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Differential Effects of Input Quantity and Input Quality on Bilingual Development: A Study with Kurdish–English Adolescents

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Abstract: Previous research has shown that both input quantity and quality play a role in dual language learning. However, it is unclear whether input quantity factors (e.g., school input) and input quality factors (e.g., home media input) work similarly in the language development of bilinguals while other potential internal and external factors are controlled for. This paper addressed this issue through investigating the influence of input quantity and input quality factors, both at the individual and group levels, on morphosyntax, vocabulary size, and lexical access ability in the Kurdish-L1 and English-L2 of Kurdish–English bilingual adolescents. Data were collected via a battery of standardized and researcher-developed measures and a detailed questionnaire. The results from backward regressions revealed that higher parental Kurdish proficiency and more exposure to Kurdish input through siblings and reading activities were associated with better Kurdish morphosyntactic skill, while a larger Kurdish vocabulary size was predicted by more exposure to native-speaker input in Kurdish. Both more Kurdish input received in preschool/school and through Kurdish media were related to better lexical access ability in Kurdish. Further, more exposure to English input in preschool/school predicted better English morphosyntactic skill and a larger vocabulary size, whereas higher paternal English proficiency was associated with better lexical access ability in English. Hierarchical regression analyses showed that input quality was more important in explaining Kurdish morphosyntactic and vocabulary size skills and lexical access ability in both languages, while input quantity explained more variance in English morphosyntactic and vocabulary size skills. Out-of-class Kurdish input outweighed instructional input to a certain extent in relation to Kurdish skills and lexical access ability in English, while instructional English input was more important for English morphosyntax and vocabulary size.

Keywords: bilingual development; individual differences; input quantity; input quality; morphosyntax; vocabulary size; lexical access; Kurdish–English adolescents

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1. Introduction

Since the time that bilingualism became the norm in the world (Crystal 2003; Grosjean 2013), much research in second language (L2) acquisition and dual language learning has focused on questions pertaining to the role of individual difference factors in second and dual language development. In this regard, the effect of internal and external factors on language skills, especially morphosyntax and vocabulary size, has been an area of interest in the last few years (e.g., Arnaus Gil and Jiménez-Gaspar 2022; Paradis 2011; Sun et al. 2016; Thordardottir 2017) to reveal more about the extent to which bilingual development is shaped by these factors, and whether internal or external factors play a more prominent role in better bilingual language outcomes.

At least among external factors, the lion's share of this development has been attributed to the language input bilinguals are exposed to in both instructional and naturalistic settings (e.g., Anderson et al. 2021; Muñoz 2014). However, most of these attempts investigated the

contribution of either input quantity or quality on certain bilingual language skills (e.g., Dicataldo and Roch 2020; Gorba 2023; Unsworth 2013), and few have focused on the impact of both the amount of language exposure and the richness of the language environment on bilingual development. Those studies that have done so have mainly concentrated on a limited number of input factors, mostly in naturalistic language learning contexts, and explored their relationship to a specific language domain (e.g., Eide and Hjelde 2023; Verhagen et al. 2022). There is comparatively less research documenting the effect of various components of input in terms of both quantity and quality on different bilingual skills in an instructional setting.

Therefore, investigating the contribution of various factors related to the amount of language exposure and the richness of the language environment and comparing their role as two different sets in dual language learning would contribute to a much better understanding of the extent to which bilingual development relies on input factors. In other words, if researching and measuring input as a composite variable is important, disentangling the components of this construct and then examining them individually is crucial. This is particularly interesting since research findings from instructional contexts (e.g., Muñoz 2014; Pfenninger and Singleton 2018) indicate that the effect of age of onset (AO) of language exposure on bilingual development is limited, and language input trumps and mitigates the influence of AO of language exposure. Additionally, when compared, early exposure to L2 seems not to be as effective as late exposure in foreign language contexts due to input factors as well as the cognitive and linguistic maturity of late starters (Muñoz 2008). In a nutshell, as Hoff (2020, p. 82) states, "studies of the relation of input to bilingual development provide a unique window onto basic processes of language development". For this purpose, while controlling for the effect of the internal and external factors of the AO of language exposure, age at the time of testing (AT), nonverbal analytical reasoning, language learning aptitude, language use, and maternal and paternal education, the present study aimed to examine the specific effects of variations in input quantity (i.e., preschool/school input, length of exposure (LoE), and home input) and input quality factors (i.e., home media input, maternal language proficiency, paternal language proficiency, and native-speaker input) to determine how much each individual factor and group of factors contributed to Kurdish and English morphosyntax, vocabulary size, and lexical access ability in one of the most under-studied bilingual populations, namely Kurdish–English bilinguals.

It is important to remember here that Kurdish comprises several dialects and subdialects, including Northern Kurdish, Central Kurdish, and Southern Kurdish. Of course, since Kurdish has been in interaction with the neighboring languages, namely Arabic, Turkish, Persian, Assyrian, and Armenian, it has been affected by these languages at the lexical, phonological, syntactic, and morphological levels (Ahmadi 2021). Of note, although Central Kurdish is the mother tongue of the participants investigated in this study, the term Kurdish is used in the current study to avoid confusion. In this respect, Kurdish has certain distinctive linguistic properties. Very briefly, it is an SOV language that does not have gender and case-endings. As a source of scrambling, Kurdish allows for the placement of clitics in various positions. Further, Kurdish is a split ergative language, which means that it has an ergative feature in the past tense and nominative–accusative alignment that appears in the present tense. Similarly, Izafe is another morphosyntactic feature of Kurdish in which the Izafe particles (i.e., î, e) mark nouns and NPs that are modified by adjectives or DPs, such as:

1. ew guł-î ciwan de-çên=êt He/she flower-IZF beautiful AM-plant=3.SG 'He/She plants beautiful flowers.'
2. guł-e ciwan-ekan=im bonkird flower-IZF beautiful-DEF.PL=1.SG smell.PAST 'I smelt the beautiful flowers.'

1.1. English as a Source of Bilingualism in the Kurdistan Region of Iraq

Identifying Kurdish society as bilingual is significantly influenced by the presence of English as a major factor. This is due to the fact that although Iraqi Kurdistan is an autonomous region in northern Iraq where Kurdish and Arabic are two official languages, rich linguistic diversity is hugely advocated at both governmental and societal levels. Consequently, this has led to the emergence of multilingual individuals. In this respect, in the last few years, a great shift has started when a new generation, accompanied by their families' support, have begun to appreciate knowing English more than any other language.

This avid interest in learning English stems from the point that having a good command of English is a prerequisite for sharing experience, access to science and technology, career advancement, and cultural awareness. Moreover, there is a common agreement in the region that being bilingual is one of the best ways to becoming bicultural and, thus, English is considered as an appropriate choice in this regard. This is especially true at a time when, as Gordon and Meir (2023) argue, globalization upsurges and English plays a very prominent role in the world.

These factors have, therefore, prompted policy makers, curriculum designers, educators, and parents to encourage young learners to learn English. At the governmental level, teaching English has been made compulsory from the first grade onwards. In addition, English-medium instruction is applied in science, engineering, and medical colleges. What is more, it is required that every college student should take at least one year of English at freshman level. Interestingly, due to the rapid increase in the number of private schools and universities where English is implemented as a medium of instruction, the interest in learning English is growing further.

At the familial level, on the other hand, most parents have a heightened awareness of the fact that through English exposure their children would have a great opportunity to at least excel in some English domains and, ultimately, pave the way for being bilingual, which is required to have an enriching experience (Bialystok 2013). In this respect, some parents go too far in the sense that they hire caregivers, who are native speakers of English, to increase their children's English exposure and use. Additionally, providing private English tutoring is common in the region. It is also worth mentioning that a new view has recently started to emerge among some parents in which they perceive English as a threat since they think that their children are, to a great extent, more proficient in it than Kurdish, which might create obstacles in preserving their mother tongue in the future. Nevertheless, the attrition of Kurdish is less likely because of the richness of the Kurdish environment and the great amount of Kurdish exposure. It is important to stress that although Arabic is an official state language in Iraq, it is implemented far less frequently than Kurdish and English in instructional and out-of-school settings in the Kurdistan Region of Iraq. This is due to the fact that Arabic is only taught as a subject in some schools and institutions, in which only around two hours are dedicated to Arabic lessons per week. Thus, as claimed by themselves, students suffer from not having even a basic level of Arabic proficiency. Based on this, having one or two hours of language exposure only in an instructional setting was not considered as a source of bilingualism in this study. For these reasons, bilingualism in the present study was operationalized as experiencing consistent and significant language exposure and use in both instructional and out-of-school settings.

In sum, despite these facts, no existing study, to the best of our knowledge, has investigated the influence of input quantity and quality factors simultaneously on certain Kurdish and English skills among Kurdish–English bilinguals who have been learning English under the aforementioned circumstances. Accordingly, the current study attempted to fill this gap.

1.2. Effects of the Amount of Language Exposure on Bilingual Development

A robust finding in the literature (e.g., Bohman et al. 2010; Habib 2017; Peters et al. 2019; Unsworth 2016) indicates that a greater amount of language exposure is strongly associated

with a greater proficiency in the first language (L1) and L2. This includes the results of the studies that examined the quantity of input cumulatively (e.g., Unsworth 2013) and those that explored different components of this construct (e.g., Sun et al. 2016). One of the input components, which is considered as an input quantity factor, is LoE. Although the way in which this factor is measured varies, the general results show its deterministic role in better bilingual language outcomes. For example, Bohman et al. (2010) examined the impact of certain individual difference factors on semantic and morphosyntactic development in a group of Spanish–English bilingual children. The results revealed that cumulative LoE was crucial for the improvement of the linguistic domains. Similarly, Dicataldo and Roch (2020) found that larger Italian vocabulary, better narrative comprehension, and higher working memory abilities were positively predicted by longer bilingual exposure to Italian after controlling for the variation in socioeconomic status. Chaouch-Orozco et al. (2021) also found that, among a group of experiential factors, the amount of English exposure was the only factor to have a notable effect on the lexical processing in English.

Moreover, studies often find that exposure to bilingual input during preschool (e.g., kindergarten) and school time is important for bilingual development. In a study conducted by Sun et al. (2016), it was found that the amount of the input to which Chinese–English bilingual children were exposed to in kindergarten and school was a good predictor of receptive and productive vocabulary size and receptive grammar. Of course, as Pfenninger and Lendl (2017) emphasize, the enhancement in bilingual skills is more pronounced when the amount and quality of the input match with the language proficiency of the bilingual learners (see the discussion below). Additionally, pinpointing the amount of the language exposure that is required for the positive effect of input to start to emerge has been an area of interest in some previous studies. In relation to this, Unsworth et al. (2015) claim that more than sixty minutes of weekly exposure for around two years is needed in order for the impact of input to start to appear in an instructional context. However, it seems that the case is different when bilingual language learning takes place in naturalistic settings, especially when the argument involves issues related to ultimate attainment. Findings from previous research (e.g., DeKeyser 2000; Stevens 2006) indicate that around ten years of continuous language input is required to reach ultimate attainment.

On the other hand, there are comparatively fewer studies on the amount of language exposure that's source is siblings or/and books, especially at home. The available data in this respect reveal that the input received from siblings in families, particularly older siblings, and engaging in reading activities are influential for the improvement of the L1 and L2 skills. Patterson (2002) found that the proportion of exposure that Spanish–English bilingual toddlers experienced through shared reading activities in each language was positively related to expressive vocabulary size in the same language. By the same token, Bridges and Hoff (2014) investigated a group of Spanish–English bilingual toddlers settling in the United States. The results showed that those toddlers who had older siblings and attended school performed better on the vocabulary and grammatical complexity tasks. As a result, this suggests that having siblings adds to the chance of having more sources of language exposure.

Certainly, these findings and others in the literature should not randomly be generalized from one context to another. For instance, the amount of the provided input varies from a setting where L2 is learnt as a minority/foreign language to a setting in which L2 is the majority/societal language. Of course, the amount of L2 exposure and number of input sources are greater and more diverse in the latter than in the former. Thus, it is illogical to expect the same level of bilingual proficiency from dual language learners, especially for the L2, in these two different settings. The same view can be extended to the debate over bilingual proficiency of simultaneous and sequential bilinguals on the one hand and bilinguals and monolinguals on the other. Thordardottir (2017) compared three groups of participants, namely French–English simultaneous and sequential bilinguals and French monolinguals. It was revealed that simultaneous bilinguals performed better than sequential bilinguals on the receptive and expressive vocabulary and word morphology measures,

and both groups performed more poorly than monolinguals on the same tasks. This was attributed to the amount of exposure the participants of each group had experienced.

Moreover, it is important to highlight that the degree of the impact of input quantity factors differs depending on the examined linguistic domain. Based on neuroimaging data, Fedeli et al. (2021) examined a group of Italian–English bilinguals and they found that the switch between L1 and L2 is easier when the amount of L2 exposure increases. In another study, Berghoff and Bylund (2023) reported that larger L2 exposure leads to the increase in L2-to-L1 crosslanguage activation, which means crosslinguistic effect increases when language exposure increases. Apart from the relationship between input quantity and crosslinguistic effect, there have been some attempts to compare the role of input quantity factors to other individual difference factors. In this regard, despite calls for not viewing them as two opposite factors (e.g., DeKeyser 2020), a considerable number of studies compared the influence of the amount of language exposure and the AO of language exposure as two of the most notable factors influencing bilingual language outcomes. Although these factors are interacting in one way or another (Birdsong 2018), most recent studies (e.g., Jia and Fuse 2007; Ojima et al. 2011; Pfenninger and Singleton 2018) indicate that the effect of the amount of language exposure overshadows the influence of the AO of language exposure in both instructional and naturalistic settings. Kaltsa et al. (2020) concluded that the amount of input is far more influential than the AO of language exposure after carrying out a study on a number of Albanian–Greek bilingual children.

More interestingly, the debate is heated further when the impact of input quantity is compared with that of input quality. Actually, the argument is far from settled since few studies were conducted in this respect and the available data from these studies show conflicting findings. The findings from Correia and Flores (2017) are in favor of the input quantity factors. In this study, it was found that the lexical knowledge of Portuguese–German bilingual children was predicted more by the amount of Portuguese exposure at home than the quality of input. By the same token, Verhagen et al. (2022) explored the contribution of the amount of Dutch and English exposure a group of bilingual children had and compared this with the family language patterns. The results revealed that there was no concrete evidence supporting the robustness of family language patterns, but rather input quantity in terms of the input provided by parents was a vital factor.

Overall, it is apparent that there are conflicting findings on the degree of the impact of input quantity factors on bilingual development. A part of these mixed results lies in investigating one aspect of the amount of language exposure or exploring it as a composite variable in the majority of previous studies. Therefore, it would be interesting to examine the contribution of different components of input quantity in order to reach a better conclusion. Moreover, due to the lack of studies on Kurdish–English bilinguals in terms of exploring the quantity of language input both comprehensively and deeply, the present study was considered to be the first to highlight the degree of robustness of the input quantity factors.

1.3. Effects of Richness of the Language Environment on Bilingual Development

The input quality or the richness of the language environment is another core dimension of language exposure. Despite this fact, the role of this aspect of input in bilingual skills has received little attention in comparison with input quantity. Just recently, some attempts have been made to examine the impact of input quality factors, such as native-speaker input, input received from home media, and parental language proficiency. In a study conducted by Jia et al. (2014), it was revealed that a stronger language proficiency of Chinese and Korean–English bilinguals in both languages, as measured through lexical skills, was associated with the richness of input gained through watching TV. However, in Patterson's (2002) study, there was no relationship between the frequency of watching TV and vocabulary size among Spanish-English bilingual children. This echoes King and Fogle's (2006) speculation that recorded sounds and programs might not be as influential as live interaction.

Bearing this in mind, some studies (e.g., Gathercole and Thomas 2007; Paradis and Jia 2017) point to the role played by the input received from parents who have certain level of proficiency. For instance, Sun et al. (2016) found that maternal English proficiency was a significant predictor of English productive vocabulary among Chinese–English bilingual children, who were learning English as a foreign language. Sorenson Duncan and Paradis (2020) also reported that, among a group of immigrant/refugee children who were learning English in Canada, the mother's English proficiency positively contributed to bilingual development in terms of syntactic and lexical abilities. Interestingly, special attention should be given to the degree of the language proficiency of parents while this factor is considered. More specifically, a low level of parental language proficiency seems not to be useful in making significant difference in language skills.

This leads to the question of whether native-speaker input over nonnative-speaker input should be prioritized. The level of the nonnative-speaker proficiency is also decisive in leaving an impact on bilingual development if nonnative input is relevant at all. Concerning this, Place and Hoff (2011) found that the proportion of native-speaker input significantly contributed to the vocabulary knowledge of Spanish–English bilingual toddlers. In contrast, Unsworth et al. (2019) carried out a study on fifty preschoolers acquiring Dutch in addition to another language in the Netherlands. The results led the researchers to baldly suggest that the proportion of native input was not a significant predictor of the Dutch skills of vocabulary and morphosyntax, but rather the degree of non-nativeness was crucial.

At this point, it is worth remembering that the effect of input quality is still apparent no matter what mode of input is used. Kersten et al. (2021) found that rich verbal input was very deterministic for grammar comprehension to an extent that its robustness was not moderated by cognitive skills of German–English bilingual children. Likewise, but this time for the written sources, Eide and Hjelde (2023) concluded that the exposure to qualitative input through written sources was a significant predictor of syntactic production. Furthermore, the degree of contribution by input quality factors differs for the skills in L1 and L2. In a study carried out by Pham and Tipton (2018), it was found that rich and frequent exposure to Vietnamese as a minority language was the best predictor of Vietnamese vocabulary knowledge. Sun et al. (2018) also found that input quality was more important for the development of ethnic language knowledge than societal language knowledge.

On the other hand, as previously mentioned, the aim of some studies in the literature was to compare the degree of effectiveness of individual difference factors with the aim of reaching a much richer understanding of the role of both internal and external factors. In this regard, Rothman and Guijarro-Fuentes (2010) hypothesize that input quality might be more influential than age of exposure. Joining this debate, Anderson et al. (2021) compared the strength of the association of the quantity and quality of input with language outcomes via a meta-analysis study. The results revealed that input quality was more strongly associated with children's language outcomes. Of note, the findings of previous studies are mixed regarding whether out-of-school input is more effective than instructional input (Gámez and Levine 2013; Huang et al. 2020; Kuo et al. 2020).

Taken together, while prior research shows a key role played by the richness of the language environment, it is still unclear whether input quality outweighs input quantity, especially after going beyond comparing only one component of these two major dimensions when other internal and external factors are controlled for. This study sought to provide some evidence in this regard.

2. The Present Study

After shedding some light on the available data and addressing the gap in the existing research on the impact of input quantity and quality on bilingual development, the present study, which is part of a larger project, aimed to examine the role of input quantity and quality in Kurdish–English bilingual adolescents' receptive morphosyntax, receptive vocabulary size, and lexical access ability. Here, the input quantity factors of preschool/school

input, home input, and LoE and input quality factors of home media input, maternal and paternal language proficiency, and native-speaker input were measured. The following research questions were asked:

1. What is the association of individual input quantity and quality factors of preschool/school input, home input, home media input, parental language proficiency[1], and native-speaker input to Kurdish and English morphosyntax, vocabulary size, and lexical access ability?

Based on the findings in the literature in both naturalistic and instructional settings (e.g., Paradis et al. 2020; Sun et al. 2018), components of both input quantity and input quality were expected to relate and contribute to the Kurdish and English morphosyntax, vocabulary size, and lexical access ability, but not necessarily in the same way for the skills in both languages.

2. What are the relative contributions of input quantity and input quality factors taken as two different sets to predicting variation in Kurdish and English morphosyntax, vocabulary size, and lexical access ability when internal and external factors of AO of language exposure, AT, nonverbal analytical reasoning, language learning aptitude, language output, maternal education, and paternal education are controlled for? Does input quantity or input quality explain more variance in the bilingual adolescents' abilities?

As two different sets, it was assumed that both input quantity and quality significantly predict the Kurdish and English skills, even after controlling for other internal and external factors. However, due to the mixed results in prior research (e.g., Eide and Hjelde 2023; Huang et al. 2020; Pham and Tipton 2018; Sun et al. 2016; Unsworth et al. 2019) with respect to the superiority of one group over the other, any prediction was precluded.

3. Materials and Methods

3.1. Participants

Ninety-eight Kurdish–English sequential bilingual adolescents were recruited from three state schools in Sulaimani and Halabja in the Kurdistan Region of Iraq. Of this number, 53 of the adolescents were female and 45 were male. The average age of the students was 17.08 (SD = 0.78, range = 16–19). Kurdish is the majority/societal language in the region, and English is taught as a foreign language. Accordingly, the majority of the participants were exposed to Kurdish from birth[2], and their exposure to English started later, either in kindergarten or at school. Although teaching English as a subject is compulsory from the first grade at school, the selected schools have been applying English-medium instruction program. Therefore, the bilingual adolescents could be considered as heterogenous in terms of their exposure to Kurdish and English. As selection criteria, adolescents were required to have no indication of suspected developmental or cognitive delays, as well as no indication of hearing loss. Further, they were required not to be trilingual, not even in Arabic, which is the majority language in Iraq. This is due to the fact that Arabic is rarely taught in the included schools and exposure to Arabic is seldom in the Kurdistan Region of Iraq. Similarly, the students were informed that they will not be qualified for inclusion in this study if one or both of their parents has/have had frequent exposure to Arabic.

3.2. Materials

A battery of standardized and researcher-developed instruments were used to measure both predictor and outcome variables. It is noteworthy that, for the language abilities in Kurdish, the tasks were designed and developed by the researchers. This is due to the fact that the measures have no standardized monolingual norms as Kurdish is a low-resourced language.

3.2.1. Bilingual Language Experience Questionnaire

The questionnaire designed for the purpose of this study was based on Alberta Language Environmental Questionnaire (Paradis 2011), Utrecht Bilingual Language Exposure Calculator (Unsworth 2013), and Gutiérrez-Clellen and Kreiter's (2003) Parent Questionnaire. In addition to its English version, a parallel Kurdish version of the questionnaire was prepared in case participants preferred the translated version. Students and their parents were asked to respond to these sections: AO of language exposure, AT, home input, preschool/school input, LoE, native-speaker input, parents' language proficiency, home media input, language output, and maternal and paternal education level. AO of language exposure in this study was defined as the onset age of having consistent and significant exposure to languages through formal instruction and/or through community individuals. LoE was a coarse measure calculated by subtracting AO of language exposure from bilingual's AT.

For AT, participants provided their date of birth. Preschool and school input was calculated by summing up the total hours of kindergarten and school input. That is, the sum of formal instructional hours in a week across preschool/kindergarten, elementary school, middle school, and high school was calculated. Home input was measured after summing up total hours of weekly Kurdish ad English exposure obtained via reading books and siblings. The participants rated their media exposure on a 4-point scale (0 = almost never/never, 1 = at least once a week, 2 = almost every day, 3 = every day) and native-speaker input in Kurdish/English on a 3-point scale (0 = never/almost never, 1 = sometimes, 2 = always). For parents' language proficiencies, mother's and father's language proficiency, in terms of diverse vocabulary and complex morphosyntactic constructions, was calculated on a 5-point scale (0 = no understanding/speaking ability, 1 = some understanding and can say short, simple sentences, 2 = good understanding and can express myself on many topics, 3 = can understand and use Kurdish/English adequately in most situations, 4 = can understand everything and comfortable expressing myself in all situations). Adolescents' language use was rated on a 5-point scale (0 = never, 1 = seldom, 2 = sometimes, 3 = usually, 4 = almost always). Finally, the highest educational level obtained by mother and father was taken as the index of socioeconomic status. Parental education was classified into eight categories (0 = no degree, 1 = elementary school degree, 2 = middle school degree, 3 = high school degree, 4 = associate degree, 5 = bachelor's degree, 6 = master's degree, 7 = PhD degree). It is worth noting that the reason behind using parental education level without considering family income level as the index of socioeconomic status was that some of the participants refused to provide any information about their families' income level even though they were informed that their personal and familial characteristics would be kept anonymous. Finally, the interrater reliability of the questionnaire was checked, yielding 94% agreement between the scores provided by two judges.

3.2.2. The LLAMA Aptitude Test

LLAMA (Meara 2005) is a computerized test of language learning aptitude, which is based on the MLAT (Carroll and Sapon 1959) to a large extent. The test measures four components of language learning aptitude, viz. vocabulary learning (LLAMA-B), sound recognition (LLAMA-D), sound–symbol matching (LLAMA-E), and grammatical inferencing (LLAMA-F). The LLAMA tests depend on picture stimuli and verbal materials adapted from a northern Canadian indigenous language. The maximum total score is 100 for each of LLAMA-B, LLAMA-E, and LLAMA-F, while it is 75 for the LLAMA-D. Some previous research (e.g., Rogers et al. 2017) has shown that the test meets reliability and validity criteria. A Cronbach's alpha of 0.76 was obtained for this test.

3.2.3. Raven's Standard Progressive Matrices

As a nonverbal intelligence test, Raven's Standard Progressive Matrices (SPM; Raven et al. 1998; Raven 2000) allows for an evaluation of nonverbal analytical reasoning skills. It comprises five sets made of a series of diagrams with a part missing. Six similar patterns

are printed beneath each design, and those taking the test should select the appropriate piece to complete the diagram. SPM is a culture-fair test and it can be administered to all ages. The Cronbach's α index of reliability for this test was 0.76.

3.2.4. Grammaticality Judgement Task

To gauge students' morphosyntactic skill in English, 72 items from DeKeyser's (2000) modified version of the original GJT of Johnson and Newport (1989) and Jia and Aaronson's (2003) grammaticality judgement task (GJT) were adopted. The test assessed participants' knowledge of twelve structures, namely third person singular present, plural, pronominalization, past form, present/past progressive form, wh-questions, predicate structure, determiners, word order, particle movement, subcategorization, and yes–no questions. The test consisted of 36 grammatical and 36 ungrammatical items with three correct and three incorrect items in each subcategory. Having this number of items was considered to be appropriate to avoid fatigue effects and cognitive load. The reliability coefficient (KR-20) for this task was 0.88.

On the other hand, a written Kurdish GJT was designed and developed by a committee of three members and the researchers, whose native language was Kurdish, used the English GJT as a model to ensure that both tasks were comparable. After revising and editing the draft version of the test by three experts in Kurdish linguistics, 72 items (36 grammatical and 36 ungrammatical) remained in the final version. The structures were plural, (past, present, future) form, clitics, pronominalization, word order, present/past progressive form, Izafe, wh-questions, particle movement, yes–no questions, subcategorization, and determiners. For this test, the reliability coefficient (KR-20) was 0.73.

3.2.5. The X-Lex Test

The X-Lex test (Meara and Milton 2003), which is a yes/no test, was used to measure English receptive vocabulary size knowledge of the participants. The X-Lex draws on vocabulary knowledge from first five frequency bands (1 K to 5 K). This paper-and-pencil test consists of 20 real words in each column, and 20 pseudowords in the sixth column. The highest score on the test is 5000. The alpha coefficient for this test was 0.88.

Like the Kurdish GJT, a Kurdish version of X-Lex has been designed and developed in the present research. In the design of the test, certain steps were followed. First of all, the test was required to distribute over five frequency levels and an additional band of pseudowords for the sake of being comparable to the English version. Since the available Kurdish corpora and datasets do not provide the frequency of the included words, texts from the Kurdish Textbooks Corpus (Abdulrahman et al. 2019) and the Sorani Kurdish Corpus (Malmasi 2016) were imported into the AntConc software (version 4.0.5) (Anthony 2022) to calculate the frequency of the words. Totally, the software analyzed 7,000,251 word tokens (308,000 word types). In total, twenty real words for each of the five levels were randomly selected after computing the texts, and an extra level of nonwords was added. The alpha coefficient for the test was 0.83.

3.2.6. The Picture Naming Task

A picture naming task was carried out to test the lexical access ability of the participants. In this regard, 36 black and white line-drawn object pictures were selected from Snodgrass and Vanderwart (1980) to be named in English as quickly as possible. The main criterion in choosing these pictures was that the English naming of the pictures should be comparable as much as possible to the Kurdish naming in terms of phoneme length.

Regarding the Kurdish picture naming task, since the name agreement of the pictures in Kurdish was not checked previously, it was necessary to check this feature of the pictures prior to using them. Forty-seven pictures were presented sequentially using PsychoPy (Builder interface; version v2021.2.3) (Peirce et al. 2019) on a Windows laptop (Windows 10Pro) with 15.6-in. The participants were tested individually in a dimly lit, quiet room in which they were instructed to name the pictures using a single word without making a

mistake to give the best name they could think of. Unlike the main phase of the present study that examined naming speed, the aim here was to examine the name agreement of the pictures. Thus, the subjects had as much time as they wanted to come up with a name for a picture. The participants were informed to press the space bar to move on to the next picture when they had named the current picture. The participants' responses were manually recorded. The analysis of the data was done to calculate the percentage of the name agreement. Only 36 object pictures, with 100% name agreement, remained in the final version.

3.3. Data Preparation and Analysis

The measures were piloted with a group of high school students and consecutively revised to increase their validity and reliability. Then, after obtaining consents, adolescents filled out the questionnaire at home with their parents, while all other tests and tasks were administered in the schools' labs in group sessions, except for the picture naming task, which was conducted individually. The English and Kurdish versions of the tasks were two weeks apart to avoid priming effects. Similarly, tests were administered on different days. The SPM and LLAMA tests were conducted after administering the tasks in English. Then, the Kurdish version of the same tasks were done. It is worth mentioning that PsychoPy was used for the picture naming task in which the experiment was entirely created in the Builder interface (Version v.2021.2.3), except for Code Components used to record naming times in milliseconds in which voice-activated headset microphones were used as well.

On the other hand, in the analysis, the raw scores were used since none of the tests have standardized monolingual norms. In Table 1, the means, ranges, and standard deviations for predictor and outcome variables are shown. In addition, Spearman's correlations (see Table 2) were conducted to avoid multicollinearity problems and, therefore, the predictors were excluded whenever there was moderate or high correlation (r = 0.5–0.9). Due to the strong correlation between Kurdish LoE and AT (r = 0.783), it was decided to exclude Kurdish LoE. Likewise, English LoE was moderately and positively correlated with AT (r = 0.511) and highly and negatively correlated with English AO (r = −0.727). Therefore, English LoE was also excluded from subsequent analysis. Finally, values of the maternal and paternal Kurdish proficiency variables were combined (i.e., ParProf) because of the moderate correlation (r = 0.534) between them. Next, tolerance and variance inflation factors (VIF) for the remained variables were examined. The results demonstrated that the tolerance values ranged between 0.309 and 0.822 and the VIF scores ranged from 1.216 to 3.239. Since the tolerance and VIF values of the variables were out of the multicollinearity range (i.e., 0.20 or less for tolerance and 5 or more for VIF), it was decided to keep all of the variables, and multicollinearity was not considered as an issue for the regression models.

Table 1. Scores of predictor and outcome variables.

	Mean	SD	Range
Input quantity factors			
K.Pre/SchInp	32.89	22.47	19.0–52.0
E.Pre/SchInp	31.71	19.30	11.0–54.0
K.HomInp	38.84	22.37	10.3–46.0
E.HomInp	8.54	14.94	5.0–21.0
K.LoE	16.65	1.11	12.0–19.0
E.LoE	11.28	1.47	9.0–18.0
Input quality factors			
K.MatProf	3.56	0.79	0–4
E.MatProf	0.90	1.01	0–4
K.PatProf	3.58	0.98	0–4
E.PatProf	1.21	1.20	0–4
K.HomMed	0.88	0.67	0–3
E.HomMed	1.58	0.63	0–3
K.NatInp	1.96	0.20	1–2
E.NatInp	0.58	0.62	0–2
Other factors			
K.AO	0.56	1.16	0–3.0
E.AO	4.48	2.68	3–7.0
AT	17.08	0.78	16.0–19.0
NonInte	50.81	5.03	36.0–59.0
LangApt (raw score)	209.21	57.76	40.0–345.0
LangApt (z-score)	00	0.64	−1.76–1.64
K.Output	3.65	0.72	0–4
E.Output	0.88	0.75	0–2.83
MatEdu	2.48	1.56	0–6
PatEdu	2.84	1.42	0–6
Outcome variables			
Kurdish morphosyntax	62.59	3.93	46–70
English morphosyntax	57.18	8.73	32–70
Kurdish vocabulary size	4731.63	277.45	4000–5000
English vocabulary size	3902.55	369.05	3500–5000
Kurdish lexical access [a]	1156	60.13	417–3870
English lexical access	1294	78.48	521–4992

Note. K = Kurdish; E = English; Pre/SchInp = Weekly input in preschool and school in hours; HomInp = Weekly input at home in hours; LoE = Length of exposure in years; MatProf = Maternal language proficiency on a 0–4 point scale; PatProf = Paternal language proficiency on a 0–4 point scale; HomMed = Input from media sources on a 0–3 point scale; NatInp = Native-speaker input on a 0–2 point scale; AO = Age of onset of exposure in years; AT = Age at the time of testing in years; NonInte = Nonverbal intelligence on a 0-60 scale; LangApt = Language learning aptitude; Output = Language output on a 0–4 point scale; MatEdu = Maternal education on a 0–7 point scale; PatEdu = Paternal education on a 0–7 point scale. [a] Reaction times in milliseconds were used as a measure of lexical access ability.

Table 2. Correlation matrix of the predictors.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
1. AT	-																						
2. NonInte	0.307 **	-																					
3. LangApt	0.201 *	0.303 **	-																				
4. K. AO	0.215 *	0.138	−0.065	-																			
5. E. AO	0.146	−0.049	0.025	0.026	-																		
6. K. LoE	0.783 **	0.216 *	0.217 *	−0.414 **	0.096	-																	
7. E. LoE	0.511 **	0.224 *	0.089	0.111	−0.727 **	0.423 **	-																
8. K. Pre/SchInp	0.047	0.271 **	0.323 **	−0.189	−0.058	0.168	−0.043	-															
9. E. Pre/SchInp	−0.020	0.179	0.078	−0.115	−0.251 *	0.128	0.213 *	0.487 **	-														
10. K. HomInp	0.014	−0.099	−0.018	−0.135	−0.107	0.092	0.073	0.109	0.025	-													
11. E. HomInp	−0.091	−0.062	−0.123	0.067	−0.095	−0.101	0.053	−0.145	0.142	0.046	-												
12. K. HomMed	−0.134	−0.092	−0.080	0.109	−0.119	−0.172	0.063	−0.214 *	−0.166	−0.049	0.172	-											
13. E. HomMed	−0.202 *	−0.280 **	−0.193	−0.044	−0.107	−0.196	0.045	−0.252 *	−0.066	0.090	0.290 **	0.213 *	-										
14. K. NatInp	−0.049	0.380	0.085	−0.080	0.208 *	−0.030	−0.151	0.053	−0.205 *	0.098	−0.055	−0.178	−0.195	-									
15. E. NatInp	0.061	−0.085	−0.075	−0.019	−0.031	0.068	0.072	−0.129	0.214 *	−0.002	0.274 **	0.004	0.252 *	−0.126	-								
16. K. MatProf	−0.052	0.277 *	0.029	−0.243 *	−0.072	0.126	0.001	0.328 **	0.121	0.227 *	0.046	−0.023	0.067	0.002	−0.153	-							
17. E. MatProf	−0.169	−0.193	−0.260 **	−0.008	−0.203 *	−0.145	0.084	−0.132	−0.047	0.111	0.059	0.089	0.165	−0.048	0.209 *	0.068	-						
18. K. PatProf	−0.074	0.156	0.066	−0.163	−0.091	0.046	0.015	0.271 **	0.106	0.075	−0.022	−0.064	0.041	−0.005	−0.038	0.534 **	0.121	-					
19. E. PatProf	−0.028	−0.051	−0.087	0.006	−0.040	−0.010	0.042	−0.123	−0.043	−0.009	0.223 *	−0.082	0.216 *	−0.102	0.340 **	−0.056	0.458 **	0.301 **	-				
20. K. Output	0.111	0.168	0.068	−0.007 *	−0.036	0.127	0.140	−0.093	−0.171	0.073	−0.299 **	0.033	−0.143	0.065	−0.149	0.086	−0.063	−0.003	−0.108 *	-			
21. E. Output	−0.039	−196	−0.140	−0.079	−0.262 **	−0.069	0.172	−0.056	0.132	0.256 *	0.337 **	0.149	0.310	−0.118	0.214 *	0.042	0.361 **	−0.019	0.255 *	−0.354 **	-		
22. MatEdu	−0.157	−0.040	−0.116	−0.074	−0.109	−0.078	−0.050	−0.009	−0.068	0.158	−0.046	−0.019	0.181	0.035	0.161	0.256 *	0.489 **	0.156	0.246 *	0.086	0.051	-	
23. PatEdu	−0.030	0.032	−0.176	0.088	0.101	−0.068	−0.160	−0.080	−0.013	−0.081	0.054	−0.121	0.120	−0.092	0.117	0.077	0.327 **	0.214*	0.420 **	−0.222 *	0.130	0.051	-

* $p < 0.05$. ** $p < 0.01$.

4. Results

Backward regression analyses were performed in order to address the first research question on the relationship between individual quantity factors (i.e., preschool/school input and home input) and quality factors (i.e., parental Kurdish proficiency, maternal English proficiency, paternal English proficiency, home media input, native-speaker input) and morphosyntax, vocabulary size, and lexical access ability in Kurdish and English. For this purpose, separate models were built for each language ability in each language. To answer the second research question, on the other hand, on the relative contribution of the input quantity and input quality factors as two different sets to adolescents' Kurdish and English skills after controlling for other internal and external factors (i.e., AO of language exposure, AT, nonverbal analytical reasoning, language learning aptitude, language use, maternal education, paternal education), hierarchical regression analyses were conducted. In all hierarchical regressions, other internal and external factors were entered into the regression analysis in the first step; then, input quantity factors were entered in the second step. Finally, input quality factors were added in the third step. In this way, the unique variance accounted for by each group of the language input was obtained after controlling for the effect of biological, cognitive, and other environmental factors.

It is also noteworthy here that only those factors that were statistically significant in the backward regression analyses were entered into the models while hierarchical regression analyses were conducted. Similarly, only those factors that were statistically significant are displayed in the tables. Moreover, while addressing the second research question, in cases when only one component of either input quantity or quality predicted variation in a language skill, only the amount of the variance explained by the factor in the backward regression was mentioned. However, in cases when there was more than one factor in either set, another hierarchical regression was carried out to diagnose the exact variance explained by each factor of the same group above and beyond that captured by other factors.

4.1. Contribution of Individual Input Quantity and Quality Factors

Regarding morphosyntax, the model for Kurdish morphosyntax (see Table 3) was significant and accounted for 41% of the variance ($F(2, 36) = 6.624$, $p < 0.05$), and the remained predictors in the model were home Kurdish input and parental Kurdish proficiency. The portion of the variance was the largest for the Kurdish proficiency of the bilingual adolescents' parents (β = 0.343, semipartial $r = 0.592$). This could uniquely explain about 35% of the total variance of Kurdish morphosyntax, while the variance explained by home Kurdish input was 17%.

Table 3. Backward regression model results for Kurdish and English morphosyntax.

Variable	B	*SE*	β	*T*	Part
Kurdish					
Constant	44.712	12.836		3.483	
HomInp	0.089	0.078	0.348 *	1.150	0.412
ParProf	4.466	3.388	0.343 *	1.318	0.592
	$R^2 = 0.413$, $F(2, 36) = 6.624$, $p < 0.05$.				
English					
Constant	53.160	1.621		32.803	
Pre/SchInp	0.121	0.042	0.272 **	2.857	0.272
	$R^2 = 0.074$, $F(1, 102) = 8.162$, $p < 0.01$				

* $p < 0.05$. ** $p < 0.01$.

On the other hand, the results from the backward regression (see Table 3) demonstrated that the model accounted for 7% of the variance in English morphosyntax ($F(1, 102) = 8.162$, $p < 0.01$). Preschool and school exposure to English input was the only significant factor

in the final model, in which it explained 7% of the variance in English morphosyntactic knowledge (β = 0.272, semipartial r = 0.272).

Turning to vocabulary size, the results from backward regression (see Table 4) showed that the model accounted for 19% of the variance in Kurdish vocabulary size ($F(2, 37) = 6.567$, $p < 0.001$). The predictors remained in the best fitting model were parental Kurdish proficiency and Kurdish input provided by native speakers. The proficiency of parents in Kurdish explained more variance in Kurdish vocabulary size (β = −0.184, semipartial r = −0.275) than native-speaker input. This could uniquely explain 7% of the total variance of Kurdish vocabulary size.

Table 4. Backward regression model results for Kurdish and English vocabulary size.

Variable	B	*SE*	β	*T*	Part
Kurdish					
Constant	4138.158	437.968		9.449	
ParProf	−36.516	70.313	−0.184 *	−0.519	−0.275
NatInp	261.842	223.209	0.187 *	1.173	0.267
	$R^2 = 0.193$, $F(2, 37) = 6.567$, $p < 0.001$				
English					
Constant	3821.835	90.648		42.161	
Pre/SchInp	4.494	2.556	0.259 ***	1.758	0.365
HomInp	−0.391	5.091	−0.212 *	−0.077	−0.319
	$R^2 = 0.252$, $F(2, 43) = 3.091$, $p < 0.05$				

* $p < 0.05$. *** $p < 0.001$.

With respect to English vocabulary size, the model was significant (see Table 4) and 25% of the variance, $F(2, 43) = 3.091$, $p < 0.05$, was explained by two factors, namely preschool and school English input and home English input. The strongest standardized beta coefficient and semipartial correlation was for preschool and school English input (β = 0.259, semipartial r = 0.365) in which it explained 13% of the variance in English vocabulary size.

As for lexical access ability, the final model (see Table 5) held the factors of preschool and school input in Kurdish and home Kurdish media as significant predictors of Kurdish lexical access ability. The best fitting model captured around 21% of the variance, $F(2, 40) = 4.501$, $p < 0.05$. Home Kurdish media showed the largest contribution (β = 0.318, semipartial r = 0.360) since it explained 12% of the variance in Kurdish lexical access ability.

Table 5. Backward regression model results for lexical access in Kurdish and English.

Variable	B	*SE*	β	*T*	Part
Kurdish					
Constant	1.016	0.079		12.826	
Pre/SchInp	0.020	0.002	0.220 *	0.126	0.341
HomMed	0.161	0.076	0.318 *	2.122	0.360
	$R^2 = 0.213$, $F(2, 40) = 4.501$, $p < 0.05$				
English					
Constant	1.686	0.158		10.705	
Pre/SchInp	−0.006	0.003	−0.306 *	2.191	−0.296
HomMed	−0.237	0.077	−0.432 **	−3.086	−0.417
	$R^2 = 0.393$, $F(3, 38) = 5.597$, $p < 0.01$				

* $p < 0.05$. ** $p < 0.01$.

In terms of English lexical access ability, approximately 39% of the variance, $F(3, 38) = 5.597$, $p < 0.01$, could be explained by three factors in the best fitting model, viz. preschool and school input in English, home English media, and paternal English proficiency. As displayed in Table 5, home English media explained more variance (β = −0.432, semipartial

$r = -0.417$) than the other two factors, in that it could uniquely explain around 17% of the variance in English lexical access ability.

4.2. Contribution of Input Quantity and Input Quality as Two Different Sets

In terms of morphosyntactic knowledge, the input quantity factor of home Kurdish input and the input quality factor of parental Kurdish proficiency in the backward regression predicted Kurdish receptive morphosyntax. A hierarchical regression analysis was conducted, and the results (see Table 6) revealed that the model was significant, and the home Kurdish input accounted for only 3% of the variance in Kurdish morphosyntax, R^2 change = 0.031, $F(5, 9) = 1.594$, $p < 0.01$. On the other hand, parental Kurdish proficiency added 38% of the variance in Kurdish morphosyntax, R^2 change = 0.376, $F(6, 8) = 7.292$, $p < 0.01$, indicating the fact that input quality overwhelmingly surpassed input quantity in terms of predicting Kurdish morphosyntactic skill.

Table 6. Hierarchical regression results for Kurdish morphosyntax.

Variable	B	*SE*	β	*T*	R^2	ΔR^2
Kurdish						
Step 1					0.439	0.439 **
Constant	−6.833	49.083		−0.139		
AT	2.501	2.688	0.234	0.930		
NonInte	0.572	0.366	0.499 **	1.565		
LangApt	0.383	3.175	0.038 **	0.121		
Output	−1.606	1.346	−0.306 ***	−1.193		
Step 2					0.470	0.031 **
Constant	−42.716	70.805		−0.603		
AT	4.415	3.829	0.413	1.153		
NonInte	0.626	0.382	0.546 *	1.638		
LangApt	0.318	3.256	0.031 *	0.098		
Output	−2.636	1.988	−0.502 ***	−1.326		
HomInp	0.074	0.103	0.289 ***	0.720		
Step 3					0.846	0.376 **
Constant	−7.419	2.303		−3.221		
AT	−5.058	2.194	0.442 **	−2.305		
NonInte	0.612	0.219	0.534 *	2.798		
LangApt	5.312	2.181	0.525 *	2.435		
Output	−3.069	1.143	−0.584 *	−2.685		
HomInp	0.199	0.066	0.775 *	3.043		
ParProf	11.148	2.528	0.857 **	4.409		

* $p < 0.05$. ** $p < 0.01$. *** $p < 0.001$.

Regarding English morphosyntax, since only preschool and school English input predicted this skill in the best fitting model (see Table 3), no further statistical steps were taken. In other words, only one input quantity factor contributed to the English morphosyntactic scores in which it uniquely explained around 7% of the variation in English morphosyntax (β = 0.272, semipartial $r = 0.272$).

As for vocabulary size, no hierarchical regression analysis was carried out to compare the contribution of the input quantity and input quality factors in either language because, as shown in Table 4, factors of only one set significantly predicted vocabulary breadth in the backward regressions. However, since the input quality factors of the native-speaker input in Kurdish and parental Kurdish proficiency contributed to Kurdish vocabulary size, it was decided to conduct a hierarchical regression to find out whether Kurdish input provided by native speakers or parental Kurdish proficiency explained more variance. The results showed that parental Kurdish proficiency significantly explained 10% of the variance in the Kurdish vocabulary size skill, R^2 change = 0.102, $F(3, 36) = 3.693$, $p < 0.05$, while exposure to native-speaker input in Kurdish explained 9% of the variation, R^2 change = 0.092, $F(4, 35) = 4.259$, $p < 0.01$.

In contrast to Kurdish vocabulary size, the input quantity factors of preschool and school English input and home English input predicted English vocabulary size scores. Again, a hierarchical regression analysis was done to compare the contribution of the input quantity factors. Consequently, it was found (see Table 7) that exposure to English input in preschool and school accounted for 15% of the variation in English vocabulary size, R^2 change = 0.151, $F(6, 38) = 5.557$, $p < 0.001$, while home English input explained 10% of the variance in the same skill, R^2 change = 0.101, $F(7, 37) = 6.154$, $p < 0.001$ after controlling for the influence of other factors.

Table 7. Hierarchical regression results for Kurdish and English vocabulary size.

Variable	B	*SE*	B	*T*	R^2	ΔR^2
Kurdish						
Step 1					0.233	0.233 *
Constant	3572.968	441.279		8.097		
NonInte	19.347	9.228	0.320 *	2.097		
PatEdu	46.273	33.827	0.209 *	1.368		
Step 2					0.335	0.102 *
Constant	3799.224	449.981		8.443		
NonInte	21.916	9.120	0.363 *	2.403		
Pat Edu	65.149	34.766	0.294 *	1.874		
ParProf	−117.449	68.546	−0.270 *	1.713		
Step 3					0.427	0.092 *
Constant	2875.783	601.002		4.785		
NonInte	22.934	8.687	0.379 *	2.640		
PatEdu	84.814	34.268	0.383 *	2.475		
ParProf	−130.791	65.484	−0.301 *	1.997		
NatInp	442.136	202.008	0.316 *	2.189		
English						
Step 1					0.287	0.287 *
Constant	3681.486	1102.719		3.339		
NonInte	20.396	12.607	0.263 *	1.618		
LangApt	−139.454	76.874	−0.267 *	1.814		
AO	155.242	57.383	0.409	2.705		
Output	160.021	65.997	0.346 *	2.425		
AT	−107.999	75.969	−0.235 *	−1.422		
Step 2					0.438	0.151 ***
Constant	3463.060	967.286		3.580		
NonInte	20.318	11.036	0.262 *	1.841		
LangApt	−127.110	67.387	−0.243 **	−1.886		
AO	217.201	53.118	0.572 ***	4.089		
Output	197.846	58.730	0.428 **	3.369		
AT	−132.428	66.854	−0.288 *	−1.981 *		
Pre/SchInp	7.866	2.191	0.453 ***	3.590		
Step 3					0.540	0.101 *
Constant	3429.994	913.104		3.756		
NonInte	27.014	10.791	348 *	2.503		
LangApt	−65.977	65.672	−0.317 **	−2.527		
AO	232.437	50.545	0.612 ***	4.599		
Output	252.967	60.086	0.547 ***	4.210		
AT	−154.907	63.806	−0.337 *	−2.428		
Pre/SchInp	7.476	2.075	0.431	3.604		
HomInp	−9.572	4.026	−0.301 *	−2.378		

* $p < 0.05$. ** $p < 0.01$. *** $p < 0.001$.

Unlike vocabulary size, both input quantity and input quality factors explained some variation in the lexical access ability in both languages (see Table 8). With respect to Kurdish lexical access, both exposure to Kurdish input in preschool and school and home Kurdish

media contributed to Kurdish lexical access. More precisely, Kurdish input in preschool and school explained only 4% of the variance in lexical access, R^2 change = 0.042, $F(3, 38) = 4.692$, $p < 0.01$, while controlling for other factors. An additional variance of 14% was explained by exposure to home Kurdish media, R^2 change = 0.145, $F(4, 37) = 6.567$, $p < 0.001$, indicating that input quality had a larger contribution to Kurdish lexical access ability.

Table 8. Hierarchical regression results for lexical access in Kurdish and English.

Variable	B	*SE*	β	*T*	R^2	ΔR^2
Kurdish						
Step 1					0.229	0.229 **
Constant	2.562	0.516		4.966		
NonInte	−0.027	0.010	−0.397 *	−2.710		
LangApt	−0.087	0.072	−0.178 *	−1.218		
Step 2					0.270	0.042 **
Constant	2.726	0.520		5.239		
NonInte	−0.032	0.010	−0.472 **	−3.085		
LangApt	−0.118	0.074	−0.241 *	−1.601		
Pre/SchInp	0.003	0.002	0.232 *	1.475		
Step 3					0.415	0.145 ***
Constant	2.561	0.475		5.390		
NonInte	−0.033	0.009	−0.490 ***	−3.529		
LangApt	−0.143	0.067	−0.292 *	−2.125		
Pre/SchInp	0.005	0.002	0.373 *	2.482		
HomMed	0.203	0.067	0.401 **	3.025		
English						
Step 1					0.085	0.085 ***
Constant	2.132	0.617		3.455		
NonInte	−0.017	0.012	−0.231 *	−1.450		
LangApt	0.136	0.086	0.253 *	1.588		
Step 2					0.111	0.026 **
Constant	1.995	0.630		3.168		
NonInte	−0.012	0.013	−0.167 *	−0.979		
LangApt	0.150	0.087	0.279 *	1.734		
Pre/SchInp	−0.003	0.003	−0.179 **	−1.058		
Step 3					0.479	0.368 ***
Constant	3.031	0.602		5.033		
NonInte	−0.026	0.011	−0.344 *	−2.336		
LangApt	0.201	0.071	0.373 **	2.812		
Pre/SchInp	−0.005	0.003	−0.286 *	−2.031		
HomMed	−0.287	0.075	−0.522 ***	−3.802		
PatProf	0.155	0.039	0.522 ***	3.934		

* $p < 0.05$. ** $p < 0.01$. *** $p < 0.001$.

By the same token, the English input in preschool and school settings was the only input quantity factor that contributed to the English lexical access ability in that it explained around 3% of the variance, R^2 change = 0.026, $F(3, 38) = 1.584$, $p < 0.01$. The data from the same hierarchical regression showed that the two input quality factors alone accounted for a large portion of the variance in the English lexical access ability, namely home English media and paternal English proficiency, R^2 change = 0.368, $F(5, 36) = 6.624$, $p < 0.001$. As a further step and to find out the contribution of each of the two input quality factors, another hierarchical regression was conducted. In this respect, home English media accounted for 14% of the variance, R^2 change = 0.144, $F(4, 37) = 3.170$, $p < 0.05$. In comparison with the home media input, paternal English proficiency explained 22% of the variation, R^2 change = 0.224, $F(5, 36) = 6.624$, $p < 0.001$.

5. Discussion

This paper examined the role of input quantity and input quality at the individual and group levels in the development of Kurdish and English morphosyntax, vocabulary size, and lexical access ability. In what follows, the findings, in light of the research questions, are discussed.

5.1. Effects of the Individual Input Quantity and Quality Factors on Bilingual Development

The aim here was to illustrate the role of input quantity and quality factors at the individual level in Kurdish and English morphosyntactic, vocabulary size, and lexical access outcomes. The assumption was that the components of both the amount of Kurdish/English exposure and the richness of the Kurdish/English environment contribute to adolescents' language development. The findings revealed that this prediction was met.

More specifically, in terms of Kurdish morphosyntax, both home Kurdish input and parental Kurdish proficiency explained a significant portion of variance in Kurdish morphosyntax. This finding seems to fall in line with some previous studies (e.g., Gathercole and Thomas 2009; Rojas et al. 2016; Silvey et al. 2021) in which it was found that home language exposure (i.e., language input received from older siblings) and parental language proficiency affect L1 syntactic patterns and morphological complexity. In fact, the variance explained by the model and the effect sizes of these two factors were large, which supports the assumption suggested by Anderson et al. (2021) that the large effect sizes seem to be due to the fact that the bilingual adolescents of the current study have been exposed to Kurdish input for a long period of time. Additionally, the reason behind emerging parental Kurdish proficiency as the best predictor might be that the bilingual adolescents were exposed to rich and frequent input in terms of complex and intensive morphological and syntactic constructions, the source of which was their parents who had high Kurdish language proficiency.

On the other hand, preschool and school English input was the only input factor that predicted English morphosyntactic skill. Although the contribution of this factor was not large, explicating its moderate role is worthwhile, especially in the absence of the effect of other input factors. This finding, which is in line with that of Muñoz (2008) and Sun et al. (2016), supports the view that exposure to L2 input in kindergarten and school, especially when L2 is learnt in a foreign language context, plays an influential role due to the limited L2 exposure. However, the moderate role of the factor echoes the fact that there are other factors that were not examined here, such as teacher's language proficiency, working memory, and motivation, but could be influential in predicting the English morphosyntactic development of the bilingual adolescents.

Regarding vocabulary size, both parental Kurdish proficiency and native-speaker input in Kurdish were significantly associated with Kurdish vocabulary breadth. Although their contribution was almost similar, the Kurdish input provided by native speakers seems to be the only factor that contributed to the vocabulary size development since parental Kurdish proficiency was a negative predictor. Consistent with some studies in the literature (e.g., Gámez et al. 2023; Pham and Tipton 2018; Place and Hoff 2011), the findings here support Vygotsky's (1978) Social Interactionist Theory in that the development of language skills depends on the input-rich environment to a large extent. On the other hand, the negative contribution of parental Kurdish proficiency could be due to the fact that their Kurdish proficiency was not at a level that the adolescents can utilize to expand their knowledge of Kurdish vocabularies.

With respect to English vocabulary size, the input quantity factors of preschool and school English input and home English input were found to significantly predict vocabulary breadth in English. Indeed, exposure to English input in kindergarten and school was the only factor that positively and effectively contributed to English vocabulary size. This pattern of the effect is also documented in certain bilingual studies (Chondrogianni and Marinis 2011; Paradis et al. 2020) but stands in contrast to some others (Huang et al. 2020; Peters et al. 2019). It is also noteworthy that when the contribution of preschool and

school English input in English vocabulary size and morphosyntax is compared, it can be concluded that, unlike the findings of Sun et al. (2016), the factor is more important for fostering vocabulary size than for morphosyntax. The reason for this might be that the participants in their study were children while adolescents were examined here. As a result, it is expected that vocabulary development continues to expand throughout one's lifespan (Hellman 2011), while the growth of morphological and syntactic aspects seems to be vulnerable to aging. It is also important to remember that the focus of the present study was on input quantity and quality factors and, thus, it was impossible to investigate the adolescents' language use, which could be an effective factor as there is some evidence in the literature (e.g., Bohman et al. 2010) showing that language use has a prominent role in morphosyntax since practice improves accuracy and automaticity in the production of morphological and syntactic constructions.

Turning to lexical access ability, exposure to both preschool and school Kurdish input and home Kurdish media were related to the speed of accessing Kurdish lexical words with the emergence of home Kurdish media as the best predictor of lexical access ability in Kurdish. On a par with previous findings (Brysbaert et al. 2016; Monaghan et al. 2017), the results of the current study confirm that language exposure plays a key role in the process of lexical access in that more exposure to home Kurdish media and more exposure to Kurdish in kindergarten and school lead to richer lexical–semantic associations, which is necessary for accelerating the processing speed. Furthermore, as Wiener and Tokowicz (2021) speculate, exposure to a language frequently over a long period of time in a naturalistic setting strengthens conceptual links that might not require a reference to lexical form information in the lexical access process.

Finally, each of preschool and school English input, home English media, and paternal English proficiency significantly predicted lexical access ability in English. Contrary to the contribution of preschool and school English input to English morphosyntax and vocabulary size, this factor negatively predicted the lexical access ability in English. Similarly, exposure to home English media had a negative impact on the speed of naming objects in English. This is possibly due to the fact that the bilingual adolescents' English proficiency did not match with the level of the English input received from media. Interestingly, English proficiency of the bilingual adolescents' fathers had the largest positive effect on the English lexical access ability, proposing that the higher the English proficiency of the fathers, the faster the bilingual learners will be in retrieving object names. The reason behind the contribution of paternal English proficiency, but not maternal English proficiency, might be that the overall proficiency of the adolescents' fathers was higher than that of the mothers, confirming that the English proficiency of the parents should reach a certain threshold in order for its effect start to emerge. Moreover, the higher proficiency of the fathers paved the way for frequent and rich exposure, which led to a large number of word repetitions, which, as Gollan et al. (2005) claim, supports faster naming latencies. This finding, however, is opposite to that of Berghoff and Bylund (2023) who explain that increased crosslanguage activation is more likely to occur during exposure to a greater language input, which is expected to influence lexical access. The reason for this finding by these researchers might be that they measured language exposure cumulatively, while different subcomponents of language input are required to be examined to reach a better conclusion.

To sum up, the contribution of different components of input quantity and input quality varies to a large extent based on the investigated language. More specifically, in terms of Kurdish skills, both home Kurdish input and parental Kurdish input have an effect on Kurdish morphosyntax, while native-speaker input in Kurdish contributes to the development of Kurdish vocabulary size. Additionally, preschool and school Kurdish input and home Kurdish media have a significant influence on the Kurdish lexical access ability. On the other hand, preschool and school English input is very important for fostering English morphosyntax and vocabulary size. Further, paternal English proficiency seems to be the only factor that contributes to the English lexical access ability. Therefore, this calls for special attention to the fact that each language should be examined independently, and

exploring various dimensions of language exposure is needed to reach firm conclusions since an individual input factor does not guarantee a similar contribution to different language skills.

5.2. Input Quantity versus Input Quality

Comparing the contribution of the amount of language input and the richness of the language environment as two different sets after controlling for other internal and external factors was another primary goal of the current study. Based on the findings, the conclusions that could be drawn with respect to the effect of the two groups on Kurdish skills is more straightforward. In contrast, the role of input quantity and input quality in the development of English outcomes is less consistent. More specifically, the richness of the Kurdish environment plays an effective role in Kurdish morphosyntax, vocabulary size, and lexical access ability by making the largest contribution to morphosyntactic development via parental Kurdish proficiency. These findings, pertaining to the robustness of input quality, are generally in line with some previous findings (e.g., Anderson et al. 2021; Kaltsa et al. 2020; Kuo et al. 2020; Pham and Tipton 2018; Sun et al. 2018), and, to a great extent, lend support to the hypothesis that rich input matters more for older bilinguals (i.e., adolescents and adults) than younger bilinguals (i.e., children) (Grøver et al. 2018; Ryan 2021; Rowe 2012). It should be remembered that these studies only examined vocabulary or/and morphosyntax. Thus, the findings of the present study enrich our understanding of the impact of input quality on lexical access ability in addition to vocabulary size and morphosyntax.

Concerning the influence of the amount of English exposure and the richness of the English environment on English skills, it can be concluded that input quantity in terms of exposure to English input in instructional settings plays a deterministic role in comparison with input quality, which is in parallel to the findings of certain studies in the literature in both naturalistic and instructional settings (e.g., Paradis et al. 2020; Pfenninger and Singleton 2018; Unsworth et al. 2015; Thordardottir 2017), but in contrast to some others (e.g., Peters et al. 2019; Huang et al. 2020). However, this claim should be interpreted cautiously because of the fact that the amount of English exposure is only effective for morphosyntax and vocabulary size, while rich and frequent English exposure, in terms of paternal English proficiency, determines lexical access ability. Accordingly, the bilingual adolescents and their parents should make higher parental English proficiency, especially paternal English proficiency, and a greater amount of English exposure in instructional contexts their top priorities. Of course, this implies that explicit learning, which mostly takes place in kindergartens and schools, should be encouraged with respect to understanding English morphological and syntactic patterns and memorizing English words. This is especially true for English vocabulary size because of the significant contribution of nonverbal analytical reasoning, which, as DeKeyser (2020) and Kersten et al. (2021) explain, seems to be useful for learning vocabulary and grammatical aspects consciously. However, there appears to be a different scenario in relation to lexical access ability. That is, implicit learning, rather than explicit learning, could be important for the faster retrieval of lexical English and Kurdish words from the mental lexicon due to either the marginal or negative contribution of cognitive and instructional factors. Related to lexical access ability, the findings support that of Chaouch-Orozco et al. (2021) but are in contrast to the findings of Hintz et al. (2020), who suggest that lexical access and lexical decision skills are more dependent on nonverbal analytical reasoning than linguistic sources.

To conclude, input quality, especially the richness of the language environment outside school, seems to explain more variance in Kurdish skills and English lexical access ability than input quantity. Contrary to this, input quantity, in terms of exposure to English input in instructional settings, appears to explain more variance in English morphosyntax and vocabulary breadth. Undoubtedly, these findings need not to be interpreted in the sense that only one set of language input matters for the improvement of the skills in either

language since the examined factors in this study, and others that were not investigated here, are expected to interact in a complex way (DeKeyser 2020).

6. Conclusions

The present study investigated the development of morphosyntax, vocabulary size, and lexical access ability in Kurdish as a majority language and English as a foreign language among Kurdish–English bilinguals. Participants were adolescent students ranging in age from 16 to 19, living in the Kurdistan Region of Iraq. The aims of this study were to explore the association between individual input quantity and quality factors to both L1 and L2 outcomes. Moreover, it aimed to determine the impact of input quantity and input quality at the group level on the development of L1 and L2 domains after controlling for the variation in AO of language exposure, AT, nonverbal analytical reasoning, language aptitude, adolescents' L1/L2 use, and socioeconomic status. In this way, we sought to contribute to a better understanding of the role of language input in terms of the amount of language exposure and the richness of the language environment in dual language learning.

The findings indicate that both the amount of L1/L2 input and the richness of L1/L2 environment are associated with the bilingual skills. However, the degree of the contribution of the input quantity and quality factors varies according to the language skill under scrutiny. In general, exposure to out-of-class input outweighs instructional input to a certain extent with respect to the Kurdish skills and lexical access ability in English. This suggests that each language domain is sensitive to variation in language input in a way which is different from that for another language domain. Consequently, each language skill needs to be explored independently as far as special attention is paid to different components of input quantity and quality. Regarding the contribution of two sets of input quantity and input quality to the development of L1 and L2 skills after controlling for other internal and external factors, this study reveals that input quality is more important than input quantity for enhancing Kurdish morphosyntax, Kurdish vocabulary size, and lexical access ability in both languages. On the other hand, the role of input quantity is more prominent for English morphosyntax and vocabulary size. We believe that although priority needs to be given to the components of one set based on the language and domain, such an attempt should not be at the expense of the factors of the other set.

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Notes

[1] In the regression analyses, maternal English proficiency and paternal English proficiency were used as two independent factors in this study. However, due to multicollinearity issue, maternal Kurdish proficiency and paternal Kurdish proficiency were combined into parental Kurdish proficiency.

[2] A few bilingual adolescents were exposed to another language (i.e., Dutch, French, German, or Finnish) from birth till three years of age due to migration and academic reasons. However, before reaching age four, these children and their families have returned to and resided in the Kurdistan Region permanently. Through personal contact, parents of these adolescents emphasized that their children experienced a complete loss of the aforementioned languages.

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