

Effect of Word Frequency and Word Class on Swedish Upper Secondary Pupils' Receptive Knowledge of English Academic Vocabulary

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Abstract

Assigned reading materials in Swedish universities are often in English. Therefore, pupils planning to pursue higher education need to develop a good receptive knowledge of English academic vocabulary. However, previous research indicates that upper secondary pupils completing obligatory English instruction may lack sufficient knowledge of English academic vocabulary. This study further explores Swedish pupils' receptive knowledge of English academic vocabulary, focusing on how it is influenced by word frequency and word class, two factors found to impact L2 learner vocabulary knowledge. Moreover, we examine correlations between vocabulary test scores on word frequency and word class and self-reported extramural English activities. Ninety-three pupils at a Swedish upper secondary school completed a vocabulary test and a questionnaire about their extramural English activities. The results showed that pupils performed significantly better on high-frequency words than on low-frequency words. An analysis of how high- and low-scoring pupils answered different questions revealed some different tendencies in their receptive English academic vocabulary knowledge. We also found that low scorers performed more poorly on verbs than nouns and adjectives. Moreover, engagement in extramural English activities, such as reading and social media, was positively correlated with the vocabulary test scores, most consistently with scores on verbs. Based on the findings we discuss the need for pedagogical strategies for effective teaching of English academic vocabulary, including well-planned integration of extramural English activities into the English classroom. Such pedagogic support could help Swedish upper secondary pupils develop their knowledge of English academic vocabulary needed for success in higher education.

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1. Introduction

Reflecting the role of English as an academic lingua franca in Sweden (Salö 2016; Holmes 2022), as in many other countries (Mauranen, Hynniinen, and Ranta 2016), assigned reading materials in Swedish higher education are often in English (Malmström and Pecorari 2022). Therefore, Swedish upper secondary pupils planning to attend university need to develop the ability to read academic texts in English.

One of the key skills for reading academic texts is receptive knowledge of academic vocabulary for understanding words that appear frequently in academic texts (Nation 2006, 2020; Warnby 2024). In view of this, Warnby (2022, 2023a, 2023b, 2024) investigated receptive knowledge of English academic vocabulary among Swedish upper secondary pupils. The studies reported that many upper secondary pupils did not have sufficient receptive knowledge of English academic vocabulary after completing obligatory English education. Additionally, Warnby (2022) found weak but positive correlations between upper secondary pupils' receptive knowledge of academic vocabulary and their engagement in extramural English activities.

While Warnby's studies and some other previous studies (e.g., Gyllstad 2007; Sylvén and Ohlander 2019) provide valuable insights into Swedish upper secondary pupils' receptive knowledge of English academic vocabulary, there remain gaps in the research. For instance, previous studies suggest that word frequency (i.e., how often a word appears in a given context) and word class influence learners' vocabulary acquisition (e.g., Nissen and Henriksen 2006; Vasiljevic 2010; Willis and Ohasih 2012). However, it is not known how these two features of vocabulary impact Swedish upper secondary pupils' receptive knowledge of English academic vocabulary.

To address this gap, our study examines the effects of word frequency and word class on Swedish upper secondary pupils' receptive knowledge of English academic vocabulary. Since some studies suggest that these vocabulary factors may have different effects on learners at different proficiency levels (Crossley, Salsbury, and McNamara 2011; Augustin-Llach 2022), we will also explore whether, and how word frequency and

word class impact pupils with relatively higher or lower level of vocabulary knowledge. Furthermore, to build on Warnby's (2022) findings of correlations between Swedish pupils' receptive knowledge of English academic vocabulary and their engagement in extramural English, we examine correlations between pupils' vocabulary knowledge at different frequency levels and across different word classes and their extramural English activities. By investigating these previously unexplored aspects of upper secondary pupils' knowledge of English academic vocabulary, our study wishes to provide some suggestions for pedagogical practices and strategies.

Our research questions are:

1. What are the effects of word frequency and word class on the performance of Swedish upper secondary pupils in a test designed to measure receptive knowledge of English academic vocabulary?
2. Do the effects of word frequency and word class on test performance differ between pupils who achieved relatively higher or lower test scores? If so, how do they differ?
3. How do pupils' performances on the vocabulary test across different frequency levels and of different word classes correlate with their self-reported extramural English activities?

2. Literature review

2.1 Receptive second language (L2) vocabulary knowledge

Receptive vocabulary knowledge generally refers to the ability to recognise and understand words in speech or written texts, in contrast to productive vocabulary knowledge that centrally involves the ability to actively use words in speaking and writing (Nation 2020). Although receptive vocabulary knowledge typically develops before productive vocabulary knowledge, knowing a word receptively can be just as complex as knowing it productively (González-Fernández and Schmitt 2020). It involves knowledge of many different components, including phonological and orthographical (spelling) forms, morphological structure, conceptual and referential meaning, grammatical functions, collocations (its co-occurrence with other words) and usage in specific contexts (Nation 2013). Moreover, knowing a word may involve understanding its synonyms, antonyms and cognates in other languages,

as well as associating it with other members in its word family (e.g., associating *play* with *replay* or *playful*) (Nation 2013).

Research consistently shows that receptive vocabulary is foundational in second language acquisition (Webb 2008). Developing receptive vocabulary knowledge across its various components is a complex and incremental process, where recognition of the form-meaning relationship usually precedes knowledge of more complex aspects, such as collocations and plural meanings (González-Fernández and Schmitt 2020).

The growth of receptive L2 vocabulary knowledge is influenced by various factors, including word frequency, word class and learner proficiency (Nation 2013). While we review the factors of word frequency and word class in the following sections, here we briefly discuss how learner proficiency relates to the acquisition of the different vocabulary components mentioned above. Frequent words with simple, one-to-one form-meaning association are more easily learned, particularly by beginner learners (Crossley, Salsbury, and McNamara 2011). As learners become more proficient, they expand their vocabulary to include less frequent and more complex words, forming broader and deeper lexical networks, including connections to first language (L1) cognates (Bosma, Bakker, Zenger, and Blom 2023). As Bosma et al. (2023) conclude from their review of previous research on bilingual children, while cognates generally facilitate L2 vocabulary learning, proficient learners process such facilitation more efficiently due to stronger lexical networks and connections.

Moreover, the development of L2 receptive vocabulary knowledge can occur through both incidental and intentional learning processes (Nation 2013). Incidental learning refers to acquiring new vocabulary knowledge without conscious and intentional effort, often through extramural English activities like reading, gaming or watching media (Sundqvist 2009; Olsson and Sylvén 2015), although it may also occur in instructional settings. In contrast, intentional learning largely involves deliberate efforts, such as studying vocabulary lists, practicing word associations, or using mnemonic techniques (Nation 2013). These two processes are interconnected and mutually reinforcing, although one may be more dominant than the other in specific contexts (Nation 2020).

2.2 Frequency and L2 vocabulary learning

The frequency of exposure to language items, such as grammar features or vocabulary items, plays a critical role in L2 learning, according to cognitive linguists specialising in second language acquisition (e.g., Ellis 2002). Frequent items in the input language are more likely to be noticed, processed and retained through statistical learning mechanisms (Ellis 2002). That is, learners act as intuitive statisticians, and through repeated encounters, they strengthen the networks of a learnt language item probably subconsciously, such as its usage in specific contexts. However, frequency alone does not fully account for L2 learning. Other factors, such as saliency and concreteness, interplay with frequency in affecting L2 acquisition (Gries 2008).

In L2 vocabulary learning specifically, frequency appears to significantly influence learners' ability to recognize, understand and retain words. High-frequency words are generally learned earlier and retained more easily, as repeated, frequent exposure reinforces their form-meaning mappings (Nation 2020; Willis and Ohashi 2012). For beginners, frequent words in the input are mostly easily acquired, although their L2 vocabulary knowledge is unlikely to include a deep understanding of all the grammatical and semantic properties of the words they know (Crossley et al. 2014). Contextual variation, i.e., encountering the same words in different sentences or situations, enables learners to learn new words more effectively than repeated exposure to the same words in same contexts (e.g., repeatedly reading the same book) (Nation 2013). Thus, while frequency is a crucial element of vocabulary learning, meaningful engagement with vocabulary items is necessary for long-term retention and for further developing receptive knowledge to productive knowledge (Nation 2020).

2.3 Word class and L2 vocabulary learning

Research shows that, when relating vocabulary learning to word class, nouns are the easiest word class to acquire (e.g., Nissen and Henriksen 2006; Vasiljevic 2010). Vasiljevic's (2010) study demonstrated significantly higher knowledge of nouns both before and after intervention among Japanese L1 high-intermediate learners of English. Likewise, Nissen and Henriksen (2006) reported similar findings with Danish L1 upper secondary learners of English.

The relative ease of noun acquisition can be attributed to several features of nouns, as Miller (1991) discusses. First, nouns often refer to concrete, tangible objects, which makes them easier to process cognitively. Second, nouns are stored in the mental lexicon as relatively independent entities with hierarchical semantic structures, which allows new nouns to be easily integrated into the mental networks. Third, nouns frequently share relationships with other nouns, such as categorical connections, enabling language users to expand and retain vocabulary knowledge through these relationships.

In contrast, verbs and adjectives are by nature more relational and context-dependent (Goldfield 2000). Verbs in particular may be more difficult to acquire than adjectives even for L1 learners (Goldfield 2000), probably because they often lack concrete referents and require an understanding of how noun phrases are related to them (e.g., as subject, object or predicative) (Miller 1991). Verbs are also more polysemantic than nouns and adjectives, with plural meanings depending on context (Nissen and Henriksen 2006). Additionally, verbs involve more morphological complexity, such as irregular inflections (Goldfield 2000), which can delay their acquisition compared to nouns and adjectives.

As for adjectives, Berman (1988, cited in Vasiljevic 2010) discusses that they are recognized by learners as a distinct grammar category later than nouns and verbs, because adjectives typically occur with nouns in noun phrases (e.g. ‘warm tea’) or with verbs in predicates (e.g., ‘looks warm’ in ‘The tea looks warm’). However, both Vasiljevic (2010) and Nissen and Henriksen (2006) found that adjectives appeared to be learned significantly more easily than verbs by L2 learners although they were still significantly more difficult to learn than nouns.

2.4 The Academic Vocabulary List and the Academic Vocabulary Test

Academic vocabulary refers to words that appear more frequently in academic texts than in non-academic texts (Nagy, Townsend, Lesaux, and Schmitt 2012). It can be further classified into discipline-specific vocabulary (e.g., words used in engineering) and general academic vocabulary, which comprises words commonly used across disciplines (Coxhead 2016; Warnby 2023b). Our study focuses on general academic vocabulary.

Below, we briefly introduce the Academic Vocabulary List (AVL) (Gardner and Davies 2014), which provides general academic vocabulary,

and the Academic Vocabulary Test (AVT), developed based on the AVL (Pecorari, Shaw, and Malmström 2019), as our study adapts the AVT to measure our pupil participants' academic vocabulary knowledge as described in section 3.2.

2.4.1 The AVL

The AVL, developed by Gardner and Davies (2014), provides a cluster of non-field specific (i.e., general) academic vocabulary that frequently appears in academic texts. It is based on the academic sub-corpus of the Corpus of Contemporary American English (COCA), which comprises approximately 120 million words. Among other purposes, the AVL is intended to facilitate the teaching of English academic vocabulary to second language learners (Gardner and Davies 2014). Although COCA is supposed to comprise American English, its academic subcorpus may represent English as an academic lingua franca worldwide, as the texts included are from international journals.

While the AVL may be more approachable for teachers and learners than other similar lists as it offers a list of words frequently appearing in academic texts, the actual frequency of the words it includes varies widely. For example, among the total of 3,015 words on the list, the most frequent word, *study*, occurs 137,208 times in the COCA academic subcorpus, whereas the least frequent word, *relevancy*, occurs only 111 times (www.academicwords.info). This variation may matter since frequency plays a critical role in L2 vocabulary learning (Nation 2020; Willis and Ohashi 2012) as reviewed in section 2.2.

2.4.2 The AVT

As mentioned above, the AVT is an AVL-based test designed to assess receptive knowledge of English academic vocabulary (Pecorari, Shaw, and Malmström 2019). The AVT consists of two forms: Form One and Form Two. Each form contains 19 questions, testing a total of 57 words. Each question includes a cluster of six words (three correct answers and three distractors) together with three definitions or synonyms. The task is to match each word to its corresponding meaning. The AVT was designed to be easy to mark, minimize the risk of guessing, and assess a large number of words in a short time. Pecorari, Shaw, and Malmström (2019) arranged the AVL into sets of 100, considering frequency and word class.

As will be discussed further in section 2.5, the AVT has been used to assess Swedish upper secondary pupils' receptive academic vocabulary knowledge (Warnby 2022, 2023a, 2023b, 2024). Warnby (2023a) suggests two possible benchmark points (referred to as 'thresholds' in the study) for mastery. The more lenient benchmark is 32 out of 57 points (56%), while the more stringent benchmark is 45 out of 57 points (79%). Since the lenient benchmark approximately corresponds to a band score 6.5 on the IELTS test (Warnby 2024), it aligns with the expected English proficiency level upon completion of upper secondary school in Sweden (Swedish Council for Higher Education 2024). Therefore, using the lenient benchmark should provide a reasonable understanding of Swedish upper secondary pupils' academic vocabulary knowledge.

2.5 Academic vocabulary knowledge of Swedish L2 learners of English

The receptive vocabulary knowledge of Swedish adolescent learners of English has been investigated (e.g., Gyllstad 2007; Sylvén and Ohlander 2019). However, comprehensive information about Swedish upper secondary pupils' receptive knowledge of English academic vocabulary primarily comes from a series of recent studies by Warnby (2022, 2023a, 2023b, 2024). Overall, the performances of the participants (N = 817) on the AVT (Form Two) in Warnby (2022) indicated that many Swedish upper secondary pupils may not achieve the expected level of receptive knowledge of English academic vocabulary. The mean score was 24.88 out of 57 points (43.6%), which falls below the benchmark corresponding to the IELTS band score 6.5 (Warnby 2024), the proficiency level that Swedish pupils are expected to achieve after the mandatory English education, as noted above.

Similar trends were observed in Warnby (2023a), which separately investigated the academic vocabulary knowledge of pupils who entered and exited upper secondary school. The mean score of the exit group (N=414) was 31.02 out of 57 points (54%), with only 48% of the pupils reaching the benchmark. Further, the study reported score discrepancies among pupils from different study programs, with social sciences and economics students performing more poorly than those from other programs: economics = 26.89 (47%); social science = 25.01 (44%).

Moreover, Warnby's study (2022) indicated some weak, but positive correlations between Swedish upper secondary pupils' receptive knowledge of English academic vocabulary and their extramural English

activities like reading, watching TV/films, and listening to podcasts (correlations ranging 0.25 ~ 0.39). This finding somewhat aligns with an earlier study by Olsson and Sylvén (2015), which focused on productive academic vocabulary knowledge. They found weak correlations between extramural English reading and writing activities and productive academic vocabulary knowledge (correlation ranging 0.21 ~ 0.25) among first-year upper secondary pupils, although such correlations were not observed among more advanced pupils.

3. Method

To address the research questions presented in the introduction, we collected data from pupils at a Swedish upper secondary school in accordance with the Declaration of Helsinki and Swedish ethical guidelines and regulations. The data collection utilized a vocabulary test and a questionnaire. The sections below describe our participants and data collection procedure (3.1), the vocabulary test (3.2), the questionnaire (3.3) and the data analysis procedure (3.4).

3.1 Participants and data collection procedure

Participants in the study comprised 93 pupils (mean age = 17.25 years) from four English 6 classes at an upper secondary school in a suburb of Stockholm run by the municipality, after excluding two pupils who reported having blindly guessed all answers on the vocabulary test. They were recruited by the first author who contacted their English teachers, providing an information sheet about the study for distribution to their pupils. The information sheet explained the purpose of the study, outlined the requirements of participation, emphasized that participation was voluntary, and stated that withdrawal was possible at any time. During data collection, the first author was present to provide oral information about the study and to address any participant questions. Participants read and signed a consent form before beginning the study. They were then provided with a link to the academic vocabulary test and questionnaire on Google Forms, which they completed during the session.

The four English 6 classes that participants were attending represented the final mandatory English course in upper secondary education. Demographic information revealed a wide range of individual differences among participants, including varied English grades and 22 different first

languages (L1s), where 51 were Swedish L1 speakers. The diversity among participants was also reflected in the report that pupils at the school generally come from varied socioeconomic backgrounds (Skolverket 2023).

Of the 93 participants, 39 were enrolled in the economics program and taught by one English teacher, while 54 were enrolled in the social sciences program and taught by another English teacher. However, no significant differences in vocabulary test performance were observed between students from the two programmes. Therefore, we treated all participants as a single cohort in our analysis.

3.2 Vocabulary test balancing word frequency levels and word classes

3.2.1 Test structure

The vocabulary test used in this study was an adaptation of the AVT (Pecorari, Shaw, and Malmström 2019). The test is available in two versions: one with [English instructions](#) and one with [Swedish instructions](#). To gain a more detailed understanding of pupils' performance at different frequency levels and across different word classes, we selected questions from both Form One and Form Two, ensuring even representation of frequency levels and word classes. While some extant tests already contain equal numbers of questions for different frequency bands (e.g., Schmitt, Schmitt, and Calpham 2001), we decided to adapt the AVT as it tests the words from the AVL, which is based on the most comprehensive academic language corpus available (Gardner and Davis 2014).

Our test included an equal number of questions for the frequency bands of 1K (the 1–1,000 most frequent words), 2K (the 1,001–2,000 most frequent words), and 3K (the 2,001–3,015 most frequent words). It also included an equal number of nouns, verbs, and adjectives. In this way, our test consisted of 21 questions—two more than the AVT—with 7 questions for each frequency level and 7 questions for each word class.

The noun set included two questions at the 1K level, three at the 2K level, and two at the 3K level; the verb set comprised three questions at the 1K level, two at the 2K level, and two at the 3K level; and the adjective set contained two questions at the 1K level, two at the 2K level, and three at the 3K level. Consequently, the verb set was expected to be slightly easier than the noun and adjective sets.

Adopting the structure of the AVT, each of the 21 questions in our test targeted three words, allowing the test taker to be assessed on a total of 63

items, with 21 items for each frequency level and each word class. For our Google Forms-based test, we could not use the AVT's paper-based layout and had to format the questions with three items using the available options on the platform, as shown in Figure 1.

	book	kitchen	mixture	orange	pot	vase
A container for flowers	☐	☐	☐	☐	☐	☒
A kind of fruit	☐	☐	☐	☒	☐	☐
A place to prepare food	☐	☒	☐	☐	☐	☐

Figure 1: The sample question of the test, showcasing the layout of the twenty-one questions

Before the first question, the test began with instructions stating that the test taker's English academic vocabulary would be assessed. This was followed by information about the number of questions, the number of items per question, and how the test taker should respond (i.e., by selecting the small circle under the one word they thought was the correct answer for each definition).

Although all the questions in our test were from the AVT, which was refined through pilot studies, some might still appear ambiguous to test takers. For example, in the question 'Produce something', the distractor 'publish' could possibly be an answer besides the correct answer 'generate'. Nevertheless, when marking participants' answers, we accepted only the answers in the key provided by Pecorari, Shaw, and Malmström (2019) as they were the most accurate choices.

3.2.2 Analysis of test reliability and validity

Our adaptation of the AVT implies that we used an unvalidated test, which represents a limitation of our study. Therefore, we carried out a reliability and validity analysis on participants' test performance.

First, as shown in Table 1, the reliability analysis indicated that participants' scores across the questions were highly consistent. These scores were calculated by awarding one point for each of the 63 items in the 21 questions, without penalizing incorrect answers, following the approach used by Warnby (2023a).

Table 1: Reliability test results (N = 93)

	Total	Sorted by frequency			Sorted by word class		
		1 K	2 K	3 K	Noun	Verb	Adjective
N of items	63	21	21	21	21	21	21
C_α	0.935	0.860	0.855	0.779	0.799	0.856	0.832

Note: Cronbach's Alpha (C_α) > 0.7 is regarded as acceptable for internal consistency among the questions.

Second, we considered validity in relation to pupils' English grades and previous research. First, the strong correlation between pupils' self-reported English grade and the vocabulary test score (0.701, $p < 0.001$) provides some support for the validity of our test. Second, we compared our participants' test performance with that of Warnby's (2023a) participants from the same programmes (economics and social sciences). For this comparison, we adjusted our participants' scores by assigning different point values to correctly answered items based on their frequency levels, referring to the number of test items at each frequency level in the AVT Form Two used by Warnby, as shown in Table 2. Our participants' adjusted mean score (47.1 %) closely corresponded to the AVT score of Warnby's participants (mean scores of 44% for the economics program and 47% for the social sciences program), further supporting the validity of our test.

Table 2: Unadjusted and adjusted scores of the vocabulary test as percentages (N = 93)

	Mean	95% of CI	Median	SD
Unadjusted score (%)	49.8	[45.8, 53.8]	50.8	19.4
Adjusted score (%)	47.1	[43.3, 50.1]	47.6	18.4

3.3 Questionnaire

The questionnaire included questions addressing individual factors that may be related to participants' receptive knowledge of English academic vocabulary (i.e., their test scores) based on previous research (e.g., Warnby 2022, 2023a). However, in this study, we only utilised the questions about demographic information and extramural English activities, as presented in Table 3. While Warnby (2023a) used more specific questions about different extramural English activities (e.g., separate questions for reading various genres), we prepared broader, combined questions (e.g., 'reading time' as a single item). We view that the results in Warnby's study (2022) could be generalized with minor differences in the correlation scores with test performance. Combining the items about extramural English was particularly necessary to ensure manageable data analysis, given that our study had multiple parameters in the test performance, including separate scores for word frequency level and word class.

Table 3: Questions considered in this study

Sections	Questions	Types
Demographic information	Age	Open-ended
	Study programme	Multiple choice
	The latest English grade	Multiple choice
Extramural English	Reading	Likert scale 1–10
	Video game	Likert scale 1–10
	Listening (e.g., audiobooks)	Likert scale 1–10
	Watching (e.g., TV or films)	Likert scale 1–10
	Social media time	Likert scale 1–10

Table 4 summarises participants' answers to the items requesting how often they engaged in different extra-mural English activities. These outcomes will be drawn on in addressing the third research question in section 4.

Table 4: Means, standard deviations (SD), and minimum and maximum values of participants' (N = 93) responses to questions about the frequency of extramural English activities, where 1 = not at all and 10 = very often

Questions	Mean	SD	Minimum	Maximum
Reading	6.28	2.744	1	10
Video game	6.38	3.131	1	10
Listening	4.48	3.168	1	10
Watching	8.27	2.086	3	10
Social media	8.68	1.789	3	10

3.4 Data analysis for addressing research questions

First, we identified that two of the participants reported English as their first language. However, since their test scores (64.2% and 42.6%) did not stand out as outliers, we decided to include them in the data pool.

To address RQ1 about the effects of word frequency and word class on participants' vocabulary test performance, we first produced descriptive statistics for the test scores at the 1K, 2K and 3K levels and for the word classes: nouns, verbs and adjectives. We then compared the scores for frequency level and the scores for word class by means of repeated measures ANOVAs and post-hoc tests.

To address RQ2 about the performance of high and low scorers across different frequency levels and word classes, we first determined high and low scorers using the lenient benchmark score of the AVT (56%) (Warnby 2023a; Warnby 2024) on the adjusted scores reported in Section 3.2.1. As discussed in Section 2.4.2, this benchmark corresponds to the expected English proficiency when completing the English 6 course. We then performed mixed ANOVAs, after confirming that three outliers among the high scorers only at the 1K frequency level (one with an exceptionally high score and two with exceptionally low scores) did not affect the test results. The accepted p -value was < 0.05 , and for post-hoc tests, the p -value was adjusted using the Bonferroni correction. Furthermore, after discovering diverging trends in the effect of word class on low and high scorers, we performed repeated measures ANOVAs for each group, to analyse the effect of word class on their test performance separately. Further, we examined pupils' performances on individual test items to observe how the characteristics of words, including their frequency and word families, might affect their performance.

For all ANOVAs, the partial eta squared effect size (η^2) was interpreted as follows: $\eta^2 < 0.01$: negligible; $0.01 \leq \eta^2 < 0.06$: small; $0.06 \leq \eta^2 < 0.14$: medium; $\eta^2 \geq 0.14$: large.

Lastly, to address RQ3 about correlations between vocabulary test performance and extramural English activities, we performed non-parametric Spearman correlation tests, as these individual factors were treated as ordinal data. The strength of correlation coefficients was interpreted as follows: 0–0.2, very weak; 0.2–0.4, weak; 0.4–0.6, moderate; 0.6–0.8, strong; and 0.8 and above, very strong (Salkind 2016).

4. Results

4.1 Effect of word frequency and word class on test performance

As reported earlier in the method section, the mean score of our vocabulary test among 93 pupil participants was 49.8% (SD = 19.4). To address the first research question about the effect of word frequency and word class on text performance, we also calculated their scores for each word frequency level and for each word class: nouns, adjectives and verbs.

As shown in the boxplots in Figure 2, the score at the 3K level was visibly lower than the scores at the 1K and 2K levels. Meanwhile, the score for verbs was lower than the scores for nouns and adjectives. Repeated measures ANOVAs and post-hoc tests indicated that these observed differences were statistically significant. A significant effect was observed for word frequency level with a very large effect size ($\eta^2 = 0.602$): $F(1.952, 179.538) = 139.144, p < 0.001$. Post-hoc tests revealed significant differences between the scores for the 2K and 3K words and between the scores for the 1K and 3K words (both $p < 0.001$). Similarly, a significant effect was found for word class: $F(1.834, 168.759) = 9.288, p < 0.001$, with a medium effect size ($\eta^2 = 0.092$). Post-hoc tests showed significant differences between the scores for adjectives and verbs ($p = 0.001$) and between the scores for nouns and verbs ($p < 0.001$).

These results suggest that participants may have more limited knowledge of low-frequency vocabulary and verbs compared to high-frequency vocabulary and nouns and adjectives.

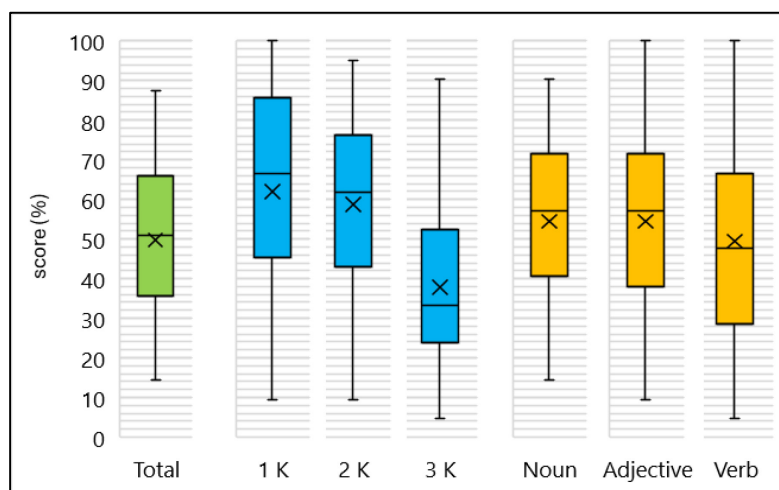


Figure 2: Boxplots for the vocabulary test scores (N = 93), showing the distribution as percentages, including median and mean (marked with an 'x') values: the overall score is on the left, the breakdown by three frequency levels is in the middle, and the breakdown by three different word classes is on the right.

4.2 Effect of word frequency and word class on low and high scorers

To address the second research question about whether and how the effect of word frequency and word class on test performance differs between high scores and low scorers, we first identified these two groups based on a benchmark score of 56% (Warnby 2023a, 2024), applied to the adjusted scores reported in Section 3.2.2. Only 28 pupils were identified as high scorers while 65 pupils as low scorers, reflecting that many pupils might not have sufficient English academic vocabulary knowledge.

4.2.1 Effect of word frequency

Regarding the effect of word frequency high and low scorers, we first produced descriptive statistics in Table 5. A mixed ANOVA first confirmed a significant difference in test performance between high and low scorers: $F(1, 91) = 133.88, p < 0.001, \eta^2 = 0.595$, indicating a large discrepancy in receptive knowledge of English academic vocabulary between these two groups. As reported in the previous section, a significant within-subjects effect was observed for different frequency

levels, with a large effect size: $F(1.95, 177.59) = 123.79$, $p < 0.001$, $\eta^2 = 0.576$, where scores at the 3K level were significantly lower than scores at the 1K and 2K levels ($p < 0.001$), while the small difference between the 1K and 2K level scores was not statistically significant. There was no interaction effect between the effect of frequency levels and test performance by high and low scorers: $F(1.95, 177.59) = 0.82$, $p = 0.444$. This suggests that both groups' test performance at different frequency levels followed a similar pattern. That is, both low and high scorers appear to have smaller vocabulary sizes at the 3K level, compared to their vocabulary sizes at the 1K and 2 K levels.

Table 5: Estimated marginal means, standard errors and 95% confidence intervals (CI) among high scorers and low scorers at different frequency levels

Scorers	Frequency	Mean	Std. Error	95% CI
High Scorers (N=28)	1K	87.6	3.07	[81.5, 93.7]
	2K	83.5	3.33	[76.9, 89.1]
	3K	60.4	2.50	[55.4, 65.3]
Low Scorers (N=65)	1K	50.9	2.01	[46.9, 54.9]
	2K	48.4	2.19	[44.1, 52.8]
	3K	28.1	1.64	[24.8, 31.3]

However, although the test performances of high and low scorers showed a similar pattern—where vocabulary size at the 3K level appeared much smaller than at the 1K and 2K levels—the two groups differed in how they answered individual questions, providing interesting observations of their vocabulary knowledge.

First, high scorers often correctly identified words that were cognates with Swedish words, while low scorers struggled even with these cognates. For example, the word *abstract* ('abstrakt' in Swedish) at the 1K level was correctly answered by 86% of high scorers but only by 42% of low scorers; similarly, the word *affiliated* ('affilierad' in Swedish) at the 3K level was answered correctly by all high scorers but only by 51% of low scorers.

Second, at the 3K level, high scorers tended to perform well with words from word families that include highly frequent members. For example, 81% of high scorers correctly answered the word *unsustainable*, which belongs to a word family with the frequently used words *sustain*,

sustainable, *sustained*, and *sustainability*. This suggests that an understanding (perhaps implicit) of word roots and morphological derivation might contribute to test performance. On the other hand, high scorers struggled with other 3K words from word families without other members, such as *proclivity* and *parsimonious*, which were understood by only 39% of them. The words *aversion*, *precedence*, and *convergence*, which in fact have Swedish cognates ('aversion', 'precedens', and 'konvergens') but from a single-member word family, were understood by fewer than 47% of high scorers (and by fewer than 21% of low scorers).

4.2.2 Effect of word class

To examine the effect of word class on test performance among high and low scorers, we performed a separate mixed ANOVA. A significant interaction effect was found between word class and test performance by high and low scorers: $F(1.84, 167.51) = 11.41, p < 0.001$, with a medium effect size ($\eta^2 = 0.111$). As shown in Table 6, this interaction occurred because low scorers obtained relatively lower scores for verbs compared to noun and adjectives, while high scorers obtained slightly lower scores for nouns than for adjectives and verbs.

To explore these effects further, we performed two separate repeated measures ANOVAs for low and high scorers to determine the effect of word class on test performance within each group. For high scorers, the test was not statistically significant: $F(1.965, 53.050) = 2.610, p = 0.083$, suggesting that they may have similar vocabulary sizes for nouns, adjectives and verbs. In contrast, the ANOVA for lower scorers revealed a significant effect of word class on their test performance: $F(1.785, 114.208) = 17.689, p < 0.001$, with a very large effect size ($\eta^2 = 0.217$). Post-hoc comparisons showed that this was mainly due to significantly low performance on verbs compared to both nouns and adjectives ($p < 0.001$ for both comparisons).

These results suggest that the previous observed low performance on verbs for the whole group (section 4.1) was primarily connected to the performance of low scorers rather than high scorers. This indicates that low scoring pupils may have a more limited knowledge of verbs compared to nouns and adjectives.

Table 6: Estimated marginal means, standard errors and 95% confidence intervals among high scorers and low scorers for different word classes

Scorers	Word Class	Mean	Std. Error	95% CI
High Scorers (N=28)	Noun	74.8	2.86	[69.1, 80.5]
	Adjective	77.6	3.17	[71.3, 83.9]
	Verb	79.0	2.66	[73.7, 84.3]
Low Scorers (N=65)	Noun	46.2	1.83	[42.5, 49.8]
	Adjective	44.9	2.03	[40.9, 49.0]
	Verb	37.4	1.70	[34.1, 40.8]

4.3 Correlations between test performance and extramural English activities

Finally, to answer the third research question, we conducted non-parametric Spearman correlations between vocabulary test scores (including the overall score items, as well as scores for frequency level and word class) and the self-reported frequencies of engagement in different extramural English activities, as shown in Table 7.

Table 7: Non-parametric Spearman correlations between vocabulary test scores and extramural English activities

Extramural English	Correlations with the test scores						
	Total	1 K	2 K	3 K	Noun	Verb	Adjective
Reading	0.452**	0.431**	0.416**	0.380**	0.403**	0.464**	0.376**
Video games	0.262*	0.269**	0.269**	0.199	0.228*	0.327**	0.159
Listening	0.212*	0.194	0.190	0.191	0.177	0.229*	0.166
Watching	0.188	0.176	0.142	0.224*	0.185	0.207*	0.144
Social media	0.354**	0.306**	0.333**	0.322**	0.313**	0.353**	0.296**

Note: Ratings for the frequency of extramural English activities was measured with the scale with 0 = not at all and 10 = very often. For statistical significance, * = $p < 0.05$, ** = $p < 0.01$; test results in grey colour are not significant.

The results showed that reading and social media were most consistently correlated with vocabulary scores across all frequency levels and word classes, with reading showing a slightly stronger association. Playing video games had more correlations than listening and watching.

Interestingly, although moderate or weak scores on verbs tended to have the strongest correlations with all extra-mural activities while scores on adjectives were correlated only with reading and social media.

These results suggest that pupils who actively engaged in extramural English reading and social media—and to some extent, video games—might have better receptive knowledge of English academic vocabulary, particularly verbs and high frequency words.

4. Discussion

4.1 Discussion of findings

This study investigated how word frequency and word class impacted Swedish upper secondary pupils' receptive knowledge of English academic vocabulary and how these factors correlate with extramural English activities. First, our data supported previous research by Warnby (2022, 2023a, 2023b), which found that many pupils did not seem to have the expected levels of English academic vocabulary knowledge by the end of their obligatory English education. This finding motivated us to look more closely at pupils' performance on the vocabulary test, addressing the three research questions.

Our analysis of the effect of word frequency on pupils' English academic vocabulary knowledge aligns with previous research on L2 learners' vocabulary knowledge, confirming that high-frequency words may be more easily acquired and retained than low-frequency words (Nation 2020; Willis and Ohashi 2012; González-Fernández and Schmitt 2020). However, our analysis of how high and low scorers answered different questions revealed some additional information. The depth and breadth of vocabulary knowledge, which often correlated with proficiency levels (Augustin-Llach 2022; Crossley et al. 2014; Nation 2013), seemed to be reflected in the two groups' test performance. High scorers' performance indicated that they might have well-developed lexical networks. This possibly enabled them to infer the meanings of low frequency words using morphological derivational patterns (e.g., *unsustainable* from *sustain*) and L1 cognates, in view of previous research (Bosma et al. 2023). In contrast, low scorers seemed to struggle to recognize even some high-frequency words, not to mention low-frequency words.

Regarding the effect of word class, extant research reports that nouns and adjectives may be generally easier to learn than verbs (Nissen and

Henriksen 2006; Vasiljevic 2010), due to the relational and morphologically complex nature of verbs (Goldfield 2000; Miller 1991). This tendency was confirmed by low scoring pupils' performance on our English academic vocabulary test, for whom verbs appeared to be the most challenging word class. However, high scoring pupils demonstrated balanced performance across all word classes, suggesting a wider and deeper vocabulary knowledge (Bosma et al. 2023; González-Fernández and Schmitt 2020). Further, while L2 learners in both Nissen and Henriksen (2006) and Vasiljevic (2010) had better knowledge of adjectives than nouns, our participants achieved similar scores on both nouns and adjectives, although high scorers performed slightly better on adjectives and low scorers performed slightly better on nouns on the test.

Our findings regarding the overall weak to moderate correlations between self-reported extramural English activities and vocabulary test performance were consistent with the findings by Warnby (2022) and Olsson and Sylvén (2015). However, our data provided some new information. Among our participants, reading and social media engagement were most strongly associated with test scores. Interestingly, as discussed above, while many pupils apparently struggled with verbs on the test, their performance on verbs consistently correlated with all extramural English activities. These correlations may indicate that using English outside school in meaningful contexts helps learners acquire academic verbs (as well as other types of words). Alternatively, they may just indicate that learners with a good knowledge of academic verbs are likely to engage in extramural English activities—or both. However, we are cautious about interpreting these findings as clear causal relationships between extramural English and pupils' knowledge of academic verbs.

4.2 Pedagogical suggestions

Based on our findings, we wish to make some pedagogical suggestions. First, to support pupils' academic vocabulary learning, particularly those with weaker vocabulary knowledge, teaching can prioritise high frequency words, to build up a strong foundation for further vocabulary development (Nation 2013). Using resources like the Academic Vocabulary List (Gardner and Davis 2014), teachers can identify and integrate frequent academic words into diverse classroom activities, to provide repeated exposure in various contexts (Nation 2013). In doing so, teachers can also help pupils develop morphological awareness and encourage them to draw

on L1 lexical knowledge. Such abilities appear to be critical in word recognition and further vocabulary growth (Bosma et al. 2023), as demonstrated by high scorers' ability to infer low-frequency word meanings using derivational patterns and L1 cognates. Explicit and implicit teaching of prefixes and suffixes may help pupils to decode new words, supporting them to expand their lexical networks (Bosma et al. 2023).

As our findings show, many pupils need pedagogical support to develop their knowledge of academic verbs, which can be best learned in specific contexts, due to their relational nature (Goldfield 2000; Miller 1991). For example, games that involve identifying verbs from engaging and sufficiently comprehensible texts can facilitate their vocabulary growth. Incorporating elements of extramural English, such as reading blogs on interesting academic topics, may also help pupils experience incidental learning of academic verbs, given the consistent correlations observed between extramural English and test performance on verbs. For more advanced pupils, teachers can challenge them with academic texts that are comprehensible but contain low frequency verbs. Teachers can also encourage students to utilize their lexical network including their L1 vocabulary knowledge, to infer meanings, as Nation (2013) recommends.

In fact, incorporating extramural English activities into classroom practices can reinforce academic vocabulary learning overall (Warnby 2022; Sundqvist 2009). For example, guided discussion after engaging in social media, or student projects that encourage English use outside the classroom, such as creating a group blog on a specific academic topic, can provide opportunities for both incidental and intentional learning of academic vocabulary.

5. Conclusion

A well-developed vocabulary is essential for using English as a lingua franca (ELF) (Jeong 2021), and this is no exception in the context of education. Our study aimed to extend the understanding of Swedish upper secondary pupils' receptive knowledge of English academic vocabulary, by examining the effect of word frequency and word class. Our study showed that pupils in general appeared to have better knowledge of high-frequency words and nouns and adjectives, whereas they struggled with recognizing low-frequency words. Verbs seemed to be most challenging for many pupils. The positive correlations between the vocabulary test

performance and extramural English activities suggest that integrating such activities into classroom teaching may facilitate learners' academic vocabulary growth.

Finally, we note several limitations of our study. Given that our data was from a small sample size at a single school, we are cautious about applying them to a wider population, although some findings aligned with previous research and can have more generalisability. Moreover, we used an unvalidated vocabulary test, although our analysis of participants' performance indicated its internal reliability as well as validity in relation to pupils' English grades and previous research. New findings, such as pupils' knowledge of vocabulary at different frequency levels and across different word classes, should therefore be further attested with larger sample sizes. Despite these limitations, our study offered initial insights into some important factors affecting pupils' L2 English academic vocabulary development and sought to provide pedagogical recommendations for helping pupils develop their receptive academic vocabulary knowledge in preparation for higher education and to become competent users of English as an academic lingua franca.

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Authors' contributions

The first author designed the method, including the instrument, collected the data, and supported the framing and conceptualisation of the article and the writing of the manuscript. The second author made a major contribution to framing and conceptualising the article, analysing the data, and writing the manuscript.

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