Psychology of Language and Communication 2023, Vol. 27, No. 1

sciendo

DOI: 10.58734/plc-2023-0021

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Depth of vocabulary knowledge in dominant bilingual children with different language profiles: The impact of vocabulary size and verbal working memory

The current study investigated the depth of vocabulary knowledge (VK) through word definitions, examining the effect of word characteristics, breadth of VK, and verbal working memory (VWM). Forty children (11-12 years old) participated (12 Greek-Albanian children Greek-dominant, 14 Turkish-Greek children Turkish-dominant, and 14 monolinguals). An expressive vocabulary task (breadth of VK), a word definition task (depth of VK) in Greek, and a VWM task were administered. The results revealed that monolinguals had larger vocabulary than bilinguals in Greek. Greek-Albanian children had also larger vocabulary than Turkish-Greek bilinguals. In the VWM task, monolinguals had better abilities than Turkish-Greek bilinguals. Controlling for vocabulary and VWM, few differences emerged in definitional skills. In simple concrete nouns and compound verbs, Greek-Albanian children gave more formal definitions than monolingual children, exhibiting a bilingual advantage. Finally, breadth and depth of VK correlated with VWM only in Greek-Albanian and monolingual children, indicating the impact of vocabulary on VWM performance.

Key words: breadth and depth of vocabulary knowledge; definitional abilities; dominant bilinguals; expressive vocabulary; verbal working memory

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Bilingualism and multilingualism are very common phenomena worldwide. Unfortunately, this issue has begun drawing attention only recently in Greece. Some communities are still ghettoized in some regions of Greece, such as the Muslim community in Thrace, while other communities have been smoothly integrated, keeping their national identity and language at the same time, such as the Albanian community. These groups are usually more dominant[1] in one language compared to bilinguals, who speak more high-status languages, such English, German, or French, and who are more balanced with respect to their knowledge of the two languages.

The rather new phenomenon of bilingualism in Greece and the limited knowledge about it often causes biases and negative reactions regarding raising a bilingual child. Unfortunately, bilingualism has often been considered a phenomenon that confuses the child and leads to lower linguistic abilities.

The motivation of the current study was to investigate these two language pairs (Greek-Albanian and Greek-Turkish) that often manifest via different language abilities in Greek. The Greek-Albanian bilinguals are usually dominant in Greek while the Greek-Turkish bilinguals are more dominant in Turkish. In addition, it is interesting to study the Greek-Turkish bilingual group, since research on this population is very limited.

Definitions depict how well a word is known. In other words, they depict the depth of vocabulary knowledge (VK). Vocabulary development is also crucial for the development of morphosyntax. Additionally, the development of definitional skills is related to the enhancement of literacy skills, and they also predict school success (Artuso, Palladino, Valentini, & Belacchi, 2022). For these reasons, definitions are used in many diagnostic tests (Wechsler, 2014; Antoniou, Ralli, Mouzaki, Diamanti & Papaioannou, 2022) as a measure of vocabulary knowledge.
Apart from the development of morphosyntax and literacy, VK, predominantly breath of this knowledge, has been found to correlate with verbal working memory in both monolinguals and bilingual speakers (Cockcroft, 2016; Korecky-Kröll et al., 2019). However, little is known about the possible interrelations with depth of vocabulary knowledge, particularly in bilingualism.
The current study aimed to enhance our understanding of how the psychology of language and cognition connect in bilingualism. It further boosts the discussion around vocabulary and cognitive development in bilingual populations. The outcomes can be leveraged by psycholinguists, researchers who work on curricula and syllabi design, as well as educators of dominant bilingual children.

1 By "dominant," we refer to bilingual speakers who are significantly more proficient in one language than the other, as the majority of the studies suggest (Hamann et al., 2019). As Treffers-Daller (2019) indicates, there are different measurements to define dominance. Vocabulary is one of these measures.

Breadth and Depth of Vocabulary Knowledge

The acquisition of VK is complex and challenging (Schmitt, 2014) and, therefore, its investigation is difficult. VK is often divided into two aspects, that is, breadth and depth (Anderson & Freebody, 1981). Breadth of VK denotes size (number of words the speaker knows, Nagy & Herman, 1987; Wesche & Paribakht, 1996), while depth specifies how well these words are known, that is, the quality of word knowledge (Anderson & Freebody, 1981; Henriksen, 1999). In addition, depth indicates mental lexicon organization and semantic relations (Haastrup & Henriksen, 2000; Read, 2004). Depth of VK is also linked with all linguistic levels of oral and written language, that is, semantic, phonological, orthographical, morphological, syntactic, and pragmatic information (Bowers & Kirby, 2010; Proctor et al., 2009). The current study focused on semantic representations (i.e., semantic depth) and syntactic information.

Breadth of VK can be tested by means of receptive and expressive vocabulary tasks (Ouellette, 2006). Monolingual learners have larger vocabularies compared to their bilingual peers, whose vocabularies are smaller in each language (August & Shanahan, 2006; Oller & Pearson, 2002). Nevertheless, their total vocabulary (i.e., the sum of the words a speaker understands across two languages) is similar to monolinguals (Core et al., 2013). Contextual factors (e.g., home and school input, language dominance, literacy) also affect the vocabulary size of bilingual speakers (Dosi & Papadopoulou, 2020).

Depth of VK can be measured by means of word definitions since formal word definitions require appropriate semantic choices and use of appropriate syntactic forms, which denote metalinguistic abilities (Snow et al., 1989). Therefore, definitions are evaluated for content (meaning) and form (syntax, Johnson & Anglin, 1995). The development of definitional abilities is a long-lasting process. The concurrent development of content (semantics) and form (syntax) is challenging and thus, it takes time for these abilities to enhance equally (Caramelli et al., 2006; Snow et al., 1989). Recent studies have found that the development of the form of definitions is less demanding compared to content (Dosi & Gavriilidou, 2020; Dosi, 2021). Regarding content, monolingual children produce informal definitions in their first school years by giving the function of the word, descriptions, or examples (Hadley et al., 2016; Johnson & Anglin, 1995; Snow, 1990), while the use of more formal definitions emerges in fifth and sixth grade of the elementary school (11-12 years old). In a similar manner, for form of definitions, monolingual children initially use nominal and verb phrases while more complex relative clauses appear in fifth and sixth grade (Johnson & Anglin, 1995; Friedmann et al., 2011). Patterns of development may be more delayed in bilingual children compared to their monolingual peers since bilingual speakers have smaller vocabularies (Dourou & Dosi, 2021). Hence, they more often produce informal definitions compared to their monolingual peers. Other studies suggest that due to their lower VK, bilinguals struggle to find the superordinate terms or the general category (El Euch & De Koninck, 2006) even though the

word classification follows the monolingual patterns (Gollan et al., 2005). The role of language dominance is an important factor that affects both breadth and depth of VK (El Euch & De Koninck, 2006; El Euch, 2007). Additionally, previous studies (Snow, 1990; Snow et al., 1991) have shown that bilingual children give more formal definitions in the language of their formal instruction (i.e., language of schooling).

Other factors, such as grammatical categories (i.e., nouns, verbs, and adjectives), semantic characteristics (i.e., abstract vs. concrete words), and morphological structure (i.e., simple/derived and compound words) have an impact on the breadth (Hadley et al., 2016) and depth of VK (Dosi et al., 2021). Nouns, which are acquired earlier than verbs and adjectives, receive more formal definitions than the other two categories (Dosi et al., 2021). However, abstract nouns, which are conceptually more complex, are thus acquired later and receive more informal definitions than concrete nouns (Dosi et al., 2021; Maguire et al., 2006). Verbs and adjectives seem to be more demanding (Gavriilidou, 2015). Compoundness is another factor that also affects definitional abilities. School-aged children decompose compound words in parts and they repeat the term which is expected to be defined (i.e., tautologies, e.g., cheese pie: cheese and pie) since, conceivably, their hierarchical categories have not been fully developed yet (Dourou, 2019; Dosi et al., 2021).

Regarding the link between breadth and depth of VK, they do not necessarily correlate (McGregor et al., 2013). Thus, size of VK does not indicate knowledge in depth. By contrast, other studies suggest that breadth and depth depict the same entity (Li & Kirby, 2015). Hence, studies in both monolingual and bilingual speakers noted that these two aspects interact when language exposure increases (Haastrup & Henriksen, 2000; Li & Kirby, 2015; Vermeer, 2001; Qian, 1999, 2002). Thus, it can be more evident in high proficient learners (Nurweni & Read, 1999).

The Role of Verbal Working Memory in the Development of Breadth and Depth of Vocabulary Knowledge

Before we focus on VWM and VK, it is important to present the research so far regarding the impact of bilingualism on VWM. The effect of bilingualism on WM is controversial. Previous studies have found an advantage over monolinguals both in verbal and nonverbal WM (Costa et al. 2009; Morales et al., 2013). Other studies did not find any advantage in either verbal or nonverbal WM (Engel de Abreu, 2011) and indicated that bilinguals have better nonverbal WM abilities compared to their VWM abilities (Feng, 2009). Further research exhibited that bilinguals have better verbal and nonverbal WM abilities than monolinguals when they are controlled for their vocabulary knowledge, especially when tasks require processing and not just storage (Blom et al., 2014).

Numerous studies have shown the correlation between breadth of VK (i.e., vocabulary size) and VWM skills both in monolingual and bilingual speakers

(Cockcroft, 2016; Korecky-Kröll et al., 2019). In other words, the better the VWM skills, the more words can somebody store and retrieve. Some interesting findings also suggest that bilinguals with smaller vocabularies have to work harder to retrieve words (Kaushanskaya et al., 2011). In a similar vein, Service et al. (2002) noted that there is an extra load on general WM when the language is not fully automatized, in other words, when a speaker's language proficiency is low. Blom et al. (2014) noted that higher bilingual proficiency is associated with better VWM performance.

The impact of VWM on definitional abilities is underexamined. Although, there are many theories about mental lexicon organization (the Semantic Feature Model, Smith et al., 1974; the Spreading Activation Model, Collins & Loftus, 1975; the Hierarchical Network Model, Collins & Quillan, 1969), claiming that specific words are activated and others are suppressed by the speaker, very few studies have examined the activation of similar procedures in the development of definitional skills of monolingual speakers (Dosi, 2021). These studies have shown that VWM is related to depth of VK (i.e., definitional skills). In other words, memory skills are required in order to remember and recall a formal definition, both in content and in form (Dosi, 2021; Dosi & Gavriilidou, 2020).

The Current Study

Research Questions and Hypotheses

Addressing these gaps, the current study set the following aims: (a) to examine any possible link between VWM and breadth and depth of VK; (b) to investigate the definitional skills of dominant bilinguals with different language profiles after controlling for their vocabulary and VWM abilities and considering different parameters such as grammatical categories, semantic characteristics, and morphological structure.

To this end, two interrelated questions were formulated:

RQ1: Do definitional skills (depth of VK) correlate with expressive vocabulary (breadth of VK) and VWM?

RH1: We expected that the breadth of vocabulary would correlate with the definitional skills (depth of VK, McGregor et al., 2013) and VWM abilities (Dosi, 2021) but only in Greek-dominant bilinguals (i.e., in the Greek-Albanian group since Greek was the language of testing; cf. Haastrup & Henriksen, 2000; Qian, 1999; Vermeer, 2001).

RQ2: Do definitional skills of dominant bilinguals with different language profiles differ between the groups and with the monolingual children after controlling for their vocabulary and VWM abilities and considering different parameters, such as grammatical categories, semantic characteristics, and morphological structure?

RH2: Since the three groups exhibited different performance in VK and

VWM, we could not compare their performance in vocabulary due to different language proficiency levels and VWM abilities. Consequently, we controlled for these two variables in the statistical analyses. We hypothesized that any differences between the groups would disappear after controlling for vocabulary and VWM abilities. Considering the parameters of grammatical categories, semantic characteristics, and morphological structure, we expected that more differences would emerge in the more complex categories compared to the simpler ones (Maguire et al., 2006; Dosi et al., 2021; Dourou, 2019).

Participants

Forty children (11-12 years old) participated in the current study. This age group was preferred since, as previous studies suggest (Johnson & Anglin, 1995), definitional skills of children in fifth and sixth grade improve significantly as a result of their general cognitive development. In addition, previous studies (Friedmann et al., 2011) have found that language abilities of 9-10-year-olds significantly differ from 11-12-year-olds, while no differences were found between 11-12-year--olds and 12-13-year-olds. So, it seems that the 11th-12th year of life are crucial for the development of definitional skills. To this end, 26 children were dominant bilingual (12 were Greek-Albanian-speaking children, Gr-Alb, and 14 were Greek-Turkish-speaking children, Turk-Gr), while 14 Greek-speaking monolingual children also participated (ML; cf. Table 1). The Gr-Alb and the ML children attended Greek-speaking monolingual schools in the prefecture of Rodopi, while the Turk-Gr attended minority schools in Thrace. Although both bilingual groups lived in Greece, only the Gr-Alb participants were Greek-dominant, while the Turk-Gr were Turkish-dominant. The groups had more exposure to either Greek or Turkish, respectively, via home and school environments, based on their teachers' reports. However, as previous studies have suggested, self-assessment or parental questionnaire are not always proved to be reliable (Baker, 2011).

In addition, sometimes parents may be unwilling to complete such questionnaires. Nevertheless, according to Bedore et al. (2011), both parent and teacher questionnaires are reliable and both should be incorporated when assessing bilingual children. In the current study, we have administered only teacher questionnaires. As it is confirmed through the baseline tests administered, the teachers had a clear picture about the children's proficiency in Greek.

The baseline tests included examination of expressive vocabulary (Vogindroukas et al., 2009) and nonverbal intelligence (Raven et al., 2008). The two groups matched in terms of gender and socioeconomic status (SES). By SES we refer to maternal education, as plenty of previous studies suggest (Armon-Lotem et al., 2011; De Houwer et al., 2014; Paradis, 2011). Previous research has shown that SES, and predominately maternal education, affect children's vocabulary development (Paradis, 2011). In the current study, it was measured by teachers' reports.

The results show that the groups did not differ in terms of their chronological

Table 1. *Group Profiles*

Group	*N*	Age (*SD*)	Expressive vocabulary (%)	Nonverbal intelligence (%)
ML	14	11.6 (0.5)	91.7 (S.D.: 4.5)	91.9 (S.D.: 5.8)
Gr-Alb	12	11.5 (0.5)	70.0 (S.D.: 11.1)	87.8 (S.D.: 5.8)
Turk-Gr	14	11.6 (0.5)	40.3 (S.D.: 7.1)	87.5 (S.D.: 6.6)

Note. ML = monolingual children; Gr-Alb = Greek-Albanian bilingual children; Turk-Gr = Greek-Turkish bilingual children.

age, $F(2, 37) = .254$, $p = .777$, and their nonverbal intelligence, $F(2, 37) = 2.396$, $p = .105$. In contrast, differences were observed in breadth of VK, $F(2, 37) = 152.539$, $p < .001$. Post-hoc criteria Bonferroni have shown that ML had larger vocabularies than both bilingual groups and Gr-Alb had larger vocabularies compared to Turk-Gr ($p < .001$, for all comparisons).

Informed consent in writing was obtained beforehand from parents or guardians. All procedures performed in the current study were in accordance with the ethical standards of the institutional Ethics Committee of Democritus University of Thrace (60589/2111/31-8-2018) and the national research committee.

Material

Apart from the expressive vocabulary task, we also administered a VWM task (Alloway, 2007) and a word definition task based on Marinellie and Johnson (2002, 2004) and adapted to Greek by Dourou (2019).

The VWM task was administered orally. Children were asked to recall a sequence of spoken digits in reverse order of what was uttered by the researcher. The number of digits to remember increased progressively over successive blocks. Accurate recall of four out of six trials per block permitted the child to move on to the next block. If they did not reach that score, the test stopped. The maximum score was 36 points.

The word definition task included 16 items. Eight were nouns (4 simple nouns and 4 compound nouns, out of them, 4 were concrete and 4 abstract nouns; 4 verbs, 2 simple and 2 compound verbs; 4 adjectives, 2 simple and 2 compound adjectives, correspondingly, see Table 2). Ten of the words were selected from school coursebooks and 6 were chosen from Gavriilidou (2015). The reliability of the items has been tested in a large-scale study by Dourou (2019) on monolingual children and adults. There, teachers selected, through a questionnaire, 500 out of 800 more frequent words in everyday class interactions and classroom activities. The words were selected based on their high frequency, age appropriateness, grammatical category, morphological structure, and semantic characteristics. The procedure was as follows: the researcher asked the participant "what does X mean?", without any prompt. The participants responses were audio-taped and

Table 2. *Definition Task Items Grouped per Word Characteristics*

Grammatical categories	Morphological structure	Semantic characteristics	Task items
Nouns	Simple	Concrete	milo 'apple' poðilato 'bike'
		Abstract	taksiði 'trip' erotisi 'question'
	Compound	Concrete	tiropita 'cheese pie' maçeropiruno 'cutlery'
		Abstract	iʌovasilema 'sunset' makrozoia 'longevity'
Verbs	Simple		ðjavazo 'read' xorevo 'dance'
	Compound		aniɣoklino 'open and close' siɣotraɣuðo 'croon'
Adjectives	Simple		astios 'funny' eksipnos 'smart'
	Compound		aspromavros 'black and white' ɣlikoksinos 'sweet and sour'

transcribed afterwards. The questions were orally administered, in order to avoid any literacy effects. The coding was based on Marinellie and Johnson (2004). Participants' responses were evaluated for content and form on a five-point scale. For content scoring, if the participant gestured or did not give any response, 0 points were given. If they gave a function, description, example, and association of the word, 1 point was given (low-level responses). If they used a class-nonspecific, class-specific, or a synonym, 2-3 points were given, respectively (mid-level responses). If they gave the superordinate category and a combination of the aforementioned responses, 4 points were given (partial formal definitions), and, finally, formal definitions included the superordinate category and at least two characteristics of the word, and they received 5 points. The two latter categories were deemed as high-level responses. Similarly, for form scoring, if the participant uttered nonverbal responses, 0 points were given. If they used one word and a determiner, 1 point was given (low-level responses). If they used a verb phrase or the words "something/thing" and a referential phrase, 2-3 points were awarded, respectively (mid-level responses). Finally, partial Aristotelian/formal definitions included the superordinate category and an infinitive or verb phrase (4 points) and Aristotelian/formal definitions included the superordinate category and at least two infinitive or nonfinite clauses, finite adverbial clauses, or prepositional phrases (5 points). In either content or form scoring, the highest possible score was 80 points.

Reliability

Inter-rater reliability of content coding was evaluated for all responses given by 40 subjects (640 definitions in total). Two raters assessed the responses using the blind making method. The raters were blind to the conditions and groups so as not to be biased. They received detailed guidelines and examples regarding the coding categories. The number of responses coded identically divided by the total number of coded definitions, both for content and for form, was taken as agreement. The inter-rater agreement for content was 91.2% and for form, it was 93.4%. To further check the reliability of the task, Cronbach's αcoefficient was calculated. The result for the overall word definition task was .939, suggesting a very good degree of internal consistency.

Data Analysis

Data were analysed by means of SPSS 25. To investigate the first hypothesis, we calculated bivariate correlations between vocabulary scores, the VWM task, and the overall scores of the word definition task (content and form) for each group separately in order to observe possible differences among the three groups. For the second hypothesis, we performed a multivariate analysis of covariance (MANCOVA), setting eighteen dependent variables (overall scores on content and form, scores on simple and compound concrete nouns [content and form], scores on simple and compound abstract nouns [content and form], scores on simple and compound verbs [content and form], and scores on simple and compound adjectives [content and form]), groups of participants as independent variables, and vocabulary and VWM as covariates. The two covariates did not interact either with the independent variables, vocabulary: $F(54, 45) = .830$, $p = .746$, $\eta^2 = .494$; VWM: $F(54, 45) = .885$, $p = .669$, $\eta^2 = .510$, or with each other, $F(18, 15) = 1.449$, $p = .237$, $\eta^2 = .635$.

Results

To answer the first research question, we calculated correlations for each group separately. In the ML group, correlations were calculated between VWM and vocabulary, $r(14) = .577$, $p = .031$, and between VWM and the content of definitions, $r(14) = .628$, $p = .016$. However, no statistically significant correlations were detected either between definitions and the vocabulary [depth and breadth of VK; content: $r(14) = .114$, $p = .622$; form: $r(14) = -.064$, $p =$, 827] or between form of definitions and VWM, $r(14) = .477$, $p = .085$. In the Gr-Alb group, statistically significant correlations were found between VWM and vocabulary, $r(12) = .648$, $p = .023$, vocabulary and the content of definitions, $r(12) = .700$, $p = .011$, and content of definitions and VWM, $r(12) = .785$, $p = .002$. No statistically significant correlations were observed between the form of definitions and vocabulary,

$r(12) = .524$, $p = .080$, and VWM, $r(12) = .470$, $p = .123$. No statistically significant correlations were found between variables in Turk-Gr group [VWM and vocabulary: $r(14) = .032$, $p = .914$; VWM and definitions, content: $r[14] = .181$, $p = .535$, form: $r(14) = .260$, $p = .369$; vocabulary and definitions: content: $r[14] = -.005$, $p = .987$, form: $r(14) = .053$, $p = .857$]. Only the statistically significant findings are reported in Table 3.

Testing the second research hypothesis, we controlled for vocabulary and VWM abilities. Interestingly, no statistically significant differences were found among the groups either in content or in form of definitions, $F(2, 35) = .886$, $p = .421$, $\eta^2 = .048$; $F(2, 35) = 3.035$, $p = .090$, $\eta^2 = .080$, respectively.

Focusing on the different word categories, statistically significant differences occurred in simple concrete nouns (see Figure 2), albeit only in content, $F(2, 35) = 8.012$, $p = .001$, $\eta^2 = .314$, and not in form, $F(2, 35) = 1.462$, $p = .246$, $\eta^2 = .077$. Post-hoc criteria Bonferroni have shown that the sole differences found were between the Gr-Alb and the ML group ($p = .030$). The former group gave more formal definitions than the latter one in simple concrete nouns. No other statistically significant differences were found, ML and Turk-Gr: $p = 1$; Gr-Alb and Turk-Gr: $p = .572$.

In simple abstract nouns (see Figure 3), statistically significant differences were found only in form, $F(2, 35) = 8.813$, $p = .001$, $\eta^2 = .335$, and not in content, $F(2, 35) = .839$, $p = .441$, $\eta^2 = .046$. Bonferroni criteria outlined that the Gr-Alb group used more complex structures ("something/thing" + a referential phrase) than the Turk-Gr group (noun or verb phrases; $p = .021$). No other differences were found between the groups, ML and Turk-Gr: $p = .769$; ML and Gr-Alb: $p = .528$.

In compound concrete nouns (see Figure 4), statistically significant differences were attested only in form, $F(2, 35) = 7.217$, $p = .002$, $\eta^2 = .292$, and not in content, $F(2, 35) = .752$, $p = .479$, $\eta^2 = .041$. Post-hoc criteria Bonferroni showed that the ML group used more complex structures (mid or high level responses) than the Gr-Alb group (predominately noun or verb phrases; $p = .005$), while no other statistically significant differences were found between the groups, ML and Turk-Gr: $p = .264$; Gr-Alb and Turk-Gr: $p = 1$.

Similar to the previous category, statistically significant differences were found only in form of compound abstract nouns, $F(2, 35) = 9.380$, $p = .001$, $\eta^2 = .349$, and not in content, $F(2, 35) = 2.275$, $p = .118$, $\eta^2 = .115$. Performing criteria Bonferroni, statistically significant differences were found only between the Turk-Gr and Gr-Alb groups ($p = .043$), where the former group used more complex structures than the latter. The other groups' performance did not differ, ML and Turk-Gr: $p = 1$ and ML and Gr-Alb: $p = .205$.

Statistically significant differences in simple verbs were not found, either in content or in form, $F(2, 35) = .487$, $p = .619$, $\eta^2 = .027$, and $F(2, 35) = 1.327$, $p = .278$, $\eta^2 = .070$, respectively.

Statistically significant differences in compound verbs were detected only in form and not in content, $F(2, 35) = 123.025$, $p < .001$, $\eta^2 = .875$, and $F(2, 35) = 2.721$,

Table 3. *Statistically Significant Correlations Between Verbal Working Memory and Breadth and Depth of Vocabulary Knowledge*

		Expressive vocabulary (breadth)	Definition task (content | depth)
ML	VWM	$r(14) = .577$, $p = .031$	$r(14) = .628$, $p = .016$
Gr-Alb	VWM	$r(12) = .648$, $p = .023$	$r(12) = .785$, $p = .002$
	Expressive vocabulary		$r(12) = .700$, $p = .011$

Note. ML = monolingual children; Gr-Alb = Greek-Albanian bilingual children; VWM = verbal working memory.

Figure 1. *Groups' overall scores on the word definition task (content and form).*

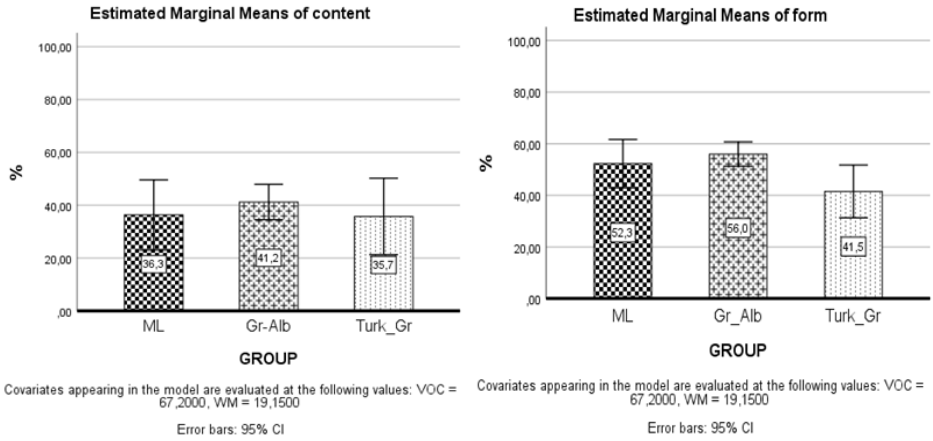


Figure 2. *Groups' performance (%) in simple concrete nouns (content and form).*

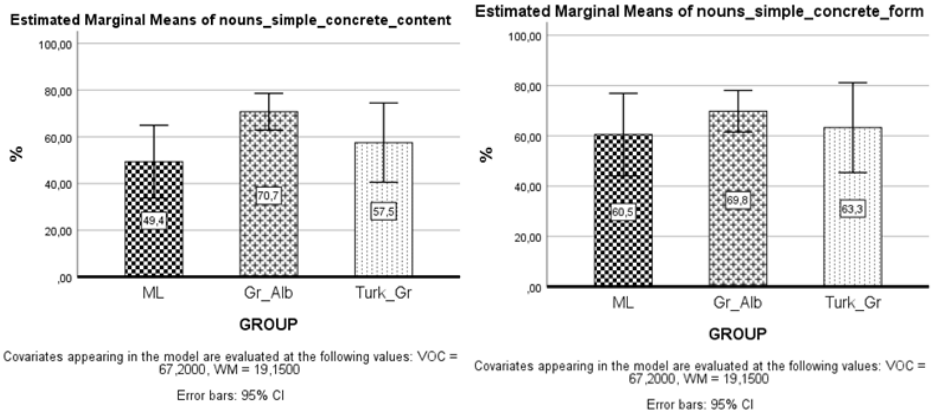
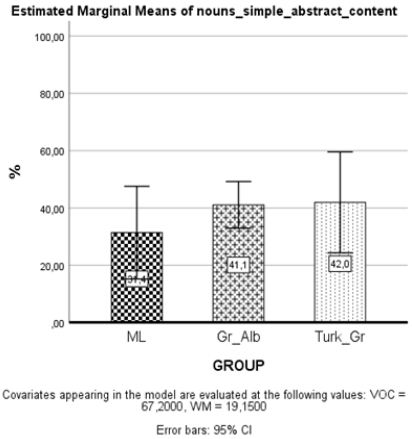


Figure 3. *Groups' performance (%) in simple abstract nouns (content and form).*



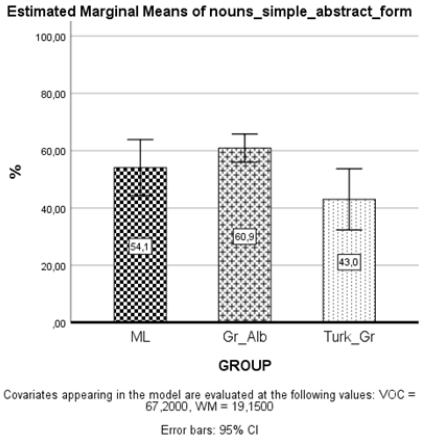
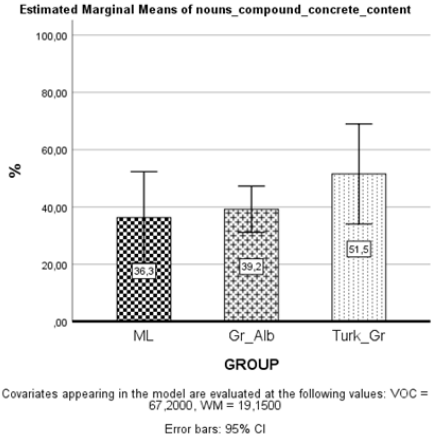


Figure 4. *Groups' performance (%) in compound concrete nouns (content and form).*



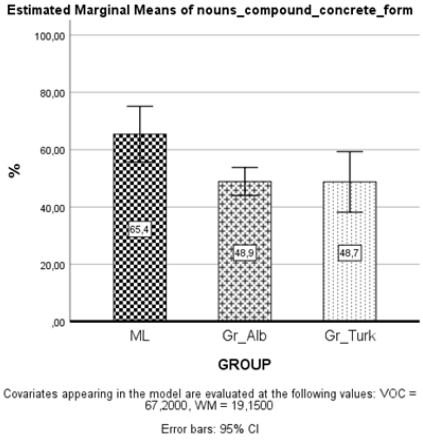
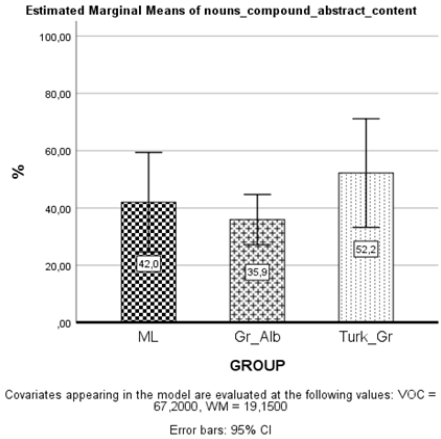


Figure 5. *Groups' performance (%) in compound abstract nouns (content and form).*



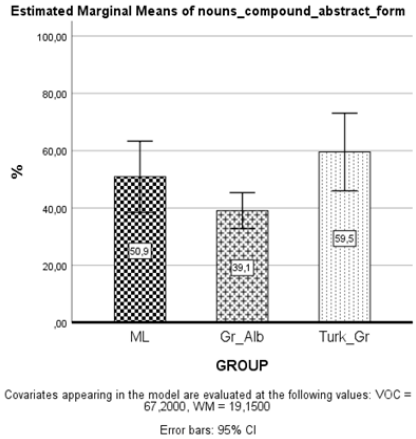
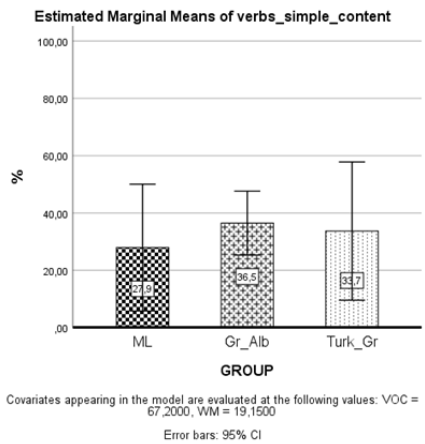


Figure 6. *Groups' performance (%) in simple verbs (content and form).*



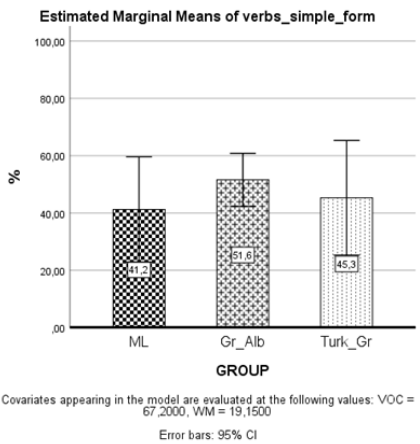
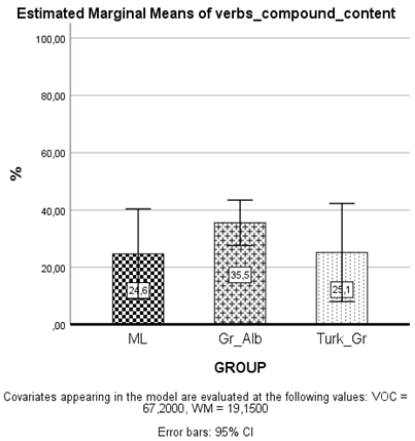


Figure 7. *Groups' performance (%) in compound verbs (content and form).*



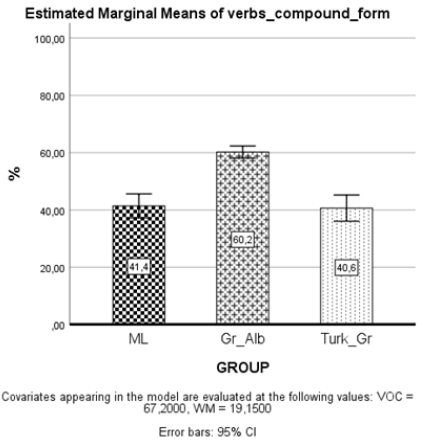
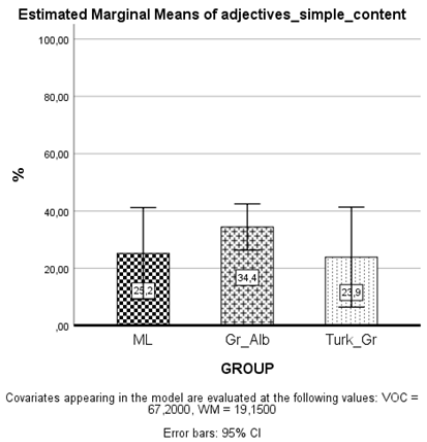


Figure 8. *Groups' performance (%) in simple adjectives (content and form)*



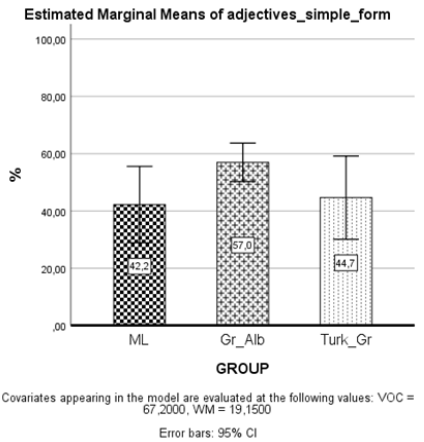


Figure 9. *Groups' performance (%) in compound adjectives (content and form).*

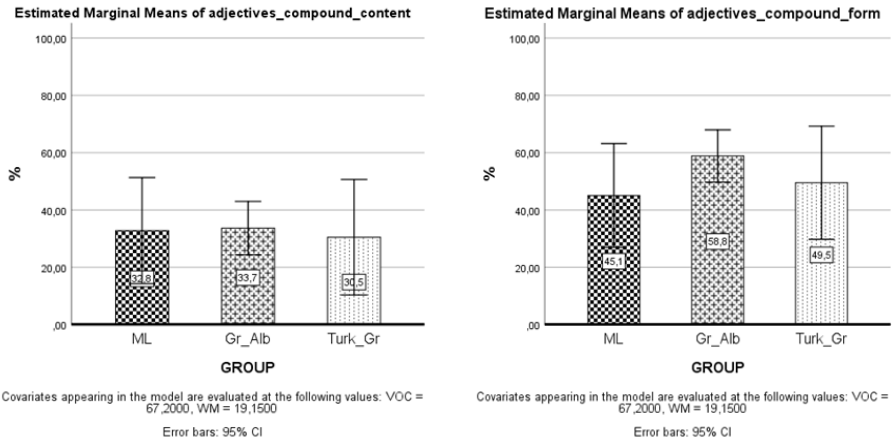


Table 4. *Groups' Performance (%) in the Verbal Working Memory Task*

Group	VWM (%)
ML	59.4 (*SD* = 9.7)
Gr-Alb	52.3 (*SD* = 9.1)
Turk-Gr	47.8 (*SD* = 6.7)

Note. ML = monolingual children; Gr-Alb = Greek-Albanian bilingual children; Turk-Gr = Turkish-Greek bilingual children; VWM = verbal working memory.

$p = .080$, $\eta^2 = .135$, respectively. Post-hoc criteria Bonferroni showed that the Gr-Alb group used more complex structures than the two other groups ($p < .001$ for both comparisons) while the performance of ML and Turk-Gr groups was similar ($p = 1$).

The three groups performed similarly in the definitions of simple and compound adjectives in both content and form [simple: $F(2, 35) = 2.204$, $p = .125$, $\eta^2 = .112$, and $F(2, 35) = 2.776$, $p = .070$, $\eta^2 = .140$; compound: $F(2, 35) = .066$, $p = .936$, $\eta^2 = .004$ and $F(2, 35) = 2.586$, $p = .090$, $\eta^2 = .129$], as depicted in Figures 8 and 9.

In the VWM task, statistically significant differences were observed among the groups, $F(2, 37) = 6.382$, $p = .004$ (see Table 4). Post-hoc criteria Bonferroni showed that the ML group had better VWM abilities compared to the Turk-Gr group ($p = .003$) while no other statistically significant differences were found between the groups, ML vs. Gr-Alb: p = .135; Gr-Alb vs. Turk-Gr: $p = .573$.

Discussion

The current study aimed to investigate (a) possible links between VWM and breadth and depth of VK and (b) definitional skills of dominant bilinguals with different language profiles after controlling for their vocabulary and VWM abilities and considering different parameters, such as grammatical categories, semantic characteristics, and morphological structure.

The main findings in vocabulary size and VWM abilities showed that monolinguals outperformed both bilingual groups in vocabulary size and Greek-Albanian bilinguals had larger vocabularies than Turkish-Greek bilinguals. These findings were expected since research has shown that monolinguals have larger vocabularies than bilinguals (August & Shanahan, 2006; Oller & Pearson, 2002). Greek-Albanian bilinguals had more exposure to Greek and received more quantity and quality input in Greek compared to the Greek-Turkish bilinguals. The aforementioned conditions have an impact on the growth of the breadth of VK (Dosi & Papadopoulou, 2020). In VWM, the only deference found was between monolinguals and Turkish-Greek bilinguals, where the former group had better VWM abilities than the latter. This result may show the impact of language dominance and proficiency on VWM abilities. In other words, bilinguals who were tested in their nondominant language in which they have lower vocabularies tried harder to retrieve words and this caused a cognitive overload (Blom et al., 2014; Kaushanskaya et al., 2011; Service et al., 2002).

Our first research hypothesis was confirmed since VWM abilities correlated with vocabulary size (breadth of VK) and definitional skills (depth of VK, Dosi, 2021; McGregor et al., 2013) but only in monolinguals and Greek-Albanian bilinguals, since both groups had high language proficiency and exposure in Greek in different settings and contexts (community and school; Dosi & Papadopoulou, 2020; Haastrup & Henriksen, 2000; Schwartz & Katzir, 2012). Another interesting finding was that breadth and depth of VK correlated only in the Greek-Albanian group, conceivably due to their increased proficiency in Greek (Haastrup & Henriksen, 2000; Li & Kirby, 2015; Nurweni & Read, 1999, Qian, 1999, 2002; Vermeer, 2001). The absence of finding such a correlation in monolingual speakers was due to the fact that monolinguals reached a ceiling effect in expressive vocabulary (91.7%) These finding conflict with findings of previous studies (Dosi, 2021; Dosi & Gavriilidou, 2020; Dosi et al., 2021; McGregor et al., 2013) in which breadth and depth of VK were correlated. A possible answer could be that in our study, the children were older (mean: 11; 6 years) than those of previous studies. In other words, this connection may also exist in monolinguals; at a younger age, though. This finding can also be interpreted in line with the suggestion by McGregor et al. (2013) that knowing a word does not imply the ability to define it. In terms of Turkish-Greek bilinguals, the absence of correlations between the three variables may suggest that due to their low vocabularies, they experience an overload on their VWM in order to retrieve words (Blom et al., 2014; Kaushanskaya et al.,

2011; Service et al., 2002). The lack of correlation between breadth and depth of VK verifies that breadth and depth of VK are not linked in bilinguals with lower vocabularies (Haastrup & Henriksen, 2000; Li & Kirby, 2015; Qian, 1999, 2002; Vermeer, 2001). This finding also supports Cummins' (1976) Threshold Hypothesis (1976), according to which a minimum language proficiency is required to facilitate linguistic and cognitive benefits in bilingual speakers (Haastrup & Henriksen, 2000; Qian, 1999; Vermeer, 2001).

To test our second hypothesis, we controlled for breadth of VK and VWM abilities since the three groups differed in these two variables and this had an impact on their definitional abilities. Our second hypothesis was partially confirmed. After controlling for vocabulary size and VWM abilities, few differences were detected. More specifically, two patterns were observed. The first pattern was found between Greek-Albanian bilinguals and monolinguals in the content of simple concrete nouns and in the form of compound verbs, where Greek-Albanian bilinguals gave more formal definitions than monolinguals. This finding indicates a bilingual advantage, since bilingual speakers exhibited a higher sensitivity in giving formal definitions (i.e., higher sensitivity in metalinguistic abilities; Bialystok, 2001). The second pattern was detected between the two bilingual groups. Greek-Albanian children gave more formal definitions than Turkish-Greek children in the form of simple and compound abstract nouns and in compound verbs. These differences, which did not arise from differences in vocabulary size or VWM abilities, could be due to the teaching methodology that they received at school (Caramelli et al., 2006; Schwartz & Katzir, 2012; Snow, 1990; Snow et al., 1991). In other words, word definitions can be introduced and taught differently in these two different schools. In any case, the finding remains open for further discussion and research.

In terms of the second part of our second hypothesis, it was not fully confirmed since we expected more differences in the more complex categories compared to the simpler ones (Dosi et al., 2021; Dourou, 2019; Maguire et al., 2006). Indeed, most of the differences were in compound and abstract words. The difference detected in simple concrete nouns is an exception and we should keep in mind that this category received the most formal definitions compared to the other categories (>50%). Hence, all groups gave more formal definitions in nouns that are more frequent and conceptually less complex (Dosi et al., 2021; Dourou & Dosi, 2021; Gavriilidou, 2015). As mentioned before the majority of the differences were attested in more complex categories. More specifically, the differences found in simple and concrete words were combined with a complex category either in semantic characteristics (simple abstract nouns) or in morphological structure (compound concrete nouns). This finding further verifies the outcomes of the study of Dosi et al. (2021) that the development of definitional skills is an interrelation of different word characteristics and cannot be studied in an oversimplified manner.

Finally, we should acknowledge some limitations of our study. Our sample

was small per group. In addition, our bilingual groups consisted only of dominant bilingual speakers. Therefore, the findings cannot be generalized. Moreover, bilinguals were not examined in their other language (Albanian or Turkish). Therefore, we do not have the whole picture of their vocabulary knowledge. Moreover, only teachers' questionnaires were provided, and not parental ones. Future research can consider these limitations and examine breadth and depth of VK in both languages in relation to VWM abilities.

Conclusions

The current study provides new insights into our knowledge about the psychology of language regarding the definitional skills in dominant bilingual children with different language pairs. It also provides useful outcomes about the interrelation of language and VWM abilities. The finding that VWM and vocabulary correlate only in monolingual and Greek-Albanian children exhibits that this link requires high language proficiency and exposure to emerge, while it is likely Turkish-Greek bilinguals, due to their limited vocabularies, have to activate more of their VWM abilities. In addition, interestingly, breadth and depth of vocabulary knowledge was found to correlate only in Greek dominant bilingual children. After controlling for vocabulary and VWM, the Greek-Albanian group exhibited a bilingual language advantage over monolingual children in simple concrete nouns and compound verbs, indicating better metalinguistic abilities. Finally, the better performance of Greek-Albanian children compared to Turkish-Greek ones in simple and compound abstract nouns and in compound verbs may reflect an effect of different teaching practices.

The aforementioned findings have important pedagogical implications, since teachers can work to enhance the development and organization of the mental lexicon of their students taking into account the effect of different word characteristics on definitional skills. Thus, an equally important finding of the current study is that the development of definitional skills is an interaction of different variables and should not be considered or taught in a simplified way. Finally, utilizing the findings of the two bilingual groups, we conclude that the equivalent reinforcement and support of both languages in oral and written form is the best and most effective approach to equally develop their languages.

Acknowledgments

We thank the children who participated in this study and their parents who gave their consent. We also thank the two anonymous reviewers for their useful and insightful comments for the significant improvement of the quality of the manuscript.

Conflict of Interest Disclosure

The Authors declare no conflicts of interest.

Funding

Part of this research is co-financed by Greece and the European Union (European Social Fund- ESF) through the Operational Programme «Human Resources Development, Education and Lifelong Learning» in the context of the project "Reinforcement of Postdoctoral Researchers - 2nd Cycle" (MIS-5033021), implemented by the State Scholarships Foundation (IKY) with PI Dr. Chrysoula Dourou.

Research Ethics Statement

The study described in this article was approved by the Ethics Committee of Democritus University of Thrace (60589/2111/31-8-2018) and the national research committee.

All procedures performed in the study (designing, conducting, and reporting) were in accordance with the ethical standards of the institutional Ethics Committee of Democritus University of Thrace (60589/2111/31-8-2018) and the national research committee. Informed consent in writing was obtained before the data collection from children's parents or guardians.

Data Availability Statement

Data available on request from the authors. The data that support the findings of this study are available from the corresponding author (Ifigeneia Dosi) upon reasonable request.

Authorship Details

Ifgeneia Dosi: research concept and design, data analysis and interpretation, writing the article, critical revision of the article, final approval of the article. Grammatia Siskou: collection and/or assembly of data. Chrysoula Dourou: collection and/or assembly of data.

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