < 0.001$ ) in English,



therefore, we derived a composite measure by scaling them using the *preProcess* function using the CARET package (Kuhn, 2008) in R. R Core Team (2020) and subsequently averaging them. These measures and the procedures we followed are described in detail in Grose-Hodge et al. (2024).

### 2.2.4.3 Lexical diversity

Lexical diversity is an aspect of lexical richness and is operationalized through computing TTR or a ratio of unique lexical items (types) divided by the total number of words (tokens) in samples controlled for length. However, TTR is highly sensitive to sample size, therefore, we used measures with greater reliability based on TTR calculations but controlled for sample size. For English, *VocD*, a measure based on mathematical modeling of TTR, was derived automatically using the KidEval function in CLAN. Since this tool is not available for Polish, we used a different approach. We computed TTRs for 100-word samples of speech using the *freq* function in CLAN and then averaged the two measures. If the child produced fewer than 200 words, we averaged the first 100 and the last 100 words of the transcript (that is to say, the middle part of the text was shared). In the subsequent analysis, we refer to this measure as *Type to Token Ratio 100 (TTR100)*.

### 2.2.5 Test for the reception of grammar (TROG-2)

Even though recent studies show that the productive language of school-age heritage speakers is highly complex syntactically (e.g., Grose-Hodge et al., 2024; Kaltsa et al., 2020), HS' receptive skills are generally believed to be stronger than their productive abilities. Polinsky (2018) refers to this phenomenon as the production-comprehension divide. Therefore, to tap into both productive and receptive grammar, in addition to looking at syntactic complexity in elicited narratives, the Test for Reception of Grammar (TROG-2, Bishop, 2003) was administered in both languages. The instrument consists of a set of cards with 4 illustrations and a cue sentence. The participants listen to each sentence and are asked to point to the picture that matches it. The Polish test was a translation of the English version.

We took the raw result of the receptive grammar test (TROG-2) as we controlled for age in our main statistical analysis. We did not stop the test after 5 consecutive incorrect answers as advised in the manual as testing all items results in greater sensitivity and consistency. The overall result was out of 80 and we followed the same procedure in both languages. Internal consistency was computed by totaling odd and even TROG blocks and computing the correlation between those. The resulting correlations of  $r = 0.88$  for English and  $r = 0.82$  for Polish indicate good reliability. This was the only test that we used that was primarily developed for monolinguals. All other measures were derived from speech samples obtained with the Frog story (for more details on how the samples were transcribed and processed, see Grose-Hodge et al., 2024).

## 2.3 Procedure

Participants were recruited in a Polish Saturday School in Southampton, and parental consent as well as participant assent

TABLE 4 A summary of data collection sessions.

	Task	Setting	Time (mins)
Session 1	Interview with parents (BILEC)	Individual	15
Session 2	Ice-breaker	Individual	5
	Motivation Survey (PI)	Individual	5
	Polish narrative	Individual	15
	Polish TROG	Individual	10
Session 3	eMLAT	Group	25
Session 4	English narrative	Individual	15
	English TROG	Individual	10

was obtained. Next, an interview with parents was conducted remotely through a videoconferencing platform. For sessions with children, all procedures were carried out either at the participant's school or using videoconferencing software. The first (Polish) session with children started with an icebreaker, which consisted in making an avatar that would represent the children in the study. This allowed children to engage in a meaningful exchange with the experimenter. The task is creative as it requires the participants to choose the appearance of their avatar and allows them to use their heritage language in a non-threatening situation. Once an avatar was built, the motivation survey was administered with the experimenter asking the questions in Polish and translating into English if required. The participants' responses were recorded by the experimenter. After that, children were shown the picture story and asked to first look at the pictures and then narrate it. They were informed that their narrative would be recorded. The last task in the second session was the Test for the Reception of Grammar. Session three involved only one task, which was conducted in a group. The children first listened to the instructions of eMLAT part 2 and then completed the task individually. The last session was conducted in English and children were asked to narrate the picture story as well as do the receptive grammar test.

All interviews with children were conducted by an experienced bilingual teacher and utmost care was taken to assure a friendly and nurturing approach. Table 4 presents a summary of data collection sessions.

## 3 Results

Descriptive statistics for all measures are presented in Table 5 below. The dataset was scaled and centered using the *preProcess* function in the CARET package (Kuhn, 2008) to facilitate the combination of measures into composite variables. Statistics for the raw variables used to derive composite measures are available in the Appendix.

Correlations between all measures in both languages are presented in Figure 4. These have been calculated to gather an initial overview of the data; however, the reported *p* values should

TABLE 5 Descriptive statistics for all measures.

Language	Measure	Pre-processed data mean (SD)*	Raw data mean (SD)	Raw data range
	Age	0.37 (0.25)	9.15 (1.28)	7.3–12.3
	Aptitude	0.56 (0.30)	15.29 (6.99)	2–26
Polish	Motivation	0.51 (0.20)	29.9 (3.95)	19–40
	Exposure	0.56 (0.23)	-	-
	Fluency	0.39 (0.17)	-	-
	Syntactic Complexity	0.39 (0.18)	-	-
	Lexical Diversity	0.66 (0.19)	0.53 (0.06)	0.33–0.63
	Receptive Grammar	0.68 (0.18)	70.8 (5.15)	51–80
	English	Exposure	0.38 (0.22)	-
	Fluency	0.44 (0.16)	-	-
	Syntactic complexity	0.33 (0.16)	-	-
	Lexical diversity	0.31 (0.19)	26.29 (6.61)	14.84–52.83
	Receptive Grammar	0.64 (0.23)	70.63 (5.45)	56–79

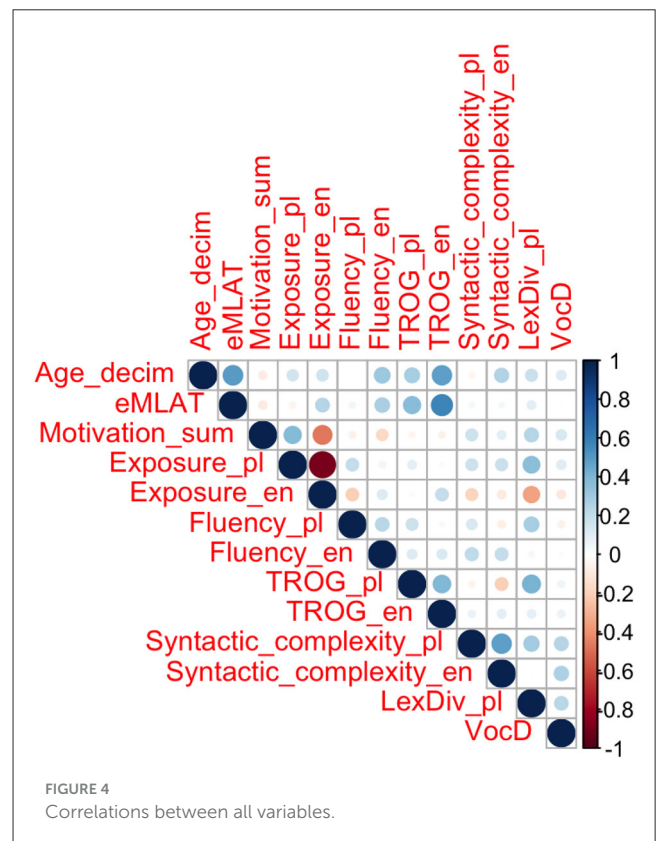
be considered with care due to the high number of tests. Age correlated strongly with language aptitude and English receptive grammar. It was also positively correlated with other linguistic achievement measures for English apart from fluency. In Polish, neither fluency nor syntactic complexity correlated with age. For other measures of linguistic achievement in Polish, i.e., lexical diversity and receptive grammar, the correlations with age were positive but not as strong as in the societal language. As to motivation to learn Polish and age, there is no effect of age ( $r = -0.07, p = 0.41$ ) at this stage.

Looking at the predictors and linguistic outcomes, the strongest positive correlations can be observed between English receptive grammar and language aptitude ( $r = 0.62, p \leq 0.001$ ), Polish receptive grammar and language aptitude ( $r = 0.35$ ), Polish lexical diversity and exposure to Polish ( $r = 0.38, p = 0.001$ ), Polish exposure and Polish fluency ( $r = 0.2, p = 0.078$ ) and Polish lexical diversity and motivation ( $r = 0.25, r = 0.028$ ).

Exposure to English was negatively correlated with all Polish linguistic measures with lexical diversity affected the most ( $r = -0.34, p = 0.002$ ), and had a strong negative correlation with motivation to speak Polish ( $r = -0.46, p < 0.001$ ). The effects of exposure to Polish on the English language, however, did not show a similar pattern. Correlations were either close to 0 or positive albeit weak and not significant ( $r = 0.18, p = 0.107$  for syntactic complexity and  $r = 0.11, p = 0.355$  for lexical diversity).

Within language correlations for the linguistic areas tested, lexical diversity and receptive grammar were positively correlated in Polish ( $r = 0.40, p < 0.001$ ) but not in English. Receptive grammar was also positively correlated with fluency ( $r < 0.18$  for both) in both languages but these correlations were not significant. Syntactic complexity and lexical diversity were positively correlated in both languages (English  $r = 0.26, p = 0.02$ ; Polish  $r = 0.3, p = 0.007$ ).

Finally, all proficiency measures were correlated positively cross-linguistically (receptive grammar  $r = 0.399, p < 0.001$ ;



syntactic complexity  $r = 0.49, p < 0.001$ ; lexical diversity  $r = 0.233, p = 0.04$ ; fluency  $r = 0.235, p = 0.038$ ).

Looking further at data exploring motivation, participants reported overall strong motivation to learn their HL and did not feel embarrassed to speak Polish. Their Polish identity was overall very important to them, they had a very positive view of the

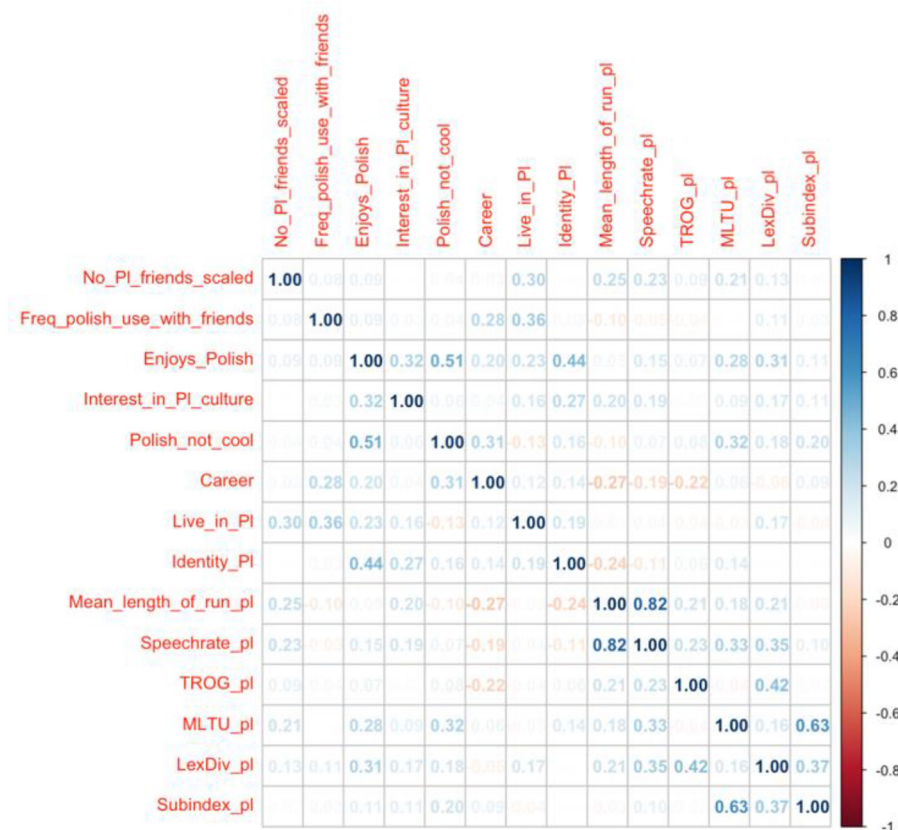


FIGURE 5 Correlation matrix between discrete items of motivation to use Polish and outcome measures in Polish.

language and enjoyed using it (see Table 3). To gain a better insight into the population’s motivation to learn the HL and its relevance to linguistic outcomes, we looked at individual items testing factors related to motivation. Figure 5 shows a correlation matrix between motivational sub-factors and achievement in Polish. Not surprisingly, speech rate was correlated with the number of friends participants spoke Polish with ( $r = 0.23, p = 0.05$ ). This motivation factor was also connected to syntactic complexity operated as mean length of T-unit ( $r = 0.21, p = 0.08$ ) but this outcome measure had additional, slightly stronger correlates, namely the degree of enjoyment participants derived from speaking Polish ( $r = 0.28, p = 0.018$ ) and their perception of Polish as a “cool” language to speak ( $r = 0.32, p = 0.006$ ). Enjoyment was also correlated with lexical diversity ( $r = 0.31, p = 0.007$ ), and perceiving speaking Polish as “cool” correlated with subordination index ( $r = 0.2, p = 0.084$ ). Instrumental motivation was either correlated negatively or had no influence on linguistic outcomes. The implications are discussed in the next section.

### 3.1 Regression analysis

As we aimed at discerning factors that predict heritage bilingual acquisition, for each language we fitted an ordinary least squares linear model regressing each of the language measures, against the three independent measures of interest. Age was added as a

covariate, i.e., a variable that is not relevant to the research question but may explain a proportion of variance. Therefore, the syntax for each model fitted was  $Outcome \sim Motivation + Language Aptitude + Exposure + Age$ . Models were reduced using the backward stepwise selection and all assumptions of linear regression were met. The *car* package was used to check whether multicollinearity was present (Fox and Weisberg, 2019) and a Studentized Breusch-Pagan test was run to check for homoscedasticity with the *lmtest* package (Zeileis and Hothorn, 2002). Distribution of errors was checked using a Shapiro-Wilk normality test and the *-W* statistic was calculated to check for autocorrelation in residuals.

As presented in Table 6, Fluency in Polish was best predicted by exposure and in English, the only significant factor was language aptitude. However, this effect was small and the predictor gained significance only after backward stepwise selection was applied. Receptive grammar was best predicted by Language Aptitude both in Polish and English with age being an additional significant variable for the societal language. Language aptitude was also the best predictor of syntactic complexity in English but not for Polish. Here, motivation played the most important role. Finally, lexical diversity was predicted by exposure in Polish but the analysis showed no significant predictors for English.

We also performed additional *post hoc* analyses of discrete items from the motivation scale in order to explore the effects of different kinds of motivation on vocabulary and syntax. For Polish, overall motivation was positively correlated with the vocabulary

TABLE 6 Predictors of bilingual acquisition—backward stepwise regression analysis.

Polish fluency	Estimate	Std. Error	t value	Pr(> t )
(Intercept)	0.24766	0.04426	5.596	3.52e-07 ***
Exposure_pl	0.24255	0.07231	3.354	0.00126 **
<b>Multiple R-squared: 0.132, p-value: 0.001257</b> <b>lm(formula = Fluency_pl ~ Exposure_pl)</b>				
English fluency	Estimate	Std. Error	t value	Pr(> t )
(Intercept)	0.09841	0.01253	7.852	2.9e-11 ***
eMLAT	0.04097	0.02012	2.036	0.0455 *
<b>Multiple R-squared: 0.05443, p-value: 0.04545</b> <b>lm(formula = Fluency_en ~ eMLAT)</b>				
Polish receptive grammar	Estimate	Std. Error	t value	Pr(> t )
(Intercept)	0.60305	0.03793	15.897	<2e-16 ***
eMLAT	0.15684	0.06064	2.586	0.0116 *
<b>Multiple R-squared: 0.08189, p-value: 0.01163</b> <b>Formula = TROG_pl ~ eMLAT</b>				
English receptive grammar	Estimate	Std. Error	t value	Pr(> t )
(Intercept)	0.21902	0.01306	16.776	<2e-16 ***
eMLAT	-0.12204	0.02261	-5.399	8.21e-07 ***
Age_decim	-0.06974	0.02617	-2.665	0.00949 **
<b>Multiple R-squared: 0.4743, p-value: 8.849e-11</b> <b>Formula = TROG_en ~ eMLAT + Age_decim</b>				
Polish syntactic complexity	Estimate	Std. Error	t value	Pr(> t )
(Intercept)	0.25471	0.0514	4.955	4.35e-06 ***
Motivation_sum	0.23617	0.09246	2.554	0.0127 *
<b>Multiple R-squared: 0.08002, p-value: 0.01267</b> <b>lm(formula = Syntactic_complexity_pl ~ Motivation_sum)</b>				
English syntactic complexity	Estimate	Std. Error	t value	Pr(> t )
(Intercept)	0.24405	0.03069	7.951	1.74e-11 ***
eMLAT	0.12411	0.04865	2.551	0.0128 *
<b>Multiple R-squared: 0.08186, p-value: 0.01283</b> <b>lm(formula = Syntactic_complexity_en ~ eMLAT)</b>				
Polish lexical diversity	Estimate	Std. Error	t value	Pr(> t )
(Intercept)	0.48153	0.05317	9.056	1.04e-13 ***
Exposure_pl	0.31592	0.08799	3.59	0.000583 ***
<b>Multiple R-squared: 0.145, p-value: 0.0005826</b> <b>lm(formula = LexDiv_pl ~ Exposure_pl)</b>				

\*Full models available [here](#). \*\*Syntax and abbreviations: *Outcome* (i.e., Fluency/Receptive Grammar/Syntactic Complexity/Lexical Diversity) ~ *Motivation* (Motivation\_sum) + *Language Aptitude* (eMLAT) + *Exposure* (Exposure\_pl/Exposure\_en) + *Age* (Age\_decim).

measure (see Figure 5) but this effect was not significant in the ordinary least squares regression analysis. It is likely to be a spurious correlation as it was weak, and vocabulary was also correlated with exposure to Polish. We looked further into different sub-factors of motivation in order to investigate this further; however, the results of this analysis should be interpreted taking into consideration that it was performed *post hoc*, and we did not correct for multiple comparisons, therefore type 1 errors cannot be excluded. When the facets of the variable were examined separately rather than grouped together, lexical diversity was predicted by attitude to

speaking Polish, tested with the statement *I enjoy speaking Polish* (see Table 7).

As motivation best predicted syntactic complexity and this effect was significant, we looked further into facets of motivation and their relationship with syntax. Here, the best predictor of syntactic complexity seems to be attitude toward the language and its use, i.e., whether the children perceived speaking Polish as something to be rather ashamed or proud of, tested with the statement *Speaking Polish is not cool* (see Table 8). As above, this result should be approached with caution.

TABLE 7 Discrete items of motivation and lexical diversity for Polish.

Polish lexical diversity and discrete motivation items				
	Estimate	Std. Error	t value	Pr(> t )
(Intercept)	0.45811	0.06691	6.847	2.67e-09 ***
Age_decim	0.14233	0.08517	1.671	0.09927
Enjoys_Polish	0.21232	0.07855	2.703	0.00868**

Multiple R-squared: 0.1328, *p*-value: 0.00788.  $\text{lm}(\text{formula} = \text{LexDiv\_pl} (\text{Lexical Diversity}) \sim \text{Age\_decim} (\text{Age}) + \text{Enjoys\_Polish} (\text{Item: I enjoy speaking Polish}))$ .

TABLE 8 Discrete items of motivation and syntactic complexity for Polish.

Polish syntactic complexity and discrete motivation items				
	Estimate	Std. Error	t value	Pr(> t )
(Intercept)	0.1312	0.1012	1.297	0.1989
Polish_not_cool	0.282	0.1086	2.596	0.0115 *

Multiple R-squared: 0.08896, *p*-value: 0.01152.  $\text{lm}(\text{formula} = \text{Syntactic\_complexity\_pl} \sim \text{Polish\_not\_cool}(\text{Item: Speaking Polish is not cool}))$ .

## 4 Discussion

*Q1: What role does motivation to maintain HL play and, in particular, does strong motivation to acquire HL hamper the development of SocL?*

Turning to the first question we have posed, regarding the role of motivation in the development of bilingualism, this study shows that while it does not seem to be significant for the acquisition of the SocL, motivation has a positive effect on some aspects of the HL. This finding has important implications for educators as well as parents of bilingual children, who may worry that strong interest in learning and using the family language may result in slower acquisition of the language used by the wider community. Furthermore, syntactic complexity, the area that was best predicted by overall motivation, is strongly correlated cross-linguistically, which could suggest either that there is a positive transfer between the languages in this area, or that metalinguistic awareness that is developed during the acquisition of syntax of one of the languages (usually HL), could accelerate the acquisition of productive grammar in the other language (usually SocL).

The findings challenge assumptions that HL motivation might have a negative effect on SocL acquisition. Instead, the study shows that motivation for HL use is beneficial for syntactic complexity in Polish without negatively affecting English outcomes. This contradicts results cited in previous studies (Mori and Calder, 2015, 2017) that HL interest has a negative influence on SocL lexis in this age group. There could be several explanations for this difference aside for the instruments used and the types of motivations they tapped into. One possibility is that participants in the present study received explicit instruction (through a community school), and this metalinguistic awareness could enhance the development of vocabulary and grammar in SocL. An alternative source of this discrepancy could be the age of participants suggesting perhaps that they were in a different developmental stage. Another plausible explanation could be offered by analyzing the directionality of causal relationships. In the case of the Japanese

bilinguals studied by Mori and Calder, weaker SocL skills may have driven a stronger affinity for HL culture, rather than HL interest reducing SocL proficiency. Finally, these effects may also be language-pair specific, and not necessarily generalizable across all heritage bilinguals.

Results within language align with those observed in previous studies in adult HL learners (e.g., Te Huia, 2017) and school-age heritage bilinguals (e.g., Jee, 2017; Mori and Calder, 2015) that motivation plays a crucial role in HL acquisition.

For Polish, overall motivation was positively correlated with the vocabulary measure (see Figure 5) but this effect was not significant in the ordinary least squares regression analysis. It is likely to be a spurious correlation as it was weak and vocabulary was also correlated with exposure to Polish. We have looked further into different sub-factors of motivation in order to investigate this further. However, the results of this analysis should be interpreted taking into consideration that it was performed *post-hoc* and we did not correct for multiple comparisons, therefore type 1 errors cannot be excluded. When the facets of the variable were examined separately rather than grouped together, lexical diversity was predicted by attitude to speaking Polish, tested with the statement *I enjoy speaking Polish*.

The result of the *post-hoc* analysis indicating that the discrete item of the motivation survey that best predicted vocabulary was the attitude to speaking Polish (tested with the statement *I enjoy speaking Polish*) would not be surprising as enjoyment and exposure, which was the strongest predictor of vocabulary, are positively correlated. More enjoyment connected to using Polish means more willingness to take opportunities to engage in interactions in the language, and therefore increases input quantity. More exposure, in turn, translates into more opportunities to learn new lexical items, and as having larger vocabulary facilitates the ease of expression, it is likely to foster enjoyment. However, the *post-hoc* analysis should be treated with caution.

Interestingly the area of linguistic achievement that was best predicted by overall motivation was syntactic complexity in Polish

and this effect was significant. Looking further into motivation, the item that predicted this area of language best was tested with the statement *Speaking Polish is not cool*. This is not a surprising result as bilingual children who may feel speaking a language different to that used by their peers may be perceived as less desirable socially are likely to express messages as simply and quickly as possible (e.g., when responding to their parents in front of their monolingual peers) in order to avoid embarrassment. Conversely, those for whom their linguistic skills are a source of pride, will not try to cut their conversations short but enjoy engaging in longer and more complex exchanges.

It is also worth noticing that the two facets of motivation that best predict vocabulary and productive grammar in HL measure attitude to the language and its use. This could be especially important for heritage school and mainstream school educators as well as parents. The results could indicate that one of the main roles of a teacher in a heritage language classroom is to foster a positive attitude toward the language and its acquisition. Therefore, the main focus should be on providing engaging materials and creating a positive and stimulating learning environment. Conversely, asking students to be seated at desks for hours with only a short break, over focusing on accuracy, drilling explicit grammar rules, or using course books for Polish children in Poland and thus focusing on concepts relevant to that population but often less engaging for children living abroad may be counterproductive. Participants in this study overall report high enjoyment connected to speaking Polish (Mean = 4.1, SD = 0.85) and pride in using the language (Mean = 4.6, SD = 0.75) and this could explain their overall high level of achievement.

As the perception of specific minority languages on an individual level is closely connected to social attitudes, and the hierarchical views of their perceived socioeconomic status are quickly internalized by children, it is vital that mainstream schools embrace diversity and help bilingual children construct their bilingual identities by creating an environment where their cultural and linguistic diversity is celebrated. This involves raising awareness, welcoming heritage languages at school, providing children access to materials in their HL and providing opportunities where native cultures can be showcased. Similarly, parents of bilinguals could help their children acquire their native language by instilling a sense of pride in their heritage culture, for example, by using HL in public instead of switching to SocL to fit in. Switching to SocL when in public is a common strategy used especially by parents who speak fluent SocL and whose native language may be seen as lower in status. Such practices may implicitly suggest to children that their HL is to be used at home but not in public, which may lead to shame or embarrassment connected to speaking the language outside home.

#### Q2: What role does input have in HL and SocL acquisition?

Exposure to English was negatively correlated with all Polish linguistic measures with lexical diversity affected the most ( $r = -0.34$ ,  $p = 0.002$ ) (a similar effect of input in SocL on vocabulary in HL was observed by [Rose et al., 2023](#)), and had a strong negative correlation with motivation to learn Polish ( $r = -0.46$ ,  $p < 0.001$ ). The effects of exposure to Polish on the English language, however, did not show a similar pattern. Correlations were either close to 0 or positive albeit weak and insignificant.

In parental interviews, a number of parents reported being advised against speaking Polish with their children. Such advice was often given by educators who worried that using HL could hamper the development of SocL. The fact that exposure to Polish predicted Polish fluency and lexical diversity in Polish but was not significant to the development of any linguistic area in English and did not correlate with any English proficiency measures suggests that the use of heritage language does not slow down the acquisition of the societal language but is crucial for the development of the heritage language. Therefore, parents of bilingual children and educators should not discourage the use of HL.

Interestingly, [Paradis et al. \(2020\)](#) found that language use at home and richness accounted for more variance in SocL than the HL but the participants in their study were school age Syrian refugees, who had just arrived in Canada (mean family residency was 23 months). The difference between the results reported by Paradis and colleagues, and the present study could be explained by the *critical mass hypothesis*, which postulates that language acquisition involves reaching a “critical mass” of data exposure. Once a child has enough data (exposure to both languages), they can identify the underlying grammatical patterns and catch up to their peers, regardless of any initial disadvantage. This suggests that language acquisition is not just about early exposure, but also about accumulating enough data to draw generalizations about the language. As the in the present study the average time of residency in the UK was 7 years, the children are more likely to have accumulated the critical mass of exposure that allows them to generalize rules and form constructions than the Syrian sample. [Gathercole \(2002\)](#), who studied the acquisition of that-trace in Spanish-English bilinguals reports that irrespectively of an early advantage in a given language, by grade 5 differences in the extent to which the structure has been acquired between the groups studied either disappeared or were negligible. This, indeed, shows that the relationship between input and HL/SocL achievement is not linear. However, as heritage speakers tend to receive much more exposure in their SocL throughout their life, they will inevitably reach a critical mass in the language of the country they reside in, and as early language practices in families are likely to persist later, parents should not be encouraged to speak the SocL to their children even at the very beginning of the SocL acquisition process. This is because the use of SocL at home is bound to have a negative influence on the children’s heritage language development (e.g., [Rose et al., 2023](#)).

The findings would suggest that the amount of exposure participants received in English is not only sufficient to generalize rules, but it is also more than sufficient for the development of the language and acquire a level comparable to that of children receiving 100% of their input in English (see [Grose-Hodge et al., 2024](#)). Reducing input in Polish, on the other hand, results in lower achievement. This has been observed in other studies (e.g., [Rose et al., 2023](#)), and was usually explained by “reduced exposure to HL” but it is somewhat surprising to observe here given their average cumulative exposure to the languages (6.13 years to Polish and only 2.7 years to English). This could possibly emphasize the role of current exposure but in this particular group, average current exposure to Polish and English were divided equally (49% and 51% respectively). Another explanation, thus, could be

related to the quality of input. The main difference relating to this factor was that the children were exposed to Polish mainly at home, while English was acquired mainly at school. During later language acquisition reading and expository conversations are the main source of new vocabulary and exposure to more complex structures (Nippold, 2004), therefore, the results could be indicative of the role schooling plays in the acquisition of language for this age group, which is supported by previous findings, which emphasize the role of input received at school in the acquisition of SocL (e.g., Golberg et al., 2008; De Cat, 2020).

The interesting question that arises here is why is it that more exposure to English does not seem to result in better achievement in this sample. This finding could be interpreted in context of research in the field of language and social disadvantage, where it is evident that children from lower socioeconomic backgrounds receive less input, catch up during the year but the gap in their linguistic achievement then widens during holidays (van der Kleij et al., 2023), which is indicative of the role input received at school plays in language acquisition. However, interestingly enough, bilingual children, whose input is divided between two languages, receive enough exposure to develop SocL to close the academic achievement gap which could be observed in children who enter a SocL education system with no/little prior knowledge of the language. Studies analyzing English as an Additional Language (EAL) student achievement in the UK (e.g., Demie and Strand, 2005; Demie, 2017; Strand and Demie, 2006) have consistently found that while they may initially lag behind, they often outperform their monolingual peers in national tests at the end of primary and secondary school.

This could suggest that the differences between linguistic achievement between children from different socioeconomic backgrounds could stem either from the quality of input they receive at home or from factors other than linguistic, e.g., parental encouragement. Participants in this study all attended a community Saturday school, which would suggest their families were committed to their education and facilitating their learning. Another non-linguistic factor could be socioemotional. Soto-Corominas et al. (2020) observed that in their studied population of school age Arabic refugees, hyperactivity and emotional problem behaviors predicted lower achievement in both HL and SocL. Children from lower SES families may also experience more challenges than those from homes with higher SES, therefore this factor could also account for some variation in socially disadvantaged monolingual and bilingual children. This supports the need to look into individual differences in bilingual acquisition.

Finally, as all linguistic measures were positively correlated across languages (receptive grammar  $r = 0.399$ ,  $p < 0.001$ ; syntactic complexity  $r = 0.49$ ,  $p < 0.001$ ; lexical diversity  $r = 0.233$ ,  $p = 0.04$ ; fluency  $r = 0.235$ ,  $p = 0.038$ ), which is consistent with correlations reported in other studies (e.g., Papastergiou and Sanoudaki, 2021; Pham, 2016; but cf. Simon-Cerejido and Gutiérrez-Clellen, 2009). It is possible that the learning of HL facilitates the development of SocL either through raising linguistic awareness, transfer or boosting cognitive skills. This could, therefore,

provide further support to the Interdependence Hypothesis (Cummins, 1979), which posits that underlying proficiencies, such as abstract thinking, problem-solving, and metalinguistic awareness, are shared by both languages, which have access to the same cognitive store (see Blom et al., 2021 for more evidence in support of the Interdependence Hypothesis in HL school age population).

Q3: *What role does aptitude have in HL and SocL acquisition?*

We found robust effects of language aptitude on the development of the SocL. This factor predicted receptive grammar, syntactic complexity and fluency in English with the strongest effect on receptive grammar. It is well evidenced that language aptitude predicts the achievement in a foreign language in instructional settings but in this study, the distinction between first and second language is not always clear as the vast majority (85%) were either born in the UK or arrived in the 1<sup>st</sup> year of their life. Additionally, all participants acquired English in a naturalistic setting, therefore, the results put into question the Fundamental Difference hypothesis (Bley-Vroman, 1989), which assumes that during language acquisition, children rely on implicit learning or domain-specific mechanisms, while adults make use of domain-general cognitive abilities and explicit learning. If this were the case, eMLAT should not be predictive of achievement in children who started learning the language early in childhood in a naturalistic setting. More interestingly, language aptitude was a significant factor that predicted achievement not only in English but also in Polish (HL or L1). Its predictive power was not as strong in Polish but the correlation ( $r = 0.38$ ,  $p < 0.001$ ) with receptive grammar measured by TROG was still similar to that found previously in L2 in adults (see Li, 2015 for a meta-analysis of effects of aptitude on second language attainment).

One explanation why aptitude predicted TROG results in English better than in Polish could simply be that eMLAT was administered in English, and therefore, tested the ability to see grammatical patterns in the English language. An alternative explanation could be that language aptitude is crucial when there is less exposure. When input is reduced, there are fewer exemplars to generalize from, therefore, the ability to notice and remember patterns would allow to form constructions quicker even when an individual might have less experience of them. Our participants on average had only 2.7 years of cumulative exposure to English compared to 6.13 years to Polish. It is possible that we tested them when those with lower language aptitude were still generalizing syntactic rules while those with higher aptitude have had enough input to generalize already. This could suggest that language aptitude or the ability to notice patterns and generalize from them could be crucial when there is less input available.

## 5 Conclusion

This study has demonstrated that strong motivation to speak Polish (HL) does not hamper the development of English (SocL) but is a significant predictor of syntactic complexity in Polish. It also suggests that the speakers' perception of HL as well as enjoyment derived from speaking it may be the most important

motivational factors for this population, which has implications for HL classroom instruction. The results also show that while cumulative exposure does not predict linguistic outcomes in English, it is the best predictor of both fluency and lexical diversity in Polish. This could highlight the role of input quality and schooling in bilingual acquisition. Finally, language aptitude has been shown to be a significant predictor of achievement in both languages, which has important implications for theories of language acquisition.

## Data availability statement

The datasets presented in this study can be found in online repositories. The names of the repository/repositories and accession number(s) can be found below: [https://osf.io/cxrdf/?view\\_only=751a57e0106646dc9d5449a5ff5cf084&fbclid=IwY2xjawGt6s1leHRuA2FlbQIxMAABHc7itcMEJcraU2NXpvVo\\_7f1lQqHParCqYtHKsXa5ot\\_WO9nvc4Zh5Nw0qQ\\_aem\\_-auAqS5CwCES6wEU202kQ](https://osf.io/cxrdf/?view_only=751a57e0106646dc9d5449a5ff5cf084&fbclid=IwY2xjawGt6s1leHRuA2FlbQIxMAABHc7itcMEJcraU2NXpvVo_7f1lQqHParCqYtHKsXa5ot_WO9nvc4Zh5Nw0qQ_aem_-auAqS5CwCES6wEU202kQ).

## Ethics statement

The studies involving humans were approved by Humanities and Social Sciences Ethical Review Committee University of Birmingham. The studies were conducted in accordance with the local legislation and institutional requirements. Written informed consent for participation in this study was provided by the participants' legal guardians/next of kin.

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MG-H: Writing – original draft, Writing – review & editing. ED: Conceptualization, Funding acquisition, Supervision, Writing – review & editing. DD: Methodology, Supervision, Writing – review & editing.

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## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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## Appendix

TABLE A1 Descriptive statistics for all measures and variables used to derive composite measures.

Language	Measure	Pre-processed data Mean (sd)*	Raw Data Mean (sd)	Raw Data Range
Polish	Age	0.37 (0.25)	9.15 (1.28)	7.3–12.3
	Aptitude	0.56 (0.30)	15.29 (6.99)	2–26
	Motivation	0.51 (0.20)	29.9 (3.95)	19–40
	Exposure	0.56 (0.23)	-	-
	Current Exposure (%)		0.49 (0.13)	0.21–0.75
	Cumulative Exposure (years)		6.13 (1.81)	2.1–8.9
	Fluency	0.39 (0.17)	-	-
	Speech Rates		2.21 (0.47)	0.96–3.65
	Mean Length of Run		12.17 (3.56)	5.92–25.88
	Syntactic Complexity	0.39 (0.18)	-	-
	Mean Length of T-Unit		5.53 (0.78)	3.8–8.15
	Subordination Index		1.17 (0.09)	1–1.45
	Lexical Diversity	0.66 (0.19)	0.53 (0.06)	0.33–0.63
	Receptive Grammar	0.68 (0.18)	70.8 (5.15)	51–80
English	Exposure	0.38 (0.22)	-	-
	Current Exposure (%)		0.51 (0.13)	0.25–0.79
	Cumulative Exposure (years)		2.7 (1.67)	0.8–8
	Fluency	0.44 (0.16)	-	-
	Speech Rates		2.38 (0.40)	1.21–3.24
	Mean Length of Run		13.36 (4.04)	5.22–31.53
	Syntactic Complexity	0.33 (0.16)	-	-
	Mean Length of T-Unit		8.33 (1.27)	5.36–13.16
	Subordination Index		1.24 (0.15)	1–1.82
	Lexical Diversity	0.31 (0.19)	26.29 (6.61)	14.84–52.83
	Receptive Grammar	0.64 (0.23)	70.63 (5.45)	56–79