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Verónica García-Castro[1]

Abstract: *Research in second/foreign (L2) vocabulary learning has recently started to take into account the role of learners' individual differences in working memory, motivation, language aptitude, phonological awareness, amongst others. However, much research up to now has not explored if verbal fluency capacity influences learning L2 English in adult learners. Thus, this study examined the possible influence of verbal fluency in L1 and L2 vocabulary learning in university students (n=58) in York, United Kingdom, from March to May 2018. A quantitative methodology, via a linguistic experiment, was employed to explore whether verbal fluency capacity facilitates L1 and L2 vocabulary learning. The experiment started with a verbal fluency capacity test, followed by a vocabulary training phase, and it finished with offline recognition and recall vocabulary post-tests. Data was processed and analysed using the statistical package R and two general linear models were created and tested with the "glm" package in the R environment. Results of general linear modelling confirmed that L1 learners scored higher than L2 learners in recognition (β =-31.54, SE= 9.38, Z=-3.362, p<0.001) and recall (β = -25.50, SE= 8.69, Z=-2.933, p<0.003) vocabulary post-tests. Additionally, L1 (M=0.53; SD=0.50; vs. M=0.47; SD=0.50) and L2 learners (M=0.39; SD=0.49; vs. M=0.36, SD=0.48) with higher verbal fluency capacity scored higher in recall post-tests (β =0.83, SE=0.33, Z=2.511, p<0.012) than those with lower capacities. It is concluded that verbal fluency capacity may influence vocabulary learning and that this information should be taken into account in vocabulary teaching and learning processes.*

Keywords: *Language teaching, Word processing, Individual differences, Adult learning*

Resumen: *La investigación en la enseñanza y aprendizaje de vocabulario en segundos idiomas/idiomas extranjeros(L2) ha empezado, recientemente, a tomar en cuenta las diferencias individuales de memoria de trabajo, motivación, conciencia fonológica, entre otras. Sin embargo, se ha explorado poco si la fluidez verbal influye en el aprendizaje del idioma inglés como segunda lengua/lengua extranjera (L2) y como primer idioma (L1) en personas adultas. Por lo tanto, este artículo examinó la posible influencia de la fluidez verbal en el aprendizaje de vocabulario en el idioma inglés L1 y L2 en personas estudiantes (n=58) universitarias en una universidad en York, Reino Unido, entre marzo y mayo de 2018. Se utilizó una metodología cuantitativa a través de un experimento lingüístico. El experimento inició con una prueba de fluidez verbal seguido de una fase de aprendizaje y finalizó con pruebas posteriores de vocabulario. Los datos se procesaron y analizaron con el paquete estadístico R y se crearon dos modelos lineales generales. Los resultados confirmaron que tanto en el reconocimiento (β =-31.54, SE= 9.38, Z=-3.362, p<0.001) como en la producción (β = -25.50, SE= 8.69, Z=-2.933, p<0.003) de vocabulario se obtuvieron mejores resultados en inglés L1. Además, las personas con más fluidez verbal lograron mejores resultados en la producción de vocabulario (β =0.83, SE=0.33, Z=2.511, p<0.012) tanto en inglés L1 (M=0.53; SD=0.50; vs. M=0.47; SD=0.50) como en inglés L2 (M=0.39; SD=0.49; vs. M=0.36, SD=0.48). Se concluye que la fluidez verbal podría influir en el aprendizaje de vocabulario y que debe de tomarse en cuenta en procesos de enseñanza y aprendizaje.*

Palabras clave: *Enseñanza de idiomas, Vocabulario, Diferencia individual, Aprendizaje de personas adultas.*

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1. Introduction

1.1 Learners' Individual Differences

Learners vary in their cognitive, social, affective, and motivational characteristics (Dörnyei, 2009); thus, exploration of the effects of individual differences has recently increased in studies regarding second/foreign language (L2) learning and processing (Brothers et al., 2021; Cheng et al., 2021; De Wilde et al., 2021; Elgort and Warren, 2014; García-Castro, 2015; Marecka et al., 2020; Montero Perez, 2020). However, until now much research has not explored whether, or how, verbal fluency capacity facilitates L2 word learning in adults. For instance, most recent studies on L2 vocabulary learning have researched learners' individual differences in working memory (Ansarin and Khabbazi, 2021; Lee and Lee, 2021), vocabulary knowledge (Elgort et al., 2018; García-Castro, 2015, 2020; Montero Perez, 2020), phonological awareness (Marecka et al., 2020; Zhang and Roberts, 2021), verbal fluency in children (Friesen et al., 2021), and verbal fluency in bilingual aphasia (Carpenter et al., 2020). Research on verbal fluency and its possible influence on L2 word learning in adulthood is needed.

Previous studies have demonstrated that verbal fluency capacity is associated to language learning and processing (Friesen et al., 2021; Lam and Marquardt, 2021; Luo et al., 2010; Rommers et al., 2015; Wang et al., 2021); however, what is less clear is if, or how, verbal fluency capacity contributes to L2 vocabulary learning in adult Spanish native speakers. Thus, it is necessary to explore the possible influence of verbal fluency capacity in L2 vocabulary learners with adults to provide a deeper account of vocabulary learning in that population. Additionally, researching that possible influence may contribute to pedagogical practices and teaching processes to boost and improve first language (L1) and second language (L2) learners' vocabulary learning processes. This article addresses the research gap just mentioned by exploring the possible influence of verbal fluency capacity in adult vocabulary learning and it is divided into eight sections. The first section is the introduction, including the aims, research questions and hypothesis of the study, followed by a theoretical framework (second section). The third section describes the methodology, materials and instruments, the population that took part in the study, procedures, and how the data was processed and analyzed. Then, the fourth section consists of results and discussion, and the fifth the conclusion. The sixth section includes acknowledgements while the seventh references. The article finishes in the eighth section with the appendices.

1.2 Aims

The main aim of this article is to explore the possible influence of verbal fluency capacity in L1 and L2 vocabulary learning in university students studying in L1 English and in English as a medium of instruction (EMI) at a university in the United Kingdom. However, the article also aims to suggest pedagogical implications of the individual difference of verbal fluency capacity and its possible effect in L2 vocabulary learning.

1.3 Research Questions and Hypotheses

Two main research questions guided this study:

RQ1: Does verbal fluency capacity influence recognition scores of recently learned nouns for L1 and L2 learners?

H1: Due to the fact that verbal fluency is related to semantic memory (Reverberi et al., 2014), participants with higher verbal fluency capacity will have higher   recognition scores of novel nouns.

RQ2: Does verbal fluency capacity influence recall scores of recently learned nouns for L1 and L2 learners?

H1: Given that verbal fluency is related to semantic memory (Reverberi et al., 2014) and that word recall challenges human cognition (Rutherford, 2006), higher verbal fluency capacity facilitates recall of novel nouns.

2. Theoretical Framework

This theoretical framework discusses cognitive individual differences in word learning, verbal fluency capacity, and word retrieval.

2.1 Cognitive Individual Differences

Cognitive individual differences can be defined as "aspects of mental functioning, such as memorization and remembering; inhibiting and focusing attention; speed of information processing; and spatial and causal reasoning" (Robinson, 2012, p.17). Researching L2 learners' cognitive individual differences can provide us with a more accurate understanding of learners' cognitive strengths that can be paired with targeted pedagogical practices (Granena et al., 2016) to enhance their learning process. Thus, recent research is taking into account learners' individual differences in vocabulary learning. However, most research has mainly focused on the role of working memory and pre-existing vocabulary knowledge on L2

vocabulary learning. For instance, Montero Perez (2020) explored whether working memory and previous vocabulary knowledge contributed to vocabulary learning via viewing video. The author concluded that both working memory and previous vocabulary knowledge influence L2 vocabulary learning. Similarly, García-Castro (2020) researched the role of previous vocabulary knowledge on L2 word learning beyond factual memory and found out that greater vocabulary knowledge influences L2 vocabulary acquisition. Hummel (2021) explored whether phonological memory (PM) affects L2 vocabulary learning and found out that for high proficiency learners, PM does not seem to contribute as much as for beginner learners. More recently, Liu et al. (2021) highlighted that L2 vocabulary learning seems to be modulated by higher working memory capacity. A study deviating from the role of working memory and pre-existing vocabulary knowledge in L2 learning is that of Marecka et al. (2020). They explored if auditory perception predicts word learning and found out that sensitivity to fast amplitude rise time contributes to word learning. The authors concluded that auditory perception may be a predictor of word learning.

The studies just mentioned highlight that there is a growing body of literature that recognises that cognitive individual differences are relevant on word learning processes. However, they also suggest that there is a lack of research on how, or if, verbal fluency capacity contributes to L2 vocabulary learning in adults.

2.2 Verbal Fluency

Verbal fluency is the cognitive capacity to retrieve information from memory (Patterson, 2011) related to verbal ability (Lu and Zhang, 2007). It demonstrates verbal ability (Wang et al., 2021) and is associated with one's capacity to semantically categorise and retrieve concepts (e.g. vocabulary) from one's semantic memory or so-called "mental encyclopedia" (Harley, 2014). When trying to retrieve information from the semantic memory, the mental processor employs a clustering mechanism to retrieve words from the same semantic subcategory activating verbal memory and word storage processes (Reverberi et al., 2014; Troyer et al., 1997).Thus, in order to test an individual's verbal fluency capacity, clustering tests are used to ask participants to recall as many words as possible from a semantic cluster with time constraints, usually a minute (Reverberi et al., 2014). In those tests participants use their lexical knowledge (Shao et al., 2014), semantic memory (Troyer et al., 1997), search strategies and conflict monitoring (Friesen et al., 2021) which makes them cognitively challenging (Reverberi et al., 2014) and indicators of a person's semantic memory (Soltani et al., 2021). Verbal fluency

tests can ask participants to recall words from the same semantic category (e.g. flowers) or from the same letter category (e.g. words beginning with the letter C). The former taps into semantic lexical retrieval processing that can shed light on how words are semantically organized in the mental lexicon. The latter also taps into retrieval processing but it might be more cognitive demanding as participants need to suppress responses related to semantic categorization to be able to only recall letter clusters (Friesen et al., 2021). Previous research has demonstrated how verbal fluency is related to word learning and processing. For instance, Rommers et al. (2015) researched how verbal fluency capacity affects language prediction in a visual eye-tracking paradigm. Their study employed a semantic category task, with clusters of animals and professions, to test for verbal fluency. Participants had a total of 60 seconds to recall as many words as possible from every cluster. Overall, their results revealed that linguistic word prediction was associated with higher verbal fluency capacity, thereby suggesting that verbal fluency capacity may facilitate language predictive processes. Similarly, Luo et al. (2010) researched verbal fluency capacity in bilingual processing. They tested verbal fluency via a verbal category test and verbal phonemic fluency tests. Their results revealed a relationship between verbal fluency and word retrieval processes. More recently, Lam and Marquardt (2021) tested L1 and L2 speakers' verbal fluency capacity when retrieving emotional and non-emotional vocabulary. They discovered that, overall, L2 learners have lower verbal productivity when compared to L1 learners when retrieving both emotional and non-emotional vocabulary. In terms of the possible differences on verbal fluency capacity between bilinguals and monolinguals, Wang et al. (2021) showed that some bilinguals seem to have lower verbal fluency capacity than monolinguals and that verbal fluency capacity in bilinguals might depend on individuals' phonological loop. Similarly, Friesen et al. (2021) researched predictors of verbal fluency in monolingual and bilingual children and found out that English receptive vocabulary and fluid intelligence may mediate bilingual verbal fluency capacity.

The studies reviewed above highlight a link between verbal fluency capacity and language processing. Additionally, the studies also demonstrated the lack of empirical evidence on whether, or how, verbal fluency capacity facilitates L1 and L2 novel word learning in adult learners. Thus, this study aims to fill that gap by exploring the possible effects of the individual difference of verbal fluency in novel L1 and L2 noun learning in adults.

2.3   Verbal Fluency and Word Retrieval

Verbal fluency tasks consist of asking participants to retrieve words from their mental lexicon. Therefore, for the purposes of this research it becomes necessary to briefly describe word retrieval processing.

In retrieval processes, individuals find, activate, and process memory traces in their mental lexicon to retrieve words (Rutherford, 2006). Similarly, in verbal fluency tasks participants activate words that are already established in their mental lexicon and make them ready to be used. However, in verbal fluency tests, participants may retrieve only semantic information even when the mental lexicon holds semantic, syntactic, and phonological components of the words that comprised it (Levelt, 1998).

Multiple authors (Caramazza, 1997; Levelt, 1992; Levelt et al., 1999; Roelofs, 1997, 2004) have researched how words are retrieved from the mental lexicon and they have mentioned that in word retrieval processes morphosyntactic, syntactic, phonological, and semantic aspects of the words can be retrieved. The aim of this article is not to discuss different word retrieval models proposed up to today; however, a brief description of Levelt et al. (1999) model will follow, given that it taps into speech production like verbal fluency tests do.

2.3.1 Levelt et al.'s (1999) Word Retrieval Model

Levelt et al. (1999) model is based on speech production and retrieval, and it sheds light on general linguistic retrieval mechanisms. The model proposes a stage process that starts at conceptual preparation and ends in the initiation of the word's articulation (Levelt et al., 1999). Speakers first select a syntactic unit, which leads them to a morphological unit and, finally, to a phonological unit that will come out as speech articulation. The first step in this model corresponds to conceptual activation tapping into lemma activation which in turn leads to lexical competition between semantically related items. For instance, a concept such as "dog" will activate the lemma "dog", but it may also activate other lemmas such as "chihuahua". In the end, only one lemma is selected. In order to select a lemma, the lexical concept activates its lemma node (Levelt et al., 1999) and once a lemma is selected, its morphological characteristics (e.g. tense, mood, or number) are activated (e.g. plural form "dogs"), which is called morphological encoding. After this, the phonological properties start to activate also in relation to its morphological characteristics and an online phonological syllabification process starts. This process accounts for how the phonological properties convert into a phonological word. In order to be able to retrieve the phonological properties of the word (in speech

production) the speaker has to undergo a series of processes to finally end up in production itself. Figure 1 illustrates Levelt et al. (1999) model of word retrieval.

Figure 1
Levelt et al. (1999) model of word retrieval
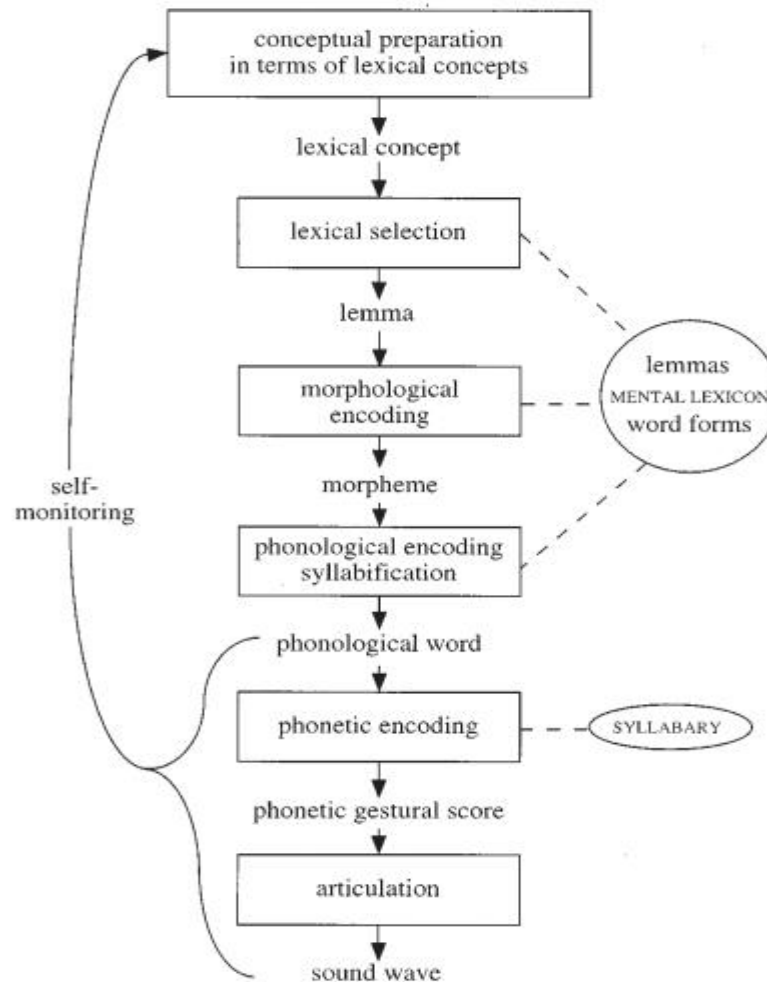
Source: Levelt et al. (1999, p. 3).

As shown in Figure 1, word retrieval processing is a complex and demanding task involving different processes that lead to spoken word retrieval.

3. Methodology

The following section describes the study's methodological framework.

3.1 Approach

This is an experimental quantitative research project, conducted from March to May 2018 that explored the possible influence of verbal fluency capacity on L1 and L2 learning of novel nouns through sentence reading. Learners' verbal fluency capacity was tested via a semantic categorization task (Rommers et al., 2015). Offline vocabulary post-tests on meaning recognition and recall of the novel nouns were used to account for participants' word learning.

3.2 Participants

Twenty-nine L2 adult advanced learners of English (female=15; M_{age} 30.82; *SD*=6.6) and 29 English native speakers took part in the study (female=20; M_{age} 22.46; *SD*=5.6). Participants were studying at a university in the United Kingdom and they had various nationalities. L1 participants had British nationality while L2 participants' nationalities were all from Latin American countries. They were all recruited by email in which L1 and L2 learners were asked to take part in the study. L2 participants were selected based on their L1 (Latin American Spanish was a must). Participants' overall L2 proficiency was high (M=7.23) as reported in their IELTS scores (M=7.23; SD=0.45) which placed them in an advanced proficiency band (i.e. C1) according to the Common European Framework of Reference (CEFR). L1 participants had to be monolinguals in order to be chosen for the study as they acted as a comparison group (Pellicer-Sánchez, 2015).

Participants agreed to take part in the study by signing an informed consent containing the study's aims, implications, and ethical considerations. None of the participants reported having learning difficulties. Participants took a verbal fluency test (Table 1) to determine their verbal fluency capacity. No comparisons between the learners' scores were made and none of them were excluded due to the tests' results or their cognitive capacities.

Table 1
Mean scores of Participants' Verbal Fluency Tests from the Verbal Fluency Task, 2018
(mean scores and standard deviation)

	Mean Scores	Standard Deviation
L1	27	8
L2	25	6

Source: Own elaboration based on participants' verbal fluency results, 2021.

3.3   Materials and Instruments

A set of seven novel nouns (Appendix 1) served as linguistic stimuli for the study. Participants read English sentences (n=168), each of which contained existing English words and one novel noun. Each novel noun was used in 24 sentences. Learning of the novel nouns was tested via offline meaning recognition and meaning recall vocabulary post-tests based on García-Castro (2015) and Webb (2008). Meaning recognition tests were used to determine whether participants were able to recognise the novel nouns in decontextualized contexts. The test included the seven target nouns and filler items. A meaning recall test was administered to find out if participants had sufficient knowledge of the novel nouns. The test included the seven target nouns and filler items. Offline recognition and recall tests have been previously employed in L1 and L2 vocabulary studies (García-Castro, 2015, 2020; Pellicer-Sánchez, 2016; Pellicer-Sánchez, and Schmitt, 2010; Webb, 2007, 2008); thus, they can be suitable for this study. The recall test was administered first followed by the recognition test.

The verbal fluency task was based on Rommers et al. (2015). Participants had one minute to recall, in their L1, as many words from the semantic cluster of animals as they could. L2 participants were tested in their L1 given that bilinguals are likely to have less L2 receptive vocabulary than L1 receptive vocabulary and this is likely to interfere in their performance in the verbal fluency task (Friesen et al., 2021). Even though verbal fluency tasks are not difficult to administer and they usually last one minute, they are effective to test semantic fluency and they are cognitive demanding (Reverberi et al., 2014). For this study, a semantic category task was administered in line with the study's aims. Participants' answers were analysed with the help of two adult Spanish native speakers and two English native speakers who did not take part in the study. Words that were repeated and that did not belong to the animal cluster were excluded from the analysis. Inter-rater reliability was calculated in R using the irr package (Gamer, et al., 2019). Reliability had an almost perfect agreement with Cohen's Kappa of 0.97 for the L2 verbal fluency scores and high with Cohen's Kappa of 0.98 for the L1 verbal fluency scores.

3.3.1. Procedures

First, participants were gently welcomed into the experimental room and soon after, participants read, discussed, and signed the informed consent. Once participants signed the informed consent, the experiment started with the verbal fluency task, using the semantic category of animals, in which participants orally recalled as many animals as they could in 60

seconds. Immediately after finishing the verbal fluency task, participants read the linguistic stimuli on a computer screen. As soon as they finished reading the stimuli, they undertook the vocabulary post-tests. Overall, the experimental session lasted approximately 60 minutes. Once the experiment was over, participants had a short debrief session.

3.4 Data Processing and Analysis

Data was processed and analysed using the statistical package R (R Studio Development Core Team, 2020). First, normality checks (i.e. skew and kurtosis) were run to test the variables' normality. Given that all variables had normal distribution, two general linear models were created and tested with the "glm" package in the R environment. Two models were created for the analysis, model 1 included recognition scores as the outcome variable L1 group (English/Spanish), and verbal fluency as predictors, and model 2 included recall scores as the outcome variable L1 group (English/Spanish), and verbal fluency as predictors. An interaction between L1 and verbal fluency was specified in each module to explore whether verbal fluency had a direct influence on vocabulary learning and if it was modulated by language group.

3.4.1. Variables

The variables taken into consideration for the study were meaning recognition and meaning recall, from the vocabulary post-tests, L1 group, and verbal fluency capacity:

- **Meaning Recognition**

  A continuous variable based on participants' results on the meaning recognition vocabulary post-test.

- **Meaning Recall**

  A continuous variable based on participants' results on the meaning recall vocabulary post-test.

- **L1 Group**

  This is a binary variable with two groups: L1 learners and L2 learners.

- **Verbal Fluency Capacity**

  This is a continuous variable based on participants' scores on the verbal fluency test.

Descriptive statistics of all numerical variables can be found on Table 2.

Table 2
Descriptive Statistics of Numerical Variables Used for the Study's Analysis, 2018

Variable	N	Mean	SD	Min.	Max.
Meaning Recognition	392	0.73	0.45	0	1
Meaning Recall	392	0.44	0.5	0	1
Verbal Fluency	392	26.03	7.25	6	49

Source: Own elaboration based on variables' descriptive statistics, 2021

4.   Results and Discussion

In this section results of the verbal fluency task are presented first. Then, mean scores of the offline vocabulary post-tests (Table 3), followed by their statistical analysis, are discussed.

4.1 Verbal Fluency Task

Results of the verbal fluency task show that L1 learners' verbal fluency capacity was slightly higher (M=27; SD=8) than that of L2 learners (M=25; SD=6); however, comparisons between the two groups were not made in this respect as it was not the purpose of the study. Additionally, monolinguals are more likely to outperform bilinguals in verbal fluency tasks (Friesen et al., 2021) as bilinguals activate both languages when processing either of them. Bilingual cross-language interaction is a well documented phenomena highlighting that lexical representations of both languages simultaneously activate while reading, listening, speaking and/or writing either in the L1 or the L2 (Kroll and de Groot, 2005). Thus, having slightly higher L1 results is not surprising.

4.2 Offline Vocabulary Post-tests

Results of the offline vocabulary post-tests are shown in Table 3.

Table 3
Mean scores (*Standard Deviation*s) of Participants' Vocabulary Post-tests, 2018
(mean scores and standard deviation)

	Recall Post-test	Recognition Post-test
L1	51(4)	80(4)
L2	37(5)	66(5)

Source: Own elaboration based on participants' scores on the vocabulary post-tests, 2021

As can be seen in Table 3, L1 learners performed better than L2 learners in both vocabulary post-tests. This observation was confirmed in the general linear models. A significant effect of first language (β =-31.54, SE= 9.38, Z=-3.362, p<0.001), and an interaction between verbal fluency and L1 (β = 1.14, SE=0.36 , Z=3.178, p<0.001) were found on the recognition scores. L1 learners (M=0.80; SD=0.40) outperformed L2 learners in their recognition scores (M=0.66; SD=0.50). In order to illustrate the result, two verbal fluency capacity groups were created based on a median split of participants' verbal fluency scores (L1 *Mdn*=29; L2 *Mdn*=25). The L1 higher verbal fluency group scored 4% higher than the lower group in their recognition scores (M=0.82; SD=0.39 vs. M=0.78; SD=0.41). The opposite effect was found on the higher L2 verbal fluency group as it scored 7% less than the lower group in their recognition scores (M=0.62; SD=0.49 vs. M= 0.69; SD=0.47) (Figure 2).

Figure 2
Verbal Fluency Capacity and Recognition Scores of Participants' Vocabulary Post-tests, 2018
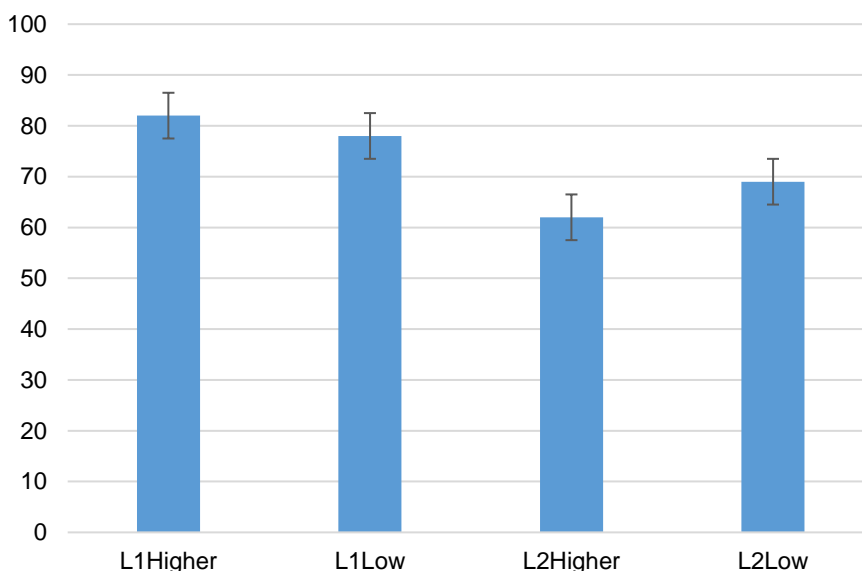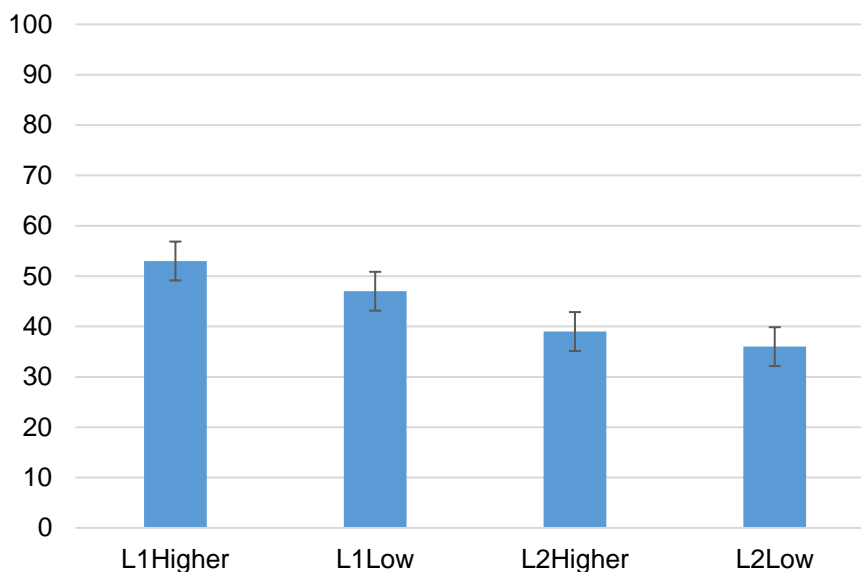

Source: Own elaboration based on participants' verbal fluency and meaning recognition scores, 2021

Recall scores showed a significant main effect of first language (β = -25.50, SE= 8.69, Z=-2.933, p<0.003) as L1 learners (M=0.51, SD=0.40) scored higher than L2 learners in the recall scores (M=0.37, SD=0.50), and a main interaction between verbal fluency and first language (β =0.83 , SE=0.33 , Z=2.511, p<0.012). Once again, participants were divided into high and low verbal fluency groups. It was found that L1 participants with higher verbal fluency capacity scored higher than those with lower capacities (M=0.53; SD=0.50; vs. M=0.47;

SD=0.50). Likewise, L2 participants with higher verbal fluency capacity slightly performed better than those with lower capacities (M=0.39; SD=0.49; vs. M=0.36, SD=0.48) (Figure 3). Full list of results can be found in Appendix 2.

Figure 3
Verbal Fluency Capacity and Recall Scores of Participants' Vocabulary Post-test, 2018

Source: Own elaboration based on participants' verbal fluency and meaning recall scores, 2021

4.3   Discussion

The empirical findings showed that L1 learners with higher verbal fluency capacity were better able to recognise the meaning of novel nouns than those with lower capacity. Similarly, L1 and L2 learners with higher verbal fluency capacity showed higher recall scores than those with lower capacities. Therefore, it can be suggested that verbal fluency capacity may influence L1 offline meaning recognition and L1 and L2 offline meaning recall of recently learned novel nouns.

In terms of the first research question of this study (i.e. Does verbal fluency capacity influence recognition scores of recently learned nouns for L1 and L2 learners?) it was found that on the recognition scores, L1 participants with higher verbal fluency capacity outperformed the lower group only by 4% (M=0.82; SD=0.39 vs. M=0.78; SD=0.41); thus, higher L1 verbal fluency capacity might be a predictor of L1 offline meaning recognition. However, due to the small difference between verbal fluency capacity groups this result has to be carefully considered. The possible relationship between L1 verbal fluency capacity and meaning recognition of novel words can be explained by the fact that processing semantic information

activates the semantic lexical storage in the mental lexicon. Additionally, when one recognises a word while reading, semantic recognition processes start to activate whilst the mental processor matches what is being recognised to existing orthographic representations in the mental lexicon (de Groot, 2011). Thus, those with higher capacities to process such information might be better able to activate and match semantic representations of existing words with those of novel words, resulting in more semantic recognition in vocabulary post-tests. It can be argued, then, that the recently learned novel nouns formed semantic memory traces in the mental lexicon (Bordag et al., 2017), given that participants were able to not only recognise them in vocabulary post-tests but also to show greater recognition when they possessed higher verbal fluency capacity. In light of the results, the hypothesis that higher verbal fluency capacity facilitates recognition scores of the novel nouns is confirmed only for L1 learners. However, more research is needed to determine the full extent of verbal fluency capacity in novel word learning.

The second research question of this study asked if verbal fluency capacity influences recall scores of recently learned nouns for L1 and L2 learners. The results on the recall scores showed that L1 participants with higher verbal fluency capacity outperformed those with lower capacities by 6% (M=0.53; SD=0.50; vs. M=0.47; SD=0.50) on the recall test. Similarly, L2 participants with higher verbal fluency capacity slightly outperformed those with lower capacities by 3% (M=0.39; SD=0.49; vs. M=0.36, SD=0.48) on their recall scores. The findings indicate then that having higher verbal fluency capacity may facilitate L1 and L2 meaning recall of novel nouns. The strength of the representation of the novel words may have been sufficient to activate and/or select their meaning, making them ready for recall (Bordag et al., 2017). Thus, participants with higher capacity to semantically recall words from the same semantic category may be better able to recall the meaning of the novel nouns. In meaning recall participants employ skills-based productive knowledge (Schmitt, 2010) in either oral or written tasks. Possibly, those with higher verbal fluency capacity consolidated the semantic knowledge of the novel nouns more robustly than those with lower capacities, thus, they were more able to entail communicative productive knowledge than those with lower verbal fluency capacity. The mental lexicon holds not only general semantic, syntactic, phonological, and morphological information about words (Levelt, 1998), but also specific information (Eysenck and Keane, 2015). Therefore, one can argue that having greater verbal fluency capacity might possess the cognitive advantage of being able to store and activate semantic information of already established words in the mental lexicon more easily. For these reasons, participants with higher

verbal fluency capacity might be better able to recall the meaning of novel words when compared to those with lower capacities. Additionally, word retrieval is a stage process that involves conceptual preparation that activates lemmas tapping into semantic activation, selection of a syntactic and of a morphological unit ending up into the phonological properties of those units which then lead to speech production (Levelt, 1998). Hence, having greater verbal fluency capacity might be an advantage when activating and processing the semantic, syntactic, morphological, and phonological properties of words leading to more word recall. Overall, the hypothesis that higher verbal fluency capacity facilitates recall of novel nouns is confirmed for L1 and L2 learners.

One cannot exclude the possible effect of the type of test used in the findings of the study. Semantic clustering, which was used in this study, is less cognitive demanding that phonemic clustering (Friesen et al., 2021); however, the aim of this study was to explore the possible effects of semantic memory on L2 vocabulary learning and semantic clustering is an indicator of semantic memory (Soltani et al., 2021).

5.   Conclusion

This study set out to explore the influence of verbal fluency capacity in L1 and L2 vocabulary learning and its possible pedagogical implications. As it can be seen from the results, L1 and L2 learners verbal fluency capacity is an individual difference that must be taken into account when learning novel words as it facilitates L1 meaning recognition and L1 and L2 meaning recall of novel nouns. Hence, one can argue that a key implication of these results is the importance of being aware of learners' individual differences in verbal fluency to better cater for their learning conditions (Granena et al., 2016). This information can be used to develop targeted interventions aimed at developing specific didactic techniques to enhance the learning process inside and outside the L2 classroom which would greatly contribute to the education sector. Relatedly, researching whether the use of verbal mnemonic techniques (Baddeley, 2015) benefits L1 and L2 learners' verbal fluency capacity and vocabulary learning is essential.

The findings of this study have a number of practical implications. First, they provide insights for developing training sessions with in-service language teachers on the possible effects of students' verbal fluency capacity in their vocabulary learning process. Training sessions can be developed by continuos professional development (CPD) practices carried out by professional colleges, universities, national departments of education, amongst others. Theoretical aspects of verbal fluency capacity and vocabulary learning can potentially be

trained via online CPD practices such as massive open online courses (MOOC) and webinars (Floris, 2021). Targeting in-service language teachers' knowledge of cognitive individual differences and their possible influence in L2 vocabulary teaching and learning may bring updated and innovative classroom practices on L2 vocabulary teaching and learning.

Second, they highlight the need for verbal fluency tests to be conducted with L2 students of all ages, and in secondary schools, to determine whether students with higher verbal fluency capacity in classroom settings also present higher recognition and recall of novel words. Simply administering a single set of tests may not necessarily lead to better understanding of the extent of students' verbal fluency capacity for L2 word learning purposes. Consequently, continued investigation and experimentation will be required to understand the full extent of verbal fluency capacities in classroom settings to enhance students' learning. For instance, experimental research on how verbal fluency capacity may enhance vocabulary learning across teaching methods (e.g. task-based approach, communicative language teaching) should be conducted. Knowing if students with lower proficiency levels learn vocabulary faster within a specific teaching method would be very beneficial for both students and teachers. For purposes of enhancing students' learning, promoting effective teaching practices, and for the betterment of the educational sector, mapping teaching methods with students' individual differences would be useful. Identifying which teaching method, or combination of methods, suits students best is crucial; hence, more experimental research in classroom settings is, undoubtedly, needed. In order to conduct such research funding and collaboration with institutions in the field of education is mandatory.

Third, by conducting verbal fluency tests with L2 students of all ages, possible learning difficulties might be detected. Verbal fluency tests have been used to detect dementia, cognitive impairment, amongst others (Zhao et al., 2013) and verbal fluency capacity seems to be one of the first language skills to decline with age (Soltani et al., 2021); hence, administering verbal fluency tests can provide useful data for both language teachers and health professionals. Nonetheless, results of verbal fluency tests have to be carefully analyzed and they cannot be taken lightly. Lastly, this study sheds light on the fact that teaching modules on the role of cognitive individual differences should be made available to pre-service language teachers while obtaining their degree. Training new language teachers on the relevance cognitive individual differences have on L2 teaching and learning processes is fundamental as L2 learners vary on how they acquired languages (Roberts and Meyers, 2012) and this should be studied by language teachers. In combination with theoretical accounts on cognitive individual

differences in L2 learning, practical sessions targeting students' differences via various teaching methods and educational interventions should be implemented. Overall, the findings of this study contribute greatly to the field of L2 English teaching and learning, alongside the education sector, as highlighted by the practical implications just discussed.

Another issue that emerges from this study is the need to inform policy makers about the importance of individual differences in verbal fluency for L1 and L2 vocabulary learning. It is necessary to bridge the gap between research and policy making by informing decision makers of the relevance of including cognitive individual differences in L2 teaching and learning processes as well as in curriculum designs.

After conducting this study, the challenge now is to further explore the extent of verbal fluency capacity in L1 and L2 vocabulary learning with other populations and proficiency levels. For instance, future research with adult learners from underprivileged populations is strongly recommended as most studies have tested university populations. Hence, whether most findings on the role of cognitive individual differences in L2 learners apply to populations that have not attended university is yet unknown. In general, the fields of L2 language teaching and learning and education should encourage research in non-WEIRD (i.e.Western, Educated, Industrialized, Rich, and Democratic) contexts. Additionally, researching low and middle L2 proficiency levels is necessary to cater for students' particular learning needs contributing to their learning process. More research taking individual differences into account to examine the full extent of word learning in adulthood is strongly recommended.

This study is not without limitations. The use of offline methods only to research the possible effects of verbal fluency capacity on L2 vocabulary knowledge is a limitation. Online methods such as eye-tracking may provide insights on participants' cognitive processing (Conklin et al., 2018) tapping into how verbal fluency capacity may affect vocabulary learning while reading like in this study. It is recommended to use online methods in future research to conduct in depth analysis on the influence of verbal fluency capacity in L2 vocabulary learning. Another limitation is that only one L2 language was included. Future research should analyze other L2 languages to explore the possible influence of verbal fluency capacity in L2 vocabulary learning. Notwithstanding these limitations, overall, this study strengthens the idea that verbal fluency capacity influences L1 and L2 vocabulary learning processes and that it must be taken into account in L1 and L2 teaching processes.

6.   Acknowledgments

7.   References

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