L1 and L2 vocabulary acquisition in Greek primary schools

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Research emphasises that vocabulary development is essential for the successful acquisition of a language (e.g. Biemiller, 2003; Alexiou et al, 2019). The volume of words learners are familiar with is thought to be a key influence on how well the lexicon functions in all linguistic domains (Webb & Nation, 2017). It is argued, too, that a speaker's L1 vocabulary may influence success in educational attainment as in the learning of an L2. This paper examines the L1 and L2 vocabulary knowledge of learners in Greek primary schools. The subjects were 411 Greek primary school students, ranging from the first to the sixth grade of primary school. Their vocabulary was assessed using two vocabulary measuring tools: Meara & Milton's X-Lex (2003) and Alexiou's Pic-lex (2019) for receptive vocabulary knowledge. Results suggest Greek L1 learners grow a lexicon of a size and at a rate consistent with learners of L1 English and Arabic. There is surprisingly little variation between learners of the same age. These learners grow English L2 vocabulary at an impressively fast rate and, by international comparisons, achieve high levels of communicability by the end of primary education. Again, there is surprisingly little variation. Comparing, L1 and L2 knowledge and progress, it is not clear that L1 vocabulary knowledge can or does influence the learning of the L2.

Key words: vocabulary, L2 vocabulary, receptive, assessment, young learners, word-gap

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1. Background

Every native speaker of Greek will need to complete the huge task of learning Greek vocabulary. And yet we know very little about the growth of the lexicon in Greek. How many words are learned? How many words are needed to become fluent and like other speakers? How quickly are these words learned? Is progress in learning regular or episodic? However, understanding the lexicon in young learners is important since it is thought to associate, maybe even underpin, educational success and attainment. There is an idea – the word gap hypothesis – that in North American English there are substantial and systematic differences in vocabulary development that drive the lack of educational attainment in some groups, and consequently, social exclusion and even crime (Hart & Risley, 1995).

L1 Greek vocabulary size and quality may drive, therefore, the progress of subjects in the Greek curriculum such as L2 learning of EFL. We know rather more of EFL learning than we do of the learning of L1 Greek. We know there is variation in L2 learning (Milton, 2011). However, because we know

nothing about the growth of the L1 in Greek, we have no idea if this can influence the learning of L2 English in Greece.

The purpose of this paper, therefore, is to report estimates of Greek L1 and English L2 vocabulary size among primary age learners, and to consider whether there is any basis for thinking that the word gap phenomenon might exist in Greece.

1.1. L1 learning

A lexicon of an appropriate size and quality is essential for language. It is important in itself, of course, but Webb and Nation (2017), suggest that acquiring lexical knowledge—defined as the variety of words we know and how well we know them—lays the groundwork for mastering other linguistic concepts. Numerous studies have shown that early vocabulary development impacts positively on later reading achievement, and is linked with future academic success (Sénéchal et al, 2006; Biemiller & Slonim, 2001; Milton & Treffers-Daller, 2013).

Characterising vocabulary knowledge in terms of numbers of words is a challenge in very young learners. Their cognitive development is still immature, thus the educational and psychological strategies used in communicating and assessing language, must be completely different from those used with older students (Prosic-Santovac, 2017). Taking into account their individual differences is crucial, namely both their cognitive and the affective elements of their disposition (Mattheoudakis & Alexiou, 2009). Young children's attention spans are incredibly short. Because of this, they get tired or bored very easily and may act out, particularly if a task seems pointless, difficult, or does not immediately pique their interest (Pinter, 2011; Alexiou, 2015; Alexiou et al, 2019). A methodology for assessing vocabulary size in such learners has yet to be developed. Despite this, it is thought young learners can acquire words and language with great facility. According to recent research, young learners can pick up new words with only one encounter (Tiefenthal, 2008 cited in Alexiou et al, 2019) and exposure to real language can result in incidental vocabulary learning (Alexiou & Yfouli, 2019).

Learners of this age present issues which challenge assessment in other ways, such as trying to assess vocabulary knowledge in terms of single words assessed by sampling a spread of words across the frequency bands. Particular classes of words, nouns that are concrete and simple to portray and translate are frequently taught to very young learners and may lay the foundation of the very early lexicon (Kersten, 2015). However, as Jóhannsdóttir's (2022) study shows, pre-school learners in Iceland can pick up a surprisingly large volume of highly frequent and structural vocabulary, perhaps about half of the most frequent 1200 words in English, from purely informal use of video games and from watching TV programs such as Peppa Pig. Additionally, most experts agree that young learners store language in lexical chunks or fixed phrases (Lewis, 2002; Muñoz, 2007). Even before children reach the final phases of cognitive development, this so-called prefabricated language is frequently used in early language learning in both their first and their second language (Wray, 2002). Songs, rhymes, classroom discourse, and caregivers' speech are all instances of the formulaic language that such learners encounter on a daily basis (Cameron, 2001; Bannard & Lieven, 2009).

As a result, the early language generated by very young children includes a range of fixed expressions (Wray, 2002), which helps them sound natural and become more fluent (Kersten, 2015; Milton & Alexiou, 2012). Nevertheless, some youngsters use formulaic language sparingly, whilst other children frequently use formulae in their speech. It seems that the child's concept of the purpose of language, can play a vital role in shaping the strategy that is taken to learning (Wray, 2002). While referential language is typically split down into individual words, expressive language tends to be stored as a whole. The key to successful language learning seems to be the combination of set sentences and single lexical elements (Kersten, 2015).

Perhaps it is not surprising, then, if much of what we know about the development of vocabulary knowledge is deduced from studies of adult learners with well-formed lexicons. Goulden et al (1990) estimate that adult educated speakers of English know approximately 17,200 words. From this Schmitt and McCarthy (1997) estimate that children acquire 1000 words annually. This number is, broadly, supported by other studies. Biemiller and Boote (2006), for example, suggest that children typically have learned the meanings of 6,000 root words by the end of second grade – aged 7 or 8 therefore. They report a wide range of scores, however. Children from families in higher socio-economic backgrounds knew 8000 root words, whereas those in the lower groups knew only 4,000. Other studies have yielded slightly lower figures, while other more recent studies employing frequency-based testing using the lemma as the measurement unit have found that children's lexical growth occurs at a rate of roughly 600 words per year (e.g., Biemiller & Slonim, 2001; Coxhead et al, 2015; Milton & AlSager, 2017). If young native speakers are picking up vocabulary at a pace of around two words per day, or 600 words per year, it becomes theoretically conceivable to catch up on any gaps in some learners' knowledge through explicit teaching and the differences in groups of different socio-economic status observed in Biemiller and Slonim's (2001) study appear, from their own data, to have largely disappeared after several years of formal education.

There are some well-constructed estimates of the L1 vocabulary sizes of learners across the primary age range, at least in English and these are summarised in Table 1. The Milton and Alsager (2017) estimate is drawn from a test of the most frequent 10,000 words in English and there will likely be some under-estimation particularly where ceiling effects come into play among the highest scores. The Biemiller and Slonim estimate comes from a test based on a school textbook corpus and the ceiling for this test is unknown. Nonetheless, these estimates appear to confirm the idea that L1 learners will probably add about 2 new words a day to their lexicon throughout primary level education.

Year	Age	Milton & AlSager (2017)	Beimiller & Slonim (2001)
3	7-8	5071	5301
4	8-9	5800	5759
5	9-10	6828	6699
6	10-11	7318	7784

Table 1: Measurements of vocabulary size in primary age children

The development of the L1 lexicon in Greek appears to be unknown and, to our knowledge, there are no studies of the growth of Greek L1 vocabulary size at primary school age or younger in the literature.

1.2. L2 vocabulary learning

While L1 learners acquire their vocabularies from naturalistic exposure, L2 learners are typically characterised by formal learning of the subject in a classroom setting. Progress will vary according to the quantity and the quality of teaching, therefore. Nonetheless, some guiding principles have emerged about the nature of L2 learning. According to Milton and Meara (1998) and Laufer (2010), students typically learn between two and five new words following an hour of classroom exposure to English as a foreign language. The rate of vocabulary uptake in class can be used as a gauge of the effectiveness of classroom teaching as in Milton (2011). The relationship between vocabulary size and proficiency also allows progress, and learning targets to be convincingly established. This is demonstrated in Table 2 where vocabulary size is linked to the levels on the CEFR and to formal exams. As Table 2 demonstrates, students will likely require at least 1500 lemmatised words in English to advance from the CEFR A1 to A2 level and perhaps 1500 additional words to attain the B1 level (Milton, 2009). A vocabulary size in the high thousands, certainly over 5000 words, is required for anything like fluency in a European foreign language.

Vocab size (max 10,000)	Vocab size (max 5,000)	Cambridge	TOEFL	IELTS	CEFR level
9000			630	8	
8000/9000	4500 - 5000	CPE	620	7	C2
7000/8000	3750 - 4500	CAE	600	6.5	C1
6000/7000			550	6	
5500/6000			500	5.5	
4500/5500	3250 - 3750	FCE	450	5	B2
About 4000	2500 - 3250	PET	350-400	4.5	B1
About 3500	1500 - 2500	KET	300	4	A2

Table 2. Summarized from Milton and Hopwood (2022, p. 64-5)

While Table 1 has demonstrated that acquiring 5000 words is normal in native speakers at a young age, Alexiou and Konstantakis (2009) recognise that this is considered very challenging for non-native speakers taking English language classes at private language schools. While learners may learn 600 to 1000 lexical items every year in their L1, Nation (1990) estimates that these same learners will likely pick up between only 1000 to 2000 word families in their L2 during their five years of exposure to formal language teaching. As Konstantakis and Alexiou point out, however, individual outcomes may differ (2012), and there will be variation according to the circumstances of learning. The rate of L2 learning Nation (2001) observes would be considered ambitious in many L2 learning environments.

While Vassiliu (2001) can report that his L2 English language learners could master 500 of the 5000 most frequent words, annually over the course of teaching to the FCE exam, perhaps 5-7 words per classroom hour, Milton and Meara (1998) in a review of rates of vocabulary uptake suggest that this is exceptional. Nonetheless, the idea that learning hundreds of words in the L2 persists. For example, according to Cameron, 500 words a year would be the ideal and most useful number of words (2001). For L2 learning to be this successful, certain conditions of vocabulary presentation are essential. As Scholfield (1991) points out, with volumes of learning this large, the learning load must be spread out, relatively evenly and in manageable amounts, across the time available for learning. Failure to do this can inhibit learning or impose near impossible demands on the learner.

Detailed studies of L2 vocabulary acquisition in Greek primary schools are lacking, however, there is some evidence (Rodousaki & Alexiou, 2021) that these young learners make good and regular progress towards the higher level vocabulary goals provided in Table 2, and compare well with other young learners internationally. Further studies are needed both to confirm these conclusions and help us understand the learning process at this young age, and to provide normative data so that standards over time can be monitored.

1.3. Links between L1 and L2 vocabularies and the word gap

Young learners at primary age in Greece are not only learning vocabulary for their foreign language, they are simultaneously growing their first language lexicon, too. The size of a learner's L1 lexicon is thought to impact on the speed of acquisition, and ultimate size, of the developing L2 lexicon (Masrai & Milton, 2015). As noted from the research of Biemiller and Slonim (2001) there is an idea that L1 lexicons can vary considerably in young learners and that this is linked to subsequent educational success. An understanding of L1 vocabulary development is important, therefore.

While studies of L1 vocabulary acquisition report comparatively large-scale and regular learning as a generality, there is a theory that there is a shortage of explicit, rich, purposeful vocabulary education in primary grade curricula or educational settings, and in the general language backgrounds of some

learners in particular. Hart and Risley use the term Word Gap to refer to this phenomenon (1995). Over the years some learners, then, will miss opportunities to be exposed to and develop their vocabulary sufficiently well to take best advantage of the educational system, and this is likely to start from the very earliest stages of learning. Additionally, it is reported that the word gap is widening as seen by the majority of instructors' testimonials, affecting not only the learner's academic performance, but also having unpredictable repercussions in various other aspects of life (Oxford University Press, 2018; Alexiou & Milton, 2020). An outcome of this idea, as noted by Graves (2006), is numerous initiatives to help lexically impoverished children increase their vocabulary knowledge, (see Whitehurst et al, 1988; Beck & McKeown, 2001; Biemiller, 2003; Juel & Deffes, 2004). The word gap theory then is widely and uncritically accepted as fact and used as the basis for educational practice.

The word gap theory has to be taken seriously, then, because it is so widely accepted and used, however, there are many problems associated with it which should undermine its credibility. It is widely criticised and condemned (for example, Dudley-Marling & Lucas, 2009); Michaels, 2013; Nation, no date). Nation's criticism is particularly damning since it points to serious deficiencies in Hart and Risley's (1995) testing method which does not test vocabulary size at all. The conclusions they draw about differences in vocabulary size are meaningless, therefore. Wilson et al (2016) point to the absence of a working model of a developing lexicon in Hart and Risley (1995). Wilson et al's (2016) research shows that the lexicons of educational high achievers are very similar in size to those of educational low achievers and both, on average, are of a size that should make high education performance possible. Wilson et al's (2016) evidence indicates, too, that there is no reason for thinking that vocabulary sizes of English speakers are declining over time. A speaker's lexicon will continue to grow with age, not least as neologisms are added. The fact that young people will tend on average to have smaller measured vocabularies than older people is not an indication of a decline in vocabulary size. Rather, these systematic differences in the vocabulary size are an artifact of the way lexicons develop with age.

It is hard to find convincing empirical evidence that supports the idea of the word gap and there is no accepted model of how a vocabulary should develop in native speakers. It should not be a surprise, therefore, that in intervention studies little, if any, justification is provided regarding the selection of words, nor the number of lexical items included. There is little or nothing to indicate the degree of success resulting from intervention programs. There are no longitudinal studies that can demonstrate a decline in vocabulary size over time or the benefits of intervention. The idea that vocabulary-rich input plays a decisive role in fostering language and academic development in very young students, appears to be an article of faith rather than the product of well-directed research. There is clearly a need for well-constructed data collection to establish vocabulary sizes in school learners and whether this might inter-relate with academic learning, as in the acquisition of a foreign language in school. There are no studies of the word gap in the Greek language context so, as a result, it is essential to measure vocabulary size routinely in both monolingual and multilingual contexts since it can help us develop a much-needed model of vocabulary acquisition in young children.

2. The Study

2.1. Aims and Objectives

The development of L1 vocabulary size and the word gap phenomenon have not been examined in Greece yet. There are no studies that can suggest how an L1 Greek lexicon develops in terms of size in childhood. This study aims to examine this vocabulary question in the context of Greek mainstream primary schools in Rhodes, Greece. The broad intention, then, is to establish figures for L1 vocabulary size. There are few studies which establish norms for lexical development in the context of L2 English

learning in schools, nor how this learning might inter-relate with the size of the L1 lexicon. A further broad intention of this study, then, is to establish vocabulary size figures for learners of EFL in primary schools. Armed with some good data in these two areas, it becomes possible to consider whether the two sets of figures might be related. If there is any basis at all to the word gap idea then a relationship between vocabulary size and educational attainment will be clearly visible.

The specific objectives in this paper are:
1. To test the Greek vocabulary sizes of learners in primary school and compare these scores with established data from other studies of L1 vocabulary size at this age
2. To test the EFL vocabulary sizes of learners in primary school and compare these scores with other studies of L2 vocabulary learning, and against the goals of learning in primary level EFL
3. To compare the learners' L1 and L2 scores to investigate whether the two correlate as might be anticipated by the word gap hypothesis

2.2. Methodology

2.2.1. Participants

Four hundred and eleven Greek primary school students (1st - 6th grade) took part in the study. The children had English instruction (45-minute EFL lessons) as a part of their school's syllabus twice a week for the first, second and third grades and three times a week for the fourth, fifth and sixth grades. These schools have not been selected because they are particularly good or bad, or because they draw learners from a particular socio-economic status. Rather, it is thought, they are a cross-section of schools and participants that might fairly represent the primary sector in Greece as a whole.

2.2.2. The tests

Two vocabulary measurement tools were utilized. Meara and Milton's X-Lex (2003) and Alexiou's Pic-lex (2019) (see the Appendix) were administered to measure the young learners' receptive vocabulary knowledge. X-Lex, (Meara & Milton, 2003) is a test of passive word recognition which measures the knowledge of the 5,000 most frequent lexical items while its raw scores produce an estimate of receptive vocabulary size within the most frequent 5, 1000 word frequency bands. It is considered to produce valid and reliable estimates of vocabulary size (Milton, 2006). The Greek version of the test was produced by Milton and Alexiou (2008). Pic-lex (Alexiou, 2019) is intended for very young learners, assessing the testee's receptive vocabulary size. It is based on picture and audio cues, it contains only nouns and comprises a principled selection of the 5000 most frequent words. The main difference from X-Lex is that is delivered aurally through the use of tablets or computers in the form of a game, since tests that resemble games on the surface are preferable for young learners (Alexiou & Milton, 2020). Both tests can be tied back to CEFR levels for comparable estimates. Both tests were administered in English and Greek.

2.2.3. Procedure

The assessment took place during the school year of 2020-2021, once at the beginning of the teaching year (September-October) and the same procedure was repeated in the end towards the end of the same school year (May-June) to measure the young learners' lexical progress.

3. Results

3.1. The Greek vocabulary sizes of learners in primary school

The passive receptive vocabulary sizes of learners, out of the most frequent 5000 words and as measured by X-Lex, a test of recognition of the written form of words, is shown in Table 3.

Year	Age	X-Lex Gr September	SD	X-Lex Gr June	SD
1	6-7	671.42	293.22	850.00	289.80
2	7-8	1298.27	325.86	1506.89	326.02
3	8-9	2110.34	337.65	2389.65	339.08
4	9-10	2906.06	277.28	3233.33	270.80
5	10-11	3633.33	326.48	3983.33	326.48
6	11-12	3913.11	438.45	4279.50	426.74

Table 3. Vocabulary sizes measured by X-Lex

The vocabulary sizes of learners, out of 5000 and as measured by Pic-lex are summarized in Table 4.

Year	Age	Pic-lex Gr September	SD	Pic-lex Gr June	SD
1	6-7	2505.71	447.98	2685.00	449.90
2	7-8	3144.82	331.49	3294.82	331.49
3	8-9	3940.51	253.65	4111.20	252.71
4	9-10	4196.21	226.90	4376.51	230.92
5	10-11	4365.21	212.01	4515.21	212.01
6	11-12	4735.24	206.62	4837.70	203.03

Table 4. Vocabulary sizes measured by Pic-lex

3.2. The EFL vocabulary sizes of learners in primary school

The learners in this study take English as foreign language in primary school and the growth of vocabulary sizes, year on year, out of 5000 and measured by X-Lex, are summarised in Table 5.

Year	Age	X-Lex Eng September	SD	X-Lex Eng June	SD
1	6-7	333.571	92.36	559.28	120.17
2	7-8	1072.98	224.10	1338.50	227.56
3	8-9	2090.51	206.35	2295.69	234.57
4	9-10	2618.93	350.02	2822.72	368.90
5	10-11	2863.76	395.73	3113.76	395.73
6	11-12	3167.21	576.11	3447.54	579.11

Table 5. EFL vocabulary sizes measured by X-Lex

The EFL vocabulary sizes of learners, out of 5000 and as measured by Pic-lex are summarized in Table 6.

Year	Age	Pic-lex Eng September	SD	Pic-lex Eng June	SD
1	6-7	1827.14	108.24	1927.14	108.24
2	7-8	2158.62	185.86	2308.62	185.86
3	8-9	3282.75	254.18	3432.75	254.18
4	9-10	3659.09	251.90	4059.09	251.90

| 5 | 10-11 | 3787.68 | 250.64 | 4087.68 | 250.64 |
| 6 | 11-12 | 4084.42 | 352.31 | 4334.42 | 352.31 |

Table 6. EFL vocabulary sizes measured by Pic-lex

4. Discussion and Interpretation

4.1. The Greek vocabulary sizes of learners in primary school

There are currently no models of the L1 lexicon in Greek, and which provide estimates of vocabulary development in terms of size. If, as the word gap hypothesis asserts, education failure can be attributed to deficiencies in vocabulary knowledge and size, then having normative figures for the size of the lexicon is essential. Only with this information can the nature and scale of departure from these norms, and deficiencies if they exist, be demonstrated and quantified. This study provides some of this normative data with estimates of vocabulary size among learners aged from 6 to 12.

The Pic-lex results in Table 4 suggest learners enter the school system with about 2500 words in Greek as measured by this test. Table 2 suggests a global vocabulary size that is, probably, larger than this, with knowledge in the less frequent bands not tested in Pic-lex, perhaps 3000 words or more. Not every aspect of word knowledge will be gained at the earliest stages of learning, of course. Learners at age 6 are likely to have mostly an aural form of a word in the lexicon and the written form is added later. Learners will likely recognise these words in some idiomatic structures but are likely to know neither a wide range of collocations nor the subtleties of word use, connotation and association. Nonetheless, these words are in the lexicon in some meaningful sense.

Both the longitudinal measures (September to June) and the cross-sectional measures (grades 1 to 6) of size indicate that the lexicon grows over the 6 years of primary education. By the age of 12, the learners in this study score close to the maximum on this test. About 4800 of the most frequent 5000 words are recognised by the end of grade 6. Table 2 suggests this might mean an overall vocabulary size of 8000 or 9000 words. A lexicon of this size means that speakers will probably have sufficient words for good comprehension of almost any text, provided it is not overloaded with technical or specialist vocabulary (Nation 2006; Laufer & Ravenhorst-Kalovski, 2010). The regularity of vocabulary acquisition in Greek, as measured by Pic-lex, is illustrated in the chart in Figure 7. The difference between scores at each grade level is statistically significant. An ANOVA using the sequence of September measurements produces the result F=542.83, Sig .000.
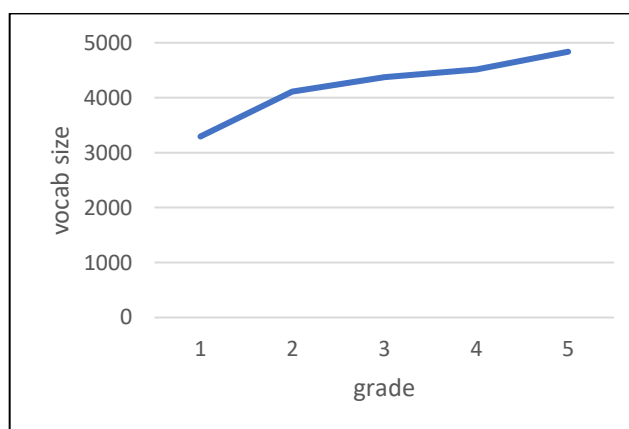

Figure 7: Vocabulary acquisition in Greek measured by Pic-lex.

These estimates fit well with other reported studies of the rate of L1 vocabulary acquisition and reported at the outset of this paper (e.g., Biemiller & Slonim, 2001; Coxhead et al, 2015; Milton & AlSager, 2017). These figures support the idea that learners may acquire about 600 new words annually in childhood and, maybe, sometimes achieve a rate of acquisition approaching the 1000 new words suggested by Schmitt and McCarthy (1997). The subjects in this study, therefore, learn words at a rate of about two or three new words a day. The figures in Table 4 suggest that the rate of acquisition may diminish with time. Milton and Treffers-Daller (2013) suggest that this decline is a feature of the acquisition of the English lexicon, however, in this study it must be kept in mind also that this diminution is a product of a ceiling effect where only the most frequent 5000 words are tested and, by the end of the testing period, the average learner clearly knew almost all of these words. Studies of the rate of acquisition are almost all drawn from learners of English as an L1 although there is also a study of Arabic (Masrai & Milton, 2017) which produces similar rates of acquisition up to adolescence. It can be speculated that where rates of acquisition in a third L1, Greek in this study, produces the same figures, that this figure of 2 to 3 words per day for L1 acquisition in childhood is something like a linguistic universal. The cognitive load of forming a new concept and attaching a word form to it is sufficiently great than faster acquisition is, maybe, impossible.

The scores from the X-Lex test display a broadly similar pattern; small at the outset with regular growth thereafter. The X-Lex scores are smaller and this is to be expected especially at the lower age range of learners in this study. While Pic-lex is a test of the aural knowledge of words, X-Lex tests the recognition of the written form, and learners aged 6 are at the beginning of the process of learning to read and write. Even at this early stage of the learning process, however, the subjects appear to know 600 or 700 words by recognition in writing. By the end of grade 6, and at age about 12, this knowledge has increased dramatically and, on average, about 4200 words are known. The regularity of vocabulary acquisition in Greek, as measured by X-Lex, is illustrated in the chart in Figure 8. The difference between scores at each grade level is statistically significant. An ANOVA using the sequence of September measurements produces the result F=1035.846, Sig .000.
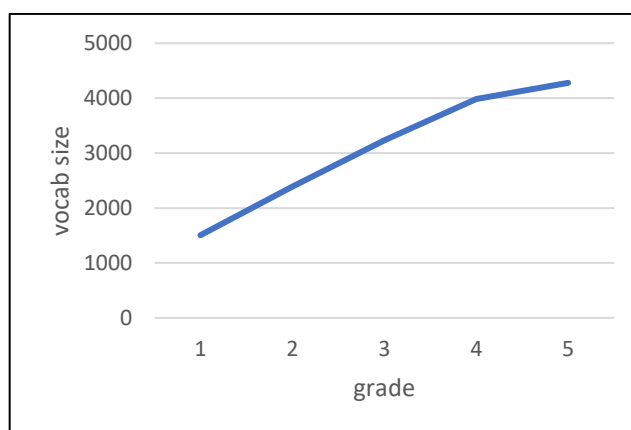

Figure 8: Vocabulary acquisition in Greek measured by X-Lex.

Table 2 shows that learners may know about 8000 words overall, in this form. As Milton et al (2010) demonstrate, the aural and the orthographic sides of the lexicon need not map onto each other perfectly. However, the X-Lex test, which has a check for guesswork and over-estimation, is likely to produce smaller scores overall that a test, like Pic-lex, which has no such check. The X-Lex scores, for the older subjects in the study appear highly comparable to the estimated knowledge produced by Pic-lex. It is probably possible to conclude that subjects will recognize words equally well in both written and aural form.

The discussion of the progress of mean scores can disguise the variation that generally occurs in this kind of data. Some learners will score higher than the mean and others lower than the mean. Where, as in this study, mean scores for each age or grade are compared, it becomes easy to believe that every subject in one grade scores higher than every subject in a lower grade. Generally, this is not the case, of course, and there is a lot of overlap. The standard deviation scores presented in Tables 3 and 4 show that there is some variation. However, a particular feature of the vocabulary scores for Greek as an L1 is how small these standard deviations are, and how tightly the scores at each grade cluster around the mean. The subjects in this study appear to progress as a cohort. The Coxhead et al (2015) study report a closer correlation of chronological age than to grade level, however, this is with older learners and the subjects in this study are learning, and being tested on, their knowledge of words in written form at the same time as they are learning to become literate in Greek through teaching in school. This may explain the tight clustering and close link between vocabulary size and grade level.

These results, then, provide some standard figures, some normalized scores, for first language lexical acquisition where none exist for Greek. They provide a good basis for investigating whether variation, and how much variation, might produce differences in academic performance.

4.2. Comparison of scores with established data from other studies of L1 vocabulary size at this age

This paper has produced scores for vocabulary size in Greek as a first language among primary age learners between 6 and 12. This section addresses the question whether the scale of learning described here fits in any way with the kind of learning described in other studies and in other languages. Table 9 summarises the scores contained in this study with scores from Biemiller and Slonim (2001) and from AlSager and Milton (2017) which present a range of scores across similar primary ages. In Table 9 the numbers for this study are presented as whole numbers for easier comparison with the other studies. Figures from this study are taken from the Pic-lex September data which matches best the oral presentation of words and testing method of the other studies. The AlSager and Milton (2017) study presents scores from a test of the most frequent 10,000 words in English. The Biemiller and Slonim (2001) study is based on words taken from a corpus of school teaching material but which seems likely have a similar ceiling. Table 9, therefore, presents 10,000 word equivalent scores based on the data which is used in compiling Table 1 in this paper.

Year	age	This study (5000 max)	This study (10,000 equivalent)	Milton and AlSager (2017)	B & S (2001)
1	5-6	2505	<4000		
2	7-8	3144	4000	5,071	5,301
3	8-9	3940	7000-8000	5,800	5,759
4	9-10	4196	7000-8000	6,828	6,699
5	10-11	4365	7000-8000	7,318	7,784
6	11-12	4735	8000-9000		

Table 9: Comparison of L1 vocabulary sizes

The outcome suggests that vocabulary sizes look very comparable especially at the older end of the age range tested. This fits with the equivalent rates of word uptake noted earlier in this paper. Greek learners, it seems, are very like L1 learners of other European languages in terms of the sizes of lexicon they develop and the speed with which they acquire it.

4.3. The EFL vocabulary sizes of learners in primary school

It might be thought that learners of a foreign language will start school with no foreign language knowledge, however, the scores obtained in this study suggest this is not the case. The results indicate that learners may start Grade 1 in the Greek educational system recognising about 1800 English words by sound and about 300 English words in written form. This conclusion probably fits well with Jóhannsdóttir's (2022) study which found Icelandic children began school with substantial EFL vocabulary, possibly over 1000 words in all, and before any formal classes in the subject began. In the absence of formal instruction, it is worth asking where this vocabulary comes from and, like Jóhannsdóttir, we conclude that it comes from the TV shows like Peppa Pig and the computer games that pre-school learners watch and play at home. There is ample evidence of vocabulary uptake from these sources in very young children (e.g., Alexiou & Kokla, 2018; Alexiou & Yfouli, 2019). Uptake of vocabulary on the scale reported here is impressive.

Once in school, the learning of EFL vocabulary continues to be impressive. About 3000 EFL words are added in 6 years of school as measured by X-Lex, the test of written word form, and about 2500 words are added in aural form as measured by Pic-lex. The final size estimates, especially on Pic-lex, may be subject to some ceiling effects and had a test with a greater range of vocabulary frequencies been used, it might have revealed even larger lexical gains. This suggests that something like 400 or 500 new EFL words a year are added, on average, to the learners' EFL lexicons in the primary stages of school. We know that learners have received approximately 400 classroom hours of instruction and this suggests an uptake rate which is very rapid. 7 or 8 words per hour are learned in written form and 6 or 7 words per hour of words in aural form.

The subjects on this study finished primary education knowing, on average about 3500 words in written form and 4300 in aural form. The relationship between vocabulary size on X-Lex and CEFR level among fully literate learners is now established (e.g., Alexiou & Milton, 2009; Milton, 2010; Milton & Hopwood 2022), and vocabulary knowledge of this order suggests the grade 6 cohort are at B2 level and most could pass a B2 level exam such as Cambridge FCE. The aural scores are higher than this, and may reflect an even higher level of communicative proficiency, perhaps C1, however, the relationship between Pic-lex scores and CEFR level is not yet well researched.

4.4. Comparison of scores with other studies of L2 vocabulary learning, and against the goals of learning in primary level EFL

The goal of EFL learning in primary school in Greece is that learners should attain knowledge and skills at the B1 level of the CEFR (Alexiou & Mattheoudakis, 2013). The results of this study suggest, then, that teaching and learning are truly impressive and that the attainment of learners is considerably beyond the target set for them. The average student in this study appears to be at B2 and maybe even C1 level. It must be kept in mind that the schools and subjects have not been specially selected in this study and are thought to be representative of the primary system generally in Greece.

This kind of progress in the learning of a foreign language compares very favourably with learning in other countries. Milton and Meara (1998) in a review of rates of vocabulary uptake reflect that about 4 words per classroom hour is good and the rates of uptake in this study far exceed this figure. They match those reported in Vassiliu's (2001) study, also of Greek learners of EFL, where learning at a rate of 5 to 7 words per classroom hour was recorded. Total attainment also appears excellent and in excess of other reported studies. For example, AlShaikhi and Milton (2017) report learners attain about 2000 word lexicons in EFL at age 15 and about 3000 words on completion of education at age 18 in Saudi Arabia. Learners in Turkey are reported to have learned about 2000 EFL words by aged 12 (Kavanoz & Varol, 2019). Learners in Spain may learn about half this, 1000 words, at this age (Alonso & Garcia, 2013). Learners of French as a foreign language in UK are reported to have learned only 500 to 800 words on average by the age of 16 (Milton, 2006; David, 2008).

Exceptionally rapid learning of vocabulary, and therefore very rapid overall progress to proficiency, requires some explanation and Milton (2011) provides this explanation by contrasting the good learning environment in Vassiliu's (2001) study with the poor environment which obtains for the learners in the Milton (2006) and David (2008) studies. The environment in Vassiliu's (2001) study is characterized by a number of positive features. There is good classroom teaching, of course, based on an effective curriculum which includes a very wide range of topics. This curriculum includes good vocabulary loading, which are included in a good textbook which sequences and presents this material appropriately for the learners. These textbooks typically include high quality and appropriate extension material in the form of work books, websites, games and tests. Both learners and their parents are very positive about learning EFL so, generally, there is high motivation. Parents routinely support this learning with additional classes in private schools and this is crucial to understanding how progress can be so rapid. In effect, the extension material and private classes extend learning beyond the classroom by hundreds of hours.

Milton (2011) contrasts Vassiliu's good learning environment with the poor learning environment which surrounds language learning in British schools. The learning of French in UK is given fewer classroom hours. The curriculum is heavily structural and focusses on only a small range of topics and a small vocabulary, leaning heavily to only the most frequent words. The textbooks, which have received much criticism, are considered poor and demotivating. Whole years can pass with very little new vocabulary provided for the learners to use. The range of classroom extension materials, and opportunity for their use, is far less than in Vassiliu's study. Neither learners nor their parents value foreign language learning as they do in Greece. There is no tradition, and much less systematic opportunity, for adding to school language learning with private classes. Learning will often be restricted to the, already limited, hours provided in the classroom. No wonder, then, that these learners make far slower progress, with far lower attainment, that their counterparts learning EFL in Greece.

As with the L1 Greek data, there is surprisingly little individual variation in the scores of the subjects at each grade level for L2 English vocabulary size, and this produces small figures for standard deviation. Particularly at the earliest stages of learning, the knowledge and progress of subject is quite surprisingly uniform.

4.5. Comparison of L1 and L2 scores to investigate whether they correlate as might be anticipated by the Word Gap hypothesis

If there is any substance to the word gap hypothesis, then it would be expected that a consistent relationship between L1 vocabulary size and attainment in an academic subject like learning an L2 would exist. Table 10 shows the correlations between L1 and L2 vocabulary size divided by grade level, so differences in age and exposure are controlled.

	Correlations	sig
Grade 1	0.429**	0,000
Grade 2	0.053	0,625
Grade 3	0.090	0,504
Grade 4	0.243*	0,049
Grade 5	0.427**	0,000
Grade 6	0.511**	0,000

Table 10: Correlations between L1 and L2 vocabulary size divided by grade level

It is not clear this consistent relationship exists. It might just be possible to argue that while there is no apparent relationship for two of the first 3 years, the correlation may be getting stronger with time. This might be consistent with the idea that a large vocabulary on entry to the school system enables a learner to make faster progress and learn even more words, and so progress faster than those who enter with smaller lexicons. However, while there is no obvious correlation at grades 2 and 3, there is a moderate, and statistically significant, correlation at grade 1. We are inclined to discount this idea, at least from this data. There is no obvious suggestion here that lexicon in Greek L1 is small or is getting smaller. It is not apparent that a portion of the population has some kind of deficiency in vocabulary that should worry educationalists. The scores of all subjects are very consistent at each grade level and they suggest that all subjects are on track to grow a large lexicon of a size that should cope with the demands of the education system.

Wilson et al (2017) point to the way all learners, unless there is some catastrophic brain injury or other problem, learn a language to fluency. This involves acquiring a vocabulary of 10,000 to 20,000 words. This is more than enough to handle any topic once specialist vocabulary is added. It is sufficient to provide probably over 99% coverage of most text. It is hard, then, to explain any lack of educational attainment in terms of a deficient vocabulary when everyone seems to have the lexical resources to cope equally. Any difference in educational attainment, in these circumstances, has to come from another influencing factor; something that can drive both lexical size and educational attainment.

5. Conclusions

This study has provided some figures for the vocabulary size of speakers of Greek as an L1 as these speakers pass through primary school. It appears they add about 2 or 3 words a day, every day, to their lexicons. They probably recognise about 8000 or 9000 words of Greek in both aural and written form at age 12, and they will continue to add to their lexicons thereafter. They appear to be like speakers of other languages, therefore, in the rate with which they learn new words, and the size of the lexicon which emerges. The wide variation in the size of the lexicon, noted in other studies of English in North America, is not observed here.

This study also provides estimated sizes for learning in the subjects L2. Here, there is evidence of considerable learning of English before even entering school and receiving formal tuition. This is probably a result of incidental learning through exposure to TV programmes and computer games which are often in English. Progress and attainment at schools is impressive. Subjects in this study complete primary level education knowing, on average, over 4000 words of English. This is far in advance of the expectation of the curriculum and of the attainment of age-equivalent learners in other countries where we have figures for comparison. While the rate of uptake per classroom hour is high, this high attainment is almost certainly supported by the environment for learning that includes positive motivation and support for learning of English, a wide range of good quality support and extension materials with a large vocabulary input across a wide range of topics, and, often, additional private classes extending the hours of instruction.

It is hard to see, in this study, any real evidence for a word gap or systematic deficiencies in the L1 vocabulary knowledge of subjects that might explain poor educational attainment. All subjects in this study appear to be in the process of growing an L1 lexicon of sufficient size to comprehend normal text and handle academic study.

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Appendix

Figure 1
X-Lex Sample (English Version)

English X-Lex Vocabulary Test 1

NAME:
AGE:
HOME LANGUAGE:
Please look at these words. Some of these words are real English words and some are not but are made to look like real words. Please tick the words that you know or can use. Here is an example.

dog✓

Thank you for your help.

that	both	cliff	sandy	candlin	century
with	darrock	stream	military	oak	refer
before	cup	normal	impress	antique	essential
alden	discuss	everywhere	staircase	chart	violent
feel	park	deny	daily	limp	sorrow
round	path	shot	kennard	permission	provide
horozone	tower	waygood	associate	headlong	trick
table	treadaway	independent	conduct	gazard	pedestrian
question	wheel	feeling	relative	fade	produce
effect	whole	bullet	upward	rake	jug
market	perform	gumm	publish	horobin	lessen
woman	pity	nod	insult	mercy	difficult
stand	probable	gentle	sumption	anxious	juice
manomize	signal	slip	humble	pardoe	person
fine	hyslop	diamond	contract	arrow	weather
instead	earn	press	mount	feeble	cardboard
frequid	sweat	cantileen	tube	fishlock	early
group	gillen	drum	moreover	brighten	dish
arrive	manage	reasonable	crisis	dam	believe
litholect	mud	boil	hobrow	outlet	trunk

Figure 2
X-Lex Sample (Greek Version)

Greek X-Lex Vocabulary Test

ΟΝΟΜΑ:
ΕΠΙΠΕΔΟ:
ΓΛΩΣΣΑ ΣΠΙΤΙΟΥ:

Διαβάστε τις επόμενες λέξεις και βάλτε √ αν τις γνωρίζετε και x αν δεν τις γνωρίζετε.

και	συνήθως	λήψη	πολιτισμός	γενεθλιώνη	άτυπος
απειλώ	καρκίνος	μοτοσυκλέτα	μεσόγειος	ισόπαλος	επιταχύνω
στρατός	ακόλουθος	εύλογος	καταπληκτικός	χιλιετία	ιδιαίτερος
πολιτισμικός	χαιρετισμός	όμιλος	παγοτούσαμε	πολλαπλασιάζω	πρότυπο
αφορολόγητος	μέρος	σηκώνω	καλημέρα	εξής	κοντός
ορολαντίνια	δημαρχείο	ευαίσθητος	έφοδος	αποζημίωση	χάριν
παίκτης	στοά	αντικατάσταση	αγαπάω	αθτοκιλάδι	θανατηφόρος
πληρώ	γίγαντας	σηματοδοτώ	κάριος	ιδεολογία	πετσετικός
αως	χρονοδιάγραμμα	προσφέρω	αποχωρώ	μεσολαβώ	εύκολα
πίνω	μεφσίνη	στρομετική	τρόπαιο	μετέωρο	σκαλαμός
αξιόπιστος	αύριο	άθλημα	εθελοντής	λεπό	διαχείριση
πρόθυμος	φίλιος	προειδοποιώ	μεταμιόσχευση	λαός	εκκρεμότητα
ετοναί	πιθανός	νύφη	σκόλιφος	αγωγή	παιδαγωγικός
νίκη	ζήτηση	καταναλώνω	μάχη	εγγραφή	ρύπος
ψήφος	γκράλος	ήττα	καταστρέφω	ντόπιος	προσωπικό
στρατόπεδο	συνεννόηση	ακτοφιλίς	φωτίζω	οβρελός	τοίχος
λουλοδίς	διασπορά	ξεφεύγω	μεταχείριση	νύχι	φότους
τσακάλι	πανεπιστήμιο	ονομασία	ελαστικός	αφορμή	αιχμάλωτος
μιμούμαι	διάταξη	παγιδεύω	περί	γραφή	ειρηνοποιός
επιτροπή	ξάφουσα	ρέμα	τοπίο	φιλόδοξος	βρύση

Figure 3
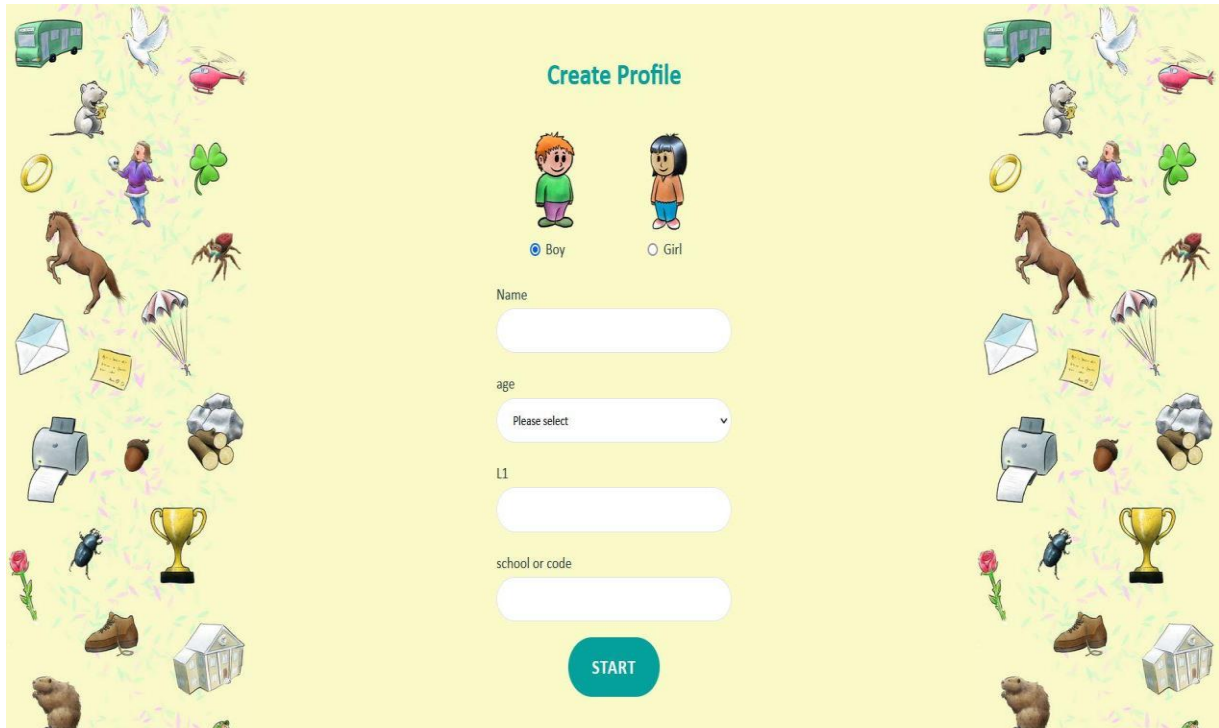*Pic-lex Main Menu Sample*

Figure 3
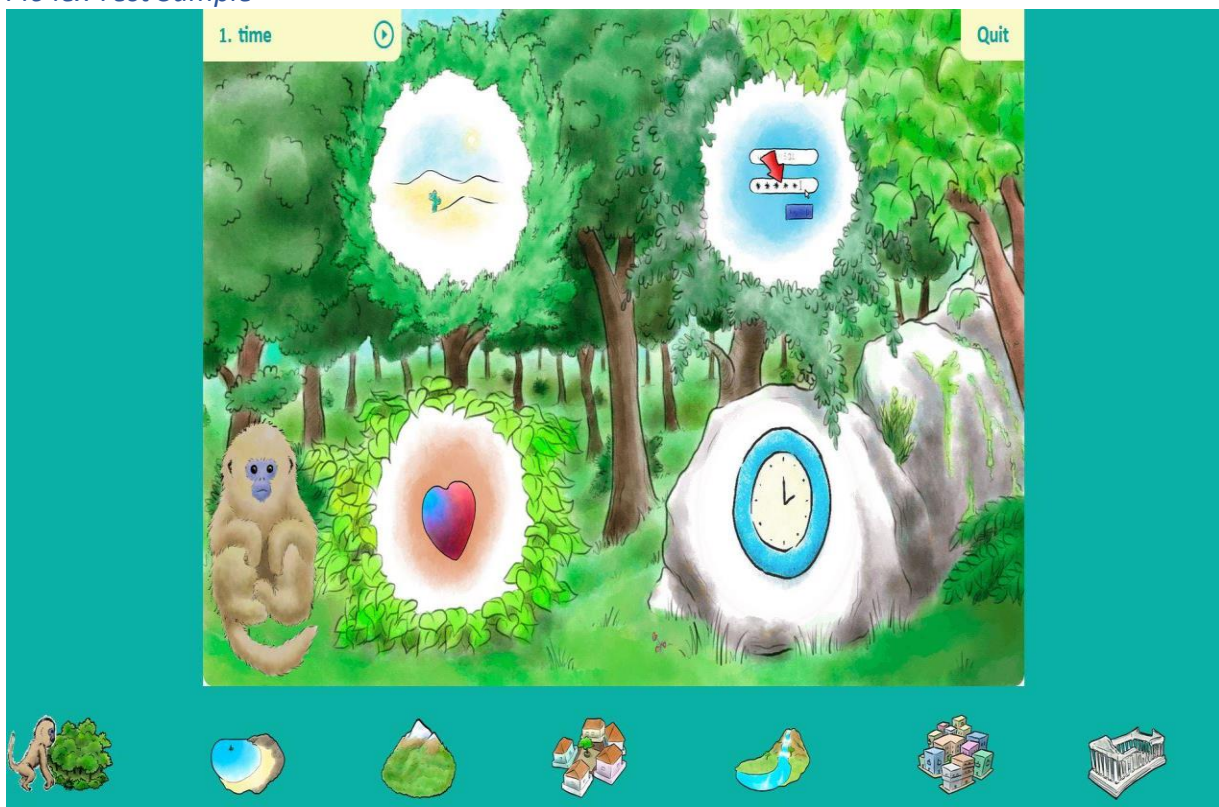*Pic-lex Test Sample*

Figure 4
PVLT Sample (English Version)

Name: _____

Boy ☐ Girl ☐

Grade: _____

Home language: _____

Write as many words as you can for every category!

	Animals	Body parts	Clothing
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
13.			
14.			
15.			

Figure 5
PVLT Sample (Greek Version)

	Φαγητό και Ποτό	Παιχνίδια	Μέρη της πόλης
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
9.			
10.			
11.			
12.			
13.			
14.			
15.			

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