THE ROLE OF INPUT QUANTITY AND QUALITY IN THE DEVELOPING LANGUAGE SKILLS OF DUTCH - GREEK BILINGUAL CHILDREN

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Abstract

The language development of a child depends both on the quality and the quantity of their language exposure. While many studies have examined bilingual language development in relation to the quality and the quantity of input, there are still some aspects that have not been explored in detail. Thus, the aim of this study was to fill in some of those gaps by examining how cumulative exposure, input of older siblings and parental language mixing affect the language development of Dutch-Greek 16 to 30-months-old bilingual children. Three parental questionnaires (CDI, BiLEC and Language Mixing Scale) were used to answer this study's research questions. The results of the current study showed that cumulative exposure is a significant predictor of children's vocabulary and grammatical development in both languages. Furthermore, this study showed that older siblings' input influences not only the language development of bilingual children in their societal language but also in their heritage language mainly in families where both parents are native speakers of the minority language, showing that older siblings are valuable sources and important agents of language input and use in bilingual homes. As far as the parental language mixing is concerned, the results of this study further promote the existing literature by showing that not only maternal and paternal language mixing are differently related to the language development of bilingual children, but also that the effect of language mixing depends on the addressee's proficiency, as well as in the context and in the way in which it is used. In conclusion, this study has theoretical implications by expanding previous findings, as well as pedagogical ones promoting more adequate parental language input strategies through a better understanding of the relationship between input and bilingual language development.

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BiLEC	Bilingual Language Experience Calculator
CDI	MacArthur-Bates Communicative Development Inventory
GED	General Educational Development
MLU3	Mean Length of the three longest Utterances
PPVT	Peabody Picture Vocabulary Test
SES	Socio Economic Status
SPSS	Statistical Package for the Social Sciences

Chapter 1
Introduction

Bilingual language development has gained a lot of interest over the past few years and many studies have focused on the similarities and/or the differences between monolingual and bilingual language development (e.g., Petitto & Kovelman, 2003; Pearson, Fernandez & Oller, 1993; Marchman, Fernald, & Hurtado, 2010; Patterson, 2004). Language acquisition is not homogeneous though, but it precedes in a different way across various environments (Genesee, 2006). In bilingual environments, variability is prevalent and many factors have been claimed to affect the language development of bilingual children (Hoff, 2006). One of those factors is the exposure that children have in their two (or more) languages.

Numerous studies have investigated and explored the role of exposure in the language development of bilingual children (e.g., Hoff et al., 2012; Place & Hoff, 2011; 2016; De Houwer, 2014; Gathercole & Thomas, 2009). In those studies, both the quantity (e.g., Unsworth, 2013b; Gathercole & Hoff, 2007; De Houwer, 2009) and the quality of input (e.g., Jia and Fuse, 2007; Paradis, 2011; Byers-Heinlein, 2013) have been found to be significant factors affecting language development. However, while there are many studies examining their role and high lightening their importance in bilingual language development, there are still some aspects of language input that either have not been investigated systematically (e.g., the role and the influence of cumulative length of exposure, as well as the influence of older siblings), or whose role remains unanswered and unspecified due to previous studies' contradicting and conflicting results (e.g., the role of the mixed language input). Therefore, in this study, we seek to contribute in the existing literature by filling in these gaps and consequently to provide a more complete and detailed picture of the factors that are related and influence the language development of bilinguals.

According to the above, the current study is organized as follows. Chapter 1 contains a detailed literature review regarding the aspects of input that influence bilingual language development, the gaps of the existing literature and how this study aimed to fill them. In chapter 2, the methodology that was used is described and precisely, information about the participants, the materials, the procedure and the analysis are

presented. Chapter 3 presents the results of this study, as well as the follow-up studies that were conducted and Chapter 4 includes the discussion of the results, how these results fit in the existing literature, the contribution and the limitations of this study, as well as ideas for future studies. Finally, in chapter 5, the conclusions of the current study are presented.

1.1. Literature Review

There are a large number of children growing and being raised in bilingual environments and families. One characteristic feature of bilingual language development is variability, which arises from the significant heterogeneity that exists in the bilingual population. Precisely, bilingual children form not just one, but various populations, as they differentiate in many domains like the age of onset of bilingualism, the amount of exposure, the constellation of their families, the status of their minority and majority languages and the circumstances and conditions in which they are exposed to these languages (like type of education (bilingual or monolingual, immersion), parental language strategies) (Genesee, 2006). It is worth mentioning that variability exists not only on the output of children in their languages (two or more), but also in the way that children acquire a language (McCardle & Hoff, 2006). Language exposure is an essential factor that contributes to that variability (Hoff, 2006). Therefore, in this section, we will explore the relation between bilingual language development and language exposure.

1.1.1. Comparison between monolingual and bilingual language development

Many studies have examined the language development of bilingual children compared to monolingual ones and there is disagreement in the literature on what, how and when there are differences between the language development of bilingual and monolingual children. On the one hand, some studies (Kovacs & Mehler, 2009; Werker & Byers-Heinlein, 2008; Petitto & Kovelman, 2003; Petitto, Katerelos, Levy, Gauna, Tetrealt & Ferraroi, 2001) have shown that bilingual children can distinguish their two (or more) languages from infancy, acquire two phonological systems, two grammars and two vocabularies and also can reach basic milestones at the same age as monolinguals. One study goes even a step further claiming that the vocabulary development of bilinguals

is within the normal range as of monolingual children in each of their languages (Pearson, Fernandez & Oller, 1993). On the other hand, there are studies (Marchman, Fernald, & Hurtado, 2010; Patterson, 2004; Pearson, Fernández, & Oller, 1993; Hoff, Core, Place, Rumiche, Señor, Parra, 2012) showing that the scores of bilingual children are lower than the monolinguals. It is worth mentioning that recent evidence in the field reports that these noticed differences in the rate at which children acquire the two languages are mostly quantitative and, in some degree, qualitative (Unsworth, 2013a).

The disagreement in the literature on whether bilingual children develop language at the same pace as monolingual children, it has been focused mainly on vocabulary and morphosyntax. Regarding bilingual vocabulary development, many studies have shown that bilingual children have smaller vocabularies than same-aged monolinguals (Bialystok & Feng, 2011; Marchman, Fernald & Hurtado, 2010; Bialystok, Luk, Peets & Yang, 2010; Vagh, Pan & Mancilla-Martinez, 2009; Catani et al., 2014; Thordardottir, Rothenberg, Rivard & Naves, 2006), while other studies support that there are no differences between bilingual and monolingual children when both of their vocabularies are measured (Patterson, 1998; Hoff, Core, Place, Rumiche, Señor & Parra, 2012; Pearson & Fernández, 1994). Additionally, some studies are claiming that the bilinguals' total vocabulary (including words from both languages) is larger than the total vocabulary of monolingual children (Pearson et al., 1993).

As far as the development of morphosyntax is concerned, a variety of studies suggest that, bilinguals and monolinguals follow the same developmental pace at least in one of their two (or more) languages and even sometimes in both of them (Bhatia & Ritchie, 1999; Nicoladis & Genesee, 1997; De Houwer, 2005; Genesee & Nicoladis, 2007; Hammer & Rodríguez, 2010; Hoff et al., 2012). Precisely, studies have shown that bilinguals reach basic milestones like production of first words and first word combinations at similar age with monolinguals (Petitto et al., 2001; Petitto & Kovelman, 2003; Genesee & Nicoladis, 2007) as well as that the longest utterances that bilingual children produce are equally comparable with those of monolinguals, providing evidence that bilingual children are in the normal developmental range (Paradis & Genesee, 1996).

It has been claimed that the reason for this existing difference between the development of vocabulary and morphosyntax is that bilinguals' vocabulary development is more

dependent on the input that children hear compared to the development of morphosyntax (Oller, Pearson & Cobo-Lewis, 2007; Paradis & Genesee, 1996). However, various studies have shown that amount of exposure has significant influence not only on vocabulary (Huttenlocher, Haight, Bryk, Seltzer, & Lyons, 1991; Thordardottir, 2011; Pearson, 2007), but also on grammar, for both bilinguals and monolinguals (Pearson, Fernandez, Lewedeg & Oller, 1997; Gathercole, 2002; Oller & Eilers, 2002; Gathercole & Thomas, 2009).

1.1.2. On the relation between bilingual language development and language exposure

It is well-known that the language development of a child depends both on the quality and the quantity of their language exposure (Hoff, 2006). It is, also, generally agreed that bilingual children in comparison with monolingual ones hear and receive less input per language and that the number of people from whom they receive input can vary, as they often receive input for each of their languages from different sources (Hoff, 2006). Additionally, bilingual children may receive input from both native and nonnative speakers (Fernald, 2006). Thus, it is possible, that exposure may be more in one language than the other but also that bilingual children may have balanced exposure in their two or more languages (De Houwer, 2009; De Houwer, 2014). Moreover, it is possible bilinguals' parents to use both languages in the same utterance when addressing to their children and as a consequence, bilingual children to receive mixed input (Pearson, 2008). It is assumed, therefore, that in children exposed to more than one language, the growth of development in each language will be different as a result of the quality and the amount of exposure on these languages (Place & Hoff, 2011). A vast body of literature has investigated the relations between bilingual language development and language exposure.

1.1.3. Quantity of input

The majority of studies examining the relations between the input that bilingual children receive and their language development focuses mainly on the quantity of input investigating the relation of the relative amount of exposure in each language on the bilingual children's development of each language (Unsworth, 2016). Numerous

studies (Pearson, Fernández, Ledeweg, & Oller, 1997; Oller & Eilers, 2002; Gathercole & Hoff, 2007; David & Wei, 2008; De Houwer, 2009; Gathercole & Thomas, 2009; Scheele, Leseman, & Mayo, 2010; Parra, Hoff, & Core, 2011; Place & Hoff, 2011; Hoff, Core, Place, Rumiche, Señor, & Parra, 2012) have shown that amount of exposure is a significant predictor in the rate of development in bilinguals' two (or more) languages.

Current and Cumulative exposure

Amount of exposure can be examined at current time (Hoff, Core, Place, Rumiche, Señor, & Parra, 2012; Place & Hoff, 2016; Grüter, Hurtado, Marchman & Fernald, 2014; De Houwer, 2014) or cumulatively (exposure over time). While there are various studies (De Houwer, 2009; Place & Hoff, 2011; Chondrogianni & Marinis, 2011; Gathercole & Thomas, 2009; Bedore et al., 2012) examining current exposure, there are only three studies examining cumulative exposure (Unsworth, 2013b; Gutiérrez-Clellen & Kreiter, 2003; Thordardottir, 2011). Amount of current exposure is an important predictor of the language development of a bilingual child (Bedore, Peña, Summers, Boerger, Resendiz, Greene, Gillam, 2012), but this also true for cumulative exposure, bearing in mind that the amount and the quality of exposure can vary in the same child over time. More specifically, the amount of exposure that a child receives during one year is quite different (e.g., amount and nativelikeness of people providing input) than that of a monolingual child. Thus, cumulative length of exposure can be a very important factor affecting the language development of a bilingual child and every study should include it as variable (Unsworth, 2013b), as it will provide an accurate estimation of a child's exposure to their languages over time (Unsworth, Argyri, Cornips, Hulk, Sorace, & Tsimpli, 2014). Typically, exposure over time was calculated by the length of exposure, but nowadays this is not preferred, as in some cases (e.g., simultaneous bilinguals) it is the same with the chronological age of a child and thus, it does not provide an accurate estimate of a child's exposure.

The results of the few studies (Gutiérrez-Clellen & Kreiter, 2003; Thordardottir, 2011; Unsworth, 2013b) examining cumulative exposure are important for the research field, as they displayed the importance and the role of cumulative length of exposure in the language development of bilingual children. However, these studies have some

limitations. Gutiérrez-Clellen and Kreiter (2003) were the first ones that examined cumulative amount of exposure and its relationship with the grammatical performance of English-Spanish bilingual children aged 7 to 9 years old, through parental and teacher reports. While this was a significant step in bilingual research, Gutiérrez-Clellen and Kreiter (2003) examined successive bilinguals in their study and not simultaneous ones and also, they examined and analyzed cumulative exposure together with other variables and not alone. Thus, the influence of cumulative exposure on bilingual language development was needed further investigation. The study of Thordardottir (2011) came to fill in these gaps. She examined 5-years-old simultaneous English-French bilinguals and she investigated the relationship between bilingual language development and amount of exposure by controlling other confound variables (e.g., age, SES and language status) in order to detect the influence of cumulative exposure to the development of each of a bilingual's child languages. She found that cumulative exposure is a strong predictor for language development (as amount of cumulative exposure increased, language scores increased) but she also found that this relationship was not the same for the receptive and the expressive vocabulary, as for receptive vocabulary the relationship was nonlinear, whereas for expressive vocabulary it was linear and very small in comparison with the receptive one. One limitation of this study was that she examined only the vocabulary development of bilingual children and not their grammatical development. Unsworth (2013b) on the other hand filled that gap by examining the role of cumulative exposure in the acquisition of the Dutch gender in English-Dutch bilingual children whose age was from 3 to 17 years old. She found that both current and cumulative exposure contribute to the grammatical development of bilingual children. A limitation of all these studies and thus, a gap in the existing literature is that none of these studies has examined in the same study the role of cumulative exposure in both the vocabulary and grammatical development of bilingual children.

In this study, we aim to examine the influence of cumulative length of exposure in the vocabulary and grammatical development of bilinguals in each of their two languages in order to have a better and more complete picture of a bilingual child's exposure to his languages over time as well as, in order to obtain more accurate results regarding the relationship between amount of exposure and language development. Also, we aim to expand the results of the previous studies that have examined cumulative exposure

by replicating them in bilingual children with different language backgrounds (Dutch and Greek) and by using a smaller age range. The reason for this latter choice is based on the claim of Gathercole (2002) that amount of cumulative exposure may play a more important role in younger age and more specifically in the early years of a bilingual's life. Thus, we aim to investigate what is the role of cumulative exposure in the early years of a bilingual child and also, to indirectly test whether cumulative exposure affects the language development of bilinguals in a different way than current amount of exposure.

The impact of home language and older siblings

Many studies (Place & Hoff, 2011; Singh, 2008; Gathercole & Thomas, 2009; Gollan, Starr & Ferreira, 2015) have examined the number of different people providing input and its impact on bilinguals' language development, as a different way of looking at input quantity and quality. It has been reported that input provided by many and different speakers is more useful and has more impact than input provided by fewer speakers (Place & Hoff, 2011). Moreover, there is a wide range of studies examining the impact of language use in the house on the developing language skills of children (Oller & Eilers, 2002; Gathercole & Thomas, 2009; Paradis, Nicoladis, Crago, & Genesee, 2011; Hoff, Rumiche, Burridge, Ribot & Welsh, 2014; Quay & Montanari, 2016). Usually, bilingual children are exposed to the heritage language at home, but the degree to which this happens depends on the family constellation (e.g., one or both parents are native speakers of the heritage language). The studies focusing on home language use and family constellation (Oller & Eilers, 2002; Gathercole & Thomas, 2009; Paradis, Nicoladis, Crago, & Genesee, 2011) have shown that the variation in parental language input actually impacts on children's rate of language acquisition. More specifically, it has been claimed that it is most likely children to speak the minority language if both of their parents or at least one of them speaks the minority language at home (Gathercole & Thomas, 2009; Hoff et al., 2014; De Houwer, 2007), especially when children start attending school classes in the majority language (Duursma et al., 2007; Dixon, Zhao, Quiroz, & Shin, 2012).

What it is truly surprising, though, is that compared to parental language use, the role of older siblings has not been examined thoroughly. To my knowledge, only two studies

have examined the role of older siblings on bilingual children's language development (Caldas, 2006; Bridges & Hoff, 2014). Caldas (2006) examined the bilingual development of French-English bilingual children that lived together with older siblings and showed that the language that siblings use when they talk to each other is not always the same as the language that children use when they speak to their parents or with the language that parents use when addressing to their children. More specifically, Caldas (2006) showed that while both parents addressed to their younger children only in French, the older children of the family (who were dominant in English) addressed to their siblings in English. As a result, younger children used English most of the times when addressing their older siblings and not French. Therefore, these results revealed the significant influence of older siblings in the language choice when sibling interact and also the prevalence of the dominant language during sibling interaction. There were however some limitations to the study. First of all, it was a case study examining just one family with three bilingual children (one older and two younger siblings) and as a consequence it is unclear how generalizable these results are, and secondly, it did not directly compare bilingual children with and bilingual children without older siblings in terms of their language development.

Bridges and Hoff (2014) in a largescale study showed that English-Spanish bilingual children who had older siblings attending school received more input at home than children without older siblings and also this found to has positive effect on their language development on the majority language (in this case on English). More specifically, Bridges and Hoff (2014) showed that bilingual children with older siblings were more advanced on the majority language than bilingual children without older siblings due to the fact that older siblings spoke to them in the majority language. These results show us that older siblings are valuable sources of language input, as well as agents of important influence in the bilinguals' language use. Despite the importance of these results, there are some limitations to this study. One of them is that they only examined one type of family constellation, in which the father is a native speaker of English (majority language) and the mother is a native speaker of Spanish (minority language). While in this way, the researchers controlled for homogeneity in their sample, it would be informative to test whether the presence and the input of older sibling in a family where both parents are native speakers of the minority language would have affected their siblings' language development of both the majority and the

minority language in the same way. One more limitation is that it is not clear how dominance was measured and operationalized in this study. More specifically, it is mentioned in the paper that they recruited bilingual children living in Spanish-dominant homes, meaning that most of their exposure at home was in Spanish. What they do not explicitly mention is whether they counted only the current or both the current and the cumulative exposure of the children in their two languages in order to found out in what language they are exposed the most at home.

In the present study, we aim to replicate and to expand the findings of the previous literature regarding the role and the influence of older siblings in the language development of their younger siblings, as well as to fill in some of the existing gaps. Thus, we are going to examine the influence of older siblings by testing bilingual children at the same age, with the same language measurements but with different language backgrounds than previous studies did and also, we are going to examine whether the influence of older siblings is the same across different types of family constellations.

1.1.4. Quality of input

In addition to examining the role of variation in input quantity on bilingual children's language development, a series of studies have also examined the role of variation in input quality. Input quality refers to the type of exposure available to a child (Unsworth et al., in press). More precisely, it refers to the so-called "richness" of input, which includes the different sources from which children receive input (friends, tv, computer, reading books, use of audio-books, sports), whether children hear input from native or non-native speakers, how proficiency of non-native speakers affect the developing language skills of a child and also to language mixing.

Richness of input

Literature has shown that using a variety of different input sources (tv, reading, etc.) is an important predictor of a bilingual child's language development (Paradis, 2011; Jia & Fuse, 2007). For example, Jia and Fuse (2007) examined Chinese/Korean-English bilingual children, while Paradis (2011) examined bilingual children from various L1 language backgrounds (Chinese, Spanish, Arabic, South Asian e.g. Hindi) in order to

found whether input of different sources such as hours playing computer games, number of friends, hours of watching tv and hours of reading books affect the development of the children's second language (in these cases English). Both concluded that the frequency, the duration as well as the density of these activities predicted bilingual children's rate of acquisition in their second language (both for vocabulary and grammar).

One issue that has not been examined thoroughly, but which has gained interest more recently (e.g., Place and Hoff, 2011; Place and Hoff, 2016) is the influence of native and nonnative input on bilingual language development. Bilinguals, unlike monolinguals, it is possible to receive input from both native and non-native speakers (Fernald, 2006). There is some evidence showing that the number of native heritage language speakers is positively correlated with bilingual language development, because parents typically use a larger vocabulary when addressing to their children in their native language in contrast with a language, which is acquired later on in life (Place & Hoff, 2011; Hoff, Coard & Señor, 2013). Other studies also report that input form non-native speakers is less helpful in language development than input from native speakers (Place and Hoff, 2011). However, this is actually matter of degree of non-nativeness with the meaning that the more proficient the non-native speaker, the better the input that a child receives and thus the better its language outcome/development (Paradis, 2011; Chondrogianni & Marinis, 2011; Goldberg, Paradis, & Crago, 2008, Unsworth et al., in press).

Language Mixing

One issue that has not been examined thoroughly, but which is interesting is the language separation or the language mixing in bilingual environments. Various studies (Genesee, 2006; Hoff, 2006; McCardle & Hoff, 2006; Gathercole, 2014; Unsworth, 2013a, 2016) have shown that there is heterogeneity in bilingual environments, and that bilingual children often are raised with different language strategies, such as the one-parent-one-language approach where there is clear language separation and in which each parent speaks to the child with only one of the languages and the mixed approach where both languages are used by both parents (Byers-Heinlein, 2013). Language mixing is the incorporation and combination of words or phrases from two different

languages in the same utterance and it is commonly used among bilinguals either as code switching or as borrowing. Studies examining the effects of mixing language on the language development of bilingual children are limited (Place & Hoff, 2011; Byers-Heinlein, 2013; Place & Hoff, 2016) and the results that they report are somehow conflicting. As a result, little is known regarding the influence of language mixing in bilingual language development and the frequency of language mixing on the input of a bilingual child.

Place and Hoff (2011) wanted to examine the role and the influence of various factors, such as the number of different speakers, the amount of input and the language mixing by parents in the bilingual language development of 25-moths-old Spanish-English bilingual children. They found that both the number of people and the amount of input were significant predictors of the bilinguals' language development. Regarding the parental language mixing, they resulted in null findings. More specifically, they found that language mixing was unrelated to the language development of bilinguals. Despite the significance of these results, as they promote the research in the properties of language exposure that influences the bilingual language development, there are some limitations in the findings concerning the parental language mixing. More specifically, in this study the measure of mixed language input was measured in time blocks and was analyzed as co-occurrence of the two languages in these time blocks and there was not a measure of intra-sentential mixing[1]. However, bearing in mind that intra-sentential mixing is the type of mixing that it has been claimed to be related to children's difficulties in their two languages (Byers-Heinlein, 2009), this is an important limitation.

Byers-Heinlein (2013) aimed to fill that gap and she examined bilingual children with English as one of their languages and one of the following as their second language (Chinese, Spanish, French, Hungarian, Japanese, Korean, Portuguese, Punjabi, Russian, and Vietnamese) and she found a negative correlation between parents' self-reported frequency of mixing and their children's language development. More specifically, she found that higher scores of parents' language mixing within a sentence (incorporation of words from both languages in the same utterance) were related with significantly lower scores in productive vocabulary of bilingual children aged 2 years

[1] Intra-sentential language mixing is the incorporation and combination of words or phrases from two different languages in the same sentence.

and even smaller scores in receptive vocabulary of bilingual children aged 1.5 years. One limitation of this study is that children's vocabulary size in English was measured, but their vocabulary size in their non-English/second language was not measured, because as Byers-Heinlein (2013) mentions in her article there weren't appropriate vocabulary measures in these languages. Therefore, in the current study in order to fill in this gap we are going to measure the effect of mixing language in children's both languages, in order to detect whether language mixing affects one language more than the other.

Place and Hoff (2016) wanted to further examine the reason for the contradicting findings in which the two aforementioned studies (Place & Hoff, 2011; Byers-Heinlein, 2013) resulted. Thus, they examined 30-months-old English-Spanish bilingual children and they measured the language mixing by mothers with both the measures (The Language Diary and the Language Mixing Scale) that were used in the previous studies, as they thought that these could be the reason for the conflicting results. In their study, Place and Hoff (2016) actually replicated the results of both of the previous studies. More specifically, they showed that the language mixing results of the Language Diary measure were not related with any measure of children's language development, while the language mixing results of the Language Mixing Scale were negatively correlated with children's language skills in Spanish. It is worth mentioning that Place and Hoff (2016) in contrast with Byers-Heinlein (2013) did not observe any statistically significant difference in the effects of language mixing on comprehension and production of the two languages and also that the negative effect of language mixing was significantly smaller in Place and Hoff (2016) compared to Byers-Heinlein (2013). According to Place and Hoff (2016), a possible explanation why the results of the two measures (Language Diary and Language Mixing Scale) were different in their study could be a possible error in the transcription of the Language Diary results.

Even though the results of all these studies are significant promoting the research regarding the influence of language mixing in the bilingual language development, there are some limitations. One of them is that in her study Byers-Heinlein (2013) did not examine the vocabulary development of the bilingual children in their non-English language. Furthermore, both Byers-Heinlein (2013) and Place and Hoff (2016) measured and analyzed only the mixed input provided by the mothers and not by the fathers. Bearing in mind, though, that nowadays often children's main caregiver is their

father and not their mother, we believe that it is worth examining whether the language mixing provided by fathers affects the language development of bilinguals in the same way as maternal language mixing. Thus, filling the gaps of the previous studies, in this study we are going to examine the influence of mixed language input provided by both parents on the language development of bilingual children in both languages, for both comprehension and production and by using the Byers-Heinlein mixing questionnaire. The reasons for the measurement choice are explained thoroughly in the Method section.

To summarize, a vast majority of studies has shown that there is a strong relation between bilingual language development and language exposure (Hoff, 2006). The quantity of input and mainly the current amount of exposure has been examined thoroughly in the literature and has been showed to be a strong predictor of bilingual language development (Hoff et al., 2012; Place & Hoff, 2016; Grüter et al., 2014; De Houwer, 2014). In contrast, the role and the influence of cumulative length of exposure has been investigated only in few studies (Gutiérrez-Clellen & Kreiter, 2003; Thordardottir, 2011; Unsworth, 2013b), which have examined the role of cumulative exposure either on the vocabulary or on grammatical development of the bilinguals. Thus, the influence of cumulative exposure in both the vocabulary and the grammatical development has not yet been examined in the same study and this one of the gaps that the current study aims to fill in. Moreover, while various studies have examined the role of parental language input in bilingual development (Gathercole & Thomas, 2009; Paradis et al., 2011; Hoff et al., 2014; Quay & Montanari, 2016), the influence of older siblings has been examined either on case studies (Caldas, 2006) or in studies (Bridges and Hoff, 2014) testing the influence of older siblings in a specific type of family constellation. Therefore, in this study we aim to replicate the results of the previous studies regarding the influence of older siblings in different language population and with different family constellations. As far as the quality of input and its relationship with the language development of bilinguals is concerned, while there are some studies (Paradis, 2011; Jia & Fuse, 2007) that have examined some aspects of input quality, the role of the mixed language input has not been examined thoroughly and remains a bit unanswered due to the conflicting results and the limitations (only one of the languages or only maternal mixed input has been examined) of the previous studies (Place & Hoff,

2011; 2016; Byers-Heinlein, 2013) and that is the reason why in this study we aim to explore its role on bilingual language development.

1.2. Research Questions

The aims of this study are to replicate and expand the results of previous studies by examining the role of cumulative exposure, the role of older siblings and the role of language mixing in bilingual language development. More specifically, we aim to investigate the relation between these three aspects of exposure and the developing language skills of Greek-Dutch bilingual children aged 16 to 30 months old. It is worth mentioning that this language background (Dutch and Greek) and this age range (16-30 months) have not been examined thoroughly in the literature, as the majority of the previous studies has examined older (at least 30-months-old) English - Spanish/French/Dutch bilingual children. By testing this age range, we want to test whether cumulative and current amount of exposure differentiate in the way that affect the language development in the early years of a bilingual child and also to reproduce and further elaborate the results of previous studies regarding language mixing and the influence of older siblings in younger bilingual children.

The **research questions** are as follows:

1) To what extent is cumulative length of exposure related to the vocabulary and grammatical development of bilingual children?
2) To what extent is the input of older siblings related to the language development of bilingual children and does its role differentiate depending on the family constellation?
3) To what extent is parental language mixing related to the language development of bilingual children?
4) Do cumulative length of exposure, input from older siblings, and parental language mixing affect language comprehension and language production to the same extent?

1.3. Hypotheses

Regarding the effect of amount of exposure and more specifically the effect of cumulative exposure to the bilingual language development, we expect that when

bilingual children have heard more input over time their language development will be more advanced than children who have heard less input over time. That is, if most of a child's language cumulative exposure is in Greek, then their language development in Dutch will be less advanced than in Greek and vice versa if most of a child's cumulative exposure is in Dutch, then their language development in Greek will be less advanced than in Dutch.

Concerning the second research question, we expect that the input from older siblings will be a significant predictor of bilingual language development. Moreover, we expect that amount of exposure by older siblings in each language will be a significant predictor for the development of both the societal and heritage language of their younger siblings. Furthermore, we expect that the influence of older siblings' input in the societal language will be more in houses where both parents are Greek compared to houses where one parent is Dutch and the other is Greek, because as Bridges and Hoff (2014) and Caldas (2006) mention older siblings influence not only the language development of their siblings, but also the language use in bilingual homes.

Regarding the effect of mixing by both parents we expect that either mixed language input will be negatively correlated with the language development of a child, confirming the results of Byers-Heinlein (2013) and Place and Hoff (2016), or that mixed language input will not be related at all with any of the outcome variables, providing support to the null findings that Place and Hoff (2011) reported in their study.

Finally, regarding the influence of cumulative exposure, input of older siblings, as well as the parental mixed input in bilinguals' production and comprehension, we expect that all of them will be significant predictors and that their role on the receptive and productive vocabulary of children will either be the same or different.

To test these hypotheses, we are going to use three different parental questionnaires, the MacArthur-Bates Communicative Development Inventory, Words and Sentences in Greek and Dutch (Markodimitraki, Papailiou, Politimou, & Franco, 2015; Zink & Lejaegere, 2002), the Bilingual Language Experience Calculator, BiLEC (Unsworth, 2013b) and the Language Mixing Scale (Byers-Heinlein, 2013).

Chapter 2
Method

2.1. Participants

The participants were 33[2] Dutch-Greek bilingual children aged between 16 to 30-months-old, 12 of them were boys and 21 were girls. Of the 33 participants, 30 were raised in the Netherlands, while three of them were raised in Belgium. Recruitment was conducted through the website and the Facebook page of the 2in1 project of Radboud University, Facebook pages of Greek people living in the Netherlands or in Belgium and of Dutch people living in Greece, but also by word of mouth. The reasons why 16 to 30 months old children were chosen for this study were numerous. First of all, we wanted to test the role of cumulative exposure in young aged bilingual children, testing whether the claim of Gathercole (2002) that cumulative exposure may play a more important role in the early years of a bilingual's life is valid and also, we wanted to examine whether cumulative and current amount of exposure differentiate in the way that affect the early bilingual language development. Additionally, by testing this age range, we aimed to replicate the previous finding of Bridges and Hoff (2014) about the influence of older siblings, as they used children from this age range and lastly, we wanted to shed light on the mixed results concerning language mixing in previous research (Byers-Heinlein, 2013; Place and Hoff, 2011, 2016). As far as the socioeconomic status of the parents is concerned there were 59 caregivers with high SES (college diploma and/or master's or doctoral diploma), while four with middle SES (post-secondary non-tertiary education, short-cycle tertiary education) and four with low SES (high school diploma, or less).

Children with hearing and language problems were excluded from this research. Caregivers reported that their children have been checked and they do not face any hearing or language problems. All children were exposed to both Dutch and Greek to at least some degree from birth, but the systematic exposure in Dutch either through the daycare or an in-house care varied among our participants from the third month to the

[2] At first, we had 34 participants, but one participant was excluded from the final analysis, because his whole environment (father, daycare, older siblings, place of living) was Greek dominant and thus, it was not comparable with the rest participants of our sample.

twentieth month of their lives (see Table 1 for a summary). A total of 25 children attended daycare, while two children had an in-house care and six stayed in home with one of their parents. The daycares and the in-house care were in Dutch. Caregiver estimates of the balance of Dutch and Greek currently used in the house and outside the house were obtained in the context of the parental questionnaire, BiLEC and seven children were equally exposed in both languages, while 11 children were more exposed in Dutch and 15 children were more exposed in Greek. Caregivers also mentioned the constellation of the family and whether there are younger and older siblings and other adults (e.g., grandparents) that live with them in the same house. According to their reports, there were no other adults that lived in the house of any of the families that took part in this study. There were 14 children with older siblings, one child with younger siblings (1-year-old twins) and 18 with no siblings at all. The age of the 14 older siblings varied between 4 and 15 years old, with mean age to be 7.5 years old (see table 1 for a summary). All the older siblings attended Dutch schools.

Table 1: Descriptive information about children

	Frequency (n)
Age of Onset Greek	
From Birth	33
Age of Onset Dutch	
From Birth	16
3 months	3
4 months	1
5 months	1
6 months	3
8 months	1
11 months	3
15 months	1
18 months	2
20 months	2
Age of Older Siblings	
4 years old	1
5 years old	3
6 years old	3
7 years old	2
8 years old	1
9 years old	1
10 years old	1
12 years old	1
15 years old	1

As far as family constellation is concerned, there were 21 families where both parents were native speakers of Greek, nine families where the father was a native speaker of Dutch and the mother a native speaker of Greek, and two families where the mother was the native speaker of Dutch and the father the native speaker of Greek. There was also one family where the mother was a native speaker of Greek and the father native a speaker of Spanish (see Table 2 for a summary). In that family, the child's exposure to Dutch came from the daycare. At the time of testing, 18 of the mothers and 14 of the fathers (almost) exclusively spoke Greek to their child, three mothers and eight fathers (almost) exclusively Dutch, four mothers and four fathers spoke both languages to the child, while nine mothers and six fathers mostly Greek (see Table 2 for a summary). Also, caregivers provided a self-report estimation of their language proficiency for both perception and production in both languages, Greek and Dutch (see Table 2 for an overview).

Table 2: Descriptive information about parents

	Frequency (n)
Non-Native Parents' Proficiency in Dutch [a]	
Fairly Fluent [b]	22
Quite Fluent [c]	21
Very/Native-like Fluent [d]	11
Non-Native Parents' Proficiency in Greek [a]	
Fairly Fluent [b]	10
Quite Fluent [c]	2
Very/Native-like Fluent [d]	0
Family Constellation	
Both Parents Greek and Older Siblings	7
Both Parents Greek, but no Older Siblings	13
One Parent Greek, One Parent Dutch and Older Siblings	7
One Parent Greek, One Parent Dutch, but no Older Siblings	6
Parental language use towards children	
(Almost) Exclusively Dutch	11
(Almost) Exclusively Greek	32
(Almost) Equally Both Languages	8
Mostly Greek.	15
Current exposure (house and outside house)	
Mostly Greek [e]	15
Equal [f]	7
Mostly Dutch [g]	11

[a] Measured in a 5-point scale. [b] From 1 to 2. [c] From 2.5 to 3.5. [d] From 4 to 5. [e] At least 60% of exposure in Greek. [f] Exposure was between 40-60% in both languages. [g] At least 60% of exposure in Dutch.

2.2. Materials

Parental questionnaires were used to collect information about the parental use of mixing, the children's patterns of language exposure, as well as the children's (receptive and productive) vocabulary and grammatical skills both for the Greek and for the Dutch language.

2.2.1. Language Development Measure - MacArthur-Bates inventories

Caregivers completed the MacArthur-Bates Communicative Development Inventory, Words and Sentences (CDI) in Greek (Markodimitraki, Papailiou, Politimou, & Franco, 2015) and in Dutch (Zink & Lejaegere, 2002). These instruments are parental questionnaires which measure various developing abilities of the children (e.g., vocabulary and grammatical skills) in their early languages. Both of them have been normed on monolingual children, as well as have established high validity in bilingual populations (Fenson, Marchman, Thal, Dale, Reznick & Bates, 2007). The Dutch adaption is designed to examine the language development of children aged between 16 and 30 months old, while the Greek one is designed for children whose age is between 9 and 30 months old. In this study, each measurement was completed by the caregiver who was fluent in the language of the measurement and was aware of the child's language abilities. However, there were 21 families, where neither of the parents was fluent on Dutch. In these cases, parents were kindly asked to request from the child's daycare teacher (or in-house caregiver) to complete the Dutch version of the MacArthur CDI.

The reason why we chose to use these instruments in this study is that they have been shown to be valid and reliable measurements of language development (Fenson, Marchman, Thal, Dale, Reznick & Bates, 2007; Law and Roy, 2008 for review). Of course, as parental questionnaires, they have the limitation that do not provide direct evidence of child's skills in the language but an estimation by the main caregiver. However, correlations have been conducted in various studies (Yurovsky and Frank, 2015; see Chapter 4 of Fenson et al., 2007) between CDI vocabulary scores and direct measures of vocabulary such as the number of different words used in a sample of spontaneous speech or scores of other standardized vocabulary tests (e.g., PPVT) and has been found that their results are comparable. The same is valid also for the

grammatical development and the longest utterances that children produce (Ezeizabarrena and Garcia Fernandez, 2018). The other reason why we chose them, is that CDIs examine both receptive and productive vocabulary skills, as well as the three longest utterances that children produce in each language. In this way, it was possible to us to directly compare the role of exposure in the vocabulary and grammatical development of children in each language.

Each instrument yielded a measure of receptive vocabulary, a measure of productive vocabulary and the mean length of the three longest utterances (MLU3) that the child produces in the target language. However, there were some important differences between these two instruments. More specifically, the Greek adaption did not contain measures of children's grammatical complexity and also contained a smaller number of items in the vocabulary list compared to the Dutch one. More specifically, the Greek version contained 412 items, while the Dutch one 702 items. Thus, the two instruments were not directly comparable (see Appendix for a detailed comparison).

2.2.2. Input measures

The Language Mixing Scale

The Byers-Heinlein Language Mixing Scale is a self-report measurement of caregivers' language mixing frequency and use (Byers-Heinlein, 2013). The questionnaire includes five questions about the frequency with which the caregivers mix the target languages and four items regarding the context in which they mix the two (or more) languages. Caregivers answer the questions regarding frequency of language mixing by showing their degree of agreement to each statement on a 7-point scale (1 very true to 7 not at all true), while in the questions regarding the context of mixing caregivers are instructed to choose as many answers as they want from five options.

The main reason why we chose to use this instrument is that we want to shed light in the contradicting results of the three previous studies (Place & Hoff, 2011; Byers-Heinlein, 2013; Place & Hoff, 2016) examining the relationship between bilingual language development and parental language mixing. One reason that these studies resulted in contradictory results is the usage of different language mixing measures. More specifically, Byers-Heinlein (2013) used the Language Mixing Scale, while Place

and Hoff (2011) used Language Diary-Based measures. While Language Diary-Based measures are broadly used, they have some limitations. Completion requires a large time commitment and consistency of the parents, thus quite often completion rates are low or problems arise regarding the accuracy of data. More specifically, it is often the case that caregivers do not remember to fill in the diary on time and as a result they complete it with inaccurate and incomplete data at a later time. Moreover, there is the possibility the completion of the diary to affect their language behavior towards their children, or to fill in data that they think are more appropriate and socially acceptable. Additionally, there is the possibility an error to occur during the transcriptions of the diaries and some results to be inaccurate (Place and Hoff, 2016). Therefore, on the basis of the above limitations, we believe that the Language Mixing Scale is more adequate for our purpose as it requires less consistency behalf of the parents and thus the possibility of incomplete or missing data is reduced, in contrast with the Language Diary-Based measures.

The Bilingual Language Experience Calculator, BiLEC

BiLEC (Unsworth, 2013b) is a detailed parental questionnaire which measures children's language exposure in the target languages. It contains both qualitative and quantitative measures of language exposure. BiLEC is completed during an interview with the main caregiver, who is kindly requested to answer a series of questions regarding the current and cumulative exposure of their child at home and outside of the house in their child's both languages. More specifically, in the beginning, it contains some general questions regarding the child's name, place and date of birth, the current occupation of the parents and their highest educational level, as well as information about the constellation of the family (i.e., whether there are other siblings or other adults living in the same house). Subsequently, there is a section of questions regarding the current language exposure of the child at home in both languages (e.g., what language do people living in the house use, the amount of Dutch and Greek used by them when addressing to the child, etc.). Additionally, caregivers are asked to indicate how well do they, their partner and the older siblings (if exist) understand and speak the target languages (proficiency level) on a scale from 0 (no fluency) to 5 (native). Furthermore, caregivers are asked to indicate with whom the child spends time during an average day in the week and at the weekend, for how long and the amount of exposure in the two

languages. Besides the current language exposure at home, caregivers are also asked to indicate how much time children spend outside of the house, at the daycare/school and at the out-of-school care, as well as on other activities like watching tv, reading books, using computers and the internet, doing sports and spending time and interacting with friends. For each of all these, caregivers should indicate which languages are used and their proportion.

What is also significant is that not only current exposure of a child in the two languages is examined in this questionnaire, but also cumulative length of exposure or in other words how much exposure a child had over time in the target languages, from his birth till his current age (holidays, exposure by parents, older siblings, other adults, exposure in the daycare/school, etc.). This is really important as bilingual children divide their language exposure between two languages and thus the amount of input that receive is limited compared to a monolingual child. Through cumulative exposure, we have a more precise indication of a child's exposure over time to the under-investigation languages and thus we can reach in more accurate results.

We assume that BiLEC is the most appropriate measure for this study, as it entails information about the interaction between siblings and also calculates automatically the cumulative length of exposure, which are two of our research questions. Moreover, it is it has been used in many studies (Unsworth, 2013a; 2013b; 2014; 2015; 2016; Serratrice & De Cat, under review; Potgieter, 2016; Rodina, & Westergaard, 2017) and it has been showed to be a reliable mean of collecting data about bilingual language exposure.

2.3. Procedure

As a first step of this study and in order to facilitate data collection, I created a digital version of the two CDI questionnaires, as well as of the Language Mixing Scale using Google Forms. The digitalizing of the questionnaires was useful both for the participants and the researcher. Regarding participants' perspective, it was convenient because the questionnaires were administered to them via e-mail and they could complete them at their convenience at their houses. As far as the researcher's perspective is concerned, the online administration minimized the danger of paper not being returned or getting lost and also, the results were immediately delivered to me

after the questionnaires' completion and thus, I could use them as soon as possible for statistical analysis.

Subsequently, I sent via email the consent form to the parents. After the caregivers' agreed to participate in this study, the researcher administered via e-mail the links for the online digital version of the Byers-Heinlein's Language Mixing Questionnaire and the MacArthur-Bates inventories (in Greek and Dutch), as well as providing detailed instructions on how to complete them. The BiLEC was completed via a meeting via Skype or in person, during which I interviewed one of the caregivers about their child's language exposure in the target languages. The duration time of the interview varied between 15-30 minutes depending on how many details parents provided. Data collection lasted about 11 weeks.

2.4. Coding

2.4.1. Answers of Language Mixing Questionnaire

According to Byers-Heinlein's (2013) and Place and Hoff's (2011) procedure, we recoded the answers of the Language Mixing Questionnaire's scale questions from a 1 - 7 scale to a 0 - 6 scale. After the recoding, parental answers were summed and a composite score was yielded which range was from 0 - 30. This procedure occurred for the answers of both parents.

2.4.2. Mean Length of Utterances

In the current study, the grammatical development of bilingual children in Greek was measured only through the MLU3, while their grammatical development in Dutch was measured through the MLU3 and two more tasks (*Woordvormen* and *Zinnen*) that were included in the Dutch CDI. This difference arises from the fact that the Greek CDI did not contain any other measure of grammatical development except of the MLU3.

The mean length of utterances is a broadly used and valid measure of morphosyntactic development (Yip and Matthews, 2006; Meisel, 2011). However, the analysis and the coding of the utterances require consistency behalf of the researcher, in order the results to be accurate. Therefore, in the current study, if a word in another language than the

target one was included in the utterances that parents had completed in the CDIs, then this word was excluded from the final analysis. Furthermore, in this study, MLU3 was measured through morphemes[3] instead of words. Various studies (e.g., Ezeizabarrena & Garcia Fernandez, 2018) have shown that the analysis through morphemes is valid and that in some cases provide more accurate results compared to an MLU3 analysis through words. Morphemes are the basic elements of a language and display both the morphological and syntactical skills of the children. Thus, it is assumed to be more informative to measure the length of a child's utterances in morphemes than in words (see Tables 3 and 4 for an example).

Table 3: Example analysis of MLU in words

	Analysis in words
Dutch Example	En toen kwam er een paarse draak die vliegde weg
Number of words	1 2 3 4 5 6 7 8 9 10
English Translation	And then came there a purple dragon that flew away
Greek Example	Ο παππούς πήγε με τον Παναγιώτη στις κούνιες
Number of words	1 2 3 4 5 6 7 8
English Translation	The grandpa went with Panagiotis to the swings

Table 4: Example analysis of MLU in morphemes

	Analysis in morphemes
Dutch Example	En toen kwam er een paars-e draak die vlieg-de weg
Number of morphemes	1 2 3 4 5 6 7 8 9 10 11 12
English Translation	And then came there a purple dragon that flew away
Greek Example	Ο παππού-ς πήγ-ε με τον Παναγιώτ-η σ-τις κούνι-ες
Number of morphemes	1 2 3 4 5 6 7 8 9 10 11 12 13
English Translation	The grandpa went with Panagiotis to the swings

2.4.3. Measures of Language Development (CDI)

As we mentioned earlier, each CDI instrument yielded a measure of receptive vocabulary, a measure of productive vocabulary and the mean length of the three

[3] A morpheme is a meaningful grammatical unit that cannot be divided in other elements. A morpheme can be either part of a word '-ed' or an entire word by itself e.g. 'and'. For example, in the word ununified, there are three morphemes: un-, unifi- and -ed.

longest utterances (MLU3) that children produce in the target language. However, the Dutch CDI version included two more tasks of grammatical complexity (*Woordvormen* and *Zinnen*). As these two tasks measure the same thing (grammatical development of children) and in order to facilitate the data analysis, we combined them in one variable called *Grammatical Development*. Thus, the measures that accrue from the Greek CDI are Receptive Vocabulary, Productive Vocabulary and MLU3, whereas from the Dutch CDI are Receptive Vocabulary, Productive Vocabulary, Grammatical Development and MLU3.

2.5. Analysis

All the statistical analyses were carried out using SPSS version 25.0 (IBM Corp, 2017), which is a broadly used software package for statistical analysis.

Prior to any further analysis, the data were screened for extreme scores and outliers and it was found that there were not any. Subsequently, we screened the data for normal distribution and checked whether there is some kind of asymmetry (skewness[4] and/or kurtosis[5]). Three of our variables were positively skewed: the Grammatical Development, which is the combined measure of children's grammatical development in the Dutch language, the input provided by mothers in Dutch, and the input provided by mothers in Greek measured through the BiLEC. Furthermore, there was one variable, the children's scores in the receptive vocabulary of the Greek CDI, which was negatively skewed. In order to address this problem, the aforementioned four variables were square-root transformed. After the square-root transformation, variables were no longer skewed and these are the data that were used in the inferential statistics.

Subsequently, in order to examine whether there was any possible confound variable or whether our variables measuring input quantity were related to each other, we performed intercorrelations among them and we found that current and cumulative exposure in each language were related to each other (see Table 5). Thus, we decided

[4] Skewness is an indication of the data's normally distribution, showing whether there is asymmetry in the distribution and more specifically, whether the data are seen in the right side (positive skewness) or in the left side of the distribution (negative skewness).

[5] Kurtosis is another indication of the data's normally distribution, showing whether the tail of the distribution is fatter and the peak is higher than in a normal distribution (leptokurtic) or whether the tail is thinner and the peak is flat than in a normal distribution (platykurtic).

that we will enter only the cumulative exposure as a predictor variable in the regression analyses, as this was our main variable of interest. Moreover, we found that there was a strong correlation between the age of onset in Dutch with both the current and cumulative exposure in the two languages (see Table 5). As we were interested mainly in cumulative exposure and these two variables were correlated, we decided that we should exclude also this variable from the subsequent regression analyses. This decision was made in the basis of previous literature showing that the exposure (age of onset) in one language before the age of 3 does not seem to affect in a different way the language development of bilinguals compared to exposure since birth (Paradis, Genesee, & Crago, 2011).

Table 5: Intercorrelations between input quantity variables

	Current Exposure Dutch	Current Exposure Greek	Cumulative Exposure Dutch	Cumulative Exposure Greek	Age of Onset Dutch
Current Exposure Dutch	1	-.946**	.639**	-.396*	-.515**
Current Exposure Greek		1	-.605**	.432*	.497**
Cumulative Exposure Dutch			1	-.520**	-.671**
Cumulative Exposure Greek				1	.638**
Age of Onset Dutch					1

**Correlation is significant at the 0.01 level (2-tailed). *Correlation is significant at the 0.05 level (2-tailed).

In a next step, in order to establish the extent and direction of any relations between our predictor variables (cumulative exposure in Greek and in Dutch, the input provided by older siblings, as well as the language mixing by parents) and children's language skills, a series of zero-order correlations were conducted.

Our main analysis included seven separate hierarchical regression analyses, one for each of the outcome variables, which were the measures of language development yielded from the CDI (three for Greek, four for Dutch). In the first step of these regression analyses, the gender, the age of the participants, as well as the main caregiver's SES were entered together. This was done in line with the analysis of Place and Hoff (2016) and Byers-Heinlein (2013) and also because these are background

variables that have been claimed to be related to language development, thus we used them as control variables. In the second step of these regression analyses the cumulative exposure in the language of interest was entered, which was the critical predictor of the first research question. In the third step, the language mixing by mother was entered, while in the fourth step the language mixing by father. These two variables were the third research question's critical predictor. In the final step of the regression analyses, the input provided by older siblings was entered, which was the point of interest concerning the second research question. The order according to which the predictor variables were entered is not random, but it aimed to indicate with the most sufficient way the role of language exposure in bilingual language development. It should be mentioned that for all the regression analyses, we checked whether the model fitted our data by controlling and inspecting for any possible outlier and large residuals. Furthermore, each of these regression analyses was checked for multicollinearity between the variables and it was found that the assumption of no collinearity was met. Finally, the assumptions of homoscedasticity and normality were also met.

Except of the seven separate hierarchical regression analyses, our main analysis also included a series of independent t-tests. More specifically, in order to answer the second research question regarding the role of siblings' input in bilingual language development and in order to found out whether there are differences in the language development of children with and without older siblings, we performed seven separate independent t-tests one for each of the dependent variables between the children who have older siblings and children that do not have older siblings. Moreover, in order to further explore whether the influence of the older siblings' input in the language development of their younger siblings is different depending on the family constellation, seven different independent t-tests were performed between children with older siblings living in families where both parents were Greek or living in families where one parent was Dutch and the other was Greek.

Finally, in order the fourth research question to be answered, we examined the contribution of each predictor variable by comparing the r^2 values of the models that had as outcome variable either the productive or the receptive vocabulary, as well as we examined the standardized beta residuals of each predictor.

Chapter 3

Results

3.1. Descriptive Statistics

The mean, the standard deviation, the range, as well as the skewness and kurtosis for the measures of children's language development in their two languages (Greek and Dutch) are presented in Table 6. Analyses were carried out on raw scores or in square-root transformed raw scores (where needed). Furthermore, the mean, the standard deviation as well as the skewness and kurtosis for the predictor variables are presented in Table 7.

Table 6: Descriptive statistics for measures of Dutch and Greek language skills

	Measures of Language Development			
Language	Productive Vocabulary	Receptive Vocabulary	MLU3	Grammatical Development
Greek				
M	179.18	315.67	7.20	
SD	157.75	105.30	6.96	
Range	7-412	41-412	0-28.4	
Skewness (SD)	.285 (.409)	-1.075 (.409)	1.679 (.409)	
Kurtosis (SD)	-1.757 (.798)	.216 (.798)	3.147 (.798)	
N	33	33	33	
Dutch				
M	267.06	432.64	2.85	17.42
SD	255.37	210.34	2.74	22.44
Range	0-686	38-702	0-11.4	0-78
Skewness (SD)	.625 (.409)	-.311 (.409)	1.251 (.409)	.1.482 (.409)
Kurtosis (SD)	-1.248 (.798)	-1.147 (.798)	1.769 (.798)	-1.295 (.798)
N	33	33	33	33

Table 7: Descriptive statistics for independent variables

	Variables					
Descriptive Statistics	SES	Age [a]	Mixing Mother [b]	Mixing Father[b]	Cumulative Exposure Dutch [c]	Cumulative Exposure Greek [c]
M	6.9	24.82	6.03	5.27	0.77	0.75
SD	0.68	4.83	5.67	5.48	0.45	0.43
Skewness (SD)	.111(.409)	-.326(.409)	.591(.409)	.713(.409)	.451(.409)	.765(.409)
Kurtosis (SD)	.111(.798)	-1.440 (.798)	-.822 (.798)	-.545(.798)	-1.055(.798)	-.519 (.798)
N	33	33	33	33	33	33

[a]Age was measured in months. [b] Composite score that varies from 0 to 30. [c] Cumulative exposure was measured in years.

3.2. Relation between Predictor and Outcome Variables

In order to establish the extent and direction of any relations between our predictor variables (cumulative exposure in Greek and in Dutch, the input provided by older siblings, as well as the language mixing by parents) and children's language skills, a series of zero-order correlations were conducted. The results of these zero-order correlations are presented separately for each language in Table 8. More specifically, Table 8 shows us that the age of the participants was significantly positively correlated with all the measures of children's language development in both languages. Moreover, cumulative exposure in each language was significantly positively related with the measures of that language, e.g., cumulative exposure in Dutch with measures of Dutch language development and cumulative exposure in Greek with measures of Greek language development. Finally, the input provided by older siblings was significantly positively related only with the children's language development in Dutch (majority language).

Table 8: Zero-order correlations between predictor and outcome variables

	Outcome Variables			
Predictor Variables	Productive Vocabulary	Receptive vocabulary	MLU3 [a]	Grammatical Development [b]
Greek				
Gender	-.202	-.339	- .201	
SES	-.068	-.058	.016	
Age [c]	.623**	.738**	.550**	
Mixing Mother [d]	.030	.244	.097	
Mixing Father [d]	.096	.177	.192	
Cumulative Exposure Dutch [e]	.120	.213	.021	
Cumulative Exposure Greek [e]	.403*	.426*	.462**	
Older Siblings	.215	.034	.068	
Dutch				
Gender	.113	-.138	.179	.059
SES	-.158	-.134	-.206	-.339
Age [c]	.615**	.607**	.684**	.526**
Mixing Mother [d]	.096	.201	.228	.136
Mixing Father [d]	.013	.134	.187	.006
Cumulative Exposure Dutch [e]	.760**	.651**	.770**	.737**
Cumulative Exposure Greek [e]	-.157	-.067	-.135	-.223
Older Siblings	.654**	.585**	.426**	.584**

[a] The Greek MLU3 was square-root transformed. [b] Square-root transformed. [c] Measured in months. [d] Composite score that varies from 0 to 30. [e] Cumulative exposure was measured in years. **Correlation is significant at the 0.01 level (two-tailed). * Correlation is significant at the 0.05 level (two-tailed).

Prior to our main analyses and in order to explore this study's participants' language dominance, we performed scatterplots between the measures of language proficiency in both languages with the age of the participants. Children were categorized in three age groups (16-20 months, 21-25 months and 26-30 months old) in line with previous studies (Fenson, Marchman, Thal, Dale, Reznick & Bates, 2007; Jackson-Maldonado, Marchman & Fernald, 2013). The results showed that children in our sample are Dutch-dominant as far as their vocabulary development is concerned, but Greek-dominant regarding their grammatical development (see Figures 1, 2 and 3). It should be noted though, that these results should be taken into account with caution due to the fact that the two CDI versions include different number of items (see Appendix) and thus, they are not directly comparable.

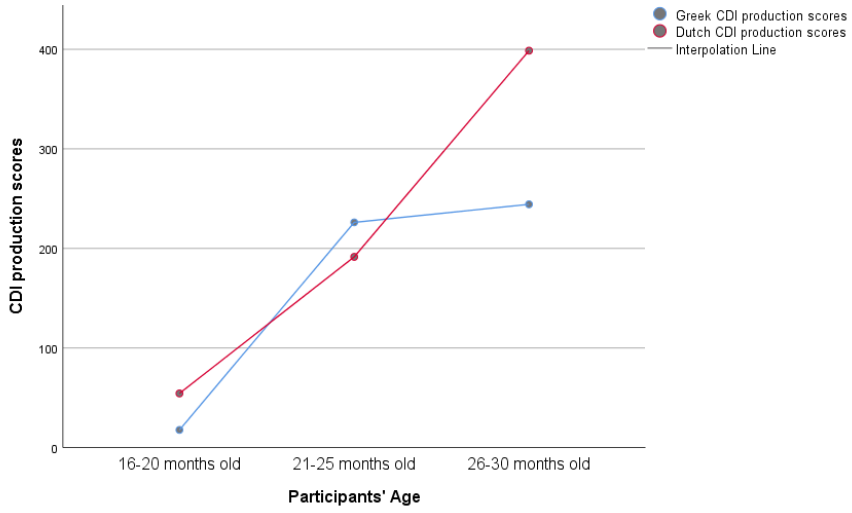

Figure 1: Scatterplot showing participants' dominance regarding their productive vocabulary.

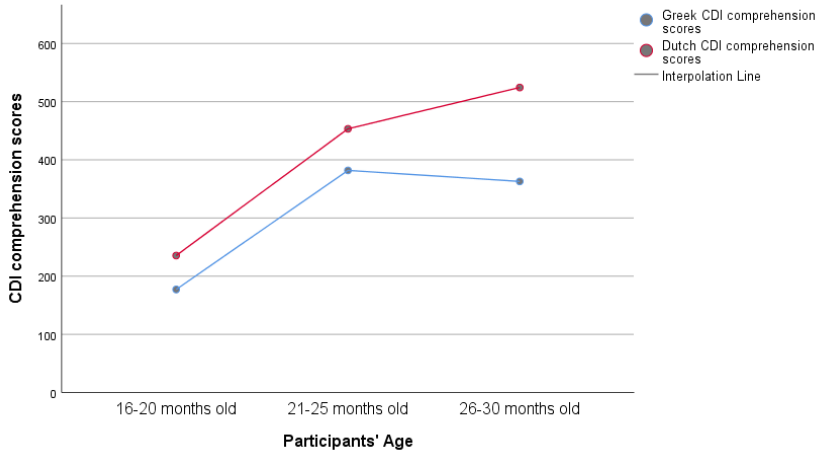

Figure 2: Scatterplot showing participants' dominance regarding their receptive vocabulary.

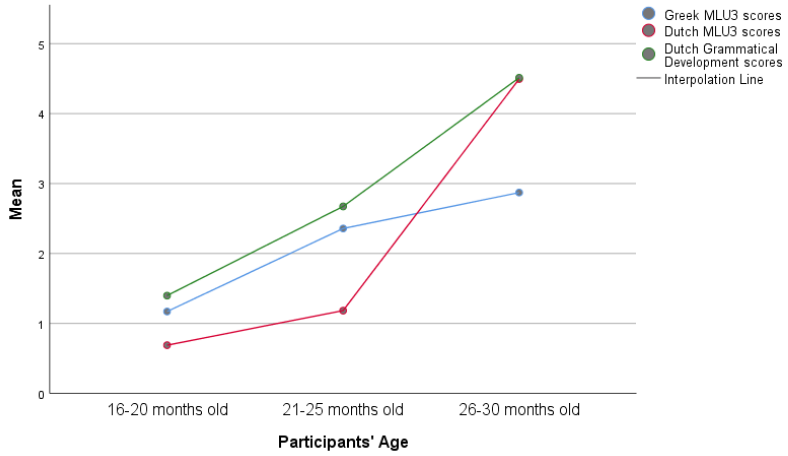

Figure 3: Scatterplot showing participants' dominance regarding their grammatical development.

Furthermore, prior to our main analysis, we examined the intercorrelation between the cumulative exposure in each language and we found that there is a significant relationship between these two variables (Table 5). For this reason and in order to avoid any possible collinearity between our variables, we inserted only one of these variables in the regression analyses, according to the language of interest. More specifically, the cumulative exposure in Greek was entered as a predictor variable in the regression analyses with outcome variables the scores of the Greek language development's measures, while the cumulative exposure in Dutch was entered in the regression analyses with outcome variables the Dutch language measures.

The results of the seven separate hierarchical regression analyses examining the role of language exposure in bilingual children's language skills in Greek and Dutch language are presented in Tables 9 and 10, respectively.

3.2.1. Relation between language exposure measures and children's language skills in Greek.

The results of the regression analyses for children's language skills in Greek are presented in Table 9. In all cases, the model that better fitted in our data was the last one where all predictor variables were entered, explaining 53% of the variance in children's performance in productive vocabulary (R^2 = .525, $F(1, 25) = 5.16$, $p < .05$),

65% of the variance in receptive vocabulary (R^2 = .653, F(1, 25) = 0, p = .99) and 43% in MLU3 (R^2 = .427, F(1, 25) = 2.59, p = .12).

Table 9: Hierarchical multiple regression analyses predicting measures of 16 to 30-months-old Greek-Dutch bilingual children's Greek language skills

Predictor Variables	**Outcome Variables**					
	Productive Vocabulary		Receptive vocabulary		MLU3[a]	
	ΔR^2	β	ΔR^2	β	ΔR^2	β
Step 1	.401***		.599***		.319**	
Gender		-.116		-.238$^+$		-.117
Age [b]		.603***		.701***		.536**
SES		-.031		-.026		.048
Step 2	.015		.003		.047	
Gender		-.083		-.222$^+$		-.059
Age [b]		.543**		.673***		.431*
SES		-.048		-.034		.017
Cumulative Exposure Greek [c]		.145		.068		.253
Step 3	.007		.029		.000	
Gender		-.064		-.259*		-.061
Age [b]		.584**		.663***		.431*
SES		-.078		.026		.019
Cumulative Exposure Greek [c]		.167		.024		.252
Language Mixing Mother [d]		-.095		.188		.006
Step 4	.003		.021		.003	
Gender		-.058		-.243$^+$		-.066
Age [b]		.559**		.690***		.421*
SES		-.091		-.008		.031
Cumulative Exposure Greek [c]		.175		.047		.244
Language Mixing Mother [d]		-.042		.328$^+$		-.045
Language Mixing Father [d]		-.084		-.223		.078
Step 5	.098*		.000		.059	
Gender		-.004		-.244$^+$		-.024
Age [b]		.437*		.691***		.327$^+$
SES		-.005		-.008		.097
Cumulative Exposure Greek [c]		.411*		.046		.426*
Language Mixing Mother [d]		-.143		.329$^+$		-.121
Language Mixing Father [d]		.051		-.224		.182
Older Siblings		.401*		-.001		.310
Total R^2	.525*		.653		.427	

*** p = <.001. ** p = < .01. * p = <.05. $^+$ p = < 1.

[a]Square-root transformed. [b] Measured in months. [c] Cumulative exposure was measured in years. [d] Composite score that varies from 0 to 30.

When productive vocabulary was predicted, age (b = 14.265) was found to be a predictor variable, indicating that an increase in child's age per month, leads to the production of 14 more words. Another significant predictor for productive vocabulary was cumulative exposure in Greek (b = 149.441), which shows that an increase in child's cumulative exposure in the Greek language by one year, leads to a production of 149 more words. One final variable that was found to be significant predictor for the productive vocabulary was older siblings' input (b = 125.912), which indicates that children with older siblings produce more words than children without older siblings.

As far as the receptive vocabulary is concerned, it was found that only age (b = 15.055) was statistically significant predictor for it, indicating that as age increases by one month, the receptive vocabulary of children increases by 15 more words. Moreover, gender (b = -52.523) and language mixing by mother (b = 6.099) were found to be marginally significant predictors. The gender value indicates that there is a difference between boys and girls with regard to their receptive vocabulary, with boys to be more advanced than girls, while maternal language mixing value shows that every time that a mother uses mixed utterances, 6 words are added to a child's vocabulary.

Finally, when the mean length of children's utterances was predicted, cumulative length of exposure in Greek was the only significant predictor (b = 1.356) showing that as cumulative exposure in Greek is increased by one year, the length of utterances that children produce increases by approximately one morpheme. Age (b = 0.094) on the other hand, was found to be a marginally significant predictor. Age value actually shows us that every month, approximately one more morpheme is produced by the children.

In sum, age was found to be a significant predictor for all measures of language development, whereas cumulative exposure in Greek was found to be a significant predictor for the productive vocabulary and the grammatical development of children, but not for their receptive vocabulary. It should be noted, though, that in productive vocabulary, cumulative exposure emerged as a significant predictor only after the entrance of older sibling's input as a variable in the model. In the previous steps, cumulative exposure was not a significant predictor. Therefore, a further investigation between the relationship among Greek productive vocabulary, older siblings' input and cumulative exposure is needed. The socio-economic status of the main caregiver was not related to any measure of language development, whereas boys unexpectedly were found to be more advanced than girls regarding their receptive vocabulary. One more unexpected finding was that language mixing by mother was marginally significant for children's receptive vocabulary. Language mixing by father, on the other hand, was not related to any language measure. Finally, the input provided by older siblings was significantly related only with the measure of children's productive vocabulary.

3.2.2. Relation between language exposure measures and children's language skills in Dutch.

The results of the regression analyses for children's language skills in Dutch are presented in Table 10. In all cases, the model that better fitted our data was again the last one where all predictor variables were entered. More specifically, as far as the productive vocabulary is concerned, the last model explained 86% of the variance (R^2 = .857, F(1, 25) = 23, p < .001), while for the receptive vocabulary 73% of the variance was explained (R^2 = .730, F(1, 25) = 12.16, p < .01). Regarding the MLU3 and the grammatical development, 80% (R^2 = .801, F (1, 25) = 1.41, p = .246) and 74% of the variance (R^2 = .742, F (1, 25) = 3.25, p < .1) was explained respectively.

Table 10: Hierarchical multiple regression analyses predicting measures of 16 to 30-months-old Greek-Dutch bilingual children's Dutch language skills

	Outcome Variables							
Predictor Variables	Productive Vocabulary		Receptive vocabulary		MLU3		Grammatical Development [a]	
	ΔR^2	β	ΔR^2	β	ΔR^2	β	ΔR^2	β
Step 1	.429***		.379**		.562***		.376**	
Gender		.199		-.061		.272*		.106
Age [b]		.638***		.591***		.714***		.519**
SES		-.085		-.093		-.120		-.286$^+$
Step 2	.246***		.180**		.202***		.250***	
Gender		.105		-.140		.188$^+$		.012
Age [b]		.359**		.352*		.462***		.238$^+$
SES		-.006		-.025		-.048		-.206$^+$
Cumulative Exposure Dutch [c]		.580***		.496**		.525***		.584***
Step 3	.000		.023		.016		.000	
Gender		.105		-.168		.169$^+$		.010
Age [b]		.359**		.317*		.438***		.236
SES		-.005		.026		-.014		-.202
Cumulative Exposure Dutch [c]		.580***		.518***		.540***		.586***
Language Mixing Mother [d]		.002		.166		.110		.012
Step 4	.051*		.016		.015		.082**	
Gender		.124		-.157		.180$^+$		.034
Age [b]		.425***		.354*		.475***		.320*
SES		-.054		-.001		-.040		-.264*
Cumulative Exposure Dutch [c]		.559***		.506**		.528***		.559***
Language Mixing Mother [d]		.223		.289		.232$^+$		.292$^+$
Language Mixing Father [d]		-.345*		-.192		-.189		-.436*
Step 5	.131***		.131*		.011		.033$^+$	
Gender		.174*		-.107		.195*		.060
Age [b]		.547***		.475***		.510***		.381**
SES		.050		.103		-.010		-.212$^+$
Cumulative Exposure Dutch [c]		.233*		.181		.433**		.395*
Language Mixing Mother [d]		.110		.176		.199		.235
Language Mixing Father [d]		-.165		-.012		-.137		-.345*
Older Siblings		.493***		.494**		.144		.249$^+$
Total R^2	.857***		.730**		.801		.742$^+$	

*** p = <.001. ** p = < .01. * p = <.05. $^+$ p = < 1.

[a] Square-root transformed. [b] Measured in months. [c] Cumulative exposure was measured in years. [d] Composite score that varies from 0 to 30.

When productive vocabulary was predicted, age (b = 28.901) was found to be a predictor variable indicating that as age increases by one month, 29 extra words are produced by a child. Another significant predictor for productive vocabulary was cumulative exposure in Dutch (b = 133.505), which shows that for each year of exposure in Dutch, 133 extra words are produced by a child. Two more variables that were significant predictors for the productive vocabulary were older siblings' input (b = 251.096) and gender (b = 91.116). More specifically, the gender value indicates that there is a difference between boys and girls with regard to their productive vocabulary, with girls to be more advanced than boys, while the older siblings' input value shows us that children with older siblings produce more words than children without older siblings.

As far as the receptive vocabulary is concerned, age (b = 20.700) and older siblings' input (b = 206.949) were found to be significant predictors for it. Regarding age, its value points out that per month, 20 more words are comprehensible by a child. Older siblings' input value, on the other hand, shows that children with older siblings understand more words than children without older siblings.

When the mean length of children's utterances was predicted, cumulative exposure in Dutch (b = 2.657) was a significant predictor, showing that each year of exposure in Dutch language, approximately two more morphemes are acquired by a child. Furthermore, gender (b = 1.091) and age (b = 0.289) were significant predictors of children's MLU3, indicating that there is a difference between boys and girls, with girls to be more advanced than boys, as well as that an increase in child' age per one month leads to the acquisition of 0.3 more morphemes.

Finally, concerning the grammatical development of children in the Dutch language, it was found that age (b = 0.202) was one more time significant predictor variable showing that for each increase in a child's age per one month, 0.2 more grammatical features are acquired by a child. Moreover, cumulative exposure in Dutch (b = 2.262) was one more time significant predictor indicating that for each year of exposure in Dutch, two extra morphemes are produced by a child. Language mixing by father (b = -0.161) was also one of the significant predictors, which shows that that every time that a father uses mixed utterances, child's grammatical development is reduced. In addition to all that, SES (b = -0.798) and older siblings' input (b = 4.267) were marginally

significant predictors, showing that as SES increases, the language development of children is reduced and that children with older siblings have acquired more grammatical features than children without older siblings.

In sum, the age of the participants was found to be a significant predictor of all the measures of children's language skills, while gender was related with participants' receptive vocabulary and production of utterances. The cumulative exposure in Dutch was significantly related with both measures of children's grammatical development, but only with the productive vocabulary measure. Language mixing by mother was not related with any measure of children's language development, while language mixing by father was significantly negatively related with the grammatical development of children measured through the Dutch CDI. Finally, the input provided by older siblings was significantly positively related with the (productive and receptive) vocabulary measures and marginally related with the grammatical skills measured by the Dutch CDI. One unexpected finding of these regression analyses that it should be mentioned, though, is that the socioeconomic status of the main caregiver found to be marginally negatively related with the grammatical development of children.

3.2.3. Comparison between the language development of children with and without older siblings

In order the role and the influence of the input provided by older siblings in the language development of bilingual children to be further examined, we conducted seven separate independent t-tests one for each outcome variable between the children who have and the children who do not have older siblings. The overall results are presented in Table 11, while a visual representation of the vocabulary development measures in Figure 4 and of the grammatical development measures in Figure 5. The t-tests showed that children with older siblings are more advanced in all the measures of the Dutch language development. Precisely, children with older siblings are more advanced in the productive vocabulary, $t(17.55) = -4.37$, $p = .000$, two tailed, Cohen's $d = 1.61$, the receptive vocabulary, $t(31) = -4.02$, $p = .000$, two tailed, Cohen's $d = 1.43$, the production of longer utterances, $t(17.77) = -2.38$, $p = .028$, two tailed, Cohen's $d = 0.87$, as well as in their grammatical development, $t(19.01) = -3.693$, $p = .002$, two tailed, Cohen's $d = 1.35$.

Table 11: T-test between the language development of with and without older siblings

Outcome Variables	Group	Mean	SD	t	p
Greek productive vocabulary	Without Older Siblings	150.58	135.14	-1.169	.255
	With Older Siblings	218	182.07		
Greek CDI receptive vocabulary	Without Older Siblings	312.68	98,87	-.187	.853
	With Older Siblings	319.71	117.17		
Greek MLU3 [a]	Without Older Siblings	2.23	1.32	-.381	.706
	With Older Siblings	2.42	1.49		
Dutch productive vocabulary	Without Older Siblings	125.79	128.02	-4.374	.000***
	With Older Siblings	458.79	262.82		
Dutch CDI receptive vocabulary	Without Older Siblings	328.63	187.12	-4.016	.000***
	With Older Siblings	573.79	152.18		
Dutch MLU3	Without Older Siblings	1.87	1.67	-2.384	.028*
	With Older Siblings	4.19	3.35		
Dutch Grammatical Development [a]	Without Older Siblings	2.06	1.53	-3.693	.002**
	With Older Siblings	5.04	2.71		

*** p = <.001. ** p = < .01. * p = <.05.

[a] Square-root transformed.

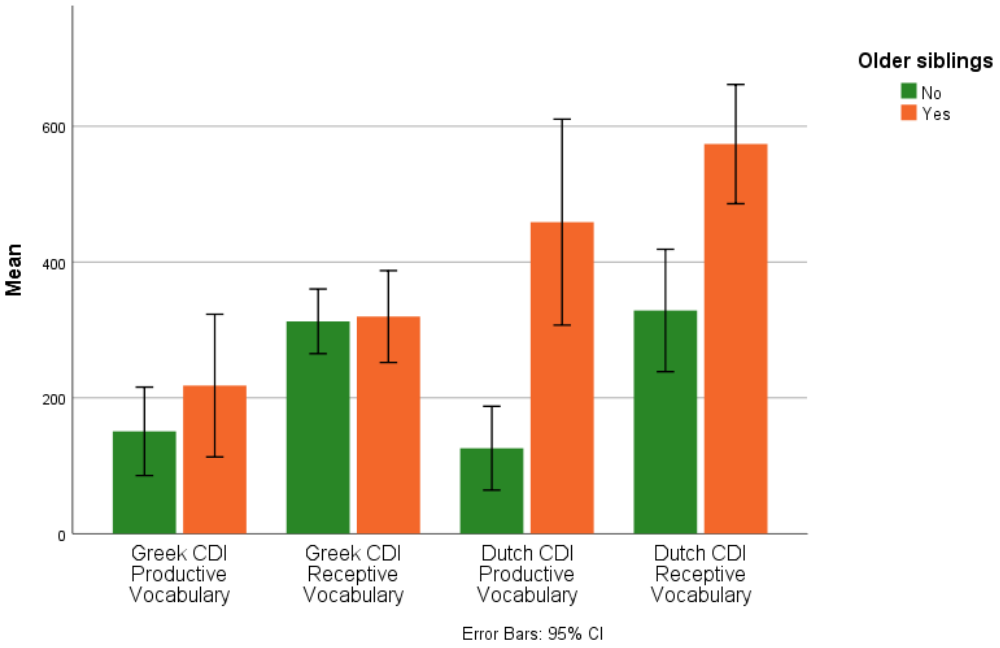

Figure 4: Comparison regarding the vocabulary development of bilingual children with and without older siblings

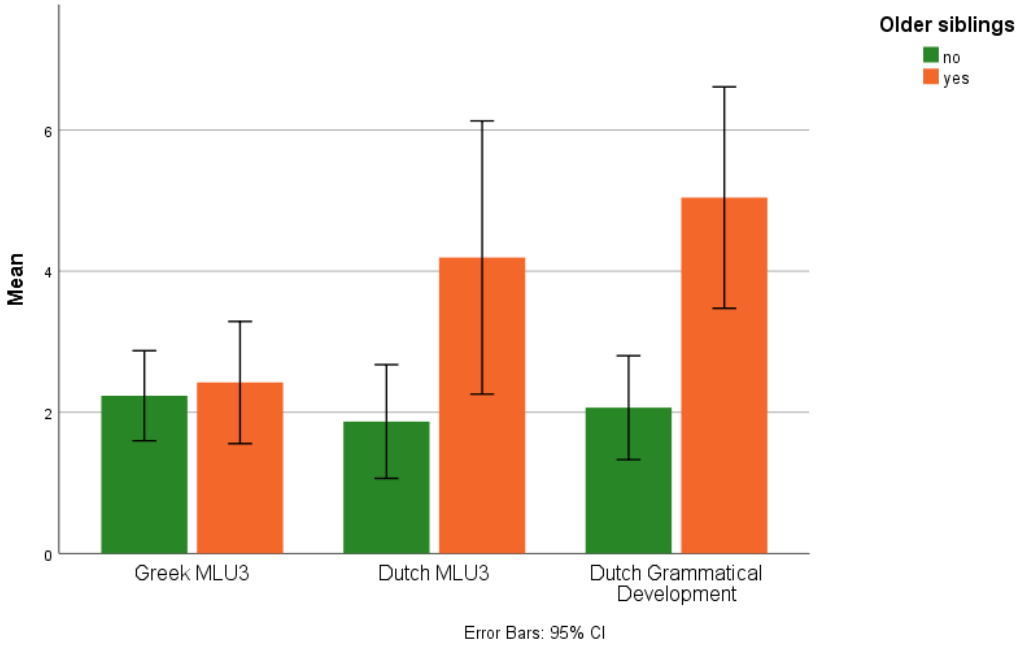

Figure 5: Comparison regarding the grammatical development of bilingual children with and without older siblings

3.2.4. Relation between the language development of children with older siblings and their family constellation

In an attempt to further investigate the role and the influence of older siblings in different family constellations, we carried out seven different independent t-tests, one for each outcome variable between children that have older siblings and their both parents are Greek and with children with older siblings whose one parent is Greek and one parent is Dutch. The overall results are presented in Table 12, while a visual representation of the vocabulary development measures in Figure 6 and of the grammatical development measures in Figure 7. The t-tests showed that there is no difference between the two groups, except of the productive vocabulary measurement in Greek where children with older siblings that were raised in families where both parents are Greek are more advanced compared to children with older siblings raised in families with one Greek and one Dutch parent, $t(12) = 2.45$, $p = .031$, two tailed. Effect size (Cohen's d) was 1.3.

Table 12: T-test between children with older siblings growing up in families where both parents are Greek or one parent is Greek and the other is Dutch

Outcome Variables	Group	Mean	SD	t	p
Greek CDI productive vocabulary	Both Parents Greek	319.29	139.46	2.449	.031*
	One Greek-One Dutch	116.71	168.63		
Greek CDI receptive vocabulary	Both Parents Greek	347.14	135.46	.867	.403
	One Greek-One Dutch	292.29	98.19		
Greek MLU3 [a]	Both Parents Greek	3.02	1.18	1.574	.141
	One Greek-One Dutch	1.82	1.62		
Dutch CDI productive vocabulary	Both Parents Greek	535.43	196.79	1.100	.297
	One Greek-One Dutch	382.14	311.82		
Dutch CDI receptive vocabulary	Both Parents Greek	610	121.19	.883	.395
	One Greek-One Dutch	537.57	180.08		
Dutch MLU3	Both Parents Greek	3.68	2.16	-.550	.596
	One Greek-One Dutch	4.70	4.37		
Dutch Grammatical Development [a]	Both Parents Greek	5	1.97	-.044	.966
	One Greek-One Dutch	5.07	3.47		

* p = <.05. [a] Square-root transformed.

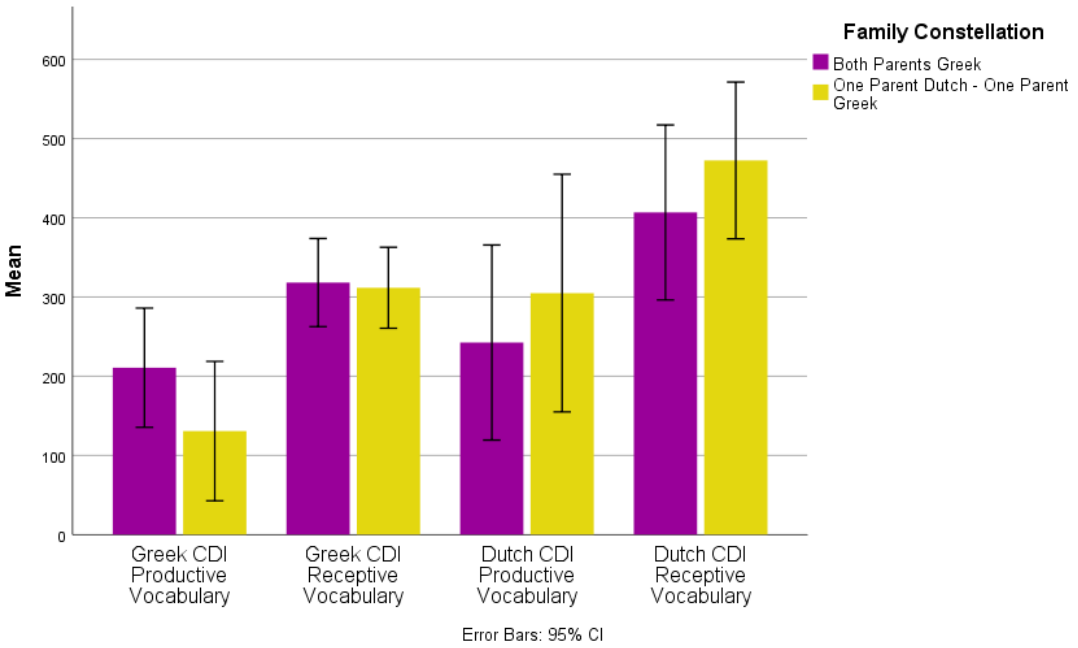

Figure 6: Comparison regarding the vocabulary development of children with older siblings being raised in families with different constellation.

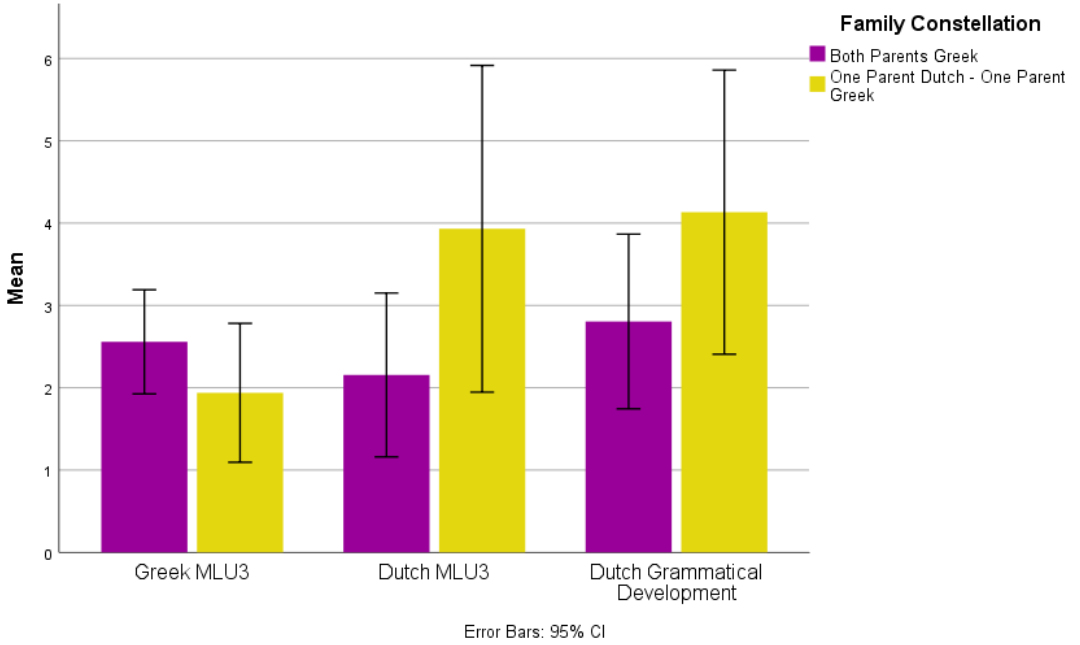

Figure 7: Comparison regarding the grammatical development of children with older siblings being raised in families with different constellation.

3.2.5. Factors affecting production and comprehension

In order to answer this study's fourth research question, whether cumulative exposure, input from older siblings and parental language mixing affect production and comprehension of a language in the same way, we compared the R^2 values of the regression analyses in which the outcome variable was either the productive vocabulary or the receptive vocabulary. The comparison showed that cumulative exposure, parental language mixing and input by older siblings are differently related to the language development of bilinguals. More specifically, while cumulative length of exposure is related to the productive vocabulary of bilinguals in both languages (for Greek [B = .411 p < .05], for Dutch [B = .233 p < .05]), it is not related with their receptive vocabulary in any of the two languages. Maternal language mixing, on the other hand, is related only with the receptive vocabulary of children in the Greek language (B = .329, p < .1), while paternal language mixing is not related with any measure of vocabulary development in none of the two languages. Finally, the input provided by older siblings is related to the productive vocabulary of children in both languages (for Greek [B = .401, p < .05], for Dutch [B = .493, p < .001]), whereas as far as comprehension is concerned, is related only to the receptive vocabulary of children in the Dutch language (B = .494, p < .001).

To summarize, the results of this study showed that participants' age was a significant predictor of all the measures of children's language skills in both languages, whereas gender and primary's caregiver SES were related to some of them. Cumulative exposure was found to be a significant predictor of children's productive vocabulary, as well as of both measures of grammatical development, but it was not significant predictor of their receptive vocabulary. Language mixing by mother was not related with any measure of children's language development in Dutch, but unexpectedly it was a marginally significant predictor of children's receptive vocabulary in Greek language. On the other hand, language mixing by father was not related to any measure of Greek language development, but it was negatively related with the grammatical development of children in Dutch. Older siblings' input found to be a significant predictor of the (productive and receptive) vocabulary measures and a marginally significant predictor of grammatical skills in Dutch, while in Greek was predictor only of children's productive vocabulary. Additionally, the many t-tests showed that children with older siblings were more advanced than children without older siblings in all the measures of the Dutch language development, whereas it was shown that there was no difference in the influence of older sibling's input depending on the family constellation, with only exception the children's productive vocabulary in Greek in which children with older siblings that were raised in families where both parents were Greek were more advanced compared to children with older siblings raised in families with one Greek and one Dutch parent. Despite the importance of these results, there were some unexpected findings that needed further investigation. Thus, in the next section we mention the next steps that we followed.

3.3. Follow-up/ Post-hoc Analyses

3.3.1 Gender Differences

The hierarchical regression analyses showed that the gender of the participants is a significant predictor for the Greek receptive vocabulary, for the Dutch productive vocabulary as well as for the Dutch MLU3. Thus, in order the role of gender in bilingual language development to be further investigated, we explored our data and we found unexpectedly that boys are more advanced in the Greek receptive vocabulary, while

girls were more advanced in the Dutch productive vocabulary and in the Dutch MLU3 (see Figures 8 and 9).

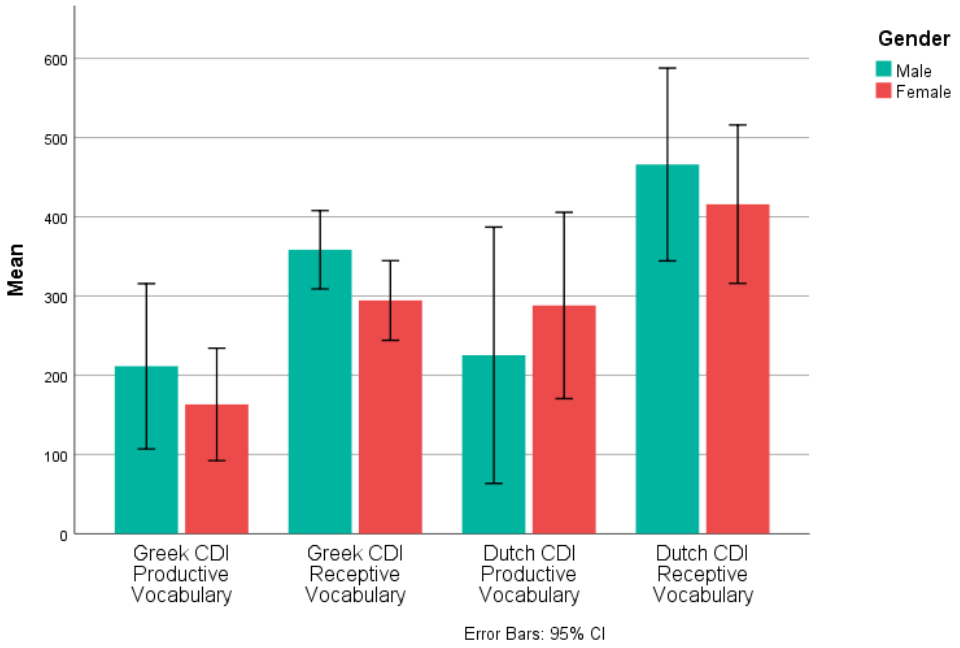

Figure 8: Comparison between males' and females' vocabulary development.

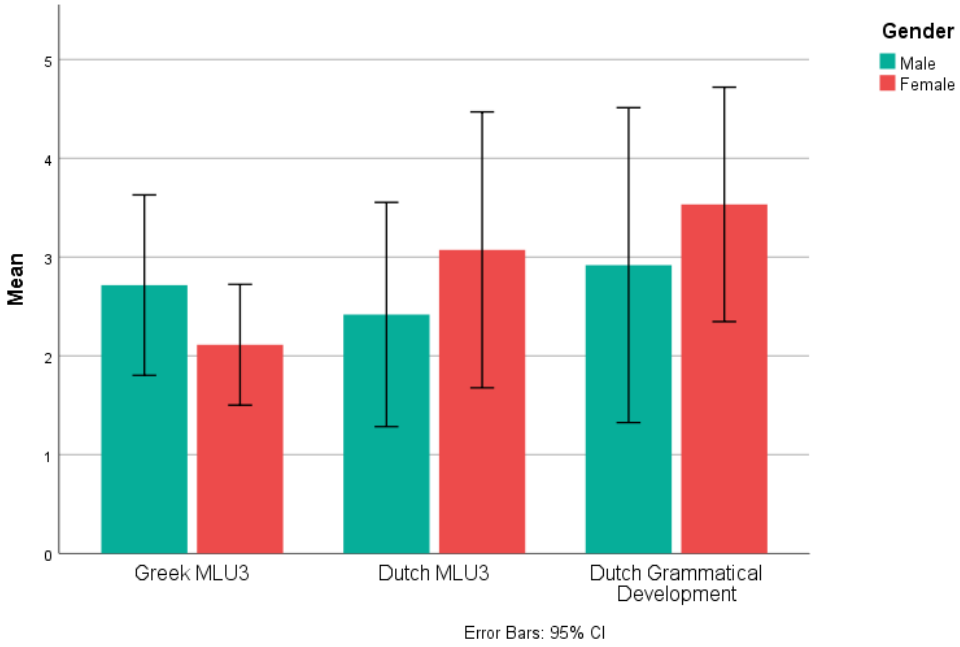

Figure 9: Comparison between males' and females' grammatical development.

Furthermore, we noticed from the Figures 8 and 9 that in general boys were more advanced in the Greek language measures, while the girls in the Dutch ones. At first,

we checked the distribution of boys and girls in the different family constellation, as we thought that this might have influenced the results but we found that girls were more in number than boys in all cases (see Table 13). Subsequently, we conducted a t-test between the current and the cumulative exposure of boys and girls, as we thought that exposure might be the reason for the existing difference and not the gender itself. The t-test (see Table 14) actually confirmed our hypothesis showing that males had more exposure in Greek at the time of testing, t (30.77) = 2.23, p = .033, two tailed, Cohen's d = 0.66, while females in Dutch, t (30.67) = -2.053, p = .049, two tailed, Cohen's d = 0.72 (see also Figure 10).

Table 13: Gender distribution across different family constellations

	Gender	
Family Constellation	Male	Female
Both Parents Greek	7	13
One Parent Dutch-One Greek	4	9

Table 14: T-test between males and females regarding their current and cumulative exposure

Outcome Variables	**Group**	**Mean**	**SD**	**t**	**p**
Cumulative Exposure in Dutch	Male	.72	.35	-.471	.641
	Female	.79	.49		
Cumulative Exposure in Greek	Male	1.47	.54	1.673	.116
	Female	1.17	.34		
Current Exposure in Dutch	Male	.42	.082	-2.053	.049*
	Female	.50	.15		
Current Exposure in Greek	Male	.56	.07	2.228	.033*
	Female	.48	.14		

* p = <.05.

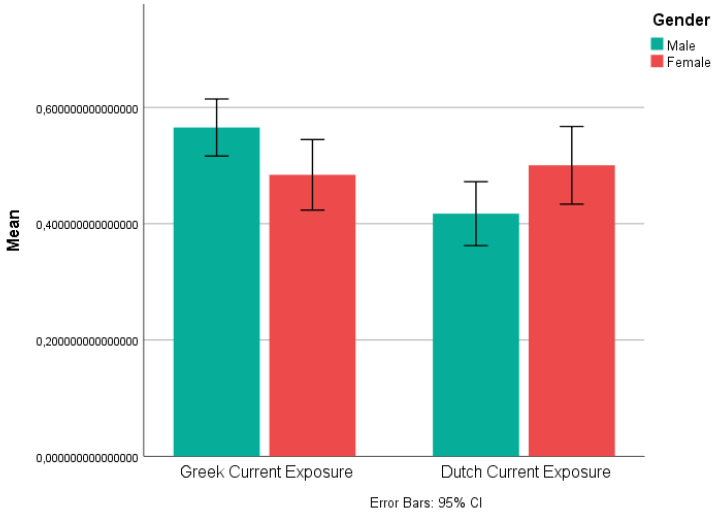

Figure 10: Difference in males' and females' current exposure in Greek and Dutch.

3.3.2. The role of SES in Dutch Grammatical Development

One more unexpected result that came up from the regression analyses and it needed further examination was the marginally negative relation between the main caregiver's SES and the measure of children's Dutch Grammatical Development. The fact that SES variable's standard deviation was quite small (see Table 7) showing that there were no significant differences between families' SES in combination with the fact that SES was only related to this variable, made us think that a possible correlation with another variable might be the explanation for this odd finding. Therefore, we conducted a series of zero-order correlations between SES and the rest independent variables and we found that SES is correlated with the paternal language mixing (see Table 15) which in turn is negatively related with the Dutch Grammatical Development variable (see Table 10). Thus, we assume that paternal language mixing is a confound variable that affects the relation between the SES and the Dutch Grammatical Development variable. Furthermore, the fact that the relation between those two variables is marginally and not statistically significant could be an explanation why no collinearity was found in our regression model.

Table 15: Zero-order correlations among the independent variables

	Variables						
	Gender	Age [a]	Cumulative Exposure Dutch [b]	Cumulative Exposure Greek [b]	Language Mixing Mother [c]	Language Mixing Father [c]	Older Siblings
SES	-.096	-.081	-.193	.111	-.316	-.354*	-.250

* Correlation is significant at the 0.05 level (two-tailed). [a] Measured in months. [b] Cumulative exposure was measured in years. [c] Composite score that varies from 0 to 30.

3.3.3. The positive relation between maternal language mixing and bilingual language development

An unexpected finding that we wanted to further investigate was the marginally positive relation between the maternal language mixing with the Greek receptive vocabulary, as well as with the Dutch MLU3 and the Dutch grammatical development. In a first step, we investigated whether there is difference between mothers' and fathers' proficiency in their non-native language. Tables 16 and 17 show that mothers not only are more proficient than fathers, but also that mothers' proficiency is positively related with the maternal language mixing. This implies that the more proficient a mother is in her non-native language, the more she mixed the two languages when she speaks to her child. Bearing that in mind, we further examined the answers in the qualitative questions of the Language Mixing Scale (Byers-Heinlein, 2013) in order to explore whether parents use language mixing in different contexts. The results revealed that mothers usually use mixed input when they want to teach a new word and/or structure to their child, whereas, fathers mostly mix when they either do not know the Greek/Dutch word or when there is not a good translation of that word in the other language. Therefore, we assume that maternal language mixing is positively related with children's language development in both languages, because mothers are quite proficient in both languages and they use them as teaching method/tool in order to facilitate their child's language development.

Table 16: Descriptives for parents' non-native language proficiency

	Frequency (N)	**Percentage (%)**
Mothers' Proficiency [a]	33	100
Fairly Fluent [b]	8	24.2
Quite Fluent [c]	16	48.5
Good/Native-like Fluent [d]	9	27.3
Fathers' Proficiency [a]	33	100
Fairly Fluent [b]	13	39.4
Quite Fluent [c]	16	48.5
Good/Native-like Fluent [d]	4	12.1

[a] Self-report, Measured in a 5-point scale. [b] From 1 to 2. [c] From 2.5 to 3.5. [d] From 4 to 5.

Table 17: Correlation between parents' proficiency and parents' language mixing

	Mothers' Proficiency [a]	Fathers' Proficiency [a]	Language Mixing Mother [b]	Language Mixing Father [b]
Mothers' Proficiency	1	.482**	.427*	.227
Fathers' Proficiency	.482**	1	.100	.123

** Correlation is significant at the 0.01 level (two-tailed). * Correlation is significant at the 0.05 level (two-tailed). [a] Self-report, Measured in a 5-point scale. [b] Composite score that varies from 0 to 30.

3.3.4. Relations among productive vocabulary, cumulative exposure, older siblings' input and family constellation

One last thing that emerged from the regression analyses and needed further investigation was why cumulative exposure appeared to be a significant predictor of the Greek productive vocabulary only after when older siblings' input was entered as a variable in the model. Inspecting our data and analyses closely, we noticed that while older sibling' input is a significant predictor for Greek productive vocabulary in the regression analyses (see Table 9 and Figure 11), the t-test (see Table 11) showed that there is no significant difference, t (25.21) = -1.169, p = .255, two tailed, between children with and without older siblings regarding their productive vocabulary in Greek language. On the other hand, the t-test (see Table 12) between children with older siblings being raised in families with both Greek parents or with one Greek and one Dutch parent showed that children with older siblings that were raised in families where both parents are Greek are more advanced in their productive vocabulary compared to children with older siblings raised in families with one Greek and one Dutch parent, t (12) = 2.45, p = 0.31, two tailed, effect size (Cohen's d) was 1.3. Therefore, we thought that there might be an interaction among them. As a first step, we performed correlations in order to explore whether there is a relationship between these variables and we found that cumulative exposure is related with all the rest variables (see Table 18).

Table 18: Zero-order correlations among cumulative exposure, older siblings, family constellation and Greek productive vocabulary

	Cumulative Exposure Greek	**Older Siblings**	**Family Constellation**	**Greek CDI Productive Vocabulary**
Cumulative Exposure Greek	1	-.471**	-.653**	.403*
Older Siblings		1	.186	.215
Family Constellation			1	-.252
Greek CDI Productive Vocabulary				1

**Correlation is significant at the 0.01 level (2-tailed). *Correlation is significant at the 0.05 level (2-tailed).

Subsequently, a two-way ANCOVA was conducted to determine the effectiveness of older siblings' input, as well as of the family constellation on children's productive vocabulary scores in the Greek language whilst controlling for the cumulative exposure

that children had in Greek. Levene's test and normality checks were performed and the assumptions met. The results showed that there was a statistically significant interaction between older siblings' input and family constellation on productive vocabulary, whilst controlling for cumulative exposure, $F(1, 28) = 15.17$, $p = .001$, partial $\eta^2 = .351$. Overall, the comparison of the estimated marginal means showed that children with older siblings (M = 299.12) had larger productive vocabulary scores than children without older siblings (M = 132.57), especially in families where both parents were Greek (M = 319.29).

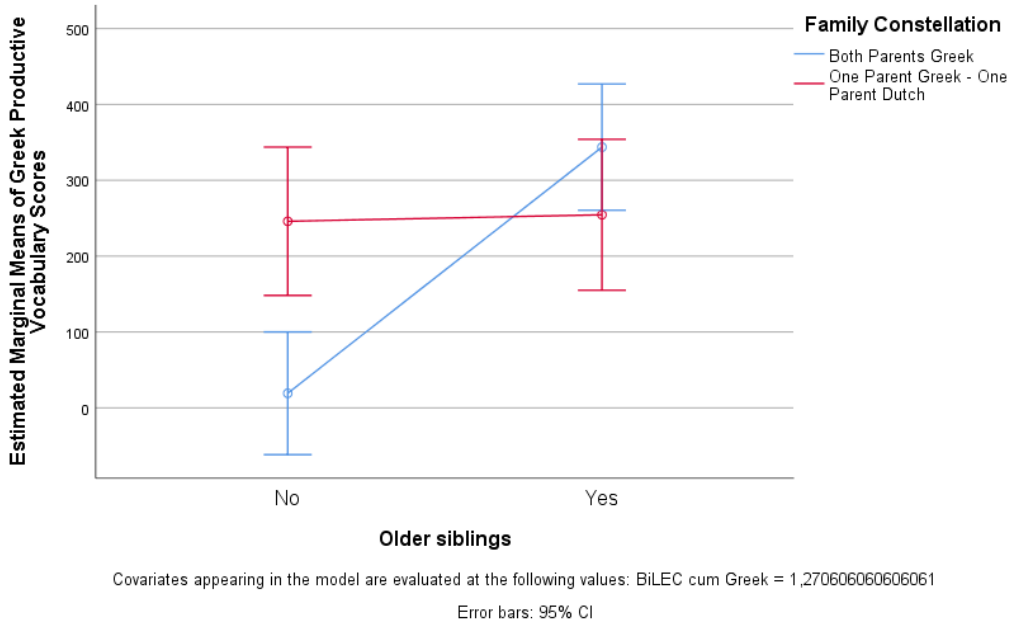

Figure 11: Interaction between family constellation, existence of older siblings and cumulative exposure on the productive vocabulary of Greek language.

3.4. Summary of the Results

To summarize, the findings of the current study clearly show that age is a significant predictor for the language development of bilingual children in both languages (see Tables 9 and 10). Regarding the influence of gender and SES in bilingual language development, this study's results show that they are not significant predictors by themselves, but an interaction with other variables (current exposure and paternal language mixing respectively) make them appear as significant predictors (see Tables 14 and 15). As far as cumulative exposure is concerned, the results of this study show

that it is a significant predictor of bilingual language development (see Tables 9 and 10). However, there is a noticed difference in the way that is related to children's productive and receptive vocabulary, with productive vocabulary to be more related than receptive vocabulary (see Tables 9 and 10). With concern to older siblings' input, it appears to be a significant predictor of children's development in their societal language, as children with older siblings are shown to be more advanced than children without older siblings in the Dutch language (see Table 11, as well as Figures 4 and 5). As far as the role of older siblings' input in the heritage language, it seems that its influence depends on the family constellation. More specifically, children with older siblings that were raised in families where both parents are Greek seem to be more advanced in the productive vocabulary of the Greek language than children who are raised in families with one Greek and one Dutch parent (see Figure 11). Finally, the results of the current study show that maternal and paternal language mixing affect language development in a different way. While maternal mixed input is positively related with the language development of bilingual children (see Tables 9, 10, 16 and 17), paternal language mixing is negatively related with bilingual children's language development (see Table 10). This study's results also show that the proficiency of the person who uses mixed input, as well as that the context and the way in which the addressee uses the mixed language play a significant role in the language development of children.

Chapter 4
Discussion

A vast majority of studies has examined the relations between bilingual language development and language exposure. However, there are still some aspects of language exposure that either have not been examined thoroughly, or that remained unanswered and unspecified. In this study, we aimed to fill in some of those gaps by examining the role of cumulative exposure, the role of older siblings as well as the role of parental language mixing in the developing language skills of Greek-Dutch bilingual children aged 16 to 30 months old.

4.1. Age, gender and SES in bilingual language development

One of the findings that emerged regarding the control variables that were used in the first step of our regression analyses was that age constantly consisted a significant predictor for all the measures of language skills in both languages. This finding not only is not surprising, but provides further support to many previous studies (Fenson, Marchman, Thal, Dale, Reznick & Bates, 2007; Paradis, 2011; Hoff, Core, Place, Rumiche, Señor & Parra, 2012; Place et Hoff, 2016; Bridges and Hoff, 2014) that have shown that the relationship between (bilingual) language development and age is linear. This implies that as the age of a child increases, their language development becomes more advanced.

An unexpected finding of this study was that boys in this sample were more advanced than girls in the Greek receptive vocabulary. The majority of the previous studies (e.g., Fenson, Marchman, Thal, Dale, Reznick & Bates, 2007; Place et Hoff, 2016) has consistently reported a difference between boys and girls with regards to their language development, in favor of girls. Especially regarding vocabulary development it has been claimed that girls have larger vocabularies than same-aged boys (Fenson, Marchman, Thal, Dale, Reznick & Bates, 2007; Fenson, Dale, Reznick, Bates, Thal, Pethick, Tomasello, Mervis & Stiles, 1994; Huttenlocher, Haight, Bryk, Seltzer & Lyons, 1991; Eriksson, Marschik, Tulviste, Almgren, Pérez-Pereira, Wehberg,, Marjanovič-Umek, Gayraud, Kovacevic, & Gallego, 2012). That is the reason why different norms

that measure boys' and girls' language development have been established (e.g., CDI) (Fenson, Marchman, Thal, Dale, Reznick & Bates, 2007). However, this is not always the case, as there are some studies reporting that there is no difference between boys' and girls' language development (e.g., Luijk, Linting, Henrichs, Herba, Verhage, Schenk &Van IJzendoorn, 2015), or even that boys are more advanced than girls (Kern, 2001; Boyle, 1987). Therefore, the existence of gender differences in (bilingual) language development is questionable and the reason for an observed difference could be an interaction with another factor (Stolarova, Brielmann, Wolf, Rinker, Burke & Baayen, 2016). Actually, in our study, we found that the existing difference between boys and girls is not due to gender itself, but due to the amount of current exposure that children had at the time of testing in their two languages (boys more exposure in Greek, while girls in Dutch). This finding not only provides further support to the claim that gender differences in language development do not arise due to gender itself, yet due to an interaction with other factors (e.g., language exposure) and thus, we should be cautious reporting and interpreting them, but also it is consistent with previous literature reporting that the vocabulary knowledge of children in a language is related to the amount of exposure children have in that language (e.g., De Houwer, 2007; Pearson, Fernández, Lewedeg & Oller, 1997).

As far as the socioeconomic status of the main caregiver and its role in the language development of bilinguals is concerned, in almost all cases SES was not related to the measures of language development. While the vast majority of studies reports a positive relation between language development and socio-economic status (Hoff, 2006; Eilers, Pearson, & Cobo-Lewis, 2006; Hurtado, Marchman, & Fernald, 2008; Umbel & Oller, 1994), there are also some studies (e.g., Place and Hoff, 2016; Hoff and Giguere; 2015; DeAnda, Arias-Trejo, Poulin-Dubois, Zesiger & Friend, 2016) reporting null relationship between SES and language development, like what we resulted in this study. The anecdotal finding that emerged from our results, though, was the negative relation between SES and grammatical development of children measured by the Dutch CDI. Surprisingly, a negative relation between CDI and SES has also been reported in other studies (Feldman, Dollaghan, Campbell, Kurs-Lasky, Janosky & Paradise, 2000; Fenson, Dale, Reznick, Bates, Thal, Pethick, Tomasello, Mervis & Stiles, 1994; Reznick, 1990). The explanation that has been addressed by previous researchers is a possible reporting bias between SES and CDI, as parents with low educational level

tend to overestimate their child's language development. As in our sample there was not so much variation between our main caregiver's SES, we further explored the reason behind this odd finding by conducting a series of correlations between SES and the other variables trying to find any possible confound variable that might have led to this result. Indeed, our speculation was confirmed, as we found that SES is correlated with the paternal language mixing, which in turn is negatively correlated with the grammatical development of children. Thus, we assume that the negative relation between SES and children's grammatical development is a side effect of paternal language mixing's influence.

4.2. Language exposure and bilingual language development

With respect to the first research question of this study regarding the role and the effect of cumulative exposure in bilingual language development, the results appear to be quite clear providing support to our hypothesis. The findings of the zero-order correlations, as well as of the hierarchical regression analyses showed that cumulative exposure in each language was a significant predictor of the bilingual language development in both languages. Moreover, as it was the first time that the role of cumulative exposure was examined across different modalities, an important contribution of this study was the finding that cumulative exposure affects in the same way the vocabulary and grammatical development of bilingual children. Another interesting result in which this study resulted was that cumulative exposure is related more to the development of the expressive vocabulary than to the development of the receptive vocabulary in bilingual children. This finding is in line with the results of Thordattotir (2011) and Hammer, Davison, Lawrence, and Miccio (2009), who showed that children need less exposure in receptive vocabulary compared to productive vocabulary in order to attain monolingual performance. Actually, this implies that after a certain point the input that children receive might not be meaningful regarding the development of their receptive vocabulary on either their heritage or societal language. One explanation for this might be that it is easier for children to store words in their mental lexicon and creating concepts than producing speech, which is quite logical, bearing in mind that comprehension proceeds production (Benedict, 1979). In sum, the results of this study not only reproduce the findings of previous studies (Gutiérrez-Clellen & Kreiter, 2003; Thordardottir, 2011; Unsworth, 2013b; Hammer, Davison,

Lawrence, and Miccio, 2009), but also expand them in a population with different language background and in different modalities highlighting the important role of cumulative length of exposure in bilingual language development and showing why it should be included in every study as a variable (Unsworth, 2013b).

As far as the second research question regarding the role and the influence of older siblings' input in bilingual language development is concerned, the results of this study are quite enlightening, confirming our hypothesis. More specifically, the results of the multiple hierarchical regression analyses, as well as the results of the many independent t-tests showed that the input provided by older siblings is a significant predictor for the majority language development of bilingual children and in some cases also for the development of children's minority language. More specifically, we found that the input provided by older siblings was related with both the vocabulary and grammatical development of children in the Dutch language (majority language), while in the Greek language (minority language) older siblings' input was related only with the development of their younger siblings' productive vocabulary.

The results regarding the influence of older siblings' input in the development of children's majority language replicate and provide further support to the findings of Bridges and Hoff (2014) who showed in a largescale study that English-Spanish bilingual children who had older siblings attending school received more input at home than children without older siblings and that the input provided by older siblings found to have positive effect on their younger siblings' language development on the majority language (in that case on English), as their older siblings spoke to them mainly in the majority language. It should be noted, though, that there is one main difference between the results of this study and of Bridges and Hoff (2014). While Bridges and Hoff (2014) did not found any difference between children with and children without older siblings regarding the production of long utterances (MLU3), we did. One reason for this existing difference it could be the age of older siblings. Bridges and Hoff (2014) reported in their study that the age of the older siblings varied between 6 to 8 years old, while in this study there were four children that were older and whose age was between 9 and 12 years old (see Table 1). Bearing in mind that there are some syntactic structures, as well as grammatical features that are acquired later on in life, it might be the case that in this study bilingual children with older siblings produced longer

utterances than children in Bridges and Hoff (2014), because their older siblings were older and more advanced regarding their language development, providing more complex and more "rich" input during the sibling interactions (see Figures 12 and 13).

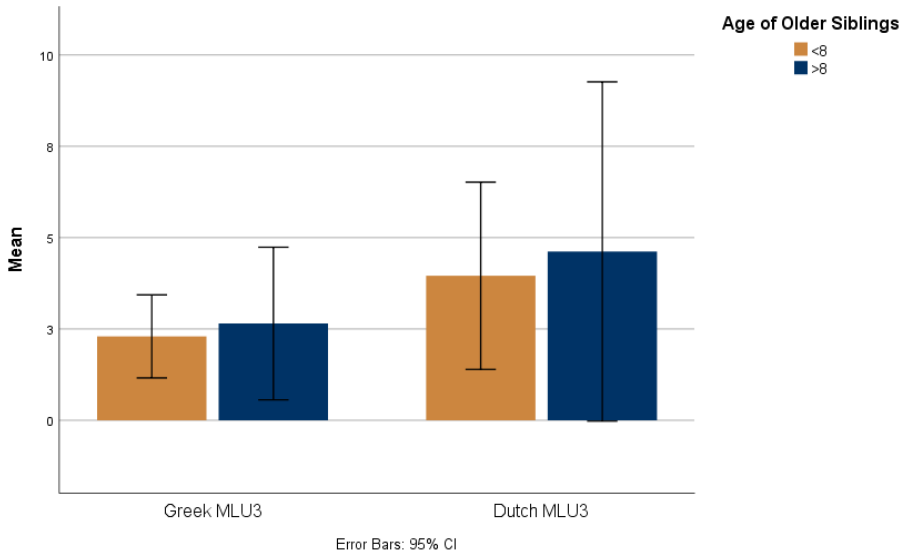

Figure 12: Children's MLU3 scores depending on the age of their older siblings.

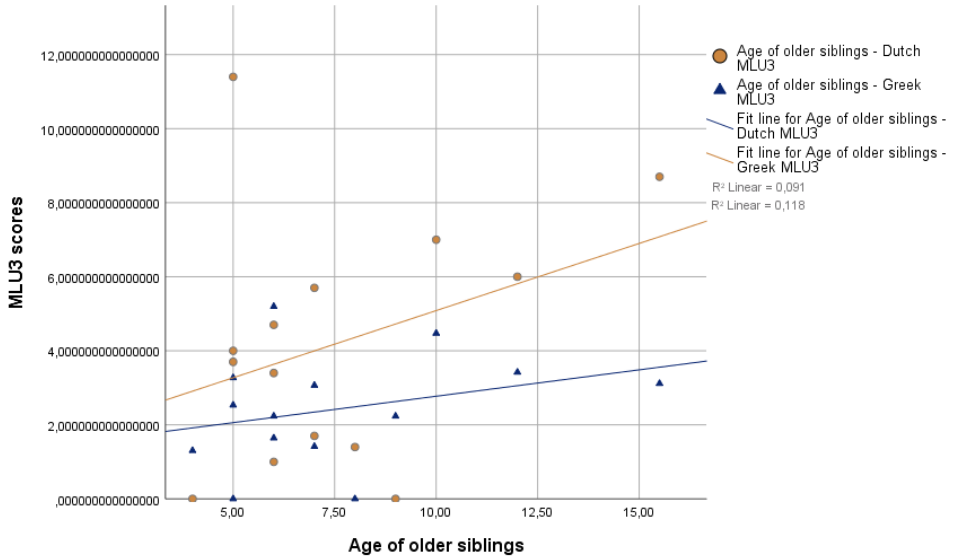

Figure 13: Relationship between children's MLU3 scores and the age of their older siblings.

As far as the influence of older siblings' input in bilingual families with different constellation is concerned, our hypothesis was not confirmed. More specifically, we did not find any significant difference in the development of children's societal language depending on whether children with older siblings are raised in families where

both parents are Greek or one parent is Dutch and the other is Greek. One explanation why no difference was noticed might be that our sample did not have enough statistical power to show any significant results, as the number of children in the two groups was quite small (7 children in each group) (Field, 2009).

What we found, though, regarding the role and the influence of older siblings in their younger siblings' minority language development was an interaction between older siblings' input and family constellation on children's productive vocabulary skills in the Greek language, whilst controlling for cumulative exposure. This indicates that older siblings' input affects in different way the children's development of heritage language depending on the family constellation. More specifically, we found that children with older siblings being raised in families where both parents are Greek are more advanced in the Greek productive vocabulary compared to children with older siblings that being raised in families where one parent is Greek and the other is Dutch. This finding is consistent with the results of previous studies (Hoff, Coard & Señor, 2013; Place, 2009; Place and Hoff, 2011; De Houwer, 2007) showing that family constellation is a significant factor affecting bilingual children's development of the minority language. More specifically, De Houwer (2007), Place (2009) and Place and Hoff (2011) have shown that it is more likely bilingual children to acquire the minority language when both of their parents are speakers of the minority language.

In the current study, we further promote the aforementioned literature (Hoff, Coard & Señor, 2013; Place, 2009; Place and Hoff, 2011; De Houwer, 2007) by claiming that when you are raised in a family where both parents are speakers of the minority language (in that case Greek) and you have an older sibling, then the older sibling is also a significant agent of children's minority language development. This finding is in contrast with the results of previous studies showing that older siblings are agents and significant influence only of bilinguals' development of the majority language (Bridges et Hoff, 2014). However, it is in agreement with other studies examining the language development and use of bilinguals in immigrant families (Kopeliovich, 2010; Park and Sarkar, 2007; Kheirkhah and Cekaite, 2018). These studies have shown that in immigrant families in which both parents are speakers of the heritage language (like in this sample), parents try to inherit and maintain the heritage culture and language in their children interacting with them (almost) exclusively in the minority language

(Kopeliovich, 2010; Park and Sarkar, 2007). In those families, it is often the case that in family conversations where both parents and younger siblings participate, older siblings address to their younger siblings in the minority language, whereas when siblings interact alone, older siblings address to their younger siblings in the majority language (Kheirkhah and Cekaite, 2018). Moreover, other studies (Kheirkhah & Cekaite, 2015; Barron-Hauwaert, 2011) have shown that in these cases older siblings, as more knowledgeable adapt the role of a model / "teacher" towards their younger siblings by correcting and improving their sibling's language use and performance in both languages. Therefore, the results of the current study show that older siblings can be agents not only of their younger siblings' language development in the majority language, but also in the minority language, mainly in immigrant families, where parental strategies for maintaining the heritage culture and language are adapted.

One more thing that it should be mentioned is that while the above finding is true for the productive vocabulary, it is not for the receptive vocabulary. One possible explanation for this difference might be that sibling interactions provide more opportunities to children for practice and production of speech leading to more advanced expressive vocabulary development. Moreover, younger siblings through their interaction with their older siblings obtain more feedback regarding their errors and use of the minority language. Thus, the children's output, as well as the feedback that receive by different sources, might contribute to the development of the productive rather than the receptive skills of bilingual children. Previous literature (Bohman, Bedore, Pena, Mendez-Perez & Gillam, 2010; Hammer, Komaroff, Rodriguez, Lopez, Scarpino & Goldstein, 2012) has shown that children's output is a significant factor of bilingual language development, especially in their minority language (Unsworth, 2015; Montrul, 2008). In sum, the results of this study regarding the influence and the role of older siblings in bilingual language development are significant showing that older siblings are valuable sources of language input, as well as agents of important influence in the bilinguals' language use.

With respect to the third research question and the role of parental language mixing in bilingual language development, this study further promotes the research, as for the first time the maternal and the paternal language mixing were examined separately. In the previous studies, only the language mixing by mothers was investigated, but bearing

in mind that nowadays quite often fathers are the main caregiver, the importance of paternal language mixing examination arises. The results of this study showed that paternal language mixing is negatively related with the development of the productive vocabulary and the grammatical development in the Dutch language confirming the results of Byers-Heinlein (2013) and Place and Hoff (2016). As far as the maternal language mixing is concerned, the results of this study showed that it was marginally positively related with the development of the receptive vocabulary in the Greek language, the Dutch MLU3 and the Dutch grammatical development. This finding was unexpected and it has never been reported in any previous study.

One possible explanation for the different relation between maternal and paternal language mixing with the language development of bilinguals might be the different level of proficiency between parents in their non-native language, in combination with the different context in which parents mix the two languages when addressing to their children. More specifically, in our sample, mothers were more proficient in their non-native language compared to fathers and also it was found that the more proficient mothers were the ones that mixed the most. This finding is supportive to previous studies that have shown that input quality is a significant factor of bilingual language development (Paradis, 2011; Place and Hoff, 2011; 2016). Paradis (2011) provided indirect evidence that parents' proficiency affects their children's language development, whereas Place and Hoff (2011, 2016) clearly showed that the amount of exposure from native speakers is a significant predictor for bilingual language development. Another explanation for the existing difference between the influence of parental language mixing in their children's language development arises from their answers in the Language Mixing Scale. More specifically, mothers' answers revealed that they mostly use mixed input when they want to teach a new word to their children. In contrast, fathers usually mix either when they do not know the word in Greek or in Dutch, or when the pronunciation of the word is difficult. This difference in the parental use of language mixing shows us that mothers use language mixing as a tool in order to explain and teach words and/or structures that may be difficult for their children, promoting in this way their language development in both languages, whereas fathers as not being proficient enough in their non-native language, when they mix, they suppress their children's language development.

In sum, our hypothesis regarding the relation between parental language mixing and bilingual language development is partially confirmed, as paternal language mixing found to be negatively related with the language development of bilinguals, as we expected, whereas maternal language mixing unexpectedly was marginally positively related with the language development of bilinguals. Even though, the results of this study further promote the research on bilingual language development showing that the effect of language mixing depends on the context in which is used, as well as in the addressee's proficiency and by extend in the quality of input, a further investigation in populations with different age and language background is needed in order to be investigated whether this noticed difference between maternal and paternal language mixing is culturally driven or not.

As far as this study's last research question regarding the contribution of cumulative exposure, older sibling's input and parental language mixing in the receptive and productive vocabulary of bilingual children, we found that each of these factors is differently related to bilinguals' language development in each language. As it was mentioned earlier, cumulative exposure was more related to the productive than the receptive vocabulary in both languages, showing that expressive vocabulary needs more input in order to be developed in a monolingual rate, as well as that input beyond a certain point might be superfluous for receptive vocabulary development (Ribot, 2012; Thordardottir, 2011). These results are consistent with previous studies showing that comprehension is more readily achieved than production in monolingual children (Benedict, 1979), in bilingual children (Thordardottir, 2011), as well as in L2 learners (Pham and Kohnert, 2014). The input provided by older siblings was related to both the productive and the receptive vocabulary in Dutch language, indicating that older siblings are valuable sources and agents of children's development in the majority language, but it was also related with the productive vocabulary of the Greek language showing that older siblings' interactions under certain circumstances (family constellation as well as parental attitudes and strategies) promote the productive skills of children by providing more opportunities for practice and feedback. Finally, while paternal language mixing was not related to either the receptive or the productive vocabulary, maternal language mixing was a beneficial factor of the receptive vocabulary development of children. More specifically, mothers used mixed input as an alternative way of learning a word and/or a structure to their children. In sum, it is

clear that the various aspects of language exposure are not related in the same way with the productive and receptive vocabulary development.

4.3. Implications

The implications of this study are numerous. From the theoretical side, the expansion of previous results (Gutiérrez-Clellen & Kreiter, 2003; Thordardottir, 2011; Unsworth, 2013b; Hammer et al., 2009) regarding the role and the influence of cumulative exposure on bilingual language development in different language background (Dutch-Greek), as well as in different modalities (vocabulary and grammar) highlightened even more its role and its importance, showing that it is really important predictor of bilingual language development and that it should be included in every study as a variable. Furthermore, the finding that cumulative exposure affects the vocabulary and grammatical development in the same way shows that the claim that vocabulary development is more dependent on input than morphosyntax (Oller et al., 2007; Paradis & Genesee, 1996) does not stand for cumulative exposure. Another theoretical implication of this study is that not only the input by older siblings is significant predictor for the language development of bilingual children, but also the age of the older siblings, as well as the family constellation in which they are raised. More specifically, it was shown that older siblings are agents and sources not only of the majority language (Bridges and Hoff, 2014), but also of the minority language, especially in immigrant families where both parents are speakers of the minority language and try to maintain and inherit their heritage language and culture in their children. Furthermore, it was shown that siblings that are older in age are important agents of their younger siblings' language development providing them probably a more "rich" and complex input than siblings in younger age.

A practical implication of this study concerns parental attitudes and strategies regarding the use of mixed language. It is often the case that parents adapt the one parent-one language strategy because they think that language mixing might confuse their children or that it might reduce their children's competence in their two languages (Byers-Heinlein, 2013). This study showed that not only this is not the case in certain occasions, but also that language mixing might prove to be substantially effective

parental strategy for enhancing bilingual children's language development. However, there are two important requirements in order this to happen and these are that parents should be quite proficient in their non-native language and that they should use each language in a complementary way of the other, or in other words to access knowledge from one language to the other e.g., explaining the meaning of a word in one language through this word's translation equivalent (which is fully acquired). Thus, based on the results of this study, we can help and advise parents to adapt more adequate language mixing strategies towards their children in order their children's language development to be facilitated.

4.4. Limitations and Future studies

The current study has some limitations. One of them is the way in which SES was operationalized. More specifically, as all of the main caregivers had high SES and thus, there was not a lot of variation, it would be preferable SES not to has been included as a variable in the regression analyses. One more limitation of this study is that due to the high correlation between current and cumulative exposure we were not able to test whether current and cumulative exposure differentiate in the way that affect bilingual language development in the early years of a bilingual child. Moreover, even though our sample size was enough providing statistical power to our analyses (see Field, 2009, for a detailed argument), when we compared groups (e.g., children with and without older siblings), the number of participants in each group was significantly lessened reducing the statistical power in our analyses. This might be the reason why no difference was noticed in the influence of older siblings' input in the language development of children being raised in families with different constellation. Furthermore, due to the small number of children having older siblings and even the smaller number of older siblings with a large age, we cannot generalize our results and our claims regarding the influence of older sibling's age in bilingual language development. Therefore, it would be advisable and beneficial future studies examining the role of older siblings in different family constellations, as well as the influence of older siblings' age in bilingual language development to be conducted with larger samples sizes, in order the reliability of the findings to be enlarged (Field, 2009).

Follow-up studies should also explore the influence of older siblings in children's language development of the minority language, in different cultures and linguistic populations. In this way, it will be investigated whether the finding in which we resulted in the current study that older siblings are valuable sources of language input in both the heritage and the societal language is culturally driven or a more general pattern. One more future study that should be conducted based on the findings of the current study is the examination and replication of the dissimilar maternal and paternal language mixing effect in the language development of bilingual children with different age range and language backgrounds than the ones that were used in this study. The examination of the parental language mixing input and its effects in a different population will further promote the bilingual language research by showing whether the current study's noticed effect is culturally driven or a general difference in the language mixing strategies that parents adapt towards their children. Finally, while the role of parental language mixing in the language development of bilingual children was examined, the language mixing by older siblings and its role was not. Bearing in mind, though, that older siblings are important agents (Bridges and Hoff, 2014) and siblings' interactions are important sources of younger siblings' language development (Caldas, 2006), the importance of older siblings' language mixing investigation arises. It would be informative if a future study could investigate to what extend siblings interact, as well as to what extend language mixing by older siblings is acting as a suppressor or contributory factor of bilingual language development.

Chapter 5
Conclusion

The current study provided evidence that both quantity and quality of exposure are significantly related to the language development of bilingual children. As far as quantity is concerned, cumulative length of exposure in each language found to be a significant predictor of children's development in both languages, as well as it was shown for the first time that cumulative length of exposure is related in the same way across modalities (vocabulary and grammar). Another interesting finding in which this study resulted was that cumulative exposure is differently related to the receptive and productive vocabulary, with the latter one to be more related than the other. Furthermore, this study showed that older siblings' input was a significant predictor for bilingual children's development in the majority language, as well as in the minority language under certain circumstances. More specifically, it was shown that in immigrant families in which there are older siblings living in the house and both parents are speakers of the minority language, older siblings acting as agents and models of their younger siblings' development and use of the minority language. Moreover, the current study showed that not only the existence of older siblings, but also the age of the older siblings should be taken into account in future studies, as the age of older siblings could be an essential factor influencing bilinguals' language development. As far as the quality of input is concerned, and precisely, the mixed language use by parents it was found that not only the proficiency of the person who mixed is important, indicating that native input is more beneficial than non-native, but also it was shown that fathers and mothers use mixed language in different occasions and with different purpose. While fathers mostly mix their languages in cases where they do not know the word in the other language, or they are not sure about the word that they should use, mothers mostly mix when they want to teach a new word to their children or help them understand a word that the is difficult for them. In other words, mothers use the two languages when they mix in a complimentary way promoting in this way their children language development in both languages, while fathers as not being proficient enough in their non-native language, when they mix, they suppress their children's language development. In conclusion, the current study's findings contribute and promote the existing literature on bilingual language development in various ways.

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Appendix

Comparison between Dutch and Greek CDI.

Vocabulary list	Dutch CDI	Greek CDI
Sounds effects and sounds	21	12
Animal names (real animals or toys)	47	36
Vehicles (real or toy)	17	9
Toys	19	8
Food and drinks	69	31
Clothing	29	19
Parts of the body	31	20
Small household objects	52	36
Furniture and rooms	34	24
Outdoor objects*	28*	
Places outside*	23*	27*
People	29	20
Games and routines	26	19
Descriptive words	60	37
Verbs	106	55
Words about time	15	8
Pronouns	23	11
Questioning words	7	6
Preposition and positioning	25	11
Quantities and articles	16	8
Auxiliary verbs	19	10
Colloquials	6	8
Total	702	414

*In the Greek CDI these two are combined.

In addition, the second part of the Dutch CDI (Deel 2: Zinnen en Zinsbouw) which measures the grammatical development of the children is missing from the Greek CDI, except of the MLU3 part, which is included.