

FAMILY AND SCHOOL LANGUAGE INPUT: THEIR ROLE IN BILINGUAL CHILDREN'S VOCABULARY DEVELOPMENT

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Abstract

The current paper constitutes part of a large project on bilingual acquisition and bilingual education and attempts to assess language dominance in bilingual children through questionnaires and standardized language tests. Mainly, this paper investigates the correlation between (a) language dominance as attested by answers in questionnaires that relate to amount of exposure to L1/L2 input, as well as types and context (formal/informal) of input in either language, and (b) language dominance as revealed by diagnostic verbal tests. One of the target languages is Greek, an underinvestigated language in bilingualism, and the other language is German.

Results indicate complex correlations between the two types of instruments with respect to language dominance, with one of the main findings being the significance of formal education in either or both of the target languages. These results point to the importance of bilingual as opposed to monolingual literacy development for language dominance, which implies the need to support the native language of immigrant, minority group or middle class children in the school setting.

1. Introduction

The present paper reports on a study of vocabulary development among bilingual children, who are here defined as children exposed to two languages either from birth or later and well before the onset of puberty. Bilingual children's language skills are highly varied due to the variability in their language experiences (Hoff & Core 2013). The onset time of exposure to the two languages as well as the amount and kind of input received in each of the two languages vary extensively among bilinguals and are particularly important for their ultimate attainment in each language. Various studies in bilingualism have indicated that bilinguals are usually more competent in one of the two languages (e.g. Grosjean 2008). Language dominance is influenced by the linguistic environment (home, social, educational) to which the bilingual individual is exposed and the input s/he receives (Oller & Eilers 2002). However, "the exact nature of the relationship between input quantity and language acquisition in a dual language setting remains largely unclear" (Unsworth 2014: 182).

The present study is part of a larger research project on bilingualism (BALED) (2012-2015) aiming to study language and cognitive abilities in simultaneous and

successive or sequential bilinguals. The broader research project examines language and cognitive abilities in simultaneous and successive bilingual children speaking Greek and other languages (Albanian, English, or German), living in Greece or in the respective countries (i.e. Albania, U.K., Germany) and attending various forms of monolingual or bilingual education.

Our paper aims to investigate the effects of family and educational contexts on bilingualism and, in particular, the type and amount of language input received at home and at school and its effect on children's vocabulary development in each of the two languages. In our study, we are going to focus on Greek-German bilingual children in Greece and in Germany.

2. Theoretical background

2.1 Language input and vocabulary development in bilingual children

Research in bilingual language development has indicated that vocabulary development in each of the two languages exhibits important delays relative to that of monolingual peers; this 'vocabulary gap', as it has been termed, is a recurrent finding in reports on various populations of bilingual children (Hoff *et al.* 2012, Marchman, Fernald & Hurtado 2010, Simos, Sideridis, Mouzaki, Chatzidaki & Tzeveleku 2012, Thordardottir 2011).

According to August, Carlo, Dressler and Snow (2005) as well as Oller and Eilers (2002) bilingual children lag behind in vocabulary development irrespective of the type of instructional setting. Deficits in bilinguals' vocabulary in the two languages have been attributed to the fact that the time devoted to each of their languages is less than what it would have been if they were learning just one language (Hoff *et al.* 2012, Thordardottir 2011, Thordardottir, Rothenberg, Rivard & Naves 2006). Hammer *et al.*'s (2014) meta-analysis of 182 studies on young typically developing bilingual children suggests that bilinguals may take longer than monolinguals to develop their vocabularies in their two languages but this delay is within the normal range of variation in their dominant language (see also Hoff *et al.* 2012).

Other studies have shown that bilingual children's rate of vocabulary development increases proportionately to the amount of input received in each language (Hammer, Lawrence & Miccio 2008, Pearson 2007, among others). On the basis of their study, Hoff *et al.* (2012: 23) concluded that "...language development is a function of the relative amount of exposure". Oller, Pearson and Cobo-Lewis (2007) suggested that vocabulary development depends mainly on input received because vocabulary acquisition is item learning (that is, learning individual units), as opposed to grammar acquisition which is system learning (that is, learning of rules).

Unfortunately, the exact nature of the relationship between language input and vocabulary development is far from clear and, apart from that, results from various studies do not consistently support this relationship. On the basis of their meta-analysis, Hammer *et al.* (2014) concluded that differences among bilinguals with respect to their vocabulary development seem to depend on the age of onset (Birdsong 2006), that is the age at which significant exposure to or immersion in the L2 context actually begins and that sequential learners seem to have faster rates of vocabulary growth both in their first language and in L2 than those of simultaneous learners (Hammer, Lawrence & Miccio 2008, Oller & Eilers 2002). However, age of onset seems to play a role only in some aspects of bilingual children's language development. In particular, it does not seem to affect children's rates of development in oral comprehension, either in L1 or in L2 (Hammer *et al.* 2014).

The results of Hammer *et al.*'s meta-analysis (2014) concluded that two factors play a key role in bilinguals' language development: the amount of language exposure and the amount of usage of bilinguals' two languages, in other words bilinguals' input and output in both languages. It is quite difficult to document with any accuracy the amount and type of language input bilingual children receive and data are usually limited to reports on bilingual children's exposure to input at home and at school. However, tracing the relationship between language input and bilingual vocabulary development is particularly important as vocabulary knowledge impacts significantly on overall oral proficiency, reading comprehension and academic achievement (Chu 2011, Tabors, Pérez & Lopez 2003, Vermeer 2001).

Children's academic achievement and school progress is influenced by their early language and literacy abilities (Hammer *et al.* 2014) and thus bilingual children's early experiences with their two languages are important to investigate. Children from minority families, in particular, need to be exposed to the minority language at home as the community and the schooling received do not always support the home language (Baker 2006, De Houwer 2007, Myers-Scotton 2006, Pearson 2007). Research has shown that these children's exposure to the majority language usually increases when they start schooling, while, at the same time, there is a decrease of the amount of input they receive in their minority language at home (Hammer, Lawrence & Miccio 2008, Oller, Pearson & Cobo-Lewis 2007). Hoff, Rumiche, Burrige, Ribot and Welsh (2014) stressed the importance of access to native speakers of the community language as well as the systematic and continuous use of heritage language by native speakers at home for immigrant children's dual language development.

Finally, minority language status and families' socioeconomic status (SES) have both been found to influence the amount of language input bilingual children receive (Thordardottir 2011). Hoff (2013), in particular, showed that mothers of low SES speak significantly less to their children than mothers of higher SES and as a result those children's exposure to language input is significantly smaller.

2.2 Literacy and vocabulary development

Recent findings point towards the contribution of biliteracy in the development of children's both languages (the minority and the majority one). In particular, evidence seems to suggest that bilinguals benefit from attending well regulated programmes which improve language and literacy skills (Buisse, Peisner-Feinberg, Pérez, Hammer & Knowles 2014, Pearson 2007). According to Polinsky (1997), attendance of complementary schools has been found to benefit children's L1 vocabulary whereas Bylund and Diaz (2012) as well as Schwartz, Moin and Leikin (2012) suggested that children's general L1 language proficiency is positively influenced when they attend those schools. In the case of immigrant and minority bilingualism, very often children do not develop literacy in the minority language. As relevant research has indicated, subtractive bilingualism is quite common among immigrant children when their first language skills are not supported through formal instruction and practice with proficient and literate speakers of the language (Baker 2006, Bialystok, Luk & Kwan 2005, Myers-Scotton 2006). The type of L1 education immigrant children receive depends mainly on parents' choices (Leseman 2002) but also on the available resources and educational provisions in the country of residence. Different educational contexts are expected to provide different amounts and types of instructional input in the two languages and these differences will impact on children's vocabulary development in the respective languages.

Baker (2006) proposed a well-known taxonomy of forms of bilingual education in which a particular programme is characterized as a 'strong' (as opposed to 'weak') form of bilingual education if it actually promotes bilingualism, biliteracy and biculturalism, and not simply the learning of a second language (be it the child's L1 or L2) to a modest degree and his/her assimilation into the mainstream culture. Among the most promising models in this respect is 'immersion bilingual education' (Baker 2006: 245-250) which applies to majority-group speakers wishing to acquire high levels of competence in both their L1 and another language (usually one which carries prestige either locally, i.e. Catalan in Catalonia, Welsh in Wales, or internationally, i.e. English in French-speaking Canada or in Japan). The model originated in Montreal, Canada in the mid sixties and since then it has been applied to many countries worldwide from Switzerland and Finland to Australia and Colombia. Despite the variation encountered in the different national and regional contexts, there are certain core features of immersion programmes, as identified by Swain and Johnson (1997, in Baker 2006: 248):

- (a) The second language is used as a medium of instruction.
- (b) The immersion curriculum is the same as the local first language curriculum.
- (c) The school supports first language development.
- (d) Additive bilingualism occurs.
- (e) Exposure to the second language is largely confined to the classroom.
- (f) Students enter with similar (limited or nonexistent) levels of second language proficiency.
- (g) All the teachers are bilingual.
- (h) The classroom culture is that of the first language community.

On the other hand, a model applicable to speakers of minority languages who wish to learn them alongside the majority ones is 'heritage language education'. This model takes many forms and carries different names according to the continent or the country (see for instance the use of the term 'community languages' in Australia or 'English as an additional language' in the United Kingdom (Baker 2011: 234-35) to avoid connotations of a particular language being associated only with a community's past). In the US, the terms often used are 'maintenance bilingual education' or 'developmental maintenance bilingual education' and refer both to indigenous (e.g. Navajo) and immigrant populations (Spanish-speaking, Hebrew-speaking, Greek, Polish, etc.).

One form of heritage-language education comprises full-fledged schools where education takes place in both the minority and the majority language to varying degrees; both languages are used as mediums of instruction but it is usually the minority one which is supported the most, on the grounds that the majority language receives plenty of support from the outside environment (Baker 2006). Such schools may be organized and run by foreign governments, religious authorities or simply by ethnic communities who wish to maintain and transmit their language. They may also be frequented solely or mostly by students of a specific ethnic or religious background. Such schools usually acquaint students with elements of culture and history besides teaching the language and, in general, promote the goals of biculturalism and bilingualism.

In many cases, though, the aim of maintaining the ethnic language is served through 'supplementary', 'community' or 'complementary' schools (Creese & Blackledge 2008), which offer courses of the heritage language and culture for a few

hours once or twice per week. Although such schools may represent sites allowing the enacting of the younger speakers' double identities (Creese & Martin 2006), parents and teachers often complain that children lack the motivation to make real progress in the heritage language (Creese & Martin 2006). It is also doubtful whether two or three hours of instruction per week can actually improve one's language skills in a language hardly ever spoken at home. So, although attendance of heritage language schools falls under the type of 'heritage language education', we would like to suggest that the amount of time devoted to minority language instruction should be taken into consideration.

Baker (2011) refers to a useful distinction made by the Canadian authorities between 'heritage language education' and 'heritage language programmes'. The first refers to full-fledged schools operating for Italian, German, Chinese, Yiddish, Ukrainian etc. speakers where both languages are taught, usually with the majority language occupying between 10% and 50% of the time. The second describes minority language courses for up to two and a half hours per week which can take place during lunch hours, after school and at weekends.

3. The present study

3.1 Aims and research hypotheses

The present study aims to investigate vocabulary development in bilingual Greek-German children who reside either in Greece or in Germany, and who attend various forms of bilingual education. In particular, we are interested in examining the role of input in Greek and in German – both in terms of home language use and instructional input – in the vocabulary development of the respective languages. As those children live in different countries, they are exposed to a different majority language and of course to varying amounts of Greek and German language input at school and at home. We thus hypothesized that bilingual children's vocabulary development will be related both with (a) the schooling context in which their literacy develops, and (b) the amount of input received in the family context.

Thus, our research questions are as follows:

- a. What are the vocabulary scores of those bilingual children in Greek and what is the role of instructional input in bilingual children's vocabulary development in Greek across the different educational contexts?
- b. What are their vocabulary scores in German and what is the role of instructional input in their vocabulary development in German across the different educational contexts?
- c. What is those children's language use and input within their home setting in Greek (language index in Greek)?
- d. What is their language use and input within their home setting in German (language index in German)?
- e. What is the correlation between bilingual children's performance in each of the two languages and their index scores across the different educational contexts?

3.2 Data collection and research instruments

In order to address the objectives set, we need to assess children's language dominance and to this aim we used (a) two diagnostic vocabulary tests – one in Greek and one in German, and (b) a 'language index' based on a selection of questions from

a questionnaire children filled in for purposes related to the larger BALED research project. The selected questions that we used examined language use by children, and language input received within their home setting.

Data collection took place between April 2012 and November 2013. The tests and questionnaire were administered on two separate days and children needed approximately 20 minutes to complete the questionnaire and about 5 to 7 minutes to do the tests. The data collection was carried out by Greek and German fieldworkers and children could choose to fill in either the Greek or the German version of the questionnaire.

The tests used were the Greek Expressive Vocabulary Task by Vogindroukas, Protopapas and Sideridis (2009) adapted from Renfrew (1995) and the German Vocabulary Screening (Petermann, Fröhlich & Metz 2010). The Greek test includes 50 pictures (all depicting nouns) which children are required to name. It is a standardized test for monolingual Greek-speaking children aged 4-8. The German Vocabulary Screening test is an expressive vocabulary task and includes 40 pictures (depicting 30 nouns and 10 verbs). The test is monolingually normed and targets 5 to 10-year-old children.

The questionnaire covered the following areas: (a) demographic information, (b) language acquisition and development, (c) literacy development in both languages, (d) language use today, (e) child's language abilities, (f) language background in the family, (g) contacts with the country of origin, and (h) evaluation of bilingualism. However, only questions from the first four sections were used for the language index and one question from section (e): "Which language do you think you understand/speak/read/write better?"

The index was calculated on the basis of the combined scores of the child's answers to four parts of the questionnaire: (i) home language (e.g. the child's language use at home and in school up to the age of 6), (ii) early literacy preparedness (whether the child was exposed to literacy before schooling and in which language(s)), (iii) literacy practices (e.g. additional language courses, use of languages in activities that cultivate literacy such as reading books, writing lists etc.), (iv) current language use (current patterns of child's language use at home and in school and during several practices, e.g. calculating, watching TV etc.).

The questionnaire was turned into a metric; on the basis of the total sum of questions a score was calculated for every participant. The sum was not the same for all, because not all questions could be answered by everyone. For example, to the question "[w]hich language do you use when addressing your siblings?", a child without siblings could not provide any answer. Therefore, his/her total score regarding the language use would differ from that of a child who had siblings and could answer the particular question. In addition, there were questions that concerned the frequency of use of a particular language: For example, "How frequently do you watch TV in Greek?" The possible choices provided were 'often', 'sometimes', and 'rarely'. In this case, only the answer 'often' gave one point whereas the other two answers did not give the participant an extra point but contributed to the total score in each category. This allowed us to discriminate among children who replied 'sometimes' or 'rarely' and children who did not provide any answer to the particular question. For example, a child who answered 'sometimes' or 'rarely' to the particular question would be given 0/1 whereas a child who left the question unanswered would be given 0/0. In order to make results comparable, children's scores were turned into percentages. The particular way of scoring allowed us to quantify the questionnaire results and make comparisons between the contextual, linguistic and cognitive variables.

3.3 Bilingual participants

The present study is based on data from 129 bilingual children who have developed literacy in both Greek and German, albeit to varying degrees. Of these children, 20 were classified as simultaneous bilinguals, 53 as early sequential bilinguals and 53 as late sequential bilinguals, depending on whether they had been exposed to both languages from birth, to an L2 between the ages 1 and 3 or after 3 years of age (respectively). For 3 participants relevant information is not available and was thus not included in our study. At the time of the study participants lived either in Greece or in Germany and attended various types of bilingual education. The children's average age was 10.36 years old and the mean age per school was as follows: German School of Thessaloniki: 9.95, Wuppertal: 9.71, Düsseldorf: 9.76, Krefeld: 12.05 and Cologne: 10.35. As for children's family background, this is similarly varied. Table 1 provides information about the parents' educational background. The information concerns only some of the participating parents as not all of them answered the relevant question.

Table 1. Parents' educational background

	<i>German School of Thessaloniki</i>	<i>Düsseldorf</i>	<i>Wuppertal</i>	<i>Krefeld Junior high school</i>	<i>Cologne</i>
Primary School	0	1	0	6	4
Junior High School	0	1	11	3	1
Senior High School	1	6	12	5	6
Professional training	14	4	7	8	16
University degree	40	0	2	1	20
SUM	54	12	32	23	47

3.4 The research sites

Our study includes five schools – one in Thessaloniki, Greece, and four in Germany. As Table 2 indicates, the particular educational contexts vary significantly as to the amount of language input provided in the two languages. In particular, the German School of Thessaloniki (the only German school in Greece that participated in the study) provides intensive instruction in German but fewer hours in the Greek language. Children in the German School of Thessaloniki are a mixed group as they may come from either Greek-origin or from German-origin families. In the particular school, Greek is taught as a second or as a foreign language for a few hours per week according to whether students are of a Greek- or a German- family background. The amount of language input in the two languages varies according to the grade (cf. Table 2). Based on the aforementioned information, we might suggest that the German School of Thessaloniki is not a clear case of immersion school and therefore we would avoid classifying it as such. However, in our study we are interested in the amount of language instructional input the students receive in each school rather than in the type of bilingual programme each school aims to promote.

The rest of the schools are located in Germany. The 'Greek' schools in Wuppertal and Düsseldorf provide mainly Greek-language instruction to Greek-origin children

following the official curriculum used in state schools in Greece. Moreover, they provide instruction in and through German for one third of the time. The so-called 'Bilingual Programme' in Krefeld is a form of bilingual education whereby Greek-origin students of a mainstream German high-school have the opportunity to attend courses in some subjects in Greek for up to eight hours per week. Finally, the last research site is a 'community' school in Cologne, organized by the Greek state in this case. This school belongs to the type of bilingual education most often available for immigrant children. Greek-origin children attend their mainstream education for thirty hours per week and then attend a course on Greek language and culture for four hours once a week.

Table 2. Research sites and amount of instructional time in each language

	<i>No of students</i>	Languages taught at school (classes per week)		
		<i>Grades</i>	<i>Greek language</i>	<i>German language</i>
German School of Thessaloniki, Greece	42	3 rd -4 th	7	21
		5 th	4	19
		6 th	4-2	28
Greek Schools in Wuppertal and Düsseldorf	42		20	10
Bilingual programme in Krefeld	19		8	16
Afternoon Greek Class in Cologne	26		4	30

If one wanted to make a connection between these schools and models or types of bilingual education, one could say that the German School of Thessaloniki is a form of immersion bilingual education – in the German language – for the Greek learners who learn German both as a foreign language and as a language of instruction. It is also a type of developmental bilingual education for German L1 students who attend only a few hours of Greek classes every week. The Krefeld High School as well as the two schools in Wuppertal and Düsseldorf provide developmental bilingual education, albeit with a different ratio of input offered in the two languages. Finally, the afternoon Greek classes in Cologne are a form a developmental bilingual education which, however, is expected to contribute less to children's progress in the target language, due to the limited amount of teaching time devoted to it and the non-compulsory attendance.

Taking into consideration the above differences among the various types of educational contexts with regard to the amount of input provided in the two languages, we decided to categorize the educational contexts in our study according to (a) the amount of bilingual instruction provided in each educational context, and (b) the use of the minority language in the school curriculum as a medium of instruction or as a subject. This categorization would allow us to relate differences in children's vocabulary performance in the two languages to the amount and type of input received within the educational context. In Table 3, we see the categorization of those schools in four broad educational contexts, based on the criteria (a) and (b).

The first context is the German School of Thessaloniki (context A) where the main language of instruction for all students is German. The second educational context includes both schools in Wuppertal and Düsseldorf (context B) where children's main language of instruction is Greek. The third educational context includes the Bilingual

programme in Krefeld junior high school (context C) which uses German as the main language of instruction. The final educational context includes the afternoon Greek class in Cologne (context D); in this case, children attend a German mainstream school and a supplementary afternoon Greek class. In contexts B, C, and D the majority language of the society is German whereas in context A, the majority language is Greek.

Table 3. *Research sites as bilingual education contexts*

<i>Four types of educational context</i>	<i>Main language of instruction</i>	<i>Lesser-used language is a means of instruction within mainstream education</i>	<i>Dominant language in society</i>
German School of Thessaloniki (A)	German	Yes	Greek
Greek Schools in Wuppertal and Düsseldorf (B)	Greek	Yes	German
Bilingual programme in Krefeld junior high school (C)	German	Yes	German
Afternoon Greek class in Cologne (D)	German	No	German

4. Results

In order to answer the research questions, we first examined bilingual children's vocabulary development in Greek and German and then we looked into the role of instructional input in the two languages across the four educational contexts.

4.1 Comparisons of Greek vocabulary scores across educational contexts

(a) What are the vocabulary scores of those bilingual children in Greek and what is the role of instructional input on Greek vocabulary across the four educational contexts?

Below are presented the mean scores and standard deviations in Greek across all educational contexts.

Table 4. *Vocabulary scores in Greek across all educational contexts*

	<i>German school of Thessaloniki (A)</i>	<i>Greek School in Wuppertal¹ (B)</i>	<i>Greek School in Düsseldorf (B)</i>	<i>Bilingual programme in Krefeld junior high school (C)</i>	<i>Afternoon Greek class in Cologne (D)</i>
Mean scores	30,34/50	32,2/50	31,96/50	22,05/50	21,96/50
Std deviations	12,9	6,4	7,59	9,58	10,7

Kruskal Wallis tests indicated statistically significant differences between groups² ($\chi^2(3)=21.944, p < 0.001$) and Dunn's-Bonferroni posthoc analysis showed statistically significant differences between children's Greek vocabulary scores in the following

¹ The two Greek schools in Wuppertal and in Düsseldorf belong to the same educational context (B) but for the sake of clarity we are presenting their vocabulary scores separately in Tables 4 and 5.

² By 'groups' we refer to the educational contexts presented above (section 3.4).

cases: Children at the German School in Thessaloniki (context A) (mean rank=71.74) scored significantly higher in Greek than children in the Bilingual Program of Krefeld (context C) (mean rank=43.21) and those in the afternoon classes of Cologne (context D) (mean rank=44.0). Children attending the Greek schools in Wuppertal and Düsseldorf (context B) (mean rank=78.70) scored significantly higher in Greek than children in the educational contexts C (mean rank=43.21) and D (mean rank=44.0). In other words, bilingual children attending the German School in Thessaloniki and the Greek schools in Wuppertal and Düsseldorf scored significantly higher in the Greek vocabulary test than bilinguals of the other two educational contexts.

4.2 Comparisons of German vocabulary scores across educational contexts

(b) What are the vocabulary scores of those bilingual children in German and what is the role of instructional input on German vocabulary across the four educational contexts?

Below are presented the mean scores and standard deviations in German across all educational contexts.

Table 5. Vocabulary scores in German across all educational contexts

	<i>German school of Thessaloniki (A)</i>	<i>Greek School in Wuppertal (B)</i>	<i>Greek School in Düsseldorf (B)</i>	<i>Bilingual programme in Krefeld junior high school (C)</i>	<i>Afternoon Greek class in Cologne (D)</i>
Mean scores	31,16/40	23,55/40	28,37/40	33,89/40	35,52/40
Std deviations	6,4	6,9	6,8	2,6	2,7

In order to examine the role of instructional input in bilingual children's vocabulary development in German, we compared children's German vocabulary scores across the four educational contexts. Once more, Kruskal Wallis tests indicated statistically significant differences between groups ($\chi^2(3)=38.320$, $p<0.001$). Dunn's-Bonferroni posthoc analysis showed that children in context B (Greek schools in Wuppertal and Düsseldorf) scored significantly lower in German than students in any other school (mean rank=31.27, compared to A=60.42, C=71.24, D=85.18). Finally, children in the afternoon class of Cologne (context D) scored significantly higher in German than children at the German School in Thessaloniki (context A). Thus, in sum, the bilingual children attending the Greek schools in Germany (educational context B) did *significantly better in the Greek vocabulary test* than most other participants (educational contexts C and D) and *significantly worse in the German vocabulary test* than children attending all other bilingual educational contexts.

4.3 Comparison of language index across educational contexts

After comparing bilingual children across all educational contexts on their vocabulary development in the two languages, we also compared them with respect to the amount of language input they receive at home in the two languages. To this aim, we took into consideration the language index as this was estimated on the basis of children's answers to relevant questions.

(c) What is those children's language use and input within their home setting in Greek (language index in Greek)?

Below are presented the results of the Greek language index across all educational contexts.

Table 6. Greek index comparisons across all educational contexts

	<i>German school of Thessaloniki (A)</i>	<i>Greek Schools in Wuppertal and Düsseldorf (B)</i>	<i>Bilingual programme in Krefeld junior high school (C)</i>	<i>Afternoon Greek class in Cologne (D)</i>
Mean rank	51.61	93.63	55.74	45.79

For the comparison of the Greek language index scores across all educational contexts we employed the Kruskal Wallis test; this showed that there is a statistically significant difference between groups ($\chi^2(3)=38.063$, $p < 0.001$). In particular, children in context B (Greek schools in Wuppertal and Düsseldorf) have higher scores of Greek language use than students in any other school (mean rank=93.63 in comparison to A=51.61, C=55.74, D=45.79).

(d) What is their language use and input within their home setting in German (language index in German)?

Below are presented the results of the German language index across all educational contexts.

Table 7. German index comparisons across all educational contexts

	<i>German school of Thessaloniki (A)</i>	<i>Greek Schools in Wuppertal and Düsseldorf (B)</i>	<i>Bilingual programme in Krefeld junior high school (C)</i>	<i>Afternoon Greek class in Cologne (D)</i>
Mean rank	75.57	27.39	85.42	89.85

Similarly, for the German language index score, the Kruskal Wallis test gave a statistically significant difference between groups ($\chi^2(3)= 63.001$, $p < 0.001$). In particular, children in schools B (Greek schools in Wuppertal and Düsseldorf) scored lower in German language use than children in any other school (mean rank=27.39 in comparison to A=75.57, C=85.42, D=89.85).

These results are in tune with the vocabulary test scores in the two languages as these have been presented above. Based on the language index scores in the two languages, the use of Greek language at home is significantly higher for children attending the Greek schools in Germany (educational context B) than for any other children, including those attending the German school in Greece; on the contrary, those children (educational context B) are exposed to significantly lower input of German within the home setting.

4.4 Correlation analysis

(e) What is the correlation between bilingual children's performance in vocabulary scores in both languages and their index scores across the different educational contexts?

In order to examine the impact of home language input on children's vocabulary development, a correlation analysis was carried out between vocabulary scores in each language and children's index scores for each of the two languages in every educational context.

4.4.1 Educational context A: German School of Thessaloniki

With respect to the first educational context, a very strong positive correlation ($\rho=0.82$, $p<0.001$) was found between the index values of Greek and the Greek vocabulary score of those children (Table 8). In particular, an increase in index values of Greek was very strongly associated with an increase in Greek vocabulary score. What the correlation analysis also showed was a strong negative correlation between index values of Greek and German vocabulary score ($\rho=-0.64$, $p<0.001$): an increase in index values of Greek was strongly associated with a decline in German vocabulary score.

Table 8. Correlation Analysis for Group A – German School of Thessaloniki

Correlation Results			
Vocabulary Scores	Total indexes		
	Greek	Both	German
Greek	$\rho=0.82$, $p<0.001$	$\rho=0.06$, $p=0.72$	$\rho=-0.72$, $p<0.001$
German	$\rho=-0.64$, $p<0.001$	$\rho=-0.11$, $p=0.47$	$\rho=0.62$, $p<0.001$

Similarly, a strong positive correlation ($\rho=0.62$, $p<0.001$) was found between the index value of those children in German and their German vocabulary scores; on the other hand, an increase in index values of German was strongly associated with a decline in Greek vocabulary score ($\rho=-0.72$, $p<0.001$).

4.4.2 Educational context B: Greek Schools in Wuppertal and Düsseldorf

In the case of the second educational context, a weak negative correlation was found between the index value of Greek and their German vocabulary scores (correlation $\rho=-0.37$, $p=0.04$): an increase in index values of Greek was weakly associated with a decline in German vocabulary score (Table 9).

Table 9. Correlation Analysis for Group B – Wuppertal and Düsseldorf Schools

Correlation Results			
Vocabulary Scores	Total indexes		
	Greek	Both	German
Greek	$\rho=0.13$, $p=0.41$	$\rho=-0.12$, $p=0.94$	$\rho=-0.25$, $p=0.12$
German	$\rho=-0.37$, $p=0.04$	$\rho=0.25$, $p=0.16$	$\rho=0.26$, $p=0.15$

4.4.3 Educational context C: Bilingual programme in Krefeld

As regards the third educational context, a strong positive correlation ($\rho=0.745$, $p<0.001$) was detected between index values of Greek and the Greek vocabulary score: an increase in index values of Greek was strongly associated with an increase in Greek vocabulary score. Conversely, an increase in index values of Greek was moderately associated with a decline in German vocabulary score (negative correlation, $\rho=-0.554$, $p=0.014$) (Table 10).

Table 10. Correlation Analysis for Group C – Krefeld school

Correlation Strength and Type			
Vocabulary Scores	Total indexes		
	Greek	Both	German
Greek	$\rho=0.745, p<0.001$	non significant	$\rho=-0.554, p=0.014$
German	non significant	non significant	non significant

4.4.4 Educational context D: Afternoon Greek Class in Cologne

Finally, with respect to the fourth educational context, we found a moderate positive correlation ($\rho=-0.471, p=0.018$) between children's index values of German and their German vocabulary score: An increase in index values of German was moderately associated with an increase in German vocabulary score (Table 11).

Table 11. Correlation Analysis for Group D – Kologne school

Correlation Strength and Type			
Vocabulary Scores	Total indexes		
	Greek	Both	German
Greek	non significant	non significant	non significant
German	non significant	non significant	$\rho=-0.471, p=0.018$

4.5 Regression analysis

In order to explore whether the bilingual children's Greek and German language indexes can predict their Greek and German vocabulary scores, we carried out two multiple regression analyses. The first one aimed to study the relation between the score type (Greek or German) dependent variable and Greek and German language indexes (independent variables) for all students who participated in the study. For this purpose one group was produced by merging all individual groups of student populations (A, B, C and D), which allowed us to examine whether children's vocabulary scores are generally affected by the educational context (A, B, C and D).

(a) Greek vocabulary score

A multiple regression was performed to explore whether bilingual children's Greek and German language indexes can predict their Greek vocabulary score. There was independence of errors implied by the Durbin-Watson statistic of 1.840. Tolerance values of .421 for both independent variables did not indicate any multicollinearity problem. Regression model was significant and independent variables explained 35.3% of the variance of Greek language score, ($F(2, 124) = 35.3, p < .001, \text{adj. } R^2 = .353$). Both independent variables added significantly to the prediction, $p < .05$.

(b) German vocabulary score

A multiple regression was performed to investigate whether children's Greek and German language indexes can predict their German vocabulary scores. There was independence of errors implied by the Durbin-Watson statistic of 1.767. Tolerance values of 0.433 for both independent variables did not indicate multicollinearity problem. Regression model was significant and independent variables explained

42.3% of the variance of German language score ($F(2, 115) = 45.398, p < .001, \text{adj. } R^2 = .423$). Both independent variables contributed significantly to the prediction, $p < .05$).

As shown above, the Greek and German language indexes can predict to a significant degree bilingual children's vocabulary scores in both Greek and German. Thus, we proceeded by conducting a multiple regression analysis in order to study the relation between the language score in Greek and German (dependent variable) and the Greek and German language indexes (independent variables) for each of the four educational contexts separately (A,B,C,D groups). For each group, assumption testing focused on multicollinearity and independence of residuals. Violation of these assumptions can severely affect the validity of regression model results. Tolerance values were well above the threshold of 0.2 indicating that multicollinearity was not a problem and Durbin-Watson values were within the acceptable 1.5 to 2.5 range suggesting independence of residuals. Any missing values were handled by use of the listwise deletion method. The presence of outliers with absolute values of standardized residuals above 3.0 standard deviations (std) was also investigated.

4.5.1 Educational context A: German School of Thessaloniki

(a) Greek vocabulary score

A multiple regression was performed to predict the Greek language score from Greek and German language indexes. There was independence of errors implied by the Durbin-Watson statistic of 1.958. Tolerance values of .364 for both independent variables did not indicate multicollinearity problem. The regression model was significant and independent variables explained 62.0% of the variance of Greek language score, ($F(2, 39) = 34.384, p < .001, \text{adj. } R^2 = .62$). Only the Greek index variable added significantly to the prediction ($p < .05$).

(b) German vocabulary score

A multiple regression was conducted to predict the German language score from Greek and German language indexes. There was independence of errors implied by the Durbin-Watson statistic of 1.819. Tolerance values of 0.991 for both independent variables did not indicate multicollinearity problem. The regression model was significant and independent variables explained 45.3% of the variance of German language score, ($F(2, 39) = 17.968, p < .001, \text{adj. } R^2 = .453$). Only the Greek index variable contributed significantly to the prediction ($p < .05$).

4.5.2 Educational context B: Greek Schools in Wuppertal and Düsseldorf

None of the respective multiple regression analyses conducted for this group was significant, suggesting that there is no significant relation between the examined dependent and independent variables.

4.5.3 Educational context C: Bilingual programme in Krefeld

(a) Greek vocabulary score

A multiple regression was performed to predict the Greek language score from Greek and German language indexes. There was independence of errors implied by the Durbin-Watson statistic of 2.064. Tolerance values of 0.784 for both independent variables did not indicate multicollinearity problem. The regression model was significant and independent variables explained 60.0% of the variance of Greek

language score ($F(2, 16) = 14.463, p < .001, \text{adj. } R^2 = .60$). Both independent index variables were significant for the prediction ($p < .05$).

(b) German vocabulary score

Multiple regression analysis for German score prediction conducted in group C was not significant, suggesting that there was no significant relation between the examined dependent and independent variables in this educational context.

4.5.4 Educational context D: Afternoon Greek Class in Cologne

(a) Greek vocabulary score

Multiple regression analysis conducted in group D for the Greek index was not significant, suggesting that there was no significant relation between the examined dependent and independent variables.

(b) German vocabulary score

One outlier, with absolute standardized residual above 3.0 std, was detected. Its removal substantially altered the regression model to significant ($F(2, 21) = 5.704, p = .011$) from non significant ($F(2, 22) = 2.140, p = .143$). Thus it was decided to proceed and perform the multiple regression analysis of the group data without the outlier. Multicollinearity and independence of residuals were met as was evident from their respective decision values of Tolerance=.563 and Durbin-Watson=2.238. The regression model was significant and independent variables explained 29.0% of the variance of German language score ($F(2, 22) = 2.140, p < .001, \text{adj. } R^2 = .29$). Only the German index variable added significantly to the prediction ($p < .05$).

5. Discussion and concluding remarks

Our study aimed to examine the role of language input in Greek and in German in the vocabulary development of Greek-German bilingual children who live either in Greece or in Germany. For the purpose of this study, the amount and type of language input were examined in both the educational and home settings. Our first research hypothesis was that children's vocabulary development in the two languages would be related to the educational context they attend. All participants attended a bilingual type of education but the five schools included in this study – four in Germany and one in Thessaloniki, Greece – did not follow the same language curriculum; as a result, the amount of bilingual input varied widely among the schools. In particular, the afternoon Greek class in Cologne and the two Greek schools in Germany represented the two extremes in this variation: children attending the afternoon Greek class in Cologne received 30 hours of German language instruction and only 4 hours of Greek, whereas the Greek schools in Wuppertal and Düsseldorf provided 20 hours of Greek language instruction and only 10 hours of German (see Table 2). In order to estimate the impact of the language input received at school on children's vocabulary development in Greek and in German, we categorized the five schools into four broad categories according to the relative amount of instruction provided in each language. This categorization allowed us to relate the language input received in each context with the vocabulary scores achieved by children in German and in Greek.

Unsurprisingly perhaps, children's vocabulary scores in German and Greek were found to reflect differences in the amount of language input received within the school curriculum. Thus, increased exposure to a particular language at school was reflected

on higher vocabulary scores in that language, and, conversely, decreased exposure to a language within the school context resulted in lower vocabulary scores in the particular language. As previously mentioned, the vocabulary scores in German attained by the bilingual children at the Greek schools in Germany (Wuppertal and Düsseldorf) were significantly lower than those attained by any other group of children; conversely, their Greek scores were significantly higher than most other bilingual children's respective scores. Such differences seem to be attributed to the high Greek language input and to the low German language input received at their schools compared to that provided in the rest of the school contexts. Such findings are in tune with previous research by Hoff *et al.* (2012), according to which, measures of vocabulary and grammar were found to be related to the relative amount of input in that language.

What is surprising, however, is the fact that children from the Greek schools in Wuppertal and Düsseldorf (context B) scored significantly higher in Greek and significantly lower in German than children in the German School of Thessaloniki (context A). We remind the reader that the students of context A were quite a mixed student population as it included both children with L1 German and children with L1 Greek. So, some of them at least could not be expected to have a high competence level in Greek while, conversely, others could not be expected to have reached high competence levels in German, which may explain why overall these children did significantly worse in Greek and significantly better in German than children of Wuppertal and Düsseldorf (context B). The fact that those children were such a mixed group of participants may also explain why they scored significantly lower in German compared to children in the afternoon classes of Cologne (context D).

Overall, our sample is quite small and only tentative conclusions might be drawn from these results. We suggest, however, that the particular findings might indicate that exposure to increased input in a particular language within the school curriculum impacts on the vocabulary development in this language, irrespective of the majority language of the society. Bigger population samples would be necessary in order to confirm our suggestion. Conversely, as children's vocabulary results in Greek at the Bilingual programme in Krefeld and in the afternoon class in Cologne indicated, weak language support in the minority language does not seem to promote the vocabulary development of this language. Based on the aforementioned results, our first hypothesis, namely that bilingual children's vocabulary development will be related to the schooling context in which their literacy develops, is clearly confirmed.

Our second research hypothesis was that bilingual children's vocabulary development will be related to the amount of input received in the home setting.

Regression and correlation analyses indicated that bilingual children's vocabulary development is related to the amount of language input received within the family setting. The results of the regression analysis indicated that the language index scores, that is, the extent to which bilinguals are exposed to the two languages and use them within the home setting, is, in some cases at least, a good predictor of their vocabulary development in both of these languages. In particular, in the case of the German School in Thessaloniki, children's Greek language index scores predicted to a significant degree their scores in both German and Greek vocabulary tests.

This is an interesting finding as the Greek language index is found to be a better predictor of children's German language scores than their German language index. In the case of Krefeld (context C), we found that both language indices (*viz.* the amount of both Greek and German used at home) can predict to a highly significant degree children's Greek language scores. Finally, in the last educational context (afternoon

classes in Cologne), the German language index was found to predict significantly children's German vocabulary scores. In addition to those results, the correlation analysis indicated that high minority language use at home correlates positively with minority language vocabulary development and negatively with majority language vocabulary development. This finding was consistent across all four contexts, i.e. groups of children. On the basis of the aforementioned results, our second research hypothesis is also confirmed.

With respect to these findings, it is worth discussing the case of Wuppertal and Düsseldorf schools (context B). The language index results in those schools indicated significantly higher use of Greek and significantly lower use of German in comparison to children in all other educational contexts. These bilingual children have been raised in a Greek speaking environment; their exposure to Greek started very early, at a pre-school age, and Greek probably remains for them the main language of oral and written communication. Such rich input in the minority language at home has a positive impact on their performance in Greek but a negative impact on their vocabulary development in German: these children scored significantly higher in the Greek language tests and significantly lower in the German tests than children of any other educational context. Dixon, Zhao, Quiroz and Shin's study (2012) similarly indicated that parents' use of the ethnic language when addressing their children has a strong positive effect on the vocabulary of this language whereas use of the majority language has a negative effect on children's vocabulary in the ethnic language.

A finding of this study that seems to have important pedagogic implications but also implications for issues related to family language policy is that the use of the minority language at home and the increased input of this language within the school setting may override the effect of the majority language of the society on bilinguals' language development. This means that choices related to the language input and use in the home setting but also in the educational setting are decisive determinants for children's bilingual development.

Overall, our results corroborate recent findings by Hoff *et al.* (2012) as well as by Hammer *et al.* (2014) which suggested that bilingual children's language development is affected by their exposure to their two languages; the more they are exposed to a particular language, the higher their abilities in that language.

Acknowledgements

This research was supported by European Union (European Social Fund – ESF) and Greek national funds through the Operational Program “Education and Lifelong Learning” of the National Strategic Reference Framework (NSRF) - Research Funding Program: Thales. Investing in knowledge society through the European Social Fund.

We thank Professor Christiane Bongartz and Dr. Eva Knopp from the University of Cologne for helping us with the data collection and Maria Andreou in particular for the actual data collection. We also thank Professor Ianthi-Maria Tsimpli, from the University of Cambridge for her support and her useful comments throughout the research. We would also like to show our gratitude to Sotiris Tantos for helping us with the statistical analysis of the data.

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