Impact of Input Types in Bilingual Children's Real-time Lexical Retrieval in L1 and L2

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ABSTRACT
This study examined the relationship between language experience and lexical retrieval ability in 12-year-old bilingual children from immigrant families in Korea. We assessed language usage across five sources (parents, siblings, friends, media, and reading) for both their first language (L1, Russian, or Chinese) and second language (L2, Korean). The children's word retrieval accuracy and speed in L1 and L2 were measured using real-time word-naming tasks. Multiple regression analyses revealed that parental input was the strongest predictor of L1 task performance, with increased L2 input and decreased L1 input from parents leading to reduced word-naming accuracy and longer response times. In contrast, L2 proficiency was the most significant predictor of L2 task performance, whereas individual input types had no significant impact. These findings underscore the crucial role of parental input in the potential decline of L1 lexical abilities while also emphasizing overall L2 proficiency as a key indicator in L2 lexical development.

Keywords: cross-linguistic influence, lexical retrieval, input type, immigrant children, picture-naming

1. Introduction

The language usage patterns of bilinguals are shaped by a myriad of factors, including both internal and external elements (Köpke et al., 2007; Unsworth et al., 2011). Among these factors, language input —essentially language experience— stands out as particularly influential (Grüter et al., 2014; Marchman et al., 2017; Paradis, 2007a). One linguistic domain notably vulnerable to language input is the lexicon, or word knowledge (Schmid & Köpke, 2009). Extensive studies have demonstrated that bilingual children encounter varying degrees of difficulty in producing and comprehending words in their first (L1) and second languages (L2), contingent on the recency and frequency of their exposure (Gathercole & Thomas, 2009; Paradis & Navarro, 2003; Place & Hoff, 2011; Scheele et al., 2010).

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The relationship between language input and word activation among bilinguals is evident in the rapid transformation of word usage patterns observed in immigrant children, who typically receive substantial L2 input upon entering formal education in the host country (Prevoo et al., 2014; Sorenson Duncan & Paradis, 2020a). The increased and recent access to L2 words, combined with diminishing exposure to L1 words, leads to a weakening of their L1 lexical abilities, ultimately resulting in a shift in language dominance from L1 to L2 (Jo et al., 2021; Kim & Kim, 2022; O'Grady et al, 2011). A central explanation for these tendencies is the assumption that cumulative exposure to L2 enhances the efficiency of accessing the language system, thereby increasing activation levels of L2 words (Gollan et al., 2008; Köpke, 2007; Montrul, 2010).

Despite substantial evidence on the impact of language input on L2 lexical abilities in immigrant children, most studies have focused on the role L2 input on L2 performance (Govindarajan & Paradis, 2019; Hopp, 2011; Paradis et al., 2017; Prevoo et al., 2014; Sorenson Duncan & Paradis, 2020a). Consequently, there remains limited understanding of how different input sources from both L1 and L2 affect the lexical access and retrieval abilities of young bilinguals across both languages. Given that bilinguals receive diverse sources of L1 and L2 input, a comprehensive analysis is necessary to scrutinize how specific language usage profiles intricately shape their lexical abilities in both L1 and L2.

The current study aims to address this issue by investigating the effects of diverse sources of L1 and L2 input on the accuracy and speed of word retrieval in both languages among bilingual children. We recruited Chinese-Korean and Russian-Korean bilingual children, aged 12 years, and assessed their language use profiles across five sources: parents, siblings, friends, media, reading materials. Subsequently, we conducted real-time word-naming tasks in both L1 and L2 to determine which type of input most strongly predicts the children's word retrieval accuracy and speed in each language. By exploring the interaction between language input and lexical abilities in all languages involved, this study seeks to provide insights into the specific input sources that contribute to the development of L2 lexical skills, as well as the potential impact on the weakening of L1 vocabulary skills.

2. Interactions of Different Types of Input and Language Abilities in Bilinguals

Bilinguals' language use profiles can have profound impacts on their overall

language development. Different types of language input may exert varying degrees of influence on the acquisition and development of L2 skills among bilingual children. To illustrate, a substantial body of evidence indicates that maternal input within the home environment plays a decisive role in shaping the L2 vocabulary development of young bilinguals aged between 2 and 3 (Hurtado et al., 2014; Marchman et al., 2010; Marchman et al., 2017; Pearson et al., 1997).

However, recent research suggests that for preschool- and school-aged children typically ranging between 5 and 6 years old, the impact of L2 input from parents at home continuously becomes minimal, while L2 input acquired in the school environment to exert a substantial influence on L2 acquisition (Govindarajan & Paradis, 2019; Paradis et al., 2017).

The observed difference in the effects of input derived from home versus school environments on school-aged bilinguals can primarily be attributed to variations in the levels of L2 proficiency among the input providers. Typically, newcomer (immigrant) parents possess lower proficiency in the community language—the majority societal language in both the community and schools (Paradis, 2007b)—compared to monolingual teachers and peers at school, rendering home input a less optimal source of L2 input (Place & Hoff, 2016; Sorenson Duncan & Paradis, 2020b). In contrast, L2 input from older siblings at home can significantly contribute to bilinguals' L2 performance in diverse domains, including lexical and morphosyntactic knowledge (Sorenson Duncan & Paradis, 2020a). For instance, given the privileged status of sibling interactions, which can provide rich and native-like L2 input (e.g., Bridges & Hoff, 2014; Rojas et al., 2016), Sorenson Duncan and Paradis (2020a) hypothesized that input from siblings, rather than maternal input, would significantly predict L2 vocabulary and morphology task scores among young Spanish-English bilingual children (with a mean age of 5.8). This hypothesis was supported by a significant correlation between the quantity of input from older siblings and task scores. Conversely, there was no significant correlation between the quantity of maternal input and task scores. Based on these findings, Sorenson Duncan and Paradis proposed the need for distinct assessments of L2 input from the home environment, differentiating between input from parents and input from siblings.

The need for separately evaluating the contributions of distinct input sources is also pertinent to examining bilinguals' L1 usage. Various hypotheses can be formulated regarding the impacts of different input types on young bilinguals' L1 performance. For instance, the language use and learning of school-aged bilinguals

might be greatly influenced by peer input (e.g., Rojas et al., 2016), owing to peer pressure and/or the amount of time spent at school. As a result, L2 input from peers could be a significant predictor of L1 lexical retrieval ability. Alternatively, interactions between parents and children at home may strongly influence L1 lexical retrieval, particularly given the substantial role of maternal input as a primary source of L1 (Prevoo et al., 2014; Sorenson Duncan & Paradis, 2020b). Bilingual or heritage children often rely on their parents to maintain their proficiency in the heritage language (Place & Hoff, 2016). Therefore, the influence of parental input could surpass that of input from peers or siblings. In this manner, variations in the quantity and quality of L1 and L2 input within different contexts could potentially serve as precursors to bilinguals' vocabulary skills. However, as Schmid and Dusseldorp (2010) pointed out, most studies have not thoroughly explored the distinct roles of various types of language input, instead "lumping them all together under one single factor" (p. 130).

In light of this context, the current study investigates the extent to which diverse L1 and L2 input sources contribute to the lexical retrieval abilities of young bilingual immigrants in both their L1 and L2. Among several theoretical models highlighting the role of language input in the acquisition and development of lexical abilities, this study focuses on the weaker links hypothesis (Gollan et al., 2008). Within this framework, the focal point is on the frequency of word usage as a key determinant of the variation in word access and retrieval speed among bilinguals. Specifically, this hypothesis posits that more frequent use of a language results in a more robust association between word concepts and forms in the bilingual mental lexicon. The heightened association enhances the activation levels of target words, facilitating access and retrieval of their information. Conversely, limited engagement with a language can diminish the efficiency of accessing word information, leading to slower and less accurate lexical retrieval. This theoretical framework allows us to postulate that reduced L1 usage by bilingual children will manifest as slower and less accurate L1 lexical retrieval, whereas their cumulative L2 usage will facilitate more efficient L2 lexical retrieval.

3. The Present Study

To explore the influence of input types on L1 and L2 lexical retrieval abilities among bilingual children, we measured the quantity of L1 and L2 input they received from five major sources. We then investigated to what extent the relative proportion

of L2 versus L1 input from these sources contributed to the variations in the accuracy and speed of L1 and L2 lexical retrieval. Additionally, considering the language learning context of the immigrant children, where the emphasis is mainly on learning L2 Korean, it is necessary to gain a more comprehensive understanding of L2 lexical retrieval and speed. Thus, we also examined the roles of L1 membership and L2 proficiency in this process.

The bilingual participants involved in this study consisted of Chinese- and Russian-speaking children living in South Korea (hereafter 'Korea'), offering unique insights into bilingual lexical processing by virtue of the specific language learning contexts they are immersed in. With its significant economic growth since the late 20th century, Korea has witnessed a rapid influx of immigrants from various countries around the world. Many of these immigrant families, including the participants in our study, relocate to Korea for permanent settlement. According to a national survey report (Statistics Korea, 2020), approximately 2.2 million immigrant families were residing in Korea in 2020, with projections estimating this number to reach 3 million by 2030. The rapidly increasing immigrant population in Korea provides us with a unique opportunity to examine how the maintenance of the linguistic systems of these immigrants is influenced by their language environments, as well as which specific input factors significantly contribute to shaping their language skills.

Many immigrant children who arrive in Korea between the ages of 5 and 10, during their pre-school or elementary school years, experience sequential language learning after their arrival. These children have already developed some degree of proficiency in their L1 before beginning to learn Korean. Their language exposure is diverse, stemming from various sources including parents, siblings, peers, teachers, mass media, online social platforms, and reading materials. As a result, the interaction between the effects of different language inputs and their L1 and L2 lexical knowledge vary, requiring a systematic analysis of how distinct input types contribute to their lexical abilities of L1 and L2 use. Furthermore, to gain a more comprehensive understanding of the factors influencing L2 lexical retrieval and speed, it is essential to considier the roles of L1 membership and L2 proficiency in these interactions.

To address these issues, we formulate the following research questions (RQs):

RQ1: Which type of language input most strongly explains the variations in the lexical retrieval and speed of L1 words among immigrant children?

RQ2: Which type of language input most strongly accounts for the variations in the lexical retrieval and speed of L2 words in these children?

RQ3: How do L1 membership and L2 proficiency influence the lexical retrieval and speed of L2 words in these children?

4. Method

4.1. Participants

A total of 68 bilingual children (41 girls) participated in this study. These children were drawn from two largest immigrant populations in Korea: 34 families from Mandarin Chinese-speaking backgrounds and 34 families from Russian-speaking backgrounds. The participants were enrolled in a local elementary school in Korea at the time of data collection, with a mean age of 12 years (SD = 0.7). According to school records and responses to a language background questionnaire, these bilingual children had been born and raised in Chinese- or Russian-speaking countries before migrating to Korea, alongside their parents. All children predominantly used their L1 in their home countries and were introduced to the Korean language after migrating, at an average age of 9 (see Table 1). This sequential language learning trajectory classifies them as sequential bilinguals.

At the school where the study was conducted, the first two years of education for immigrant children consist of a combination of intensive Korean courses and general classes that cover all mandatory subjects taught in Korean. Subsequent to this initial phase, the children were assigned to regular classes where they interacted with their Korean peers. At the time of testing, the participants exhibited varying lengths of residence in Korea, reflecting differences in their progress through the school curriculum.

When we measured their Korean proficiency using an oral picture-description task (Song & Schwartz, 2009), which assessed mean length of utterance and grammatical accuracy in spoken production, they showed some variability in task scores (M = 14, SD = 5.7). The transcribed utterance of each participant was analyzed to determine complexity, measured by the average number of words per T-unit, and accuracy, measured by the proportion of error-free T-units. These two values were then converted to comparable scores and combined to derive the overall Korean proficiency score (See Song & Schwartz, 2009 for more details).

Finally, we incorporated the participants' L1 membership, Chinese or Russian, into the analysis due to significant differences between the two language groups in terms of mean age, length of residence, and Korean proficiency. Independent samples *t*-tests showed significantly higher values for the Chinese speakers compared to the Russian speakers in terms of age ($t(66) = -2.397$, $p = .019$, Cohen's $d = 0.593$), length of residence in Korea ($t(66) = 2.799$, $p = .007$, Cohen's $d = 0.679$), and Korean proficiency scores ($t(66) = 4.425$, $p < .001$, Cohen's $d = 1.073$). Given these differences, we included the learners' L1 and Korean proficiency as predictors in this study, where age and length of residence in Korea were considered together as the L1 membership variable.

Meanwhile, the two language groups did not differ in terms of the age of onset of acquisition ($t(66) = -1.045$, $p = .300$, Cohen's $d = 0.253$). Participant information, presented as mean values for each variable, is summarized in Table 1.

Table 1. Participant information

Variable	Chinese speakers (n = 34)	Russian speakers (n = 34)
Age	11.8 (0.6)	12.2 (0.8)
Years spent in Korea	3.1 (1.2)	2.3 (1.1)
Onset age of Korean acquisition	9.1 (1.5)	9.4 (1.2)
L2 (Korean) Proficiency scores	16.8 (4.7)	11.4 (5.3)

Note. Numbers in parentheses indicate standard deviations.

4.2. Selection of input variables

We estimated participants' L1 and L2 input from five distinct sources: parents, siblings, school friends, media (including visual and audio mediums such as TV, radio, and the internet), and reading materials (including printed content such as textbooks, storybooks, magazines, and comics). Based on the approach used in Schmid and Dusseldorp (2010), we asked each child to rate their estimated weekly input in L1 and L2 using a four-point scale (0 = never use the language, 1 = seldom use the language, 2 = sometimes use the language, 3 = frequently/always/only use the language) for each language use context. The survey questions were available in both the L1 and the L2 (see Appendix for the survey questions translated into English). As summarized in Table 2, the children generally reported a higher quantity of L1 input compared to L2 input across the five domains, aligning with the prevalent

L1 dominance typically observed in sequential bilinguals (Gathercole & Thomas, 2009). In order to investigate the influence of the proportion of input in each language on the children's lexical retrieval abilities in their L1 and L2, we calculated an L2-L1 input ratio by dividing the L2 input ratings by the sum of the L1 and L2 input ratings for each domain (e.g., Kim & Kim, 2022).

Table 2. Average ratings of L1 and L2 inputs across the five sources

Input source	L1 input	L2 input	L2-L1 input ratio
Parents	2.59 (0.85)	1.34 (1.17)	0.31 (0.28)
Siblings	2.19 (1.19)	1.10 (1.17)	0.26 (0.28)
Friends	2.50 (0.80)	1.75 (1.13)	0.39 (0.24)
Media	2.06 (1.11)	1.66 (1.23)	0.42 (0.31)
Reading	2.29 (1.02)	1.14 (1.10)	0.41 (0.28)

Note. Numbers in parentheses indicate standard deviations.

4.3. Materials and procedure

We employed a real-time word-naming paradigm developed by the Hawai'i Assessment of Language Access (HALA) project (O'Grady et al., 2009). This task (hereafter referred to as the HALA task) was specifically designed to assess both the accuracy and speed with which young bilinguals access and activate lexical items in a designated language. Each participant completed this task twice, initially in their L1 and subsequently in their L2, with a three-week interval between the two testing sessions. The tasks were administered in a quiet classroom after regular school hours. In order to alleviate cognitive demands, each task session was scheduled on a separate day, after the participants had completed the language background questionnaire and the picture-description task.

The HALA task comprised a set of 31 images depicting various human body parts, categorized into higher- and lower-frequency groups, as shown in Table 3 (O'Grady et al., 2009). Our selection of these human body parts as target items was guided by O'Grady et al.'s (2009) rationale. These items represent fundamental semantic categories typically acquired at an early stage of language development. As such, the accuracy and speed of accessing and retrieving information of these items can serve as a reliable indicator of language development and potential weakening (Kim

& Kim, 2022; O'Grady et al., 2009). Following O'Grady et al. (2009), the higher-frequency items were presented prior to the lower-frequency items to reduce the cumulative cognitive load.

Table 3. HALA task items

Frequency group	Item (in English translation)
Higher frequency (k = 17)	back, leg, ear, lips, eye, mouth, face, nose, fingers, shoulder, foot, stomach, hand, teeth, head, tongue, knee
Lower frequency (k = 14)	ankle, forehead, arm, heel, cheek, neck, chin, palm, elbow, thumb, eyebrow, toe, fingernail, wrist

Before the task, participants received oral and written instructions in L2. To ensure their familiarity with the task, they worked through 12 practice trials. The task items were presented on a computer screen using Shockwave Flash animation. Each trial began with an auditory beep, immediately followed by the presentation of an image on the screen. Participants were instructed to vocally name the target image in their L1 (Chinese or Russian) during the L1 task and in their L2 during the L2 task. The specific target image was visually highlighted with a red circle. The image remained on screen for 4000 milliseconds for higher-frequency items and 4500 milliseconds for lower-frequency items (e.g., Jo et al., 2021; Kang, 2011; Kim & Kim, 2022). Subsequently, the screen automatically transitioned to the next trial. The whole task procedure was audio-recorded, and each participant's responses were transcribed for data analysis. Response times were only included in the analysis if the target word was correctly named.

4.4. Data analyses

For the evaluation of the participants' lexical retrieval skills, we coded their responses in the L1 and L2 HALA tasks in terms of retrieval accuracy and speed. Word naming accuracy was annotated by trained native speakers of the respective languages. Each word accurately responded within the designated time limit was assigned one point. Instances where a hypernym was provided instead of the target word (e.g., mentioning *a face* for the word *an eye*) were regarded as incorrect. However, these instances were counted as accurate when they were quickly corrected for the target word (e.g., mentioning *a face* and then *an eye*). The measurement of

word retrieval speed involved the calculation of response time in milliseconds for every correctly articulated word. This time span was operationalized as the duration between the onset of the auditory beep and the onset of the verbal response (O'Grady et al., 2009). The analysis of response times was conducted using Praat phonetic analysis software (Boersma, 2001). Response times that exceeded two standard deviations from the mean were excluded as outliers, affecting 4.1% of the entire data.

To investigate the extent to which input variables influenced the immigrant children's word retrieval accuracy and speed, we conducted a stepwise multiple regression analysis, separately for both the L1 and the L2 tasks. Before conducting the analyses, we inspected collinearity among the variables to check whether they met the requirements for multiple regression, using the variance inflation factor (VIF). When the variables were regressed on the naming accuracy scores and the response times, none of them had VIFs larger than 4, a threshold for possible multicollinearity problems (Tabachnick & Fidell, 2013). We therefore entered all the predictors, including learners' L1, Korean proficiency, and the five input variables (parents, siblings, school friends, media, reading), into the regression models.

Stepwise multiple regression models were created separately for the accuracy and the response time outcomes, using the 'ols_step_both_p' function in R version 4.3.3 (R Core Team, 2024). Starting with an empty model, the analysis added each predictor, beginning with the lowest *p*-values, to the model in a stepwise manner until the model identified no variable to add or remove based on the *p*-value of each model.

5. Results

The outcomes of the L1 and L2 HALA tasks are presented in Table 4. In the following sections, we report detailed results from the regression analyses conducted for the L1 and L2 tasks.

Table 4. Word naming accuracies and response times for each language group

Task	Group	Accuracy (max = 31)		Response time (milliseconds)	
		Mean	SD	Mean	SD
L1	Chinese-L1	25.4	5.6	1,355.0	280.9
	Russian-L1	27.5	2.6	1,256.3	205.1
L2	Chinese-L1	24.1	5.6	1,324.5	264.4
	Russian-L1	17.1	5.5	1,511.8	238.9

5.1. L1 HALA task

Table 5 summarizes the outcomes of the models for the L1 task.

Table 5. Results of the final models in the L1 task

Dependent measure	Entry	R2 change	*B*	*SE*	*B*	Sig
Accuracy	Parents	.345	−9.349	1.586	−0.587	< .001
Response time	Parents	.130	0.419	0.116	0.470	.001
	Siblings	.036	−0.193	0.114	−0.220	.096

The final model analyzing accuracy scores included input from parents as the sole predictor, accounting for 34.5% of the total accuracy score variance ($F(1, 67) = 34.765$, $p < .001$, $r = .587$, $R^2 = .345$). The significant contribution of parental input indicates that children who received a higher quantity of L2 input compared to L1 input from their parents exhibited reduced accuracy in L1 lexical retrieval.

On the other hand, the model focusing on response time data included two input variables: one from parents and another from siblings. The combined contributions of these variables explained 16.6% of the total variance ($F(2, 67) = 6.479$, $p = .003$, $r = .408$, $R^2 = .166$). However, upon closer examination of the individual contributions, only the input from parents was a significant predictor, whereas the contribution of input from siblings was insignificant. These results suggest that participants tended to spend longer times for L1 word retrieval as they received larger amounts of L2 input over L1 input from parents.

In summary, the results of the regression analyses conducted for the L1 task demonstrated that parental input emerged as the most influential predictor of the

participants' word-naming accuracy and speed in the L1 task. The predictive contributions of each input source were further corroborated through correlation analyses, where accuracy scores and response times exhibited the strongest correlations with input from parents. These findings are presented in Figures 1 and 2.

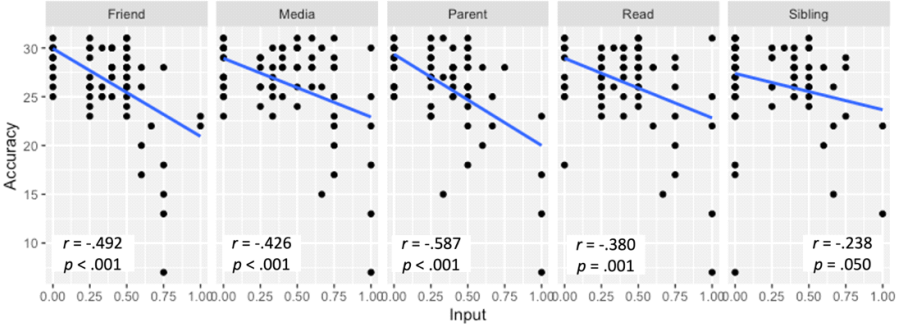

Figure 1. Correlations between word-naming accuracies and L2-L1 input ratios across the five sources in the L1 task.

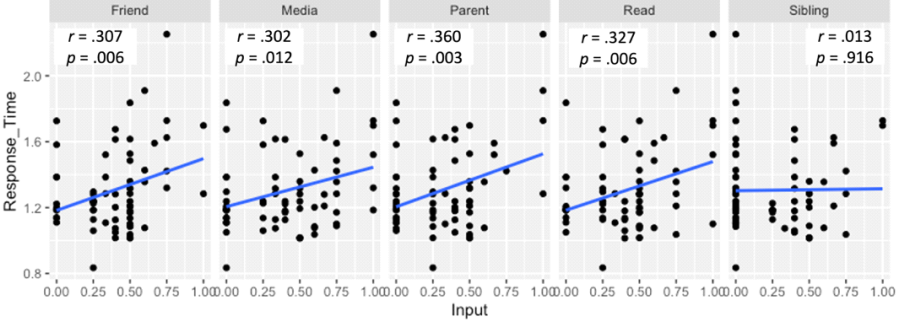

Figure 2. Correlations between response times and L2-L1 input ratios across the five sources in the L1 task.

5.2. L2 HALA task

Model outcomes from the L2 HALA task are presented in Table 6.

Table 6. Results of the final models in the L2 task

Dependent measure	Entry	R2 change	*B*	*SE*	*B*	Sig
Accuracy	L2 proficiency	.647	0.820	0.093	0.709	< .001
	L1 membership	.030	−2.586	1.044	−0.199	.016
Response time	L2 proficiency	.416	−0.030	0.004	−0.645	< .001

The model analyzing accuracy scores included two variables, L2 proficiency and L1 membership, which collectively accounted for 67.7% of the total variance ($F(2, 67) = 68.180$, $p < .001$, $r = .823$, $R^2 = .677$). Between the two variables, L2 proficiency made a stronger contribution to the model ($B = 0.709$), suggesting the participants' higher accuracy in L2 lexical retrieval with increasing L2 proficiency. The significant effect of L1 membership was ascribed to the higher accuracy scores for the Chinese-L1 group compared to the Russian-L1 group.

In the model analyzing response time data, L2 proficiency emerged as the sole predictor, accounting for 41.6% of the total variance ($F(1, 67) = 47.018$, $p < .001$, $r = .645$, $R^2 = .416$). These results suggest that participants spent shorter times retrieving L2 words as they had higher L2 proficiency.

Although none of the input variables were included as significant predictors in the models, we conducted an additional exploratory analysis, focusing exclusively on the input variables to address our research question. The outcomes of the models are summarized in Table 7.

Table 7. Results of the models focusing on input variables in the L2 task

Dependent measure	Entry	R2 change	*B*	*SE*	*B*	Sig
Accuracy	Reading	.272	7.258	3.640	0.306	.050
	Media	.039	6.072	3.198	0.291	.062
Response time	Media	.159	−0.339	0.096	−0.399	.001

The model focusing on accuracy scores included two input variables, reading and media. Their joint contribution accounted for 31.1% of the total variance ($F(2, 67) = 14.651$, $p < .001$, $r = .557$, $R^2 = .311$). However, the individual contribution of

each variable did not exhibit statistical significance, suggesting a weak trend towards increasing accuracy in the L2 task as participants received a greater proportion of L2 input from reading materials and media.

In the model analyzing response times, only media emerged as a significant predictor, explaining 15.9% of the total variance ($F(1, 67) = 12.498$, $p < .001$, $r = .399$, $R^2 = .159$). This outcome indicates that participants spent shorter time naming L2 words as they received a greater proportion of L2 input from media.

In summary, the analyses conducted on the L2 task revealed that L2 proficiency was the strongest indicator of both L2 lexical retrieval accuracy and speed. When the focus was narrowed down to the input variables, input from reading and media marginally contributed to the variability of L2 lexical retrieval accuracy, while input from media demonstrated a significant contribution to the variability of L2 lexical retrieval speed. The associations between each input source and the outcomes of the L2 HALA task are visually presented in Figures 3 and 4.

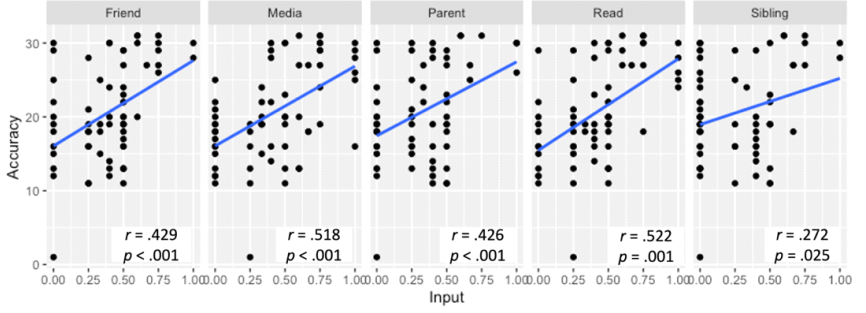

Figure 3. Correlations between word-naming accuracies and L2-L1 input ratios across the five sources in the L2 task.

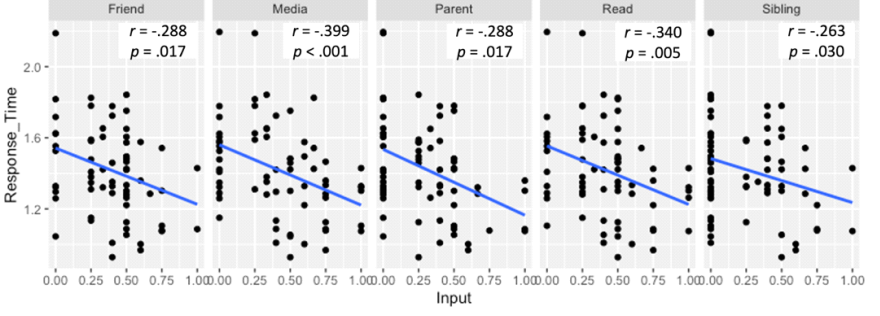

Figure 4. Correlations between response times and L2-L1 input ratios across the five sources in the L2 task.

6. Discussion

The purpose of the current study was to investigate the extent to which learner-related variables and input from various sources predict word retrieval accuracy and speed in both the bilingual children's L1 and L2. The study revealed distinct findings across the two word-naming tasks. In the L1 task, the input received from parents emerged as the most influential predictor for both word-naming accuracy and speed. Specifically, the children exhibited lower accuracy and slower naming latencies for target words in their L1 when their engagement with parents was more oriented towards L2 Korean and less towards their L1. In contrast, the models centered on the L2 task indicated a strong positive relationship between higher L2 proficiency and enhanced L2 word-naming accuracy and speed. When the analysis focused on the input variables, input from reading and media served as predictors for L2 word retrieval accuracy and speed.

The observation that parental input strongly influenced the children's L1 word-naming accuracy and speed underscores the crucial role of child-parent interactions in maintaining L1 lexical skills. Immigrant families often place emphasis on preserving their home country's language due to a strong sense of ethnic identity (Extra & Yagmur, 2010) or the parents' higher proficiency in the L1 (Sorenson Duncan & Paradis, 2020b). Moreover, maternal input tends to serve as a consistent and stable source of L1 usage, particularly in a social milieu where the host language takes precedence over ethnic minority languages (e.g., Kenji & D'Andrea, 1992). Consequently, if parental input in an immigrant family is more inclined toward the L2, the child might have fewer opportunities to use the L1, thereby exhibiting signs of L1 weakening. In line with this assertion, the schoolteacher of our participants informed that some immigrant parents expressed a strong desire to assist their children in acquiring the Korean language by communicating with them in Korean at home. Such desire is often driven by the linguistic uniformity of the Korean society (Kymlicka, 1995), which mandates the use of the host language for societal participation, and by the parents' expectation for their children to swiftly assimilate into the mainstream by learning Korean early (Hong, 2010).

The notable impact of parental input on L1 lexical retrieval could also be attributed to its potential to provide rich and meaningful interpersonal interactions. The HALA task involves participants naming common body part terms, which are frequently used in everyday life. Therefore, the outcomes of this study may have been more strongly influenced by the parental input received at home, where routine

language use predominantly takes place, as opposed to input from media and reading, which provides fewer opportunities for engaging with everyday vocabulary through personal interactions. The other types of input, involving engagement with siblings at home or peers at school, also entail some level of interaction. However, it appears that parental input holds a special status as a primary source of L1 input within the context of meaningful personal interactions, significantly affecting the children's L1 lexical abilities.

In contrast to the L1 task, none of the input variables made significant contributions to the outcomes of the L2 task. Instead, L2 proficiency emerged as the most influential predictor of L2 lexical retrieval accuracy and speed. The prominence of L2 proficiency indicates its close association with L2 experience, suggesting that L2 lexical retrieval abilities are more influenced by overall language experience rather than by specific input sources. This significant effect of L2 proficiency is consistent with the core principles of the weaker links hypothesis (Gollan et al., 2008), which posits that increased usage of L2 words enhances their activation levels, thereby facilitating lexical access and retrieval. Our findings are also compatible with the revised hierarchical model (Kroll & Stewart, 1994). According to this model, bilinguals' mental lexicon comprises interconnected forms and meanings between L1 and L2 words, enabling a direct access from the word form to its meaning in both languages. In the early stages of L2 learning, the process of accessing semantic information from L2 is mediated by L1, leading to slower and less accurate L2 retrieval. However, as L2 proficiency increases, the connections between L2 word forms and meanings become stronger, allowing direct access to semantic information of L2 words without L1 mediation. Consistent with this theoretical framework, the higher L2 proficiency observed in our bilingual participants in this study suggests the establishment of robust connections between L2 word forms and meanings, contributing to more accurate and faster retrieval of L2 words. This finding highlights the intricate nature of bilingual lexical processing, wherein L2 proficiency and overall language experience play a crucial role in shaping the lexical abilities of bilingual children in their L2.

Another notable observation from our study is the absence of any significant contribution of sibling input to the children's lexical retrieval abilities in both L1 and L2 tasks. This finding stands in contrast to the outcomes reported by Sorenson Duncan and Paradis (2020a), where sibling input, particularly from older siblings, played a prominent role in enhancing bilingual children's L2 lexical and morphological skills. The discrepancy in findings might be attributed to particular

characteristics of the sibling interactions experienced by our participants. As indicated in Table 2, the mean rating of sibling input was higher in the L1 compared to the L2 for our participants, suggesting that on average, they engaged more frequently in their heritage language when interacting with their siblings. Given that the participants had spent only 2–3 years in Korea and presumably retained their heritage language proficiency, it is reasonable to assume that their interactions with siblings involved either their L1 or language mixing (or code-switching), which is a common language use practice observed among children in immigrant communities (Köpke & Schmid, 2004). The use of inconsistent language during sibling interactions may have limited the impact of sibling input on both L1 and L2 lexical retrieval.

Furthermore, the variability in the ratings of sibling input, as reflected by the relatively large standard deviations for both L1 and L2, could contribute to the lack of a significant effect of sibling input on L1 and L2 lexical abilities. This variability suggests that participants had varying degrees of sibling interaction in each language. This variability is likely due to some missing data, particularly among participants without siblings. Out of our participant sample of 68 children, 10 participants did not have siblings and therefore did not contribute data regarding sibling interactions. Those missing data points could have impacted the overall statistical power, obscuring any potential relationship between sibling input and lexical retrieval abilities.

However, the questionnaire used in this study did not collect specific information about older versus younger siblings, which limits the direct comparison of our findings with those of Sorenson Duncan and Paradis (2020a). In the absence of detailed data on the role of older siblings, it is difficult to draw definitive conclusions about the impact of sibling input. To address these limitations and to more precisely capture the role of sibling input, further research should consider expanding the sample size to include more participants with siblings and collecting detailed information on sibling characteristics, particularly the role of older and younger siblings. Additionally, involving participants whose siblings provide substantial L2 input could help clarify the specific impact of sibling interactions on bilingual lexical abilities, both in the L1 and L2 tasks.

Combining the results from both L1 and L2 tasks, our findings suggest that the improved speed and accuracy in retrieving of L2 words due to increased L2 use may come with a tradeoff involving fewer opportunities for L1 usage, which could result in slower and less accurate retrieval of L1 words. This outcome aligns with a substantial body of research demonstrating that prolonged exposure to an L2 not

only fosters L2 proficiency but also leads to diminished skills in L1 processing among bilingual immigrants (e.g., Hopp & Schmid, 2013; Isurin, 2007; Köpke, 2007; Montrul, 2010). This trend resonates with the principles of the weaker links hypothesis (Gollan et al., 2008), which posits that recent and frequent L2 use helps bilinguals establish a robust L2 mental lexicon, yet it may simultaneously constrain access to L1 words. Such a phenomenon seems to be reflected in the task outcomes of our participants. The distribution of language experience across their two languages might have resulted in reduced use of their L1 and increased use of their L2, potentially influencing their performance in the L1 and L2 HALA tasks. The participants' enhanced lexical ability in the L2, coupled with reduced access to their L1 lexicon, could serve as an early indication of a shift in their language dominance from the L1 to the L2 (e.g., Gathercole & Thomas, 2009). Further research is required to explore the longitudinal aspect of this phenomenon to obtain a deeper understanding of how language experience and proficiency evolving over time shape bilinguals' lexical abilities across different linguistic contexts.

Finally, we acknowledge some limitations of the study. First, previous research has investigated various learner-external factors, such as the socioeconomic status of the family (e.g., De Houwer, 2007; Prevoo et al., 2014), parents' education levels (e.g., Sorenson Duncan & Paradis, 2020b), and languages spoken at home other than the participants' L1 and L2 (e.g., Unsworth et al., 2019). Further investigation is necessary to determine whether these factors interact with the effects of learner-related variables and diverse sources of input to impact bilinguals' lexical abilities. Second, our analyses might not have fully captured the effect of cross-linguistic differences. The two language groups, Chinese-L1 and Russian-L1 children, exhibited significant differences in several variables, including age, length of stay in Korea, and Korean proficiency. Our regression models including the L1 factor demonstrated a reliable contribution to the accuracy of L2 word retrieval, but not to the outcomes of the L1 task. However, the null effect of participants' L1 membership on L1 lexical retrieval may not necessarily imply the absence of a group effect, especially given the relatively small sample size of 34 children in each group. Future research should consider increasing the sample size to achieve sufficient statistical power for detecting potential effects associated with language group differences. Moreover, it is necessary to examine the interaction effects between various variables that might influence L1 and L2 lexical retrieval and speed. For example, in this study, the variables under L1 membership, such as age and length of residence in Korea, can be treated as continuous variables to investigate how they

interact with different types of input and influence L1 and L2 lexical retrieval and speed. Using other statistical mothods that can identify interactions between variables will allow us to see the interaction clearly. This would be a meaningful follow-up study that could deepen the understanding of the bilingual children's lexical retrieval abilities.

Notwithstanding these limitations, the outcomes of the current study highlight the significant roles of parental input and L2 proficiency in predicting bilingual children's lexical retrieval abilities in their L1 and L2, respectively. These results suggest that both the input type and overall quantity of input make significant contributions to shaping bilinguals lexical skills. The study's findings shed light on the associations between input sources, proficiency, and lexical retrieval abilities in young bilinguals. Further research should involve a wider variety of factors, including more learner-internal and -external variables, as well as including participants in diverse learning contexts, to advance our understanding of the factors underlying bilingual children's lexical abilities.

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