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MAPPING THE MENTAL LEXICON OF EFL LEARNERS: A NETWORK APPROACH

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Abstract: *The present paper explores the lexical profiles of monolingual and bilingual learners acquiring English as a second and third language, respectively. Those profiles allow to get insights into learners' lexical access and lexical organization in the new language. To shed more light in this issue, a lexical fluency task was used to gather data. Results showed lack of significant differences in all the measures taken, but some very interesting differences appear when graph theory metrics are applied. Thus, educational bilinguals show higher levels of lexical organization and stronger connections among the nodes. This can be indicative of a mental lexicon which is better organized, more compact, and more stable. Additionally, educational bilinguals' networks display highest clustering coefficient and shortest path length. In semantic terms, this means that educational bilinguals can navigate their lexicon more efficiently and in a way that better resembles native lexical search. These findings open up new avenues for insightful studies concerning lexicon organization in different types of learners, with bilingualism being a relevant modulating factor.*

Key words: *productive vocabulary, lexicon organization, graph network theory, monolingual learners, bilingual learners.*

1. INTRODUCTION

Work on bilingual and multilingual language acquisition addresses how information is stored and organized in the multilingual mind, the relationships between the different languages or the constraints at work when languages are accessed and retrieved (cf. García Mayo, 2012). Specifically, when dealing with how monolingual and bilingual learners acquire a new language most studies try to establish similarities and differences as concerns a) lexicon access and organization of monolingual, bilingual, and multilingual learners, or b) cross-linguistic influence processes, that is, the language(s) where learners transfer from. This second line of research has been very abundant and fertile with interesting findings giving rise to insightful theories such as, the foreign language effect (e.g. Bardel and Lindqvist, 2007; Williams and Hammarberg, 1998), the proficiency level effect (e.g. De Angelis, 2005; Celaya, 2006), the frequency effect or last in use effect (e.g. Hammarberg, 2001), the (psycho)typology or linguistic closeness effect (e.g. Kellerman, 1983; Ringbom, 1987). However, the former line of research has been more modest in research studies and findings with most interest concentrating rather on examining lexical access in monolingual *versus* bilingual learners using verbal and semantic fluency tests (e.g. Rosselli *et al.,* 2000; Gollan *et al.,* 2002, 2005; Portocarrero *et al.,* 2007; Sandoval *et al.,* 2010; Sullivan *et al.,* 2018). In the present paper, we want to explore the impact of speaking two languages on the lexical production of a third language. To that end, we will look into how the lexicon is organized via a semantic fluency task (lexical availability task) completed by three groups of learners: monolinguals, environmental bilinguals and educational bilinguals. We build up on Collins and Loftus (1975) and related theories of lexical activation and spread. To date, we are not aware of any study that explores the mental structure of the EFL lexicon in monolingual and bilingual learners (learning EFL as an additional language). Accordingly, this study intends to cover that gap.

A review of the research-related literature is offered, which includes studies on the differences found in lexical learning and lexical knowledge in monolingual and bilingual learners learning an additional language. We then turn to review the topic of lexical availability as a semantic fluency task eliciting lexical production of thematic vocabulary. The methodology follows and results and discussion sections precede the conclusions of the paper.

LEXICAL LEARNING IN SLA AND TLA

It seems generally acknowledged that SLA (Second Language Acquisition) and TLA (Third Language Acquisition) are different processes (see e.g. Cenoz, 2013; Hirosh and Degani, 2017), basically because they present different

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scenarios concerning a) learners' metalinguistic awareness and linguistic experience and b) cross-linguistic interactions regarding both the source language(s) and the direction of the influence (cf. Jessner, 2008). The source of the influence depends on a number of factors, as we have already hinted at the introduction above.

Studies on SLA and TLA suggest that multilinguals are better language learners than monolinguals (e.g. Sanz, 2000; Cenoz, 2013). The fact that learners have knowledge of two languages when they take to learn an additional or third language derives in a heightened metalinguistic awareness. This can help them focus on language aspects relevant in the acquisition process (e.g. Sanz, 2000). In this sense, Klein (1995) already suggested that bilinguals have a larger lexical awareness than monolinguals learning an additional language, because of their prior two lexicons. This makes them able to understand better the relationship between form and meaning, and provides an advantage in transfer behaviour. According to Gabrys-Baker (2005) and Otwinowska (2016), bilinguals are able to make more conscious cross-linguistic comparisons and accordingly, benefit more from positive transfer, i.e. cognate use, have better memory performance, and are more verbally creative. Molnar (2008) also found that bilinguals could benefit more from the facilitative effect of cognates than monolinguals learning the same additional language (cf also Szabo, 2016). Also, Keshavarz and Astaneh (2014) found that two groups of bilinguals, one group literate in both languages and the other group literate in only one of the languages, surpassed a group of monolingual learners when tested on vocabulary learning in a novel language.

Motivational and attitudinal aspects are also favoured by larger learning experiences, as well. Thus, Rutgers and Evans (2017) highlight that the functioning of the multilingual lexicon provides learners with a more functional awareness of the language and causes bilingual learners to have more positive attitudes towards foreign language learning. Additionally, the wider language learning experience is also useful in establishing learning objectives and pacing them as well as in the employment of learning strategies conducive to successful learning (Halimi, 2016; Cenoz, 2013; Sanz, 2012). However, other studies have shown no differences in e.g. a) metalinguistic awareness (e.g. Bruck & Genesee, 1995) or b) additional language skills (e.g. Balke-Aurell & Linblad, 1982; Berthele & Udry, 2019; Elsner, 2007; Sanders & Meijers, 1995).

On a different path, studies on verbal and especially semantic fluency tasks performed by bilinguals seem to agree that bilinguals produced fewer "correct" responses in the semantic category task (e.g. Gollan *et al*., 2002, 2005; Roselli *et al.*, 2000; Portocarrero *et al.*, 2007; Sandoval *et al.*, 2010; Sullivan *et al.*, 2018). Researchers allude to cross-linguistic interferences, to weaker links between semantic and lexical systems in the bilingual, and to a reduced vocabulary size in each of the languages of the bilingual. However, this set of studies and the present one have one main difference: the population under investigation is different as they look into bilingual and monolingual learners performing in their L1, whereas we examine monolinguals and bilinguals learning an additional language. To date, we are unaware of further studies that examine lexical production of monolingual and bilingual EFL learners. Our present study intends to fill that gap.

SEMANTIC FLUENCY TASKS IN LEXICON ORGANIZATION: EVIDENCE FROM NETWORK THEORY

One of the central issues in vocabulary studies has to do with how words are stored, organized and accessed in the mind of the learner, and especially when several languages are at stake. There seems to be consensus in the assumption that lexical items are organized in a structured way within the mind, specifically words are believed to be organized as a huge network of lexical items which interrelate. (cf. Collins and Loftus, 1975; Meara, 1996; Borodkin *et al.*, 2016). New words are incorporated into this network and establish relationships based on similarity, be it formal or, mainly, semantic (cf. also Szabo, 2016: 5, Borodkin *et al.*, 2016). The speed with which words are retrieved from the mental lexicon can also be brandished as evidence of a structured and well-organized lexicon (cf. Palapanidi, 2019).

Lexical availability (LA) tasks are a type of semantic fluency and associative timed-task where students have to respond in two minutes to a certain word or expression of a certain thematic or semantic field, which acts as a stimulus, for instance: *food and drink*, *sports and hobbies*, *parts of the body*. The students write as many words as come to their mind with no constraints (e.g. Tomé Cornejo, 2015). In this sense, the LA construct claims to be an indicator of (thematic) vocabulary size, lexicon organization and it allows for reliable comparisons (cf. Tomé Cornejo, 2015: 344-345).

Additionally, semantic fluency tasks such as the lexical availability tasks appear as a very useful and accurate tool to inform the process of lexical access and retrieval, as well as lexicon organization (e.g. Ferreira and Echeverría, 2010; Henriquez Guarín *et al.*, 2016; Borodkin *et al.*, 2016; Jiménez Catalán, 2017) through exploration of the items produced and the relationships (semantic, formal, experiential) among them. The item(s) activated are related among themselves and to the prompt. To date, we are not aware of any previous study, which looks into how monolingual and bilingual learners organize the lexicon in EFL. This study intends to cover that gap.

The semantic web theory based on network theory and graph diagrams tries to explain how lexical units are arranged in the mind (e.g. Echeverría *et al.*, 2008; Echeverría and Ferreira, 2010; Morais, Olsson and Schooler, 2013; Henriquez Marín *et al.*, 2016) using mathematical models to present in a graphical way how the lexical items relate to each other and how weak or strong those relationships are (Echeverría *et al.*, 2008; Salcedo *et al.*, 2013; Borodkin *et al.*, 2016). This intends to be a picture of the lexicon of the students based on their responses to the semantic fluency task. At a theoretical level it links with semantic networks theory and graph theory, which intend to tap the structure of the mental lexicon through the lexical production in a semantic fluency task.

Valenzuela *et al.* (2018: 151) state that lexical graphs represent lexical units as nodes linked by edges or vertices when they are produced together by at least two participants. Thus, a node represents a lexical unit and the edge a sequence of two words, with one word being produced in position *i* and the other one in *i+1*. They also state that using graph methodology together with lexical availability assumptions can help determine not only the accessibility of lexical units but also the way in which they are organized in the mind and how this organization varies as the result of further lexical learning processes (Valenzuela *et al.*, 2018: 151). Furthermore, they might also help predict how new words are learned and incorporated in the lexicon (cf. Morais *et al.*, 2013).

Although specific research in this area is still scarce, Borodkin *et al.* (2016) make an outstanding example of how computing tools and network analysis can help better understand lexicon organization. In their study, they investigated the organization of the second language mental lexicon of English-Hebrew bilingual speakers (n=27) using computational tools. Learners were asked to complete a semantic fluency task and responses were analysed within the network analysis framework and measures. Thus, they revealed that the lexical network of the second language displayed greater local connectivity and less modular community structure than the network in the native language. In view of these results, they conclude that the lexical network of the second language is not as well-organized as is the network of the first language, even in highly proficient bilinguals.

In the present study with a very similar methodology to Borodkin *et al.* (2016), we believe the nature of the semantic fluency task, which is a free association test with multiple stimuli and multiple responses, can prove very useful in determining how monolingual and two types of bilingual groups of learners access and organize their lexicon in the foreign language they are acquiring. In this sense, the study of associations offers quantitative and qualitative data on semantic networks, their size and connections established (Hernández Muñoz and López García, 2014; Borodkin *et al.*, 2016). The creation of lexical networks through free association helps explore associative knowledge and is an insightful tool to disentangle any possible differences in the way monolingual and bilingual learners tackle the task of acquiring, organizing and accessing/ producing the thematic vocabulary of an additional language.

From the review of research-related studies, we observe that the picture concerning lexical production of monolingual and bilingual learners is far from clear. We believe that the present study can shed some light into that issue. By using the lexical availability task, we can obtain information concerning learners' vocabulary size, but also how their mind is organized and accessed by tapping into the words that are most available to the respondents (e.g. access most quickly or first in response) and by representing the networks showing the relationships among the lexical items produced. This study does not claim exhaustiveness; it intends to be a tentative look-out into the vocabulary knowledge states of monolingual and bilingual learners. Its results are to be considered preliminary.

With these previous considerations in mind, the present paper has the following objectives:

1. Study and compare production of thematic vocabulary by monolingual and bilingual learners through semantic fluency task and lexical availability measures.

2. Study and compare lexical organization of monolingual and bilingual learners via graph metrics.

METHODOLOGY

This paper shows a cross-sectional study with data gathered from three different student cohorts. Below, information is provided on the different aspects of the methodology followed. We use the lexical availability model and its indexes together with graph metrics to address the objectives.

Informants

Participants in this study made up three different cohorts depending on their monolingual or bilingual status. In total 42 learners participated in the study. Accordingly, Group 1 (G1) comprised 14 Spanish monolingual learners of English as a school subject. Group 2 (G2) was made of 14 bilingual L3 EFL learners. These were environmental bilinguals with Spanish being the language of schooling (and socialization) and Arabic (3 learners), Romanian

(5 learners), Portuguese (2 learners), Armenian (2 learners), Georgian (1 learner), Russian (1 learner), the home languages, or the languages of their parents [immigrant groups]. These students were, first and only, schooled in Spain in Spanish and had no formal instruction in their home language. No proficiency test was performed on these languages; it is learners who acknowledged themselves as fully bilinguals. Fourteen is the number of such environmental bilinguals we could get access to in our sample drawn from a total population of around 1000 students. Therefore, despite the dangers of the small sample size, and in order to keep the number of participants per group stable, we decided to limit to 14 the participants per group. Accordingly, the findings of the present paper can be understood to be preliminary. However preliminary due to small sample size, this study has great ecological validity since informants were taken from intact classes.[1] Finally, another 14 learners belonged to group 3 (G3). These were educational Spanish-Basque bilinguals also learning English FL at school. These participants attended a Spanish-Basque school of the "all Basque" model, which means that most of the school subjects, except for languages, are taught in Basque. This group of students come from a Spanish-speaking region, where Spanish, and not Basque, is the dominant language, and the main language of socialization in the community. We believe with Siemund and Lorenz (2020: 8) that "it seems relevant to distinguish between different types of bilinguals as the results [of L3 learning] may crucially vary".

All of them were enrolled in grade 12 (pre-university year) (aged between 17-18 years old) in different schools within the Spanish educational system, had a low B1 level of English EFL, according to Spanish curricula regulations, and all of them were learning English as a school subject under the same conditions as regulated by the official guidelines and curricula. Schools were located in urban areas of similar socio-economic status (middle class). Participants were randomly selected from the students at the participating schools within a larger project funded by public grants. The participants were informed of the objectives of the data and the tests and that the results would be anonymous. The school headship and the regional ministry of Education were informed and gave their permission for data gathering. Table 1 presents the learners' characteristics.

Table 1. Informants' characteristics.

	Group 1	Group 2	Group 3
N (42)	14	14	14
L1/L2 status	Monolingual	Environmental bilingual	Educational bilingual
Languages	Spanish English L2	Spanish + Arabic /Romanian/ Portuguese/ Armenian/ Georgian/ Russian English L3	Spanish + Basque English L3
Location	Monolingual community	Monolingual community	Bilingual community
EFL proficiency level	B1	B1	B1

Data collection instruments

A semantic fluency task was used to gather lexical knowledge data from informants. In particular, learners were shown five prompts to which they had to write, in two minutes, as many words or phrases came to their mind (cf. e.g., Hernández Muñoz, 2014; Jiménez Catalán, 2014). Specifically, the prompts to which students were asked to react were *food and drink*, *hobbies*, *animals*, *town* and *countryside*. Participants were instructed in Spanish and each prompt and the corresponding responses occupied an independent sheet of paper.

This semantic fluency type collects multiple responses from learners, giving thus a more complete picture of learners' lexicons. Multiple-response association tests tend to prompt chain responses that relate to one another rather than to the stimulus word. That is, the word produced will facilitate recall of other related concepts or word forms. This procedure presents several advantages. First, it is a free word association test, that permits the activation and the production of words without imposing restrictions related to syntax or morphology, nor to the number of responses (as many as come to their mind in the time-span). Second, by using a lexical availability task we collect more than one answer per stimulus word. In this way, we can capture not only the dominant associations but the weaker ones too. This is an easy-to-administer task, which has been used before to gauge learners' vocabulary knowledge and to approximate to learners' mental lexicon (Hernández Muñoz, 2014; Jiménez Catalán, 2014; Borodkin *et al.*, 2016). For all these reasons, this task was selected.

[1] We are aware that some statistical tests can deal with unequal groups, but for the sake of ecological validity we decided to reduce the sample size for analysis in this specific study. Participants for the other groups (monolingual and educational bilingual) were randomly extracted from larger pools of participants.

Procedure and analysis

Participants had to complete a general proficiency test (Oxford Placement Test) and the semantic fluency task in one single class session at their respective schools, as said above in their pen and paper versions. The teachers and the researchers were present all through the data gathering sessions.

The OPT was corrected and scored and students were assigned to the B1 level of proficiency, lower range. Responses to the semantic fluency task were typed in into excel files. However, data of the prompts was analyzed together, since that would give a much more accurate picture of the learners' global lexicon. Data were then submitted to analysis using the *Dispogen* (Echeverría *et al.*, 2006), *Dispografo* (Echeverría *et al.*, 2008) and *Gephi* tools. In particular, here we analyze sets of different measures, which collect quantitative and qualitative data. Specifically, we obtained lexical availability data and graph metrics. We focus on those metrics that have been found to adapt well to word association data drawn from speakers, namely average degree, clustering coefficient, path length, eigenvector, diameter and community structure figures (cf. Steyvers and Tannenbaum, 2005; Borge and Arenas, 2010; Solé *et al.*, 2010; Morais *et al.*, 2013). These previous studies revealed that language networks have been found to display small-world structures with high clustering coefficient and short path length, basically. In linguistic and semantic terms, this means that there are few nodes/ words with many connections, and many words with very few connections; some even conforming lexical islands or hermits (clustering coefficient). This structure would allow for a rapid and efficient navigation, therefore facilitating lexical retrieval (short path length).

Errors were corrected and data was carefully edited, adopting the same criteria as in Jiménez Catalán and Ojeda Alba (2009): (i) correcting spelling mistakes, (ii) counting repeated words only once per prompt, (iii) discarding unintelligible and words in other languages, (iv) inserting a hyphen in lexical units containing more than one word (e.g., orange-juice). Once the editing process of the responses was over, the data were typed into a text file.

Additionally, we submitted data to descriptive and inferential analysis via SPSS 26.0 in order to gather information about the significance and generalizability of our results, wherever possible.

All ethical considerations were taken into account. Data were collected as part of a larger state-funded research project (see reference grant by the *Ministerio de Ciencia y Universidades*, Spain) and all data gathering instruments and analyses were approved. Data were treated anonymously and the names of the participants were not taken nor disclosed.

RESULTS AND DISCUSSION

In the present study, we pursued two main aims. First, we wanted to look into learners' thematic vocabularies, and how SLA and TLA learners access their mental lexicons in the FL. Second, we wanted to explore how the three different groups organize their known vocabulary in the mind by means of word graphs. Accordingly, we first offer raw descriptive data for group comparison purposes, which can help set the scene and contextualize the rest of the measures. Tables 2-4 show the general data.

Table 2. Descriptive results for monolingual EFL learners.

	Food_drink	Countryside	Animals	Hobbies	Town	Total
Total tokens	210	144	235	207	193	989
Total types	107	112	115	126	124	
Mean tokens	15	10,28	16,78	14,78	13,78	
Mean types	7.6	8	8.21	9	8.88	
Lexical cohesion index	0.14	0.09	0.14	0.12	0.11	
Mean Individual availability index	1.28	0.57	2.66	1.35	1.25	
Singletons	69 (32.85)	92 (63.88)	78 (33.2)	89 (43)	96 (49.7)	

Table 3. Descriptive results for Environmental Bilingual EFL learners.

	Food_drink	Countryside	Animals	Hobbies	Town	Total
Total tokens	211	108	211	182	186	898
Total types	91	89	91	103	104	
Mean tokens	15,07	7,71	15,07	13	13,28	
Mean types	6.5	6.35	6.5	7.34	7.42	
Lexical cohesion index	0.16	0.08	0.16	0.12	0.13	
Mean Individual availability index	1.2	0.3	2.23	0.85	1.06	
Singletons	49 (23.22)	77 (71.3)	55 (26)	68 (37.36)	77 (41.39)	

Table 4. Descriptive results for Educational Bilingual EFL learners.

	Food_drink	Countryside	Animals	Hobbies	Town	Total
Total tokens	210	117	202	167	169	865
Total types	90	67	65	110	80	
Mean tokens	15	8,35	14,42	11,92	12,07	
Mean types	6.42	4.78	4.64	7.85	5.71	
Lexical cohesion index	0.16	0.12	0.22	0.10	0.15	
Mean Individual availability index	1.25	0.74	1.93	0.74	1.04	
Singletons	50 (23.8)	46 (39.31)	32 (15.84)	89 (53.29)	49 (29)	

A cursory look at the descriptive data shows very similar figures for the three groups in the five different semantic fields. In raw numbers, monolingual learners produce more tokens in total than the rest of their peers. Also, they produce more types (different lemmas) in each category in mean figures. Monolingual data shows more heterogeneous data, as seen in lexical cohesion indexes, and in production of singletons over total types. Lexical cohesion index refers to the homogeneity or overlap of the responses. A lexical cohesion index of 1 would indicate that all learners have produced the same responses. As the lexical availability index nears 0, the overlap in responses decreases, i.e. this points to a more heterogenous group in terms of their responses. The results concerning individual availability index, which is a measure of the communicability and representativeness of learners' responses, are very similar for the three cohorts, indicating similarly accessible and representative lexicons for the three learner groups (Callealta Barroso and Gallego Gallego, 2016). Individual availability index measures the appearance of the identified highly available words in each respondent's production.

In order to check for statistically significant differences, we conducted several tests of means comparison. Results of t-test comparisons[2] indicate non-significant results for the three comparison cohorts (group 1-group 2, group 2-group 3, and group 1-group 3) for token and type production, lexical cohesion index, production of non-shared words, and individual availability index for all semantic fields and for the three comparison groups[3].

Production of singleton words, i.e, words which appear only once in the data and are therefore produced by one single learner, also thrown very similar results in all three groups, and points to the heterogeneity of responses, and the relevance of the stimulus categories, which is worth further examination. These differences might be accounted for by the exact nature of the categories where natural or taxonomic categories such as *animals* or *food and drink*, generate more shared words among the participants than more open or slot-filler categories, such as *countryside* or *town*, which are rather based on personal experience than on real-life, observable, natural categorization. Singletons amount up to circa 70% of all the words produced in the prompt *countryside*, and in general it ranges between 25% and 50%. This finding resembles that of Meara and Miralpeix (2021) and concurs with our interpretation that EFL learners have a core vocabulary, probably directly derived from classroom input, plus some peripheral word knowledge they acquire, store and access influenced by their own personal experiences. This result is compatible with the graph data we present below.

We then looked into a more qualitative aspect and listed the most available words for all three groups (measured via lexical availability index). Results shown in Table 5 reveal that there is a big overlap of around half the most

[2] Since the sample is smaller than 30 instances, we have opted for the t-test, which is stated to work better with small samples under 30. However, we still conducted normality tests to check whether the data follow a normal distribution and results revealed that all data sets do, so the t-test was the test called for in all the comparisons.

[3] See Appendix for the tables with the results (Tables 9-11).

available words present in all three vocabularies. Availability index of responses is obtained by combining the position they occupy in the order of responses plus the frequency with which they appear. A lexical availability index close to 1 indicates that the word is frequent in the data and that it has been produced first in the data, if the word appears infrequently and in lowest positions then the value of this index will go closer to 0. This determines the accessibility of the words, with a higher availability index meaning a more accessible word.

Table 5. Most available words.

	Monolingual	Environmental bilingual	Educational bilingual
Food_drink	Water	**Water**	**Water**
	Fish	**Apple**	Salad
	Tomato	Potato	Milk
	Milk	Chip	**Tomato**
	Juice	**Fish**	Vegetable
	Apple	Spaghetti	Pizza
	Chocolate	Banana	Spaghetti
	Hamburger	Meat	Chocolate
	Coke	**Tomato**	**Apple**
	Wine	Cake	Beer
Countryside	Tree	Nature	Mountain
	Animal	**Animal**	**Animal**
	Spain	**People**	Farm
	River	**River**	Tree
	Flower	**City**	**People**
	People	**Cow**	**River**
	Town	Village	Village
	Cow	House	Country
	City	Fresh air	Nature
	Bird	Poor	Chicken
Animals	Cat	**Dog**	**Dog**
	Dog	**Cat**	**Cat**
	Horse	**Bird**	**Cow**
	Bird	**Lion**	**Bird**
	Lion	**Horse**	**Horse**
	Fish	Cow	Monkey
	Monkey	**Fish**	**Fish**
	Snake	**Snake**	Tiger
	Giraffe	Elephant	Pig
	Tiger	**Giraffe**	Tortoise
Hobbies	Sport	**Basketball**	**Music**
	Music	Draw	**Sport**
	Football	Study	**Football**
	Dance	**Read**	**Basketball**
	Read	**Dance**	Run
	Sing	**Football**	Sing
	Friend	**Sport**	**Dance**
	Cinema	Paint	Swim
	Party	Run	Listen to music
	Basketball	Swim	**Read**
Town	People	**Car**	**People**
	House	**Park**	**Park**
	Park	**People**	Street
	Street	**House**	**House**
	Car	**Shop**	City
	Shop	**School**	**Shop**
	School	Restaurant	**Car**
	Cinema	Supermarket	Village
	Bus	Small	Road
	Live	Flat	Building

Below Table 6 presents the most available ten responses for all three groups in an aggregated fashion, i.e. when all semantic fields are considered. Here we can see that 6 out of the ten most available words are common for the three groups, this indicates that clearly all three groups have similarly available lexicons. Consequently, the way their English FL vocabulary is accessed, and therefore organized seems to be similar as well. Availability is equated with accessibility and prototypicality. This can point to similar exposure rates related to similar schooling and teaching methods.

These results are not surprising considering two important aspects 1) the similarity in the schooling of the three groups (two share classroom, and the other one comes from a neighbouring community) established by regional and national educational regulations which include among other the curricula and the proficiency level at which students should be taught; and 2) the strong relationship between the input received and vocabulary knowledge development (Jiménez Catalán personal communication). Schooling effects might be ruling out any potential differences in lexical EFL acquisition and it might be an overriding factor over linguistic background and the monolingual/ bilingual status of learners. The fact that some of the group specific lexical items appeared recurrently within the group might be supportive of the said schooling effect and its potential relevance in lexical EFL acquisition. Additionally, the fact that learners share social and cultural context leads them to have similar lexicon structures involving core items plus related lexical items, this can be called a basic vocabulary, which unsurprisingly is shared by all EFL learners (cf. Ávila Muñoz and Sánchez Sáez, 2011). Accordingly, and since learners in groups 1 and 2 share class and school context, any differences might be traced back to the monolingual/ bilingual status of the learners. It is also interesting to note that FL teaching methods in Europe are thought for monolingual learners/ classrooms and they do not consider bilingual peculiarities, which might favour monolinguals, or at least rule out any possible bilingual advantage in the classroom (Siemund and Lorenz, 2020).

Table 6. Ten most available words. In bold: common in 3 groups, underlined: common in 2 groups.

Group 1	**Dog, fish, water, cat, tomato,** horse, wine, milk, people**, apple**
Group 2	**Fish, water, dog, apple, cat,** potato**, tomato**, chip, spaghetti, banana
Group 3	**Water,** salad**, fish, dog, tomato,** chocolate**, cat, apple,** cow**,** milk

In order to further look into the semantic fluency of these groups, we calculated the prominence or centrality of the words in memory. Centrality of a word indicates a better retrieval potential of that word (cf. Borge and Arenas, 2010; Morais *et al*., 2013). We used *Gephi* to obtain this metric. Specifically, we used PageRank, which is believed to be a faithful measure of the nodes' relevance within the graph. In this sense, highly prominent words are more easily retrieved and more likely to be produced, but not only does this measure refer to how many connections the node has (degree), it also denotes connected nodes whose neighbouring nodes are also critical or central themselves (eigenvector centrality). This measure is perfectly compatible with Collins and Loftus (1975) spreading activation hypothesis, which states that links spread in the network and loose strength as they move away from the central element.

Table 7. Most central nodes (PageRank based on eigenvector centrality, directed weighted graph). In bold: common in 3 groups, underlined: common in 2 groups, shaded common with most available words on a within group comparison.

Group 1	People, **fish**, house, **water**, milk, friend, **bird**, horse, chicken, restaurant
Group 2	**Fish**, **bird**, **water**, giraffe, chicken, horse, school, house, travel, tomato
Group 3	**Water**, **fish**, park, people, **bird**, monkey, music, car, banana, lion

From the information presented in the table, we can see a considerable overlap both between the most prominent and central words in the three groups and also between those central nodes and the most available words. It must be born in mind that the PageRank metric was calculated over a directed graph, i.e. where the direction of the connection is taken into account and also over a weighted graph, where the weight of the edge, i.e. the times a connection is repeated, is also considered. This resembles the way the lexical availability index of individual words is calculated. However, PageRank is a far more reliable measure, since it takes into account robust mathematical and statistical calculations. If one of these central nodes disappeared from the graph, navigations, i.e. lexical search and retrieval, would be considerably hindered.

We believe that these most central and available words make up for the core vocabulary of the learners. According to previous research, these central words are those that have been acquired early in life (e.g. Steyvers and Tennenbaum, 2005; Vitevich, 2008) and in our particular data when dealing with EFL learners these basic words might be the result of classroom input, as we have explained above. New words being learned establish links to already existing nodes; whether these nodes are among the central ones or among the less connected

ones is something research has still to elucidate (these are called *laws of node attachment*, cf. Borge and Arenas, 2010; Solé *et al.*, 2010; Morais *et al.*, 2013; Beckage and Colunga, 2016; Borodkin *et al.*, 2016).

To complete our analysis, we submitted data to the *Dispografo* and *Gephi* tools to generate graphs and find the metrics concerning the structure of the groups' lexicons. The following table (Table 8) shows the results of the graph analyses.

Table 8. Graph data (directed).

Metrics / Groups	monolingual EFL	environmental bilingual EFL	educational bilingual EFL
Nodes	484	430	369
Edges	883	793	748
Average degree	1.824	1.85	2.027
Density	0.004	0.004	0.006
Clustering coefficient	0.025	0.038	0.050
Path length	7.2	7.97	7.11
Community structure	14	9	14
Diameter	23	27	23

As suggested by the figures obtained, monolingual learners produce more word types (nodes), and more links between the nodes (edges). However, when looking into relative measures, i.e. average degree, or mean connections per node, we clearly see that educational bilinguals show higher ratios, indicating having more connections in their mental lexicon. Monolingual EFL learners show the lowest average degree, indicating that the words in the monolingual EFL learners' lexicon have fewer connections. This result concurs with figures for graph density (cf. Wilks and Meara, 2002), which show that the educational bilinguals have the most connected mental lexicon, i.e. words establish more links and are more interconnected. Educational bilinguals show higher levels of lexical organization and stronger connections among the nodes. This can be indicative of a mental lexicon which is better organized, more compact and more stable.

Clustering coefficient and path length are measures related to small-world structures. Clustering coefficient measures the number of connections shared by neighbours, whereas path length refers to the number of edges that connect one node with another. Previous findings concerning semantic networks drawn from associative data (e.g. Steyvers and Tannenbaum, 2005; Solé *et al.*, 2010; Morais *et al.*, 2013) could attest a small-world structure in those networks. These findings have suggested that language networks have small-world structures characterised by high clustering coefficient, and short path length. The graph metrics obtained from our data show values that might be compatible with that structure. Differences between the groups are very small, but educational bilinguals seem to throw figures more closely approaching those of native networks examined before with highest clustering coefficient and shortest path length (cf. Borodkin *et al.*, 2016). Morais *et al.* (2013: 131), for instance, found native directed networks with a clustering coefficient between 0.10 and 0.32 and path lengths between 5.65 and 7.05. In semantic terms, this means that educational bilinguals can navigate their lexicon more efficiently and in a way that better resembles native lexical search.

In the case of environmental bilinguals, we see that their average path length is longer and also the diameter of the graph (the maximum of distances over all pairs of nodes (in the graph)); this indicates that in this network we are going to find larger peripheral chains and probably lexical hermits. In lexical-semantic terms, this can be interpreted as a sign of more idiosyncratic connections, which are not recurrent, i.e. not repeated. Also, this points to L2 lexicons as less well-organized and to L2 networks where words are less likely to group into identifiable subcategories, as illustrated in Figures 1-3 (cf. also Borodkin *et al.*, 2016 for similar results). As a consequence, navigating this lexicon might be less efficient.

This interpretation is backed up by still another metric: community structure. A community in a graph represents those parts or components of the graph with denser connections within and fewer connections with the rest of the components. A higher number of communities might point to more efficient searching mechanisms and it will help to measure the ability of learners to shift efficiently from one sub-category to another (cf. also Borodkin *et al.*, 2016 for similar results, Patra *et al.*, 2020). Here, environmental bilinguals might have larger problems than their peers.

In order to provide visual data for the graph metrics, we include in Figures 1-3 the graphs of each of these groups of informants, monolingual, environmental bilinguals, and educational bilinguals, respectively. It is interesting to look at the dense hubs or largest connected components, which might represent the five semantic

fields considered in the present study pointing to an organization of the lexicon, which is thematic or categorial in nature. This can be observed in the graphs for the three groups. The graphs display some densely connected small areas with a majority of sparsely connected ones and the appearance of some lexical islands or isolated groups of nodes. The monolingual graph shows less separation among the communities (less modularity) which might be indicative of less organized lexicon. In the graph for educational bilinguals, we can see a bigger central component and shorter peripheral chains and lexical islands. This points to a further ability to organize words in subcategories, in a similar fashion to native speakers (cf. also Borodkin *et al.*, 2016 for similar results). This result is fully compatible with previous findings concerning semantic networks drawn from associative data (e.g. Steyvers and Tannenbaum, 2005; Solé *et al.*, 2010; Morais *et al.*, 2013), as we have explained above with metrics.

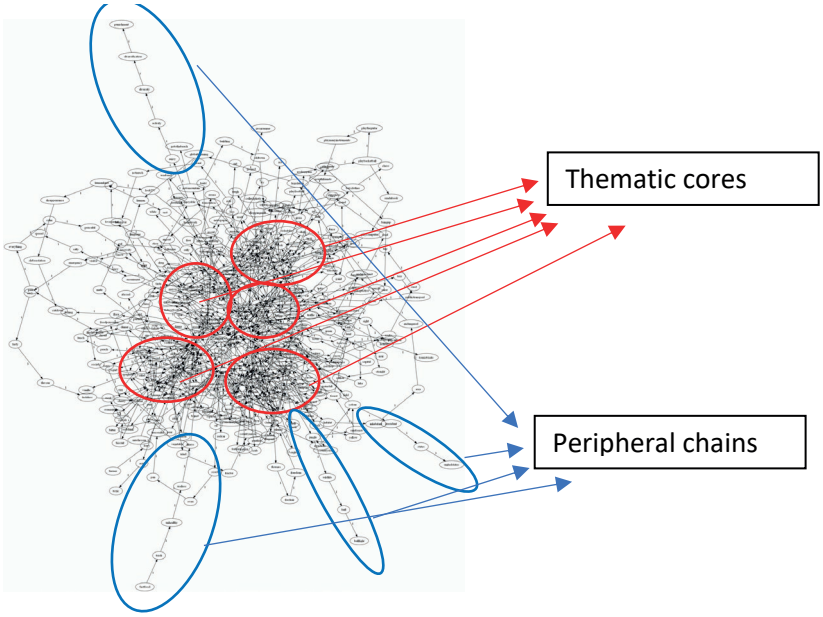

Figure 1. General graph for the monolingual EFL learners' mental lexicon.

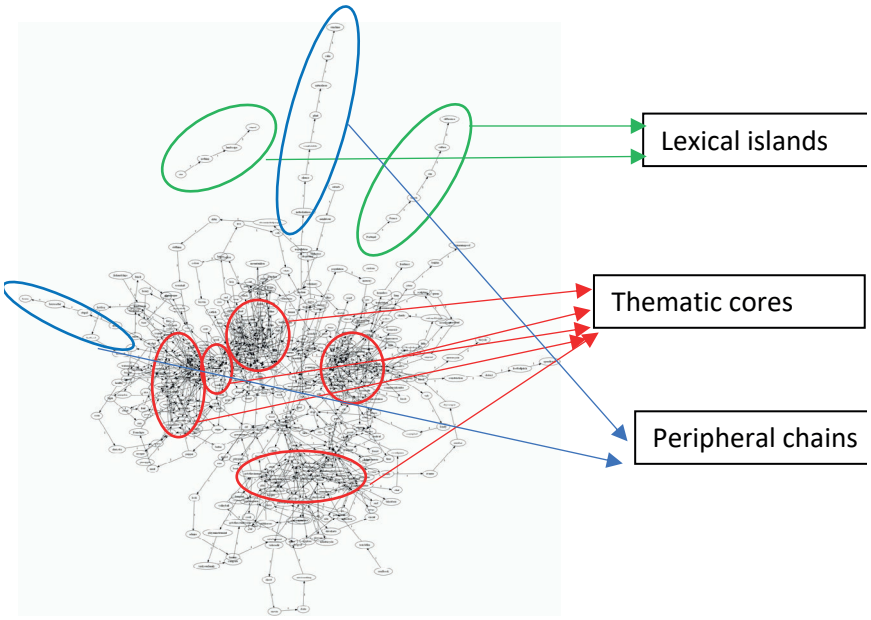

Figure 2. General graph for the environmental bilingual EFL learners' mental lexicon.

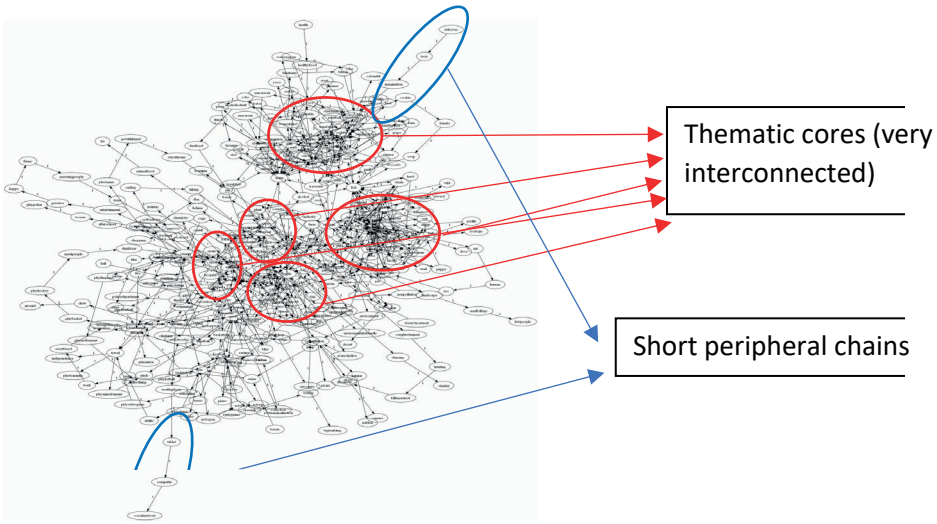

Figure 3. General graph for the educational bilingual EFL learners' mental lexicon.

A closer look at the most connected nodes, those with at least two or more connections, of each data sets allows for further interesting information. Figure 4 shows the network for the monolingual data. Here, we can see a total of 11 nodes representing one big cluster within the semantic category of animals. This cluster is densely connected with many nodes sharing neighbours. This indicates that it is a highly accessible and central or core area of the learners' vocabulary.

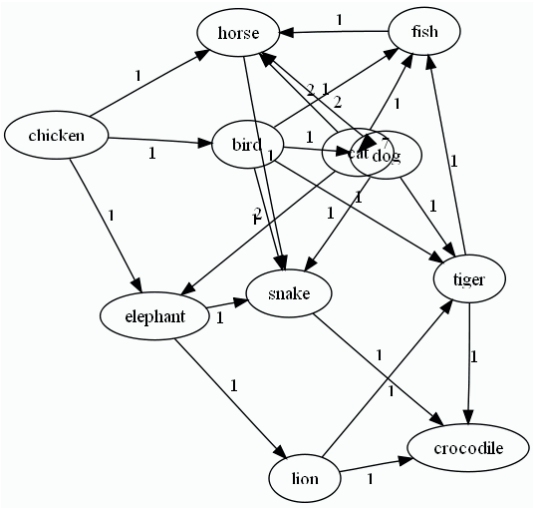

Figure 4. Most connected nodes, monolingual data.

Figure 5 shows the graph for environmental bilinguals. Here, we can clearly observe three interconnected hubs or clusters belonging to the categories: *animals, food and drink*, and *town*. Here, we can observe a total of 33 accessible nodes.

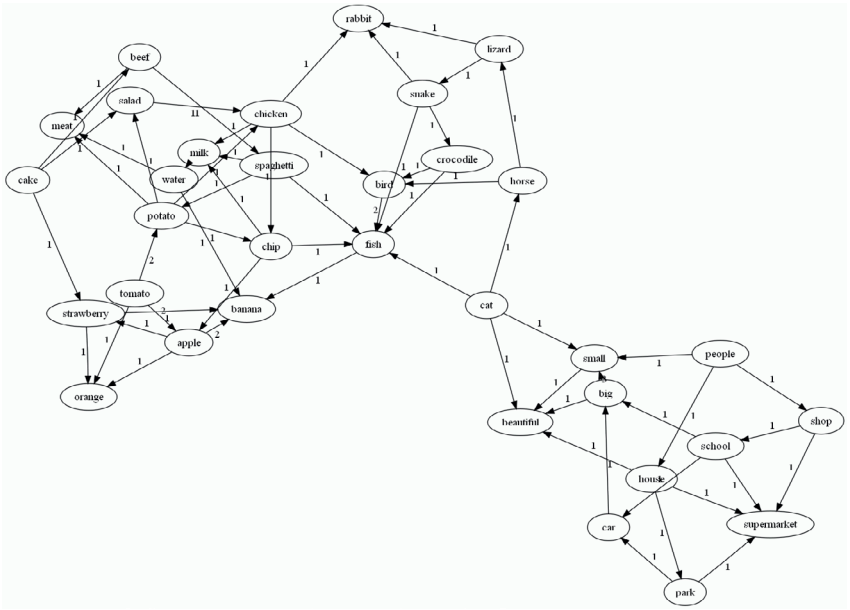

Figure 5. Most connected nodes, environmental bilingual data.

Finally, Figure 6 shows the graph for educational bilinguals. Here again, we can see an organization characterized by several core areas featuring 22 nodes referring to the categories: *animals*, *food* and *drink*, *town*, *countryside*. Additionally, we can see several lexical islands (*food and drink* and *town*) not connected to the main component made up of words pertaining to the category animals and countryside. Here, we can see that educational bilinguals have a core vocabulary which allows them for an efficient and accurate navigation and retrieval across several categories, not only in the highly connected ones, such as *animals*, but also in less predictable or freer associative categories such as *countryside* or *town*.

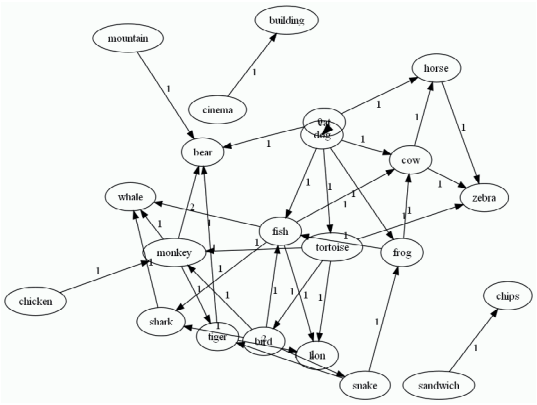

Figure 6. Most connected nodes, educational bilingual data.

These cluster results point to educational bilinguals displaying more clusters which translates in them having higher connectivity among lexical units and might be a sign of a more mature and advanced lexical organization (cf. Hernández Guarín, 2016; Palapanidi, 2019). This higher degree of connectivity might also be indicative of educational bilinguals having a bigger potential to expand their vocabulary, since some theories believe that "the probability of a word acquiring new associates is directly proportional to the number of associates it already has" (Morais *et al.*, 2013: 143). Our interpretation is that educational bilinguals' lexicon organization is more structured and precise. In educational bilinguals' data more subsets with several connections can be observed, whereas these are practically absent in the monolingual group (cf. Ferreira and Echeverría, 2010; Tomé Cornejo, 2015). As we can observe from these last three figures, bilinguals can better organize their vocabulary in specific and clearly delimited subcategories with a high specificity degree, which is a sign of more advanced and native vocabularies (cf. Tomé Cornejo, 2015; Hernández Muñoz and Tomé Cornejo, 2017).

Comparison of our results with previous studies with native speaker graphs show that the lexicons of EFL learners are more loosely connected, since we were unable to find cliques or fully connected clusters (cf. Valenzuela *et al.*, 2018).

In our learner data, nodes seem to display fewer connections; the low number of participants may account for this result, as well. This seems reasonable if we bear in mind that learners' lexicons are still in the early stages of development and the concepts or lexical units might not be well-established yet, might be known only superficially and therefore, these lexical units do not have a clear and stable position within the semantic network.

In their very insightful research study back in 2010; Ferreira and Echeverría probed that native speakers tend to produce nodes which are more interrelated, whereas EFL leaners produce nodes with only a single neighbour or associate. The production of educational bilinguals in our data is closest to that of native speakers. Native speakers and EFL learners showed the same or similar lists of highly available words, just as in our results the three groups of participants showed similar results in this respect. Despite some differences in the methodology and analyses between the present study and Ferreira and Echeverría (2010), our results might render similar interpretation.

CONCLUSION

The present paper investigated the production of thematic vocabulary of three different learner cohorts, which differ in their linguistic background. The main objective of the study was to tap their lexicon access and organization. Results showed lack of significant differences in all of the measures taken, but very interesting tendencies when graph theory metrics are applied.

Our results sustain the semantic activation model by Collins and Loftus (1975) with respect to the assumption that words flow in and enter associative relationships with other words in the mental lexicon. The words enter in the neighbourhood based on similarity, semantic or formal, and establish links of different strength with those neighbours. Accordingly, we decided to look at the mental lexicon in graph theory terms to place it as a complex psychological system. Using this broader context has allowed us to see that the mental lexicon may be governed by the underlying principles that govern other complex systems leading to small-world structures (cf. Borodkin *et al.*, 2016).

In the present study, which attempted to explore the potential differences in the thematic vocabulary production and organization of three groups of learners with different linguistic backgrounds, the data concerning semantic networks of the educational bilinguals turned out to be slightly closer to models of native networks. However, most of the data analysed threw non-significant differences. The study is descriptive and preliminary and does not claim exhaustiveness. However, we believe it is valid for its descriptive power, and the preliminary comparison it offers of the available lexicon of small samples of students with different linguistic backgrounds. Results also revealed very interesting tendencies, which are worth further examination with larger groups of students. In fact, a preliminary analysis with larger samples of around 100 students drawn from similar populations have revealed results comparable and compatible with the ones reported in the present study.

Schooling effect, classroom composition in terms of language represented in the class, as well as a more eclectic methodology which considers linguistic and cultural differences of learners and aims at the development of intercultural communication in the FL class have been suggested as key elements to consider in nowadays EFL classrooms around the world. Social factors and educational opportunities need to be considered as intervening variables because of their potential explanatory power. Further research in this direction is warranted for future studies.

Considering the always increasing multilingual and multicultural composition of school classes in Europe and around the globe, and in light of the results presented here, we advocate towards a methodology focused on the development of intercultural competence in EFL: cultural words (international culture + target culture + home culture). This methodology should aim at fostering intercultural communication and helping learners get along in culturally different and diverse environments (cf. Siemund and Lorenz, 2020; Lirola, 2018). Additionally, CLIL methodologies can turn out to be a differences-levelling approach situating majority language learners and heritage bilinguals or educational bilinguals on similar grounds and ruling out possible initial advantages, which is a desired aim in inclusive schools and societies.

Graph metrics provide very insightful findings concerning a static picture of lexicon organization. Our study suggests that graph theory and the mathematically rigorous tools it offers can be used to increase our understanding of complex cognitive systems, such as the mental lexicon. However, the question still remains about how lexical growth and lexical attachment proceeds. Further questions are: What are the process followed when a new word is incorporated to the lexicon? What attachment procedures take place? We believe we need to take two main research avenues to answer this question. First, examine the strongest links and look for what they rely on, i.e. the semantic relations that our mind uses to attach one new word to already existing words, e.g. hyponymy, synonymy, causal relations, metaphorical and metonymical, to name a few. Second, we need to conduct experimental studies to explore the location of the new words acquired, whether they locate in the core vocabulary attached to highly connected nodes or in the periphery and attached to sparsely connected words with few neighbours.

Further research should try to amend the limitations of the present study mostly concerning sample size. We need to gather more data from heritage learners or learners from immigrant origin in mainstream classes. Understanding how they manage to learn multiple languages within formal education is essential to advance in their education and improve the outcomes of EFL in all our classes. However, bearing in mind the exploratory nature of the present study, we are hopeful our results and findings can be seen as firm and that they can be solid ground for future studies in this very line of research. Besides, focus on how different groups of learners coming from different linguistic backgrounds access and organize their mental lexicons is called for. The study of how figurative language and more complex semantic and conceptual structures are stored in the mind of the FL with varying linguistic knowledge is also a matter of increasing interest and future studies in this field should take this avenue of research.

The present research complies with the Ethical statements and has been approved and funded by a state agency.

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REFERENCES

Ávila Muñoz, A.M. & Sánchez Sáez, J.M. (2011). La posición de los vocablos en el cálculo del índice de disponibilidad léxica. Procesos de reentrada en las listas del léxico disponible de la ciudad de Málaga [online]. *Estudios de Lingüística de la Universidad de Alicante*, *25*, 45-74. https://doi.org/10.14198/ELUA2011.25.02

Balke-Aurell, G., & Linblad, T. (1982*). Immigrant children and their languages. Department of Education Research*, University of Gothenburg.

Bardel, C., & C. Lindqvist. (2007). The role of proficiency and psychotypology in lexical crosslinguistic influence. A study of a multilingual learner of Italian L3. *Proceedings of the 6th International Conference of the Italian Association of Applied Linguistics*, Napels.

Beckage, N.M., & Colunga, E. (2015). Language networks as models of cognition: Understanding cognition through language. *Towards a theoretical framework for analyzing complex linguistic networks* (pp. 3-28). https://doi.org/10.1007/978-3-662-47238-5_1

Berthele, R., & Udry, I. (2019). Multilingual boost vs. Cognitive abilities: Testing two theories of multilingual language learning in a primary school context. *International Journal of Multilingualism*, *19*(1), 142-161. https://doi.org/10.1080/14790718.2019.1632315

Borge-Holthoefer, J., & Arenas, A. (2010) Semantic networks: Structure and dynamics. *Entropy, 12*, 1264–1302. https://doi.org/10.3390/e12051264

Borodkin, K., Kennet, Y.N., Faust, M., & Mashal, N. (2016). When pumpkin is closer to onion than to squash. The structure of the second language lexicon. *Cognition, 156*, 60-70. https://doi.org/10.1016/j.cognition.2016.07.014

Bruck, M., & Genesee, F. (1995). Phonological awareness in young second language learners. *Journal of Child Language*, *22*(2), 307-324. https://doi.org/10.1017/S0305000900009806

Callealta Barroso, F.J., & Gallego Gallego, D. (2016). Medidas de disponibilidad léxica: comparabilidad y normalización. *Boletín de filología*, *51*(1), 39-92. https://doi.org/10.4067/S0718-93032016000100002

Celaya, M.L. (2006). "Lexical transfer and L2 proficiency: A longitudinal analysis of EFL written production". In A.S. Alcaraz, C.P. Soto, and M.C.G. Zunido. (Eds.). *Paper presented at AEDEAN Conference*, Jaén. CD format.

Cenoz, J. (2013). The influence of bilingualism on third language acquisition: Focus on multilingualism. *Language Teaching, 46*, 71-86. https://doi.org/10.1017/S0261444811000218

Collins A.M., & Loftus E.F. (1975). A spreading activation theory of semantic processing. *Psychological Review*, *82*, 407-428. https://doi.org/10.1037/0033-295X.82.6.407

De Angelis, G. (2005). Multilingualism and non-native lexical transfer: an identification problem. *International Journal of Multilingualism*, *2*(1), 1-25. https://doi.org/10.1080/17501220508668374

Echeverría, M.S., Urzúa, P., & Figueroa, I. (2006). *Dispogen. Programa computacional para el análisis de la disponibilidad léxica*, Concepción, Chile: Universidad de Concepción (Software).

Echeverría, M., Vargas, R., Urzua, P., & Ferreira R. (2008). DispoGrafo: una nueva herramienta computacional para el análisis de relaciones semánticas en el léxico disponible. *RLA: Revista de lingüística teórica y aplicada*, *46*(1), 81-91. https://doi.org/10.4067/S0718-48832008000100005

Echeverría, M., & Ferreira, R. (2010). Redes semánticas en el léxico disponible de inglés L1 e inglés LE. *Onomázein, 21*, 133-53. https://doi.org/10.7764/onomazein.21.05

Elsner, D. (2007). *Hörverstehen im Englischunterricht der Grundschule: Ein Leistungsvergleich zwischen Kindern mit Deutsch als Muttersprache und Deutsch als Zweitsprache* (BV022231034). Peter Lang.

Gabrys-Barker, D. (2005). *Aspects of multilingual storage, processing and retrieval*. Katowice: University of Silesia Press.

García-Mayo, M.P. (2012). Cognitive approaches to L3 acquisition. *International Journal of English Studies*, *12*, 129–146. https://doi.org/10.6018/ijes.12.1.140421

Gollan, T., Montoya, R., & G. Werner. (2002). Semantic and letter fluency in Spanish-English bilinguals. *Neuropsychology*, *16*, 562-576. https://doi.org/10.1037/0894-4105.16.4.562

Gollan, T.H., Montoya, R.I., Fennema-Notestine, C., & S.K. Morris (2005). Bilingualism affects picture naming but not picture classification. *Memory & Cognition*, *33*, 1220-1234. https://doi.org/10.3758/BF03193224

Goñi, J. *et al*. (2010) Switcher-random-walks: a cognitive-inspired mechanism for network exploration. *International Journal of Bifurcarte Chaos, 20*, 913–922. https://doi.org/10.1142/S0218127410026204

Halimi, F. (2016). The architecture of the mental lexicon and the selection of lexical nodes. *Contemporary Educational Researches Journal*, *6*(4), 189-196. https://doi.org/10.18844/cerj.v6i4.591

Hammarberg, B. 2001. "Roles of L1 and L2 in L3 production and acquisition". In J. Cenoz, B. Hufeisen and U. Jessner. (Eds.). *Cross-Linguistic Influence in Third Language Acquisition: Psycholinguistic Perspectives*. Clevedon: Multilingual Matters, 21-41. https://doi.org/10.21832/9781853595509-003

Henríquez Guarín, María Clara; Mahecha Mahecha, Viviana; Mateus Ferro, Geral (2016). Análisis de los mecanismos cognitivos del léxico disponible del Cuerpo humano a través de grafos». *Lingüística y Literatura, 69*, 229-51. https://doi.org/10.17533/udea.lyl.n69a10

Hernández Muñoz, N. (2014). Categorías en el léxico bilingüe: perspectivas desde el priming semántico interlenguas y la disponibilidad léxica. *RAEL: revista electrónica de lingüística aplicada,13*(1): 19-38.

Hernández Muñoz, N. & López García, M. (2014). Análisis de las relaciones semánticas a través de una tarea de libre asociación en español con mapas auto-organizados. *RLA, Revista de Lingüística Teórica y Aplicada*, *52*(2), 189-212. https://doi.org/10.4067/S0718-48832014000200009

Hernández Muñoz, N. & C. Tomé Cornejo (2017). Léxico disponible en primera y segunda lengua: bases cognitivas. Palabras, Vocabulario, Léxico: La lexicología aplicada a la didáctica y a la diacronía / coord. por Florencio del Barrio de la Rosa: 99-122. Ca´Foscari Edizione.

Hirosh, Z. & Degani, T. (2017). Direct and indirect effects of multilingualism on novel language learning: An integrative review. *Psychonomic Bulletin & Review* 25(3), 892–916. https://doi.org/10.3758/s13423-017-1315-7

Jessner, U. (2008). Teaching third languaes: Findings, trends and challenges. *Language Teaching*, *41*(1), 15-56. https://doi.org/10.1017/S0261444807004739

Jiménez Catalán, R.M. (Ed.). (2014). *Lexical Availability in English and Spanish as a Second Language*. New York: Springer. https://doi.org/10.1007/978-94-007-7158-1

Jiménez Catalán, R.M. (2017). Estudios de disponibilidad léxica en español y en inglés: revisión de sus fundamentos empíricos y metodológicos. *Revista Nebrija de Lingüística Aplicada, 22*, 16-31.

Jiménez Catalán, R.M. & Ojeda Alba, J. (2009). Disponibilidad léxica en inglés como lengua extranjera en dos tipos de instrucción. *Lenguaje y Textos, 30*: 166-176.

Kellerman, E. (1983). Now you see it. now you don't. In S. Gass and L. Selinker (Eds.). *Language Transfer in Language Learning*. Rowley: Newbury House, 47-57.

Keshavarz M.H., Astaneh H. (2004). The impact of bilinguality on the learning of English vocabulary as a foreign language (L3). *International Journal of Bilingual Education and Bilingualism, 7*, 295-302. https://doi.org/10.1080/13670050408667814

Klein, E.C. (1995). Second versus third language acquisition: is there a difference? *Language Learning*, *45*(3), 419-465. https://doi.org/10.1111/j.1467-1770.1995.tb00448.x

Lirola, M. (2018). La importancia de introducir la competencia intercultural en la educación superior: Propuesta de actividades prácticas. *Revista electrónica educar, 22*(1), 1-12. https://doi.org/10.15359/ree.22-1.3

Meara, P.M. 1996. The dimensions of lexical competence. In: G Brown, K Malmkjaer and J. Williams (Eds.). *Competence and Performance in Language Learning*. Cambridge: Cambridge University Press.

Meara, P., & Miralpeix, I. (2021). Bayesian Vocabulary Tests. *Vigo International Applied Linguistics, 18*, 177-204. https://doi.org/10.35869/vial.v0i18.3370

Michael, E.B., & Gollan, T.H. (2005). Being and becoming bilingual: Individual differences and consequences for language production. In J. F. Kroll & A. M. B. de Groot (Eds.), *Handbook of bilingualism: Psycholinguistic approaches* (pp. 389–407). New York: Oxford University Press.

Miralpeix, I. & Meara, P.M. 2014. The written word. In J. Milton & T. Fitzpatrick (Eds.). *Dimensions of vocabulary knowledge*. Palgrave: Macmillan.

Molnar, T. (2008). Second language versus third language vocabulary acquisition: A comparison of the English lexical competence of monolingual and bilingual students. *Toronto Working Papers in Linguistics (TWPL)*, *33*, 1-16.

Morais, A.S., Olsson, H., and Schooler, L.J. (2013). Mapping the structure of semantic memory. *Cognitive Science, 37*(1), 125-145. https://doi.org/10.1111/cogs.12013

Otwinowska, A. (2016). *Cognate Vocabulary in Language Acquisition and Use*. Bristol: Multilingual Matters. https://doi.org/10.21832/9781783094394

Palapanidi, K. (2019). Manifestaciones de "clusters" y "switches" en el léxico disponible de aprendices griegos de ELE en diferentes niveles lingüísticos. *MarcoEle*. 28.

Patra, A. Bose, A., and Marinis, T. (2020). Performance difference in verbal fluency in bilingual and monolingual speakers. *Bilingualism: Language and Cognition, 23*(1), 204-218. https://doi.org/10.1017/S1366728918001098

Portocarrero, J.S., Burright, R.G. & P.J. Donovick (2007). Vocabulary and verbal fluency of bilingual and monolingual college students. *Archives of Clinical Neuropsychology, 22*, 415-422. https://doi.org/10.1016/j.acn.2007.01.015

Ringbom, H. (1987). *The Role of the First Language in Foreign Language Learning*. Clevedon: Multilingual Matters.

Rosselli, M., Ardila, A., Araujo, K., Weekes, V.A., Caracciolo, V., Padilla, M., & F. Ostrosky-Solis (2000). Verbal fluency and repetition skills in healthy older Spanish-English bilinguals. *Applied Neuropsychology*, *7*, 17–24. https://doi.org/10.1207/S15324826AN0701_3

Rutgers, D., & Evans, M. (2015): Bilingual education and L3 learning: metalinguistic advantage or not? *International Journal of Bilingual Education and Bilingualism*, *20*(7), https://doi.org/10.1080/13670050.2015.1103698

Salcedo, P., & del Valle, M. (2016)., Disponibilidad Léxica Matemática en Estudiantes de Enseñanza Media de Concepción, Chile, *Atenas*, (online), *1*(21), 1-16.

Sanders, M., & Meijers, G. (1995). English as L3 in the elementary school. *ITL Review of Applied Linguistics*, *107*, 59-78. https://doi.org/10.1075/itl.107-108.04san

Sandoval, T.C., Gollan, T.H., Ferreira, V.S., & D.P. Salmon (2010). What causes the bilingual disadvantage in verbal fluency? The dual-task analogy. *Bilingualism: Language & Cognition*, *13*, 231–252. https://doi.org/10.1017/S1366728909990514

Sanz, C. (2000). Bilingual education enhances third language acquisition: Evidence from Catalonia. *Applied Psycholinguistics, 21*, 23-44. https://doi.org/10.1017/S0142716400001028

Sanz, C. (2012). Multilingualism and Metalinguistic Awareness. In Chapelle, C.A. (Ed.) *The Encyclopedia of Applied Linguistics* (pp.3933-3942), Oxford, UK: Wiley-Blackwell. https://doi.org/10.1002/9781405198431.wbeal0802

Schmitt, N**.** (2004). *Formulaic Sequences: Acquisition, Processing and Use*. John Benjamins. https://doi.org/10.1075/lllt.9

Siemund, P., & Lorenz, E. (2020). The acquisition of English as an additional language by multilingual heritage speakers', in: Matthias Meyer and Ulrich Hoinkes (eds.) Der *Einfluss der Migration auf Sprach- und Kulturräume - The Impact of Migration on Linguistic and Cultural Areas*.

Singleton, D. (2012). Multilingual lexical operations: keeping it all together... and apart in, editor(s) Cabrelli Amaro, J. Flynn, S. Rothman, J., *Third language acquisition in adulthood*, Amsterdam, John Benjamins, 2012, pp. 95-113. https://doi.org/10.1075/sibil.46.08sin

Solé, R., Corominas-Murtra, B., Valverde, S. and Steels, L. (2010). Language Networks: their structure, function and evolution. *Complexity, 15*(6), 20-26. https://doi.org/10.1002/cplx.20305

Steyvers, M., & Tenenbaum, J.B. (2005) The large-scale structure of semantic networks: statistical analyses and a model of semantic growth. *Cognitive Science, 29*, 41–78 16. https://doi.org/10.1207/s15516709cog2901_3

Szabo, C. (2016). Exploring the Mental Lexicon of the Multilingual: Vocabulary Size, Cognate Recognition and Lexical Access in the L1, L2 and L3. *Eurasian Journal of Applied Linguistics*, *2*(2) 1-25. https://doi.org/10.32601/ejal.461007

Sullivan, M.D., Poarch, G.J., & Bialystok, E. (2018). Why is Lexical Retrieval Slower for Bilinguals? Evidence from Picture Naming. *Biling (Camb Engl), 21*(3), 479-488. https://doi.org/10.1017/S1366728917000694

Tanabe, M. (2016). Measuring second language vocabulary knowledge using a temporal method. *Reading in a Foreign Language*, *28*(1), 1.

Tomé Cornejo, C. (2015). *Léxico disponible. Procesamiento y aplicación a la enseñanza de ELE*. Salamanca: Universidad de Salamanca, unpublished Doctoral Dissertation.

Valenzuela, M., Pérez, V., Bustos,C., & Salcedo, P. (2018). Cambios en el concepto de aprendizaje de estudiantes de pedagogía: análisis de disponibilidad lexical y grafos. *Estudios Filológicos,* 143-173. https://doi.org/10.4067/S0071-17132018000100143

Vitevich, M. (2008). What Can Graph Theory Tell Us About Word Learning and Lexical Retrieval? *Journal of Speech, Language, and Hearing Research, 51*, 408-422. https://doi.org/10.1044/1092-4388(2008/030)

Wilks C., & Meara, P. (2002). Untangling word webs: Graph theory and the notion of density in second language word association networks. *Second Language Research, 18*(4), 303-324. https://doi.org/10.1191/0267658302sr203oa

Williams, S., & Hammarberg, B. (1998). Language switches in L3 production: implications for a polyglot speaking model. *Applied Linguistics*, *19*(3), 295-333. https://doi.org/10.1093/applin/19.3.295

Wray, A. (2002). *Formulaic Language and the Lexicon*. Cambridge: Cambridge University Press. https://doi.org/10.1017/CBO9780511519772

APPENDIX

Table 9. t-test comparison for G1 and G2 (for token production and idl).

Variable	t-test	P value
Food and drink	-.035	.972
Countryside	1.129	.269
Animals	.776	.445
Hobbies	.830	.414
Town	.242	.811
idl_food and drink	.612	.546
Idl_countryside	3.542	.002
Idl_animals	2.291	.030
Idl-hobbies	4.349	.000
idl_town	1.299	.206

Table 10. t-test comparison for G1 and G3 (for token production and idl).

Variable	t-test	P value
Food and drink	.000	1.000
Countryside	.893	.380
Animals	1.184	.247
Hobbies	1.327	.196
Town	.844	.407
idl_food and drink	.203	.841
Idl_countryside	-2.079	.048
Idl_animals	3.277	.003
Idl-hobbies	5.095	.000
idl_town	1.667	.108

Table 11. t-test comparison for G2 and G3 (for token production and idl).

Variable	t-test	P value
Food and drink	.047	.963
Countryside	-.483	.633
Animals	.435	.667
Hobbies	.955	.348
Town	.969	.341
idl_food and drink	-.473	.640
Idl_countryside	-7.285	.000
Idl_animals	1.867	.073
Idl-hobbies	1.350	.189
idl_town	.118	.907