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## What does *implication* mean? An exploration of undergraduates' vocabulary size and academic achievement

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### Abstract

The aim of this research was to explore UK undergraduates' receptive knowledge of vocabulary and how these relate to academic achievement in order to improve educational outcomes for students. An estimate of undergraduate students' receptive knowledge of vocabulary was measured by administering a vocabulary size test devised by Goulden *et al.* (1990) to 389 undergraduates in one HE institution. Correlations between vocabulary size and academic achievement (measured using expected degree classifications) were investigated.

Key findings suggest undergraduates have an estimated vocabulary size of around 11,000 words. The study also found statistically significant changes to students' vocabulary sizes between Stages 1 (Year 1) and 2 (Year 2). It was hypothesised that vocabulary size would play a role in academic achievement as measured by expected degree classifications. However, no correlations between vocabulary size and academic achievement were found at any stage of study. This suggests there may be other factors that contribute to academic success other than general vocabulary and one's vocabulary size.

### Key words

academic achievement, vocabulary testing, vocabulary sizes, receptive knowledge of vocabulary

## Introduction

The importance of knowing words cannot be understated. Quigley (2018) believes vocabulary knowledge plays an important role in determining whether students succeed or fail in school. This piece of research began because of the researcher's experience working as a lecturer in Education Studies with undergraduate students who were L1 users of English (English is their first language). It became apparent that students at all stages of study (Years 1, 2 and 3) had many questions in sessions about vocabulary rather than content. Students asked about the meaning of words such as *implication* and *domestic violence*. This raised questions around whether students had a limited vocabulary and, if so, did this affect them accessing knowledge, the curriculum and academic texts.

Nation and Coxhead (2021: 5) state that 'vocabulary size is central to language use ...'. Vocabulary size tests estimate the total number of words a person knows; they are useful when comparing groups of students and measuring long-term vocabulary growth (McLean and Kramer, 2015). Testing can help to find out what vocabulary knowledge is needed for reading (Nation and Coxhead, 2021). Studies have shown a strong positive correlation between vocabulary knowledge and reading comprehension (Chall *et al.*, 1990; Lesaux and Kieffer, 2010; Mancilla-Martinez and Lesaux, 2010). In addition, the vocabulary size of L1 users of English is of interest to language teachers because it provides one kind of goal for learners of English as a second (L2) or foreign language (Nation, 2013). Given the importance of vocabulary sizes in educational performance, the aim of this research was to form an estimate of the vocabulary sizes of undergraduate L1 user of English and to investigate how vocabulary might impact on students' achievement.

## Literature review

### ***Vocabulary sizes and lexical coverage***

It is important to consider the relationship between vocabulary size and comprehension. What size of vocabulary do undergraduates have and need to access their discipline? Treffers-Daller and Milton (2013) reported that the average first-year undergraduate has a vocabulary size of 10,034-word families (base word plus its

derivations, e.g., *wide*, *widen*, *widely*) and by the time they reach the third year they know approximately 11,167-word families. This suggests that students increase their vocabulary size by around 400-500 words per year (Treffers-Daller and Milton, 2013). These findings must be interpreted with caution, though, as the data was not collected with the same participants in each year, so any notions of growth could be misleading. A university graduate will have an average vocabulary size of around 20,000 words according to Goulden *et al.* (1990). But, as Schmitt and Schmitt (2020) indicate, it is more likely that the average L1 user of English knows roughly between 10,000 and 13,000-word families.

How many words do children, adolescents and adults need to know to read successfully? Lexical coverage is the percentage of known words in spoken discourse or written texts (Webb and Nation, 2017). Much of the research on lexical coverage has been done in the context of L2 users of English (English is their second language) (Laufer, 1989, 1992; Hu and Nation, 2000; Nation, 2006; Schmitt *et al.*, 2011) and estimates have varied. Originally, it was thought that around 3,000 word families were needed to comprehend authentic texts which would give 95 per cent per cent lexical coverage (Laufer, 1989,1992). Later research conducted by Laufer and Ravenhorst-Kalovski (2010) established a minimum threshold (the ability to read with some guidance) of 95 per cent per cent text coverage, including proper nouns, which requires L2 learners to have a vocabulary size of between 4,000-to-5,000-word families. An optimal threshold (the ability to read independently) of 98 per cent per cent text coverage requires knowledge of 8,000-word families (Laufer and Ravenhorst-Kalovski, 2010). Hu and Nation (2000) found that 98 per cent–99 per cent of the words in texts needed to be known before adequate comprehension was possible. Following on from these figures, Nation (2006) found that L1 users of English need a vocabulary size of around 8,000 to 9,000-word families to read widely. Similarly, Schmitt *et al.* (2011) concluded that 98 per cent coverage was necessary for readers of academic texts. On the other hand, Carver (1994) conducted research on both primary school students and graduates and found that native English-speaking students needed to know nearly 100 per cent of the words in a text for comprehension to occur. However, even if there are a few unknown words, people can usually understand speech or writing therefore 100 per cent coverage is not usually necessary (Schmitt *et al.*, 2017).

Hsu's (2011, 2014) research suggests that students need knowledge of around 5,000-word families to access discipline specific texts. Hsu (2014) examined the vocabulary load of engineering textbooks and found that students needed to know the most frequent 5,000-word families plus proper nouns, apparent compounds and abbreviations which would command 95 per cent lexical coverage of an engineering textbook to ensure adequate comprehension. In a previous study on the vocabulary threshold needed by English as a Foreign Language (EFL) learners in business, Hsu (2011) found that students need to know the most frequent 5,000-word families to adequately comprehend texts. Even though this is in the context of business, a key consideration is whether L1 users of English have the necessary vocabulary size to know and understand these 5,000-word families? Further research is needed on the lexical needs of students in relation to subject specific texts as many students (both L1 and L2 users of English) face challenges learning technical vocabulary (Hsu, 2011; Gablasova, 2015).

### ***Vocabulary and academic achievement***

There is an increasing body of research around academic language competence and students' success in school (Nagy and Townsend, 2012). There is much evidence from the literature to suggest there is a link between vocabulary knowledge/size and academic achievement (Smith *et al.*, 1991; Treffers-Daller and Milton, 2013; Bleses *et al.*, 2016; Schuth *et al.*, 2017; Masrai and Milton, 2018). Schuth *et al.* (2017) found that children's academic vocabulary knowledge predicted school performance in four subjects, controlling for age, gender, language background, and nonverbal cognitive abilities. These results confirm the assertion that already in primary school academic language proficiency significantly influences success. Csomay and Prades (2018) conducted a study with English as a Second Language (ESL) university students in the USA and found a significant relationship between academic vocabulary use and essay scores in some text types, but not all. These findings, to some extent, strengthen Quigley's (2018) argument that the solution to closing attainment gaps in schools is to increase students' vocabulary knowledge and size.

Masrai and Milton (2018) found there was a strong positive correlation between academic vocabulary size (written, receptive knowledge), overall vocabulary size, and learners' academic performance as measured by Grade Point Average (GPA).

Furthermore, Treffers-Daller and Milton (2013) also reported a link between vocabulary size (measured in word families) and achievement (measured by degree classifications) at two universities, Swansea University and the University of the West of England, Bristol.

They found that the bigger a students' vocabulary size the higher the degree classification they obtain. However, Nation and Coxhead (2021) believe more research is needed on using data from vocabulary size tests to predict educational performance. If vocabulary plays such a key role in students' learning and achievement, then strategies should be employed to facilitate this.

This research is a partial replication of similar studies: Treffers-Daller and Milton (2013) and Goulden *et al.* (1990). Based on Porte and McManus's (2019) considerations for selecting studies to replicate, there were several reasons for choosing Treffers-Daller and Milton's (2013) in particular. Firstly, the general topic of the original paper is one that continues to generate much debate, and the findings are not consistent with previous or subsequent work in the area. Estimating vocabulary size of both adults and children has a rich history of research dating from Kirkpatrick (1891) to more recent studies such as Brysbaert *et al.*, 2016. Estimates of vocabulary size of university graduates have varied greatly from 215,040 words (Hartmann, 1946) to 11,000 (Treffers-Daller and Milton, 2013) but have mainly been located in an American context, with the exception of Treffers-Daller and Milton's (2013) study. Secondly, the original study identified limitations and effect size data is not presented. Treffers-Daller and Milton (2013: 168) state that 'The sample in this study is comparatively small so a repetition of the study with a larger and more diverse sample of monolingual university students is sure to be useful'. The total sample in Treffers-Daller and Milton's (2013) study was 161 participants, while this study tested a total of 389 which is more than double the size. Finally, the effect size was not reported in their study which is important in indicating how large any differences are between variables (Brezina, 2018a) but is stated in this research.

## **Research questions**

On the basis of the literature, the following questions were researched:

1. What is the average receptive vocabulary size of English-speaking undergraduate students?

2. Is there is a link between vocabulary sizes and academic achievement (measured by expected final degree classifications)?

## Methodology

### Sample

This research used random probability sampling within one institution in the East Midlands consisting of 389 participants where the total undergraduate population was 13,595 (full and part-time) at the time the research was conducted. Of the 389, there were 155 males and 232 females and two who did not state. All the single honours undergraduate programmes at one university (excluding a campus due to geographical location) were included in the population. Fourteen programmes out of 74 were selected at random out of a hat. A description of the sample is stated below, and the sample divided by stages of study can be seen in Table 1.

	Frequency	%
Stage 1	130	33.4
Stage 2	139	35.7
Stage 3	120	30.8
Total	389	100.0

*Table 1: Participants by stage of study*

The sampling and testing took a cross-sectional approach where data are collected at one point in time (Gray, 2018). The test was administered to several cohorts at a single point of time, so can be described as a snapshot of data collection (Paltridge and Phakiti, 2015). This method is typically quicker and less expensive than longitudinal research (Donley, 2012). Cross-sectional research does not indicate change at an individual level (UCL, 2021), and this was not the aim.

Ethical approval from the College of Education Research Ethics Committee was obtained for the study. Participants gave their Informed consent, and they were made

aware of their right to withdraw. Anonymity and confidentiality were maintained at all times. Ethical Guidelines for Educational Research (BERA, 2018) were consulted before during and after the collection of data.

### ***Data collection tool: The vocabulary size test***

A standardised test of English vocabulary size does not exist (Schmitt and Schmitt, 2020), resulting in the various estimates of vocabulary sizes. This leaves a question as to what kind of test should be used to measure vocabulary sizes of L1 users of English.

Goulden *et al.*'s (1990) test was chosen for this research because most vocabulary tests are aimed at L2 learners rather than L1 users of English. Goulden *et al.* (1990) originally used their test on L1 English undergraduates. Because this test asks participants to recall the meaning of words, there is less guessing involved as compared to multiple choice (recognition) tests such as Nation and Beglar's (2007). Research into estimating receptive vocabulary sizes of native speakers has traditionally used dictionary sampling methods (Hartmann, 1941; Goulden *et al.*, 1990; D'Anna *et al.*, 1991; Treffers-Daller and Milton, 2013). Additionally, other tests based on frequency levels or levels tests do not report a global score which would not give an overall estimate of the number of words students know. Goulden *et al.*'s (1990) test is easy to administer and cost effective since it uses a simple yes/no format, allowing for a greater number of students to be tested. Finally, because Treffers-Daller and Milton (2013) used their test, and this study is a partial replication (same instrument but different participants), it was necessary to use Goulden *et al.*'s to compare results.

### ***Procedure***

In terms of how the test was administered in this research, participants were given only one test out of the possible five sub-tests. Each test was rotated to ensure a balance (i.e., first group received test one, second group, test two and the process was repeated). The participants went through the test and marked the words they knew (i.e., they had seen it before and could express at least one meaning). Then they found the last five words they ticked and to show they knew the meaning of them gave a synonym, definition or used it in a sentence or diagram. They checked their explanations in a separate handout with the words and definitions. If more than one of

the explanations was not correct, they had to go back through the list, beginning with the sixth to last word they ticked. They had to write a meaning of that word and check it in the definition handout. They continued this until they had a sequence of four ticked words (which may have included some of the original checked five) that were explained correctly. To estimate the participant's vocabulary size, the number of known words from the 50-item test was multiplied by the ratio that the sample of words bears to the total number of words in the dictionary, in this case 500. If participants scored above 15,000 words they checked the list of words not likely to be known. For the words they knew on this list, they gave a synonym or definition as per the main test. Each word on this list represents 100 words. The score from the list of 'likely to be unknown' is added to the score from the test to give overall estimated vocabulary size.

### ***Measuring academic achievement***

Most studies that investigate the effects of a factor (e.g., interventions, peer learning) on academic achievement use grades as a means of measuring achievement (Carrell *et al.*, 2009; Dancer *et al.*, 2015; Veas *et al.*, 2015; Vulperhorst *et al.*, 2018). This study used expected degree classifications to measure academic achievement. Degree classifications are based on a weighted average of all the module marks in the second and third year of undergraduate study. Because testing took place before students had finished their degrees, they were asked to provide their expected degree classification as the actual was not available.

It must be acknowledged that there are limitations to using expected degree classifications as a measure of achievement. Students were asked to self-report their average marks at the point of taking the test. There was no way of checking whether these corresponded to their actual final degree classification. Students could have over- or under-estimated their scores.

### ***Reliability***

Goulden *et al.*'s (1990) five sub-tests all contain alternative sets of items, but are intended to measure the same construct and any one of them can be used to estimate vocabulary size equally. This made the equivalent forms reliability check the best way



to determine whether the test will give consistent results and parallel (Rust and Golombok, 2014).

A small pilot of five participants (all undergraduate students) was conducted to establish equivalent/parallel forms reliability. Each participant was given all five sub-tests and the correlation between all the scores was calculated in SPSS. Reliability was calculated by dividing the true variance by the common variance. In this case, it gave a common inter-item correlation of 0.898 and a reliability of scale score of 0.978. In other words, 98 per cent of any variance in test scores is attributed to true score differences while 2 per cent is due to measurement error. This means all five sub-tests are equivalent.

### **Validity**

Schmitt *et al.* (2020) argue that a major limitation of vocabulary testing is there is inadequate validation evidence for most of the vocabulary tests available (for example the Vocabulary Levels Test). Goulden *et al.*'s (1990) test is no exception, so it was important to consider the extent to which Goulden *et al.*'s (1990) test could be considered valid, despite the fact there is little empirical evidence in the literature to support this.

Nation (1993: 31-35) believes that in order for tests based on dictionary sampling to be valid, in this case NOT over or underestimating vocabulary size, that certain procedures must be followed when devising them (for example; choose a dictionary big enough – at least 30,000 base words – and use explicit criteria for deciding and stating what items will not be included in the count and what will be regarded as members of a word family). Nation (1993) has described Goulden *et al.*'s (1990) study as methodologically sound as they adhered to a number of these procedures. For example, Goulden *et al.* (1990) chose Webster's *Third New International Dictionary* (1961) and updates, because it is the largest non-historical dictionary of English, containing over 450,000 words.

## Findings

### ***Research question 1: Vocabulary size***

Stage of study	Sample size (n)	Min/max scores	Mean number of words ( $\bar{x}$ )
1	130	5,500/18,800	10,070.00
2	139	5,000/21,500	11,614.39
3	120	4,000/18,500	11,582.96
Overall	389	4,000/21,500	11,088.26

*Table 2: Mean ( $\bar{x}$ ) vocabulary size of undergraduates*

Table 2 displays the mean vocabulary sizes of students in Stages 1, 2 and 3 as well as the overall mean for all three stages. Changes in vocabulary sizes between the stages of undergraduate study were ascertained by comparing the means in each stage, so a one-way ANOVA (ANalysis Of Variance) was conducted to see if there was a statistically significant difference between the mean vocabulary sizes of Stage 1, 2 and 3 participants. Because ANOVA identifies statistically significant differences between groups but not exactly which group (Brezina, 2018), a Bronferroni post-hoc test was also conducted to identify the specific group. There was a statistically significant difference between groups as determined by ANOVA:  $F(2,386) = 12.182$ ,  $p = 0.000$ . The Bronferroni tests confirmed that the difference in mean vocabulary scores were statistically significant between Stages 1 and 2, 1 and 3, but not between Stages 2 and 3.

Based on a 0.05 significance level, there were significant differences in the mean vocabulary scores between Stages 1 and 2 ( $p < .001$ ), 1 and 3 ( $p < .001$ ), but not between Stages 2 and 3 ( $p = 1.00$ ). The effect size ( $r$ ) was calculated to determine how large this difference was to establish its practical importance. Between Stages 1 and 2 ( $r = 0.26$ ) and between Stages 1 and 3, the same. This indicates a small to

medium effect. This suggests that undergraduate students experience some change in their vocabulary sizes between the first and second years of study, but plateau in the third year. Figure 1 shows the mean vocabulary size of undergraduate students depending on their stage of study. From Figure 1 a difference in vocabulary sizes between Stage 1 and Stage 2 students of around 1,500 words, and virtually no difference between Stages 2 and 3 can be seen.

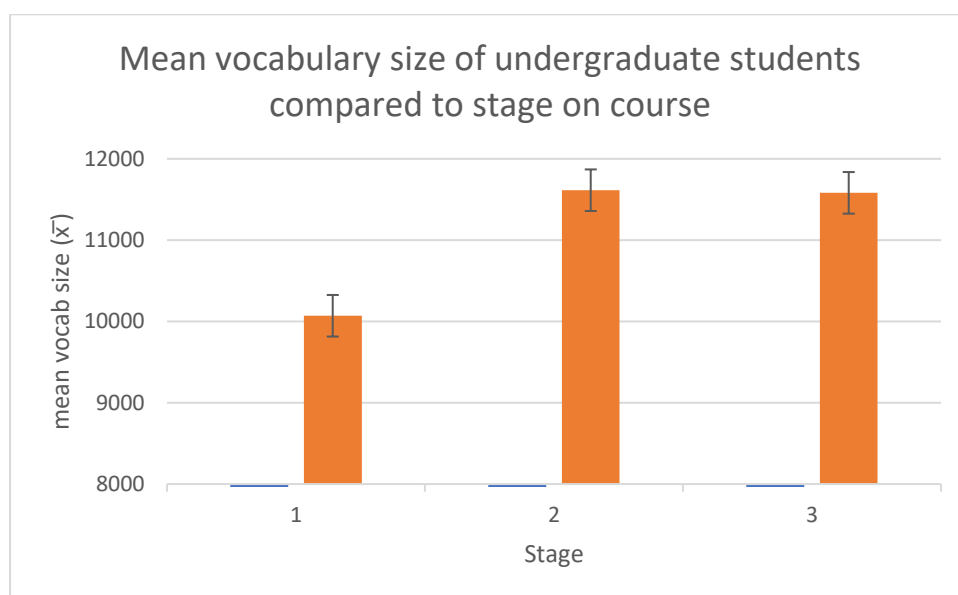


Figure 1: Mean ( $\bar{x}$ ) vocabulary size with standard error bars to show significant differences in stages of study

The estimated vocabulary size of undergraduates from this research is significantly smaller than the findings from other research (see Table 3).

<b>Study</b>	<b>Estimate</b>	<b>Sample</b>
Hartmann (1946)	215,000	US undergraduates
Anderson and Nagy (1993)	40,000	US high school seniors
Goulden <i>et al.</i> (1990)	17,200	US undergraduates
D'Anna <i>et al.</i> (1991)	17,000	US undergraduates
Nusbaum <i>et al.</i> (1984)	14,400	US undergraduates
Zechmeister <i>et al.</i> (1995)	12,000	US undergraduates
Treffers-Daller and Milton (2013)	9,800	UK first year undergraduates
<b>Current study</b>	<b>11,088</b>	<b>UK undergraduates</b>

*Table 3: Various estimates of the number of English words known by adults adapted from Brysbaert et al. (2016) and compared to the current study*

### **Research question 2: Is there a correlation between vocabulary sizes and academic achievement?**

The second research question was to explore whether there is a link between vocabulary size and academic achievement (measured by expected final degree classification). Spearman's rank correlation coefficient ( $r_s$ ) was calculated and there is no statistically significant correlation between vocabulary sizes and academic achievement ( $r_s = 0.059$ ,  $p = 0.255$ ). Comparing the mean vocabulary score with expected degree classification (see Table 6) using ANOVA also supports this finding. Correlations between expected degree classifications and vocabulary sizes were also explored at Stages 1, 2 and 3 and none were found (see Table 4). Based on this evidence, it can be concluded that there is no link between vocabulary sizes and academic achievement from this data.

Stage 1	Stage 2	Stage 3	All three stages
$r_s = -.098, p = .276$	$r_s = -.052, p = .547$	$r_s = -.160, p = .084$	$r_s = .059, p = 0.255$

Table 4 P-values and correlation coefficients generated from Spearman's rho ( $r_s$ ) between expected degree classifications and vocabulary sizes

- Please note four missing degree classifications for Stages 1 and 2 and two missing degree classifications for Stage 3.

## Discussion

### **Research question 1: Receptive vocabulary sizes**

Previous research has shown that estimates of receptive vocabulary size for university undergraduates vary from 215,000 words (Hartmann, 1946) to 9,800 (Treffers-Daller and Milton, 2013). Findings from this study suggest that a typical undergraduate may have a vocabulary size of around 10,000-12,000-word families. This supports Schmitt and Schmitt's (2020) conclusion that L1 users of English have a vocabulary size of about 10,000 to 13,000-word families. As outlined previously, the test used in this research was created by Goulden *et al.* (1990) who found the average vocabulary size of a native English-speaking university graduate to be 17,200 words, while Zechmeister *et al.* (1995) reported that first-year college students were able to recognise the meanings of about 12,000 words. Finally, Treffers-Daller and Milton (2013) using the same test as this research (i.e., Goulden *et al.*'s) found that the average vocabulary size was around 10,000 to 11,000-word families. With previous research findings in mind, it is possible to conclude from this study that L1 users of English do not have the large vocabulary sizes as previously reported.

Treffers-Daller and Milton (2013) identified that a limitation of their study was the small sample size ( $n = 161$ ), despite being taken from three universities. This is further compounded by the fact that it only consisted of students studying degrees in Humanities and Speech and Language Therapy. Goulden *et al.*'s sample was even smaller, consisting of 20 L1 users of English who were university graduates over the age of 22 (in the USA). It could be argued that their sample size was too small to make

any generalised conclusions. Even though the sample in this research was taken from only one university, it consisted of 389 participants from 14 degree courses ranging from Biology to Sociology which is arguably more representative of the population and provides confidence in the potential to draw more valid conclusions and generalisations from this study.

Treffers-Daller and Milton (2013) reported that vocabulary size studies have been mainly based on speakers of American English. Table 3 illustrates this point. This study and Treffers-Daller and Milton's (2013) were conducted in the UK, unlike previous ones. Another potential variable influencing the scores of both studies could be due to differences in linguistic contexts. There are linguistic variations of English in use between the USA and the UK as well as regional dialects in both American and British English (see Crystal, 2019). Goulden *et al.*'s (1990) test was based on Webster's Third Dictionary which is an American English dictionary. Some words are more widely known and used in one country than the other. For example, *cowsucker* is found on the test but it is a North American snake, so you would not necessarily find this word used frequently if at all in British English.

Even though Treffers-Daller and Milton (2013) used the test devised by Goulden *et al.* (1990), their results are the lowest in the literature. Most of their data came from first year participants with only 18 third-year students taking part in their research. Similarly, in this research, stage 1 students had the lowest vocabulary scores. This could suggest age and/or stage is a factor in vocabulary size. So, another potential issue rests in the age boundary of the population in vocabulary size research. Measures of vocabulary size are not always suitable for all ages of L1 users of English (Nation and Coxhead, 2021). The aim of vocabulary size research using dictionary-sampling methodology is, in general, to find out the average vocabulary size of an adult. However, the age of an 'adult' is not usually defined, and samples are typically first-year university students (Brysbaert *et al.*, 2016). If the average age of Goulden *et al.*'s (1990) sample is over 22, this could have had an impact on their results leading to an overestimation. Moreover, Bowles *et al.* (2005) claim that adults continue to learn vocabulary as they get older, peaking around the age of 50, and word knowledge only declines slowly thereafter. Brysbaert *et al.*'s (2016) research supports this notion as

they found that the average 60-year-old knows more words than a 20-year-old (13,400 and 11,100 words respectively).

In addition to age, other factors such as poor reading skills can negatively affect vocabulary sizes (Nation and Coxhead, 2021). Vocabulary knowledge is essential in learning to read, and vocabulary is acquired through reading (Nation and Coxhead, 2021). If vocabulary is acquired through reading but undergraduate students are not reading (Brost and Bradley, 2006; Hoefft, 2012; Hatteberg and Steffi, 2013; Sharma *et al.*, 2013), this could account for the lower vocabulary size scores reported in this research.

Therefore, a key question is what vocabulary size is necessary in order to 'read for a degree' at university. The literature review highlighted variations in the number of word families needed by native speakers to comprehend certain texts. In Stage 1, the mean ( $\bar{x}$ ) vocabulary size of undergraduates was 10,070 and in Stages 2 and 3, 11,614 and 11,582, respectively. There was a small, significant difference in the mean ( $\bar{x}$ ) between Stages 1 and 2 as well as 1 and 3. All three mean scores are well above Laufer's (1989,1992) estimate of 3,000 and Hsu's (2011, 2014) 5,000. However, the mean vocabulary size for Stage 1 is closer to Nation's (2006) top figure of 9,000 but, arguably, only just over this. There was a small, significant difference [ $(r) = 0.26$ ] between Stages 1 and 2 and Stages 1 and 3 in the mean ( $\bar{x}$ ) vocabulary sizes so a closer look at the minimum scores is necessary since this difference is not large.

In this study, the minimum scores for each stage were 5,500, 5,000 and 4,000 meaning some participants scored well below the average. These scores are lower than Nation's (2006) estimates and just at or below Hsu's (2011,2014), particularly in Stage 3. Research on L1 8-year-olds in New Zealand reported they have vocabulary sizes of between 4,540 to 5,056 words (Nation and Coxhead, 2021). The minimum scores for this research are at the minimum threshold for L2 learners (Laufer and Ravenhorst-Kalovski, 2010) and potentially that of an 8-year-old suggesting some L1 users of English are likely to need some support with their vocabulary and accessing academic texts.

## **Research question 2: Correlation between vocabulary sizes and academic achievement**

The second question was to explore whether there is a link between vocabulary size and academic achievement (measured by expected final degree classification). This research found there is no significant correlation between vocabulary sizes and academic achievement. This diverges from the literature which suggests there is much evidence to indicate a relationship between vocabulary knowledge/size and academic achievement (Smith *et al.*, 1991; Treffers-Daller and Milton, 2013; Bleses *et al.*, 2016; Schuth *et al.*, 2017; Masrai and Milton, 2018).

However, most participants in Masrai and Milton's (2018) study were L2 users of English. The sample in Masrai and Milton's (2018) study consisted of 96 native Arabic speaking students taking an English course at a university in Saudi Arabia, 16 native English speakers all at Doctoral level and 120 L2 users of English who were enrolled at three levels of study (Bachelor, Master and Doctoral) at British universities. Masrai and Milton (2018) used a different test, set of students and context that could account for the discrepancies in correlations between this study and theirs.

Although not an exact replication of Treffers-Daller and Milton's (2013) study, the context and process are somewhat similar as previously mentioned. However, Treffers-Daller and Milton (2013) found a correlation between vocabulary size and academic achievement (measured by mean scores from academic modules for Stages 1 and 2 and degree classifications for Stage 3 students) and this study did not. Because their sample size was small and the correlations modest, particularly in Stage 3, their findings need to be interpreted with caution to determine whether there is enough evidence to generalise the correlation to the population.

Degree classifications might not be the best measure of educational performance or academic achievement. In addition, students in this study had to self-report what their expected degree classification would be due to the timing of the test. This leaves room for error as students could under/overestimate their self-predicted grades and their final degree classification could be different. Masrai and Milton (2018) used a different measure for academic success – the Grade Point Average or GPA – and gauging academic achievement in an alternative way may yield an altered result. A GPA is



more precise than a 'First Class' which could range anywhere from a 70 per cent to a 100 per cent.

The findings relating to research question 2 suggest there are factors that may contribute to academic success other than general vocabulary and one's vocabulary size. It might have been better to measure students' academic vocabulary size instead. Goulden *et al.* (1990) state that academic vocabulary size is an important indicator of the ability of second language learners (in the context of schooling) to achieve academic success. Academic literacy is concerned with meeting the demands of tertiary education through effective language use (Weideman and Van Dyk (2014). Some of the components of academic literacy include understanding a range of *academic* vocabulary in context; interpreting the use of metaphor and idiom in *academic* usage; perceiving connotation, word play and ambiguity (Weideman, 2007 and Weideman and Van Dyk, 2014). This suggests measuring vocabulary sizes in the context of general English may not be the best method to ascertain links with vocabulary and academic achievement. In fact, Masrai and Milton (2018) query what is needed for academic success and whether it is general vocabulary size or specialist vocabulary knowledge that is the more important. A key question remains in research around the vocabulary of L1 users of English and whether vocabulary size measures predict educational performance (Nation and Coxhead, 2021).

Perhaps there is no link between degree classifications and vocabulary sizes because students do not read enough academic texts that are considered challenging (Ernawati and Ardi, 2017). It has been argued in the literature that students do not read their assigned texts (Brost and Bradley, 2006; Hoeft, 2012; Hatteberg and Steffi, 2013; Sharma *et al.*, 2013). There has been very little research on the reading habits of students in HE (Nadelson *et al.*, 2013). There could be a link between reading habits and academic achievement rather than vocabulary. Much incidental vocabulary learning comes from reading (Nagy *et al.*, 1985; Brown *et al.*, 2008), but university students are more likely to read with a purpose and focus to meet assignment deadlines (Fairburn and Winch, 2011). Perhaps vocabulary sizes are small and little gains are made in terms of academic achievement if students are not reading.

## ***Limitations of vocabulary size tests***

There are issues with what it means to know a word. There are many aspects of vocabulary knowledge: pronunciation; spelling; grammar; collocation; denotation (e.g. 'a cat' denotes a kind of animal); connotation; appropriateness and word formation (Nation, 2013; Mykhailiuk, 2016) and dictionary sampling techniques typically test the form-meaning link. Hartmann (1941: 353) states, 'Another serious limitation of the common procedure is that it makes little if any allowance for qualitative variations in the precision of the definitions. One can "know" anything very slightly or exceedingly well'. Henriksen (1999) conceptualised this knowledge into three aspects: partial to precise knowledge of word meaning; depth of knowledge; and receptive to productive use ability. But, 'it is almost impossible to blend all of these into a single holistic view of vocabulary, but separately, each of these facets provides a useful framework for conceptualization' (Schmitt and Schmitt, 2020: 34). Therefore, predictably, most vocabulary tests based on dictionary sampling methods only ask for partial, receptive knowledge of words to be demonstrated. Furthermore, vocabulary size test scores do not indicate what the learner can do with the vocabulary they have (Kremmel and Schmitt, 2016).

## **Conclusions**

There are no standard measures of vocabulary size (Read, 2000; Treffers-Daller and Milton, 2013; Schmitt *et al.*, 2020; Nation and Coxhead, 2021) and there are still questions around the methodology of vocabulary size research (Schmitt *et al.*, 2020; Nation and Coxhead, 2021) despite its long history in educational research (Kirkpatrick, 1891). Any comparisons between research findings need to be interpreted with this in mind. Sample size, geographical location and age all have an impact on the results as well. However, taking these factors into consideration, the findings from this study suggest the average vocabulary size of a UK undergraduate to be around 11,000 words. In comparison to the findings from previous research (Zechmeister *et al.*, 1995; Treffers-Daller and Milton, 2013; Brysbaert *et al.*, 2016) the average vocabulary size estimate of around 11,000 seems reasonable.

It is also important to consider the finding that undergraduate students experience changes in their vocabulary sizes between the first and second stage of study, but

plateau in their final year. Although outside the scope of this project, understanding this initial change in vocabulary sizes and subsequent stagnation could have potential implications for teaching and learning in the HE sector. This plateau might indicate poor reading skills as this can negatively affect vocabulary sizes (Nation and Coxhead, 2021). Measures to help students improve their reading skills could be actioned to support students in continually improving their receptive vocabulary knowledge.

Finally, no link was found between vocabulary sizes and academic achievement despite a plethora of literature (Smith *et al.*, 1991; Treffers-Daller and Milton, 2013; Bleses *et al.*, 2016; Schuth *et al.*, 2017; Masrai and Milton, 2018) suggesting otherwise. Not finding a correlation between these does not mean it does not exist. There are still methodological questions around vocabulary testing which necessitates calls for improvements in this area. With improved vocabulary size testing, the question of whether vocabulary knowledge is a good predictor of academic achievement needs to be revisited (Nation and Coxhead, 2021).

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