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## **The Development of Language Skills in Speakers of English as an Additional Language What Matters More, Daily Use or Age of Onset?**

### **Abstract**

While seminal work identified age of onset to L2 as a core predictor of L2 learning in naturalistic environments, recent research has shown that other variables, such as language use, are more important than an early age of onset in predicting L2 attainment in speakers who learn the second language primarily in school. In this study, we investigated whether the acquisition of vocabulary and the development of overall proficiency in English as L2 can be predicted more faithfully by daily language, intended as daily share of L2 use in comparison to L1s, or L2 age of onset. To explore this issue, we analyzed a large public dataset of 650 speakers (de Bruin et al., 2017), in which participants were native in Spanish and/or Basque and spoke English as an additional language. Participants were previously assessed on their vocabulary skills using the LexTALE task and on their overall proficiency using a semi-structured interview. Language skills were then added to a linear regression model where age of onset and daily use of English were treated as predictors. Our results show that, in this dataset, use is a better predictor of language skills (both lexical knowledge and overall proficiency) than age of onset.

*Keywords:* bilingualism, age of onset, language use, English as L2

## Age of Onset and Language Use

### Proficient L2 Late Learners

Can one learn a second language proficiently if exposure starts later in life? This general question delimits one of the main problems in second language research, it is a recurrent doubt for people interested in language learning, and it is the leitmotif of this article. In this study, we specifically investigate the differential role of two variables that are expected to be predictors of second language learning: age of onset to the second language and amount of daily language use. We will try to understand how the two variables interact with each other, and which one is a better predictor of language skills, in a group of adult speakers of English as an additional language. We will analyze a large dataset that was kindly provided by Angela de Bruin, a researcher based at the University of York, and which includes the linguistic performances of 650 people tested in Spain in the Basque Country. All of these participants are native speakers of Spanish and/or Basque and all speak English as an additional language.

### The Role of Age of Onset in L2 Learning

A common assumption in laypeople's discourse on education is that an early onset of exposure to a second language is crucial to attain native-like proficiency (Blom & Paradis, 2016; Pfenninger & Singleton, 2019). This notion is, however, mostly not corroborated by data (Muñoz, 2006; Pfenninger & Singleton, 2019), it appears to be true only for some domains of language (Herschensohn, 2013), and it appears to interact with a number of other variables in complex ways (Birdsong, 2018). This section describes this multifaceted picture. Generally speaking, age of onset is shown to be a crucial predictor for the language attainment of children emigrating to a new country. As Larson-Hall (2008) notices, this is not accidental, and it is probably due to the fact that extensive language immersion triggers implicit learning, a type of learning that may be more dependent on developmental factors than explicit learning.

One domain that seems to be particularly affected by age of onset is phonology (Sebastian-Galles & Bosch, 2005; Herschensohn, 2013). Phonology is the first linguistic domain to be acquired during childhood, and it is thus no surprise that age of onset to the second language affects the development of its phonology (Kuhl, 2004; Guasti, 2017). Studies show that children that are exposed to the second language from birth are the only ones that manage

to achieve native-like performance in phonological tasks in primary school (see, e.g., Kovelman, Baker, & Petitto, 2008, on Mexican children emigrating to the US) and similarly, adults that are exposed to a second language from birth are the only ones that perform like natives in fine-grained tasks of phonetic discrimination (Pallier, Bosch, & Sebastián-Gallés, 1997). In other words, even when speakers are very proficient in a second language, very subtle phonological differences due to the age of onset to L2 can still be recorded using experiments, and these have long-lasting effects.

Age of onset effects are, however, more controversial in other domains of language. Some studies do show age of onset effects in grammatical learning, even if these do not seem to appear across the board. McDonald (2000), for example, showed that age of onset to the L2 has long-term effects on grammatical knowledge, but these effects are modulated by the L1. In her study, groups of early and late sequential adults who emigrated to the United States were compared to monolinguals in their grammatical performance. The language of testing was English, and the L1 of the bilingual speakers could either be Spanish or Vietnamese. Age of onset showed to be a main predictor of grammatical performance, with different effects in the Spanish and the Vietnamese groups. For the Spanish group, the late sequentials performed poorly in a number of structures, including: past tense, plurals, third person, present progressive, auxiliaries, articles, yes/no questions and *wh*-questions. For the Vietnamese group, instead, difficulties were found in both early and late sequentials, though while for the early sequentials difficulties were limited to the traits that differ between English and Vietnamese, for the late sequentials the difficulties were more generalized (similarly to what was found for the Spanish late sequentials).

In other cases, the report of age of onset effects appears to be modulated by the system used to measure them. For instance, Abrahamsson and Hyltenstam (2009) investigated a large sample of Spanish-Swedish bilinguals and assessed their proficiency with two different systems. Participants in this study had a wide range of ages of onset (and life backgrounds), going between one and 47 years of age, and all of them identified as bilinguals. The first assessment consisted in the evaluation of their proficiency in Swedish, performed by a group of Swedish native speakers. This first analysis showed that the vast majority of speakers that were exposed to Swedish before 12 were perceived as native speakers by the Swedish judges, while the majority of those that were exposed to Swedish after 12 were perceived as non-native. However, once the early learners were assessed with a battery of Swedish language tasks, none of them (including the early sequentials, exposed at the time of nursery) did perform within the native-like range.

In a study investigating a sample of unprecedented size (over 600,000 people), Hartshorne, Tenenbaum, and Pinker (2018) tried to understand whether difficulties related to age of onset emerge linearly with time, or if there are

thresholds and cutting-off points. In their study, L2 speakers of English (with a wide variety of L1s) were assessed in a number of grammatical structures via online quiz. The subjects' age of acquisition was included in a model aiming at identifying any sharp decline in acquisition related to the age of onset. Their result suggests that people that were exposed to English after the age of 17 were extremely less likely to attain good performance in the language, but the model also showed a less abrupt but consistent decline taking place as early as at the age of three.

While these findings are important and do suggest a role of age of onset in second language learning, several studies have shown that age of onset may not be an actual contributing factor of the different learning trajectories just described, and in some cases, age of onset may even be a confounding variable (Birdsong, 2018).

First, one assumption in research that describes age of onset as a main predictor of language learning is the idea that there are maturational changes in our brain that make language acquisition natural at early ages, and gradually more difficult with time (stemming from classic work on the critical period, Lenneberg, 1967). When this idea is carefully put under scrutiny, it appears to be untrue to some extent. A biological description of brain development is beyond the scope of this article, but a few concepts may be outlined: evidence does suggest that brain plasticity is higher in younger learners, meaning that younger individuals' brains are overall more prone to adapt to new cognitive skills (Mundkur, 2005; Trettenbrein, 2017). However, increasing evidence shows that individual differences in brain plasticity can be extreme, with some individuals showing negligible signs of reduced plasticity over time (Wong et al., 2012; Paradis, Tulpar, & Arppe, 2016). The reasons behind these differences are yet to be fully understood, but the notion that there is a linear and regular correlation between time and cognitive decline is to be at least reconsidered. Additionally, the maturational account of age of onset effects has been critically reduced in new research approaches, as it appears that there is no decline in linguistic resources in late childhood, nor after puberty, and actually some aspects of cognition related to language may become sharper with time (Blom & Paradis, 2016).

Second, in experimental settings where multiple predictive variables are considered, it appears that the best predictor of second language learning success is to be found in socio-affective factors (Birdsong, 2018) and environmental factors (Blom & Paradis, 2016), rather than age of onset. In other words, what seems to be predicting success is how the speakers experience the language and not how early they are exposed to it (Birdsong, 2018), and speakers that are motivated and emotionally involved in their second language learning tend to be successful at any age. Often, second language learning in children with an early age of onset does indeed have the characteristic of being emotionally

important for the child, and thus an early age of onset does often correspond to successful second language learning. However, age of onset is not necessarily the key contributing factor of success, but a confounding variable. Some studies show that a late age of onset can still result in proficient learning if the motivation is high (Muñoz, 2006).

Finally, a plethora of studies show that there are complex interactions between age of onset effects and the role of quantity and quality of exposure, meaning that a later age of onset but a better quality and quantity of exposure may still result in proficient second language learning (Birdsong, 2018). The next section will discuss this variable in detail.

### **The Role of Language Use in L2 Learning**

According to a number of researchers (e.g., Larson-Hall, 2008; Muñoz, 2006; Unsworth et al. 2011; Paradis et al., 2017; Cadierno et al., 2020), a large amount of language use and exposure is an even more important parameter than an early age of onset to attain proficiency in the second language, particularly when considering learners that rely primarily on classroom instruction. According to this view, people who are exposed to a second language late in their life but use the language frequently can acquire it at a near-native or even native-like level, compensating for effects of late age of onset. Unsworth et al. (2011), for example, have shown that the acquisition of complex grammatical phenomena (in this case gender in Dutch/Greek bilingual children) depends very closely on the amount of input that people have received and produced, rather than on their age of onset to these structures. Similarly, research conducted by Paradis et al. (2017) shows that the production of complex syntax by children speaking English as L2 is better predicted by the amount of exposure to the language, rather than by the age of onset. More specifically, children with a late age of onset but large exposure showed to rapidly develop good performance with complex structures, at a learning rate that even surpasses that of L1 learners. Similar findings were obtained by Cadierno et al. (2020) in a comparison of children with matched exposure but different onset. Using a semi-longitudinal design, the authors analyzed the linguistic development of young Danish learners of English (growing up in Denmark) with different ages of onset but the same length of formal instruction in English as a second language. According to their findings, the older students (their age of onset being 9–10 years) outperformed the younger students (with the age of onset being 7–8 years) in receptive grammar as well as receptive vocabulary, with the advantage of lexical ability being traceable even two years after the onset of English exposure, and the advantage in their grammatical skills growing over time. Interestingly, the authors suggest that, in the Danish context, this finding is related to

accumulated exposure that children get outside the classroom, with older children having a few more years of exposure to movies, series and games in English.

A study by Larson-Hall (2008) investigated whether these reflections extend to second language learners that rely uniquely on language exposure in the classroom (something relevant for our study, since in Spain exposure to English outside of the classroom is generally limited). In this study, several groups of second language learners (Japanese, with English as L2) with varying ages of onset were assessed on grammatical and phonological tasks. The study showed complex interactions between exposure and age of onset: While an earlier age of onset did have a significant role in predicting attainment, this revealed to be true only for learners who were exposed to English for a significant amount of time weekly, and thus as an early age of onset, per se, was not the core predicting variable. A long-term and large-scale (2,000 participants) study conducted by Muñoz (2006) on Catalan-Spanish learners of English is particularly revealing of these patterns. In this study, four groups of learners were followed for ten years during their development of English. These learners had different ages of onset: age eight, age 11, age 14, and age 18+. Number of hours of classroom exposure to English was carefully assessed for all individuals, and then included in the models analyzing the data. Two interesting findings emerged from this study: First, contrary to maturational accounts predicting a cognitive (or at least psycholinguistic) decline over time, the older learners were the fastest learners, and the trend then proceeded accordingly, with adolescents going faster than children. Second, regression analyses showed that number of classroom hours was a significant predictor of language attainment for all groups. Together, these two findings suggest that second language attainment may be predicted by classroom exposure rather than age of onset, with minimal advantages for an early age of onset. These parameters, as already outlined in the previous section, additionally interact in complex ways with other variables, such as motivation and the general cognitive development of the learner. A recent study by Pfenninger and Singleton (2019) confirms yet again these claims. In this study, English attainment of a large cohort of Swiss high school students was assessed in a 5-year longitudinal study. Crucially, results showed that intensity of exposure was a better predictor of success than age of onset.

The notion of language exposure is closely tied to the notion of language use: when people are exposed to a language in an interactive environment, this corresponds to a larger amount of language use (where use is a notion that includes both perception and production of a second language). Studies on second language use as a predictor of language skills are less common, but their findings go in the same direction (this is not surprising, since exposure and use are correlated variables). A study by Amuzie and Winke (2009)

shows that amount of language use is a main predictor of language attainment and self-perceived proficiency in students who travel to the United States for programs of second language immersion. Similar findings were obtained for learners of Japanese travelling to Japan (Dewey, Bown, & Eggett, 2012) and learners of Arabic travelling to Jordan and Morocco (Dewey, Belnap, & Hillstrom, 2013).

Finally, even if these claims mostly stem from research on learners that rely on classroom exposure, some studies on immigrants point in the same direction as well. A large-scale study of adolescent immigrants coming from several countries (China, Mexico, Haiti, and Dominican Republic) to the United States, investigated the role of language use in their English attainment after seven years from the arrival (Carhill, Suárez-Orozco, & Páez, 2008). In this study, learners were asked to evaluate their share (in percentage) of use of English in an average day. Additionally, they were asked to specify how much of this share was in formal and informal contexts. These values, together with additional metadata, were then used to predict English scores. The results showed that use of English was a main predictor of language scores, with a fundamental role being played by use in informal contexts.

In an epistemological paper, Tsimpli (2014) tried to integrate the apparent contradiction between age of onset and language use findings. By analyzing a large number of studies, her work suggests that the roles of age of onset and exposure vary depending on the structure under scrutiny: for some structures, the so-called late structures, exposure and use are the fundamental predictors, while for the so-called early structures, age of onset is a better predictor. The division in early and late structures is a reference to monolingual development, where certain structures are acquired very early, and others are acquired much later. The order of verbs and objects, for example, is acquired by children within the first two years of life (and it surfaces in their very first multi-word utterances). Inflectional morphology, instead, is acquired much later, starting around three years and lasting for several years (with some considerable variability depending on the language under scrutiny). When it comes to second language acquisition, Tsimpli (2014) argues that the proficient acquisition of structures that fall into the “early” box is heavily dependent on age of onset, while the acquisition of structures that fall into the “late” box is heavily dependent on use and exposure. The pattern described by Tsimpli in her epistemological article was confirmed experimentally by Ågren et al. (2014) in a longitudinal study testing a variety of structures, divided in early and late, in a group of Swedish-French bilingual children. Importantly for the current research, Tsimpli’s work indicates that these two parameters (onset and use) have separate roles in second language acquisition, and thus deserve to be analyzed as separate predictors. In this study, we addressed this important and complex relationship by investigating the roles of age of onset and language

use in a large sample of English L2 learners having Spanish and/or Basque as L1. The notion of *use* adopted here is that of “daily share of English,” similarly to Carhill, Suárez-Orozco, and Pérez (2008).

## Methods

### Research Question, Hypothesis and Design

*Research question:* Are language skills in speakers with English as an additional language better predicted by age of onset or by daily use of English?

*Hypothesis:* Daily language use is more important than age of onset for the acquisition of both vocabulary and overall proficiency. Thus, our prediction is that, in this sample, daily language use will be a better predictor of linguistic attainment.

*Design:* To answer this question, we completed two multiple regressions on a dataset of speakers having English as additional language, in which age of onset and daily use were treated as predictors, and two different measures of language skills were treated as outcome variables. The predictors (age of onset and daily use) were assessed with a questionnaire. As explained in the Participants section, age of onset was coded based on a question assessing the age at which speakers started being in consistent contact with English (this meant, for most, the start of English training in school). Daily use was instead coded by asking speakers to specify the amount of share (in percentage), on an average day, of their use of English in comparison to Spanish and Basque. The predicted variables were overall language proficiency, assessed with a semi-structured interview, and lexical knowledge, assessed with the English version of the LexTALE. These two variables are described in detail in Procedure section.

### Participants

The data of this dataset (known as the BEST dataset) were collected by de Bruin et al. (2017). The study of de Bruin et al. (2017) was submitted to the BCBL Ethics Committee and it received favorable opinion. Consent forms for each participant were collected and are stored in a secure location. Permission to use the dataset was granted in written form by Dr. de Bruin to the first author of this manuscript. For a more detailed description of the assessment procedure,

please see their reference. We report here some descriptive information provided by the authors: A sample of 650 (435 female) participants completed several tasks assessing language proficiency. Their ages varied between 18 and 50 years (mean = 25, SD = five years and seven months). At the time of assessment, the highest level of education obtained ranged from high school to university, with the majority of participants (80%) having attained a higher level of education (professional, university or postgraduate). More specifically, 380 subjects had a university bachelor's degree, 69 had a postgraduate university degree, 73 had a diploma in professional training (completed after high school), and 128 had a high school diploma. All participants at the time of assessment lived in Spain, in the Basque county, and identified as native speakers of Spanish and/or Basque, and second language learners of English. Self-perceived proficiency, described on a scale from zero to ten, was highest on average for Spanish (9.2), and slightly lower for Basque (8.03). English, described as a second language, obtained on average a score of 6.1. Socio-economic measures (except for education) and data relative to occupation were not collected. All participants learned Basque and Spanish in the first years of life (mean age of onset for Spanish = eight months, SD = one year and six months; mean age of onset for Basque = one year and eight months, SD = one year and ten months). Onset of exposure to English was on average at a later age (mean age of onset for English = six years and four months, SD = two years and six months), but all participants reported acquiring English at or before 12 years of age. Subjects were assessed by de Bruin et al. (2017) with a number of tasks provided in all three languages.

## Procedure

Participants in this study were assessed with a number of tasks, and they additionally provided a self-perceived measure of their proficiency, language use and age of onset. We introduce here the measures and procedure used to assess these linguistic skills and metadata. The entire dataset was created over a period of 18 months, from January 2015 to June 2016. Participants first registered and completed the questionnaire aimed at gathering the metadata. Then, they completed the LexTALE tests, using an online website developed for this aim. Finally, they came to the research center, where they individually completed the picture-naming tests and underwent the semi-structured interview.

Initially, all subjects were asked to self-rate some parameters of their linguistic skills, by completing a questionnaire adapted from the Language Experience and Proficiency Questionnaire by Marian et al. (2007). Through this questionnaire, participants were asked to:

1. Self-evaluate their proficiency in each language on a scale from zero to ten. Specifically, they were given the following instruction: *On a scale from zero to ten, indicate your personal perception of your proficiency level for language X (ten being the highest score).*
2. Express the time they are exposed to each of the three languages in given day in percentage terms. Specifically, participants were given the following instruction: *Indicate the percentage of time that you are exposed to each of the languages. The sum of the percentages has to be 100%.*
3. State the age of first exposure to each language.

Lexical knowledge was assessed combining a set of three lexical decision tests, one for each language: LexTALE (Lemhöfer et al., 2012), LexTALE-Esp (Izura et al., 2014), and a Basque version of LexTALE developed for the purposes of the study by de Bruin et al. (2017). All participants completed the three variants of LexTALE (Spanish, Basque, & English) online. The order of the LexTALE tasks was Spanish-Basque-English. Sixty items (40 words, 20 non-words) were introduced to the participants in the English version of the test and subjects were asked to click on the appropriate button to show whether or not the item was an established English word. Finally, to measure overall language proficiency in each language, all subjects were interviewed and subsequently scored on a Likert-like scale by “a multilingual linguist with experience in assessing language proficiency” in a “semi-structured” interview (de Bruin et al., 2017, p. 2). The English interview score, and the English LexTALE score are chosen as outcome variables for this study, and the two tasks will then be described in more detail in the next section.

## Tasks

### *Interview*

The interviews were conducted by de Bruin et. al. (2017) and the data collected were made available for further research. The interview procedure was as follows: In each of their three languages, participants completed a brief semi-structured oral proficiency interview adapted from the structured *oral proficiency interview* format (Isbell & Winke, 2019). This five-minute interview was targeted at assessing the participants level of proficiency in spoken output, and more specifically their ability of producing different grammatical structures. It consisted of a series of questions that varied in complexity and required the interviewee to use multiple types of grammatical structures (e.g., questions prompting different tenses in the participant’s response). Subjects were asked to answer questions revolving around a few core topics:

1. Presentation: Who are they? Where are they from? When did they start learning each of the languages they know? What did they study? Why? [completed in Basque].
2. Hobbies: sports, music, art, dance, ... [completed in English].
3. Know BCBL: How did they get to know the BCBL? [completed in English].
4. (Optional): What do they do during the weekend? [completed in English].
5. (Optional): Say something about a film or any current or remarkable news [completed in English].
6. (Optional): ....

The interview was performed and analyzed by a group of linguists with high expertise in English who were fluent speakers of Basque and Spanish. Each participant was assessed by one linguist (following directions from Gollan et al., 2012), but a total of four linguists with previous scientific knowledge in evaluating linguistic competence participated in the process. A Likert-like scale from one (lowest level) to five (native or native-like level) was used to score the result. In summary, according to de Bruin et al. (2017), the semi-structured interview design makes it a valid measure of oral proficiency and language profile knowledge, the questions asked “ranging in difficulty and requiring the participant to use different types of grammatical constructions” (de Bruin et al., 2017, p. 3).

### *LexTALE*

LexTALE, an abbreviation for “Lexical Test for Advanced Learners of English,” is a performance-based assessment of L2 lexical knowledge in advanced L2 learners of English which offers an alternative to self-ratings of proficiency. This assessment is widely employed in L2 vocabulary knowledge research as an approximate indication of lexical knowledge and, to a smaller extent, as a prompt of general proficiency (Lemhöfer & Broersma, 2012). Its main advantage over other tests is the rapidity of the testing. The test has been designed to be employed in psycholinguistic experimental studies and is intended for adult learners of English who began with the formal instruction at school around 10–12 years of age and have been using English on a daily basis ever since (e.g., to read articles, watch TV shows, etc.). It is a short free online test (available from: [www.lextale.com](http://www.lextale.com)) which usually takes approximately five minutes to complete; the examined learner is presented with 60 items (the ratio of words to non-words is 2:1) and is required to answer in an affirmative-negative manner (y/n) whether the items presented are actual existing English words or non-words (opting for a “no” when in doubt). The existing words occurring in the task are very rare, they have “a mean frequency of between

1 and 26 (mean: 6.4) occurrences per million according to the CELEX database” (Lemhöfer & Broersma, 2012, p. 329), meaning that it is highly improbable that the examined learner would know all of these words.

Three methods of scoring are employed when assessing the results of the LexTALE test:

1. A percentage correct measure adjusted for the unequal proportion of words and non-words by averaging the percentages correct for these two item types. As the authors explain (Lemhöfer & Broersma, 2012, p. 329) this measure is a “simple percentage correct measure, but corrected for the unequal proportion of words and non-words by averaging the percentages correct for these two item types. This way, a yes bias (creating high error rates in the nonwords) would be penalized in the same way as a no bias would (causing high error rates for words), independently of the different numbers of words versus nonwords.”
2.  $\Delta M$  is a value ranging from zero to one which takes into consideration the total sum of yes answers, and false alarms (non-words which elicited a ‘yes’ answer, marked  $f$ ) when calculating the actual number of hits (existing words which elicited a ‘yes’ answer, marked  $h$ ). This scoring method is based on Signal Detection Theory (SDT) and offers a more complex way to reflect the participant’s guessing behavior (Huibregtse et al., 2002) by incorporating the concept of sophisticated guessing (guessing which does not occur randomly but rather as a result of the participant’s uncertainty about a particular item) into its design.
3.  $I_{SDT}$  is the last scoring method used in LexTALE; this formula, developed by Huibregtse et al. (2002), is again based on SDT. This method takes into consideration that there are actually four answers in y/n question format (“hit” = ‘yes’ in case of a real word; “correct rejection” = ‘no’ in case of a non-word; “miss” = ‘no’ in case of a real word; “false alarm” = ‘yes’ in case of a non-word). The ISDT formula is more advanced than  $\Delta M$  in accounting for sophisticated guessing and, in addition, it takes into account “individual response style” (the individual’s tendency to lean towards either ‘yes’ or ‘no’ when in doubt) (p. 230).

While all methods provide control for guessing effects, the first scoring revealed to be in addition the most accurate of all in measuring language skills, leading to higher correlation coefficients with language scores of various kinds, including assessments such as the Quick Placement Test and a number of translation scores (Lemhöfer & Broersma, 2012). For these reasons, the “average correct” measure is now used as default in the scoring of LexTALE, and it was thus used in the current sample.

## Data Analysis

Descriptive statistics for predictors and outcome variables are provided in Table 1. Following the guidelines of Hair et al. (2010) and Byrne (2010), all variables are to be considered normally distributed based on the values of skewness (smaller than two) and kurtosis (smaller than seven). Daily use presents a relatively high value of kurtosis because a few subjects declared a significantly higher level of daily use in comparison to the rest of the group. However, these subjects are not many, and this is why we still observe a mean of 11.15 with a standard deviation of 9.36. In total, 42 subjects out of 650 declared a daily use of 30% or higher, while the remaining 608 declared a value between 0% and 29%. Age of onset presents instead a very symmetrical distribution, with the most common age of onset occurring at the age of 6.37 (six years and four months), roughly corresponding to the start of schooling in Spain. Data were analyzed in R using multiple regression analysis, in order to assess the role of the two independent variables (daily language use and age of onset to English) in predicting the outcome variables (lex-TALE and interview score). Multiple regression was chosen because it is the most effective system to understand the relationship between predictors and outcome variables when the model is carefully constructed from theoretical considerations (Hoyt, Imel, & Chan, 2008). Since the dataset contains one datapoint for each subject (for each task), it was not possible to include random effects in any model, and a traditional regression was chosen instead.

Table 1

### *Descriptive Statistics for Predictors and Outcome Variables*

	Age of onset	Daily use	Lex-TALE	Interview
Mean (SD)	6.37 (2.49)	11.15 (9.36)	66.75 (9.23)	3.32 (0.94)
Min-Max	0 – 12	0 – 70	41.25 – 71.25	0 – 8
Skewness-Kurtosis	0.45 – 0.10	1.63 – 5.47	0.56 – 0.84	-0.22 – -0.35

Regressions were run using the function `lm()` in R, from the *stats* package (R team, 2017). Factors were compared using a forced entry method. With this method, all factors are entered simultaneously and are given the same weight. The method thus gives a reliable estimate of the importance of each factor in predicting the outcome variable (Field et al., 2012). The models used are the following:

Lm1 (formula = `interview-score ~ use * AoO`, data = BEST)

Lm2 (formula = `lex-tale ~ use * AoO`, data = BEST)

The choice of predictive factors is theory-based: this study aims at assessing the roles of daily language use and age of onset as predictors of proficiency scores, and as such daily language use and age of onset were included in both models as predictors. The interaction between these factors was also included, based on its theoretical relevance (use may show to be more or less important according to the age of onset). Both models offer a good fit for the data, with Lm1 showing an  $F(646) = 21.3$ ,  $p < .001$ , and Lm2 showing an  $F(646) = 28.45$ ,  $p < .001$ . This measure of fit compares the model used to a hypothetical model with no predictors (so-called intercept-only model), and the results indicate that there is a significant difference, implying thus that the models used manage to capture patterns in the data. Both models offer a medium correlation coefficient according to Cohen's guidelines (Cohen, 1988), with  $r = 0.3$  for Lm1 and  $r = 0.34$  for Lm2, indicating that both models account for a medium amount of variance, or, in other words, that both models offer a medium level of explained variation. Results are presented in the two tables below. P-values are automatically provided by R when running the function `lm()`:

Table 2

*Results from the Regression Model Predicting the Interview Score*

	Estimate	SE	t	p
Intercept	61.190	1.456	42.003	<.0001
Use	0.328	0.098	3.333	0.0009***
AoO	0.372	0.210	1.774	0.076
Use:AoO	-0.006	0.014	-0.478	0.632

Table 3

*Results from the Regression Model Predicting the LexTALE Score*

	Estimate	SE	t	p
Intercept	2.981	0.145	20.472	<.0001
Use	0.032	0.009	3.328	0.0009***
AoO	-0.009	0.021	-0.473	0.636
Use:AoO	0.0005	0.001	0.397	0.691

Our analysis shows that, in both cases, only use is a significant predictor of language skills, with  $p < .001$  in both models. This relationship is shown visually in the scatterplots below. While the scatterplots representing the relationship between age of onset and language skills are relatively flat, the scatterplots representing the relationship between the amount of use and language skills are both steep (Figures 1 and 2). This means that while age of onset does not have a significant effect on language skills, daily use does have a significant

effect, with larger amounts of daily use leading to higher language scores (ascending trending line).

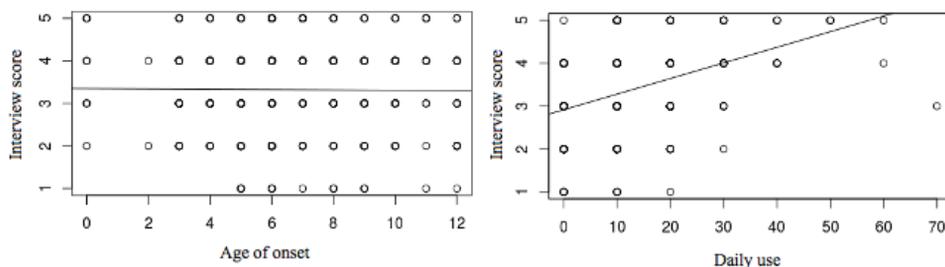


Figure 1. Scatterplots age of onset-interview score & daily use-interview score

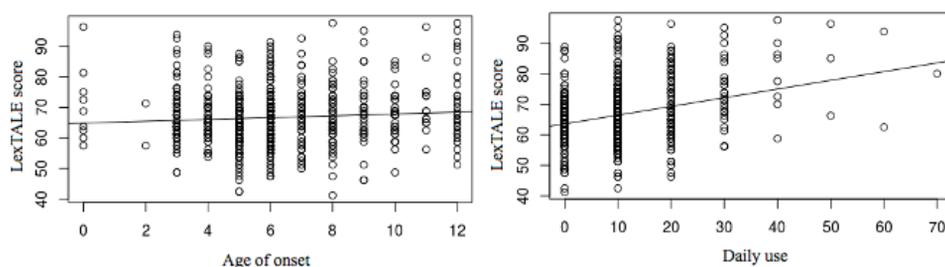


Figure 2. Scatterplots age of onset-LexTALE score & daily use-LexTALE score

## Discussion

### Daily Use as a Predictor of Language Skills

The BEST dataset is a large dataset which allows for the profiling and characterization of different sorts of multilingual subjects from the Basque Country (who speak Spanish and/or Basque and have varying proficiency levels in English) by combining several measurements of their language skills (de Bruin et al., 2017). Our study analyzed this dataset to investigate whether overall proficiency and lexical knowledge in English are better predicted by age of onset or by daily language use. Two different outcome measures were adopted: the output of the LexTALE task and the score obtained on a semi-structured interview. In short, our analysis shows that daily use is a better predictor than age of onset of both LexTALE and interview scores.

This finding contributes to a long-lasting debate as to whether it is more important to be exposed to the second language early or to be exposed to it for

many hours a day (even if the age of onset is later in life). Our data suggests that daily use may be more important than age of onset, at least in the sample currently analyzed. Our findings are consistent with studies that show that use is a better predictor than age of onset in second language learning (Carhill, Suárez-Orozco, & Páez, 2008; Larson-Hall, 2008; Muñoz, 2006; Unsworth et al. 2011; Paradis et al., 2017). The current study extends this line of work in that it investigates a specific type of measure of language use, which is daily share. This measure was previously used to predict language skills in immigrants (Carhill, Suárez-Orozco, & Páez, 2008), but not to predict attainment in second language learners who use English as an additional language while being immersed in their native language (in their native country). This simple measure of language use, that can be obtained with one unique question in a questionnaire, appears to be a highly significant predictor of language attainment. This measure does not necessarily indicate that daily use is the reason for language attainment. A high share of daily use of a language might indicate, or be related to, motivation and attitudes toward the language, factors that are shown to be crucial for second language learning, particularly when learners rely primarily on classroom instruction (Blom & Paradis, 2016; Birdsong, 2018; Pfenninger & Singleton, 2019). While it is not possible to clearly separate use from socio-affective factors, it is possible to make a comparison between age of onset effects and daily use effects. The fact that age of onset does not predict attainment in this sample complements previous work that has given similar results. The large-scale study of Muñoz (2006), for example, also investigated Spanish learners of English in Spain, and similarly concluded that age of onset was not a predictor of success, while input was. The study of Paradis et al. (2007) investigating the acquisition of grammatical structures in French-English bilinguals, also showed that input was a better predictor than age of onset. The study of Unsworth et al. (2011), investigating Greek-Dutch bilinguals showed that input was a better predictor than age of onset for the acquisition of complex structures (such as grammatical gender), as described in epistemological work by Tsimpli (2014). Similar results were obtained with second language learners of other languages (Dewey et al., 2012; Dewey et al., 2014; Bown & Eggett, 2012). In summary, when input and age of onset are included in the same model and compared, it appears that input can have a more important role in predicting attainment than age of onset. Our findings contribute to this body of research.

These claims may seem in contradiction with studies that show that age of onset is a crucial predictor of language attainment (McDonald, 2000; Abrahamsson & Hyltenstam, 2009; Hartshorne, Tenenbaum, & Pinker, 2018). However, it should be stressed that these studies did not make a direct comparison between use and age of onset in each given model (as we did). Often, an early age of onset is correlated to a large amount of use, without one actu-

ally influencing directly the other (Birdsong, 2018; Babatsouli & Ball, 2020). Thus, showing the presence of age of onset effects does not undermine the role of use effects if these are not included in the same model. However, there are also many cases in which an early age of onset does not correspond to extensive use, and it is thus important to characterize the differential effects of use and age of onset, because they may have rather different roles when they do not correlate (Tsimpli, 2014). In other words, we do not deny that in many cases an early age of onset corresponds to higher results in language attainment, especially if the sample analyzed consists of children that emigrated to a new country, but we suggest that these results may be due to additional exposure that children with an early age of onset might receive (Babatsouli & Ball, 2020), or possibly to socio-affective factors related to early exposure to a language (Birdsong, 2018). In both cases, such findings reduce the validity of maturational accounts, and contribute to the growing body of evidence showing that a late age of onset can correspond to proficient learning, given the right conditions (Paradis et al., 2017; Blom & Paradis, 2016; Pfenninger & Singleton, 2019). The lack of simple age of onset effects may be interpreted within the realm of brain development and brain plasticity research. Despite the fact that generally speaking brain plasticity is stronger in younger children (Mundkur, 2005), our results and other findings of this kind (Blom & Paradis, 2016), suggest that there is no detectable decline in cognitive language skills related to age in older children and young adults, particularly when the object of analysis is explicit learning.

### **Kinds of Language Skills**

In this study, language use appears to be more important than age of onset in predicting language skills. This finding is confirmed with two different tasks: a semi-structured interview and a version of the LexTALE assessment. It is interesting to observe an advantage of use over onset in both these tasks, since they measure rather different aspects of linguistic knowledge: the semi-structured interview taps into various components of grammar and as such offers a good estimate of overall language proficiency (de Bruin et al., 2017), including comprehension and use of complex structures. LexTALE, on the other hand, offers a quick measure of vocabulary knowledge (Lemhöfer & Broersma, 2012). Further analyses of these tasks may offer some additional characterization of what they measure, and the current section attempts at doing so.

A semi-structured interview is a flexible method that can be quite successful in assessing a speaker's general proficiency. Particularly, semi-structured interviews offer a way to approach participants individually, while also upholding a recurrent interview structure. Upon a closer look at the interview

questions used in this study, it is reasonable to say that these indeed elicit various grammatical structures, as stated by de Bruin et al. (2017), and most predominantly different tenses. Some tenses may be represented more than others: for example, the answers elicited by the first question seem to focus mainly on simple present and past tenses. Other questions are more flexible and allow for elicitation of a more varied set of structures. The topics of the interview are described rather broadly, which allows for additional questioning by the experimenter when they feel the need to further verify the participant's employment of a certain structure. The resulting score, marked on a proficiency scale (from one to five), thus, reflects a multi-component assessment, which allows for a relative in-depth inspection of the participant's proficiency. This statement is supported by the agreement between the interview scores and the rest of the measures (such as self-perceived proficiency), which indicates the "pragmatical" validity of the interview.

LexTALE, being a widely used test, has received considerable attention in the literature. The most intuitive interpretation of LexTALE is that of a lexical assessment. This idea was evaluated by Lemhöfer and Broersma (2012) by testing two experimental groups (Dutch and Korean speakers of English) with LexTALE and comparing the acquired data against self-rating scores and word translation test scores (from L1 to L2 and vice versa). The data show that LexTALE scores correlate with the translation scores more closely than with self-rating scores, and consequently suggest that LexTALE may be primarily an indicator of lexical knowledge. In some cases, LexTALE has been used as a measure of general proficiency. A study by Nakata et al. (2020) investigated correlations between a wide range of linguistic measures. The study employed LexTALE, Vocabulary Size Test (VST), TOEFL ITP (as a measure of general proficiency), a translation task, and self-ratings of speaking, writing, reading, and listening with an additional self-rating of vocabulary knowledge. The correlation of VST and LexTALE scores verified LexTALE to be a better predictor of lexical knowledge than any form of self-rating (speaking, writing, reading, listening, and vocabulary knowledge). However, LexTALE was also found to be a better measure of lexical proficiency than self-ratings, showing a high correlation with the TOEFL scores. As the authors put it, LexTALE was demonstrated to be an "approximate measure of English vocabulary knowledge and, to a lesser extent, general proficiency" (p. 335).

The fact that, in the current study, language use appears as a better predictor than age of onset with both these outcome measures, offers some material for reflection. According to Tsimpli (2014), use is expected to be a better predictor than age of onset particularly when the outcome measure is a so-called late structure. Late structures are those that are acquired later during development, and that require substantial grammar-external and even language-external resources to be comprehended and used. Are the outcome variables adopted in

this study a measure of late-structure development? In the case of the interview, we may reasonably assume so. The semi-structured interview supposedly assesses explicitly the use of complex language and, more specifically, the use of a variety of grammatical structures (de Bruin et al., 2017). It is thus indeed expected that use will be a better predictor than age of onset for this variable. In the case of the LexTALE task, the answer is less obvious. Vocabulary knowledge is something that can hardly be classified as either early or late, since the acquisition of the lexicon (in both L1 and L2) is a process that starts with the initial stages of learning and virtually never stops. However, given the correlations between lexical knowledge and overall proficiency, the answer may be positive also in this case.

Beyond these reflections, our analyses have clear practical relevance for theories concerning the acquisition of English as a second or additional language. Our results in fact suggest that the acquisition of English as an additional language is possible also when the age of onset occurs later, and that a large share of daily use can overcome the difficulties related to a later age of onset, consistently with findings from a growing number of studies (Carhill, Suárez-Orozco, & Pérez, 2008; Larson-Hall, 2008; Muñoz, 2006; Unsworth et al. 2011; Paradis et al., 2017; Pfenninger & Singleton, 2019; Cadierno et al., 2020). The implications for students are clear: speakers need to use the second (or additional) language as much as possible to obtain high proficiency levels, and, by doing so, they may even overcome in performance speakers that were exposed to a second language since early childhood (Paradis et al., 2017). In the meantime, it should be stressed that these outcome measures (the interview and LexTALE) are not an exhaustive measure of language skills. Acquisition in other domains might be more dependent on an early age of onset. As discussed in the introduction, phonology (for example) might not show native-like development with a late age of onset, even when daily use is very high (Pallier et al., 1997; Kovelman, Baker, & Petitto, 2008; Herschensohn, 2013). Further research is needed to ascertain to what degree the findings we report here for interview scores and LexTALE scores can be extended to other linguistic domains.

## Conclusion

In conclusion, this study showed that daily language use is better than age of onset in predicting vocabulary and general proficiency in a sample of English learners who are natives in Spanish and/or Basque. This finding is consistent with the growing body of evidence showing that quantity and quality of exposure are among the main pillars of second language attainment (Larson-Hall,

2008; Muñoz, 2006; Unsworth et al. 2011; Paradis et al., 2017; Pfenninger & Singleton, 2019), and suggesting that previously reported age of onset effects are not uniquely related to brain development trajectories (Mundkur, 2005), but to correlations between age of onset and other environmental and socio-affective variables (Blom & Paradis, 2016; Birdsong, 2018; Pfenninger & Singleton, 2019).

## Compliance with Ethical Standard

**Informed consent:** Permission to use the dataset was granted in written form by Dr de Bruin to the first author of this manuscript. The study of de Bruin et al. (2017), consisting in the collection of this dataset, was submitted to the BCBL Ethics Committee and it received favorable opinion. Consent forms for each participant were collected and are stored in a secure location. The statement from de Bruin (2017) original paper reads: “This study was carried out in accordance with the recommendations of BCBL Ethics Committee with written informed consent from all subjects. All subjects gave written informed consent in accordance with the Declaration of Helsinki. The protocol was approved by the BCBL Ethics Committee.”

**Disclosure of potential conflicts of interest:** We declare no conflict of interest regarding the publication of this study.

**Research involving Human Participants and/or Animal:** This study does involve human participants.

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**Die Entwicklung der Sprachkenntnisse bei Lernenden des Englischen  
als Zusatzsprache. Was ist wichtiger: der tägliche Sprachgebrauch  
oder das Alter bei Erwerbsbeginn?**

Zusammenfassung

In dem vorliegenden Beitrag wird untersucht, ob der Wortschatzerwerb und die Entwicklung der allgemeinen Sprachkompetenz im Englischen als Zusatzsprache mehr durch den täglichen Sprachgebrauch oder auch durch das Alter bei Erwerbsbeginn geprägt werden. Hierfür wurde eine zahlenmäßig große Gruppe von 650 Probanden (der Datensatz wurde freundlicherweise von de Bruin et al., 2017, zur Verfügung gestellt) einer Analyse unterzogen, die spanische und/oder baskische Muttersprachler sind und Englisch als Zusatzsprache (Drittssprache) verwenden. Die Wortschatzkenntnisse der Probanden wurden eingangs mit einem LexTALE-Test und ihre allgemeine Sprachkompetenz mit einem semistrukturierten Interview beurteilt. Danach wertete man ihre Sprachkenntnisse mittels eines Modells aus, in dem das Alter bei Erwerbsbeginn und der tägliche Sprachgebrauch als Prädiktoren behandelt wurden. Die Ergebnisse zeigten, dass in dem analysierten Datensatz der tägliche Sprachgebrauch ein besserer Prädiktor für Sprachkenntnisse (sowohl in Bezug auf die Lexik als auch auf allgemeine Sprachkompetenz) als das Alter bei Erwerbsbeginn war.

*Schlüsselwörter:* Zweisprachigkeit, Alter bei Erwerbsbeginn, täglicher Sprachgebrauch, Englisch, Hypothese der kritischen Periode