Morphological Awareness and Recall of Passive Vocabulary in Adult Learners

Tom S. Bellomo[1]

[1] Academic Affairs, Daytona State College, Daytona Beach, Florida, USA

Correspondence: Daytona State College, Daytona Beach, Florida USA.

Abstract

A modified and enhanced replication of an original experiment aimed to discover the extent of immediate and long-term vocabulary recall that exploited the mnemonic value of morphemes. Data for a sample size of 360 students were disaggregated based on age and gender using a pre/posttest instrument to determine immediate gains, and a long-term posttest (avg. 5.5 mos.) to determine the lasting effects of the intervention. Results revealed that older adults outperformed younger adults on all measures of the instrument and across all timeframes, with the oldest cohort significantly outperforming all other age groups, and women outperformed men, also on all measures across all timeframes, and significantly so on the vocabulary section of the instrument. Gain scores for all students across all measures and timeframes provide empirical support of the mnemonic value of morphemes when incorporated into a program offering direct vocabulary instruction for adult learners.

Keywords: Morphology, Vocabulary acquisition, Academic, Higher education, Adults, Reading

1. Introduction

Reading programs that prepare students—native and non-native English speakers alike—for full assimilation into higher education are more commonly incorporating direct vocabulary instruction into the curriculum. Today it is generally uncontested that vocabulary knowledge and reading comprehension correlate positively. However, less certain are the best practices for facilitating academic vocabulary acquisition. Additionally, even when particular strategies empirically demonstrate viability, research may not examine, or sub-classify, relative success based on participant composition.

This present study adds to the growing literature on morphological awareness and vocabulary acquisition strategies that target adult college students. In particular, this study analyzes vocabulary gain scores and long-term recall of adults' passive vocabulary in light of the participants' age and gender. Its emphasis is on the mnemonic value of morphemes in recalling the basic meaning of semantically transparent vocabulary. This replication of an original study (Bellomo, 2009) was modified in that it omitted classification by language origin, and instead, disaggregated data based on age and gender. Additionally, the experiment was enhanced by means of a robust sample size (n = 360), a lengthier and more stringent test instrument (from 30 to 40 questions with guessing prohibited), an original workbook to serve as the primary means of instruction, and the administration of a long-term posttest to determine the retention effects of the intervention (n = 68).

The administration of a pre/posttest instrument was given each semester to students enrolled in a reading course at one large-sized state college in the southeast United States, spanning 4 years (14 contiguous semesters and 27 sections) of course offerings. On average, five and a half months after each respective semester the same posttest was administered to a total of 68 participants. Vocabulary instruction focused on using semantically transparent word parts across a range of words, and a pedagogical approach that provided multiple exposures to the target word-parts and their corresponding vocabulary.

Analyzing the overall data to determine gain scores can provide insight to the general success, or lack thereof, of an intervention. Drilling down further to sub-classes comprising the overall composition might uncover relative strengths and weaknesses based on group identities. In this study, overall gain scores at the end of each semester and the demonstration of long-term retention months later both support the efficacy of morphological awareness as a means of retaining the meaning of directly instructed words and their component morphemes.

2. Literature Review

The link between vocabulary knowledge and reading ability in higher education is well established (Fracasso, Bangs, and Binder, 2016; Hiebert and Bravo, 2009), and extends to academic success in general (Nagy and Townsend, 2012). With such an understanding, it is becoming increasingly common for language programs to incorporate a direct instruction component into the curriculum and not expect academic vocabulary growth to emerge as an incidental byproduct solely from reading.

> Most of an individual's lexicon is not actively taught to them, but it has been attained through context reading or experience in an implicit manner. This is not often true for academic vocabulary, and learners who wish to add a specific number of words to their lexicon in a short amount of time usually need to explicitly gain this knowledge. (Nushi and Jenabzadeh, p. 54, 2016)

Nation (2007) pointed out, "There has long been substantial evidence that deliberately learning vocabulary can result in large amounts of well retained useable knowledge" (p. 6). Helpful to a language program would be empirical evidence demonstrating degrees of efficacy for particular vocabulary acquisition strategies, and to sub-classify participants to determine whether certain student-types have greater success using particular strategies.

2.1 Depth versus Breadth

Before implementing any particular strategy, initial questions to ask might be, "How deeply do we want our students to understand the vocabulary introduced in our program?" Also, "How great a range can we realistically expect to cover?" Citing relevant literature, Bowers and Kirby (2010) discuss the rich and narrow approach to vocabulary acquisition and compare it with the shallow but wide approach. The context of their article focuses on children, but the basic tenants of these contrastive approaches are universal. In essence, the *rich and narrow* approach advocates deep learning, which requires devoting more time to fewer words. In contrast, the *shallow but wide* approach often sacrifices quality at the expense of quantity.

Perhaps the determinant would be the context in which the vocabulary is taught. In a writing class, language is productive, so writers must have a comprehensive understanding of the terms in order to use them correctly and effectively. On the other hand, reading is relatively passive. Here, breadth over depth might be preferable since cognition relies on recall rather than generation; additionally, the reader has context to confirm understanding. With much of academic content disseminated via the printed word, readers with a limited range of vocabulary knowledge will find themselves at a handicap.

> One may limit his *active* vocabulary as much as he likes; he may in his own speech and writing stick to the words of his childhood if he so desires; but after the pupil reaches say the high-school stage of his education, he must develop a *passive* vocabulary which he has no such power to limit. The limits of this vocabulary are set for him by those who speak to him or write for him. (Carr, p. 193, 1921)

2.2 Morphological Awareness

In the literature, it is common to find the terms morphological awareness and morphological analysis used interchangeably. Apel (2014) aimed to bring consensus to the meaning behind morphological awareness, albeit in the context of writing. However, to clarify this present research, I elect to align my understanding of morphological awareness (MA) as stated by Carlisle (2000), "Morphological awareness, as it contributes to reading, must have as its basis the ability to parse words and analyze constituent morphemes for the purpose of constructing meaning" (p. 170).

As a mnemonic device used to summon recall, morphological awareness capitalizes on the physical form (morph = form) of word parts that remain visually stable among a range of words, even if phonologically altered. For example, aurally it would be difficult to discern that *sign* and *signature* are morphologically related (sīn; sĭg-nə-chĕr) as the root is pronounced differently in each, and in fact, the root comprises two different syllables in the latter word. Nevertheless, the visual aspect is retained and offers a clue in reading that is not apparent in listening; hence, "…the English writing system is in part morphologically based" (Nagy, Carlisle, and Goodwin, p. 4, 2013). Since morphemes are by definition the smallest units of meaning, perceptive readers exploit their knowledge of these meaning units when visually recognizing the same word parts and mentally cross-referencing them among known words. Morphemically complex vocabulary increases as students ascend grade levels, and many of these words offer semantic clues to their inherent meanings.

> More than half of the words in English are morphologically complex. Morphologically complex words are more common in written language (and especially academic language) than in spoken language, and the

proportion of such words increases as frequency decreases. Thus, with each grade children encounter an increasing number of morphologically complex words. The majority of these have meanings that can be inferred from the meanings of their component parts. (Nagy et. al., 2006, p. 134)

2.2.1 Morphological Awareness and Memory

Recent studies incorporating college students have demonstrated positive results using morpheme knowledge to infer the meaning of unknown words (To, Tighe, and Binder, 2016; Paiman, Thai, and Yuit, 2015; Law, Wouters, and Ghesquiere, 2015; Jiang, Kuo, and Sonnenburg-Winkler, 2015). Less studied is the use of morphemes to serve as mnemonics for recalling morphologically complex vocabulary introduced as part of a curriculum. "The fact that the mental lexicon of adult readers is morphologically organized suggests that morphological knowledge may serve as a framework to efficiently store words" (Kuo and Anderson, 2006, p. 162). This is corroborated by Moats (2010) who pointed out,

> There is considerable evidence that words, both spoken and written, are remembered in relation to other words, and word meanings are not stored in our memory as isolated wholes that resemble separate entries in a dictionary. Whenever possible, we learn words in connection to others that we already know. Each word is part of a network of related meanings. One of the ways that word family networks are constructed in memory is by their morphological relationships. When one word in the family is accessed, the other words in the family are activated for possible retrieval….Related words are activated in memory when they have meaningful connections and when they share structural elements at the morpheme level, especially when spelling reveals those connections. (p. 139)

2.2.2 Morphological Families

As an instructional practice for older students, Ebbers (2008) recommended selecting academic words belonging to morphological families as a key criterion. In this study, *families* extend beyond inflectional endings (grammatical morphemes, e.g., -ed, -s, -ing) and derivations that solely change parts of speech (inform → information). Participants in this study learned roots, prefixes, and suffixes, which aimed to help them recall vocabulary introduced in the curriculum and infer the basic meaning of untaught words within the family. Ebbers suggested, "Words can be clustered in root families to promote association around a related concept. For example, the Greek combining form (or root) *chron* denotes the concept 'time' as seen in the morphological family *chronological*, *synchronize*, *chronic*, *anachronism*, and *chronometer*" (p. 95). Therefore, understanding that the root *chron* has something to do with *time* fosters a cognitive link among closely related instructed words, serving as a key to retrieve the meaning of those words later when encountered in text—while also helping to decipher morphologically related words *not* introduced in the curriculum.

Using Ebbers' five words based on *chron* as an illustration, students would be directly instructed in each of those target words, learning them while simultaneously learning the basic meaning of *chron*. Importantly, though, each token needs no further direct instruction to determine the meaning of their inflections and immediate derivations, thus incidentally adding to the learning effect. For instance, adults learning the meaning of *synchronize* would in all likelihood know synchronized, synchronizing, synchronizes, synchronization, synchronous, synchronously, synchronic, and synchronicity—especially when encountered while reading and aided by context. "This sharing of morphemes among derived words creates a vast network of word relationships, and this quality means that many of these words do not have to be learned separately" (Maag, p. 11, 2007). College students would not require explicit instruction to understand that these additional terms are simply different parts of speech, grammatical categories, or immediate associations of the same headword.

Even if a target word were not encountered often in text, the more salient word *parts* are encountered frequently in a variety of words, thus increasing exposure and the accompanying opportunity to fasten their meaning to long-term memory. Word frequencies and their related ranges are the impetus behind corpus linguistics and the rationale for the creation of various academic word lists (Gardner and Davies, 2014; Youngblood and Folse, 2017); word *part* frequency extends this concept to the morphemic level. Readers, in varying degrees, associate word parts across a range of related words. Nagy, Anderson, Schommer, Scott, and Stallman (1989) contended that the best measure of frequency is not the individual word itself, but the family or those words closely related in form and meaning:

> The word inactivity, for example, is a relatively low-frequency word, occurring less than once in a hundred million words of school text....If word recognition were determined only by the frequency of the individual word, independent of morphological relationships, this word would be accessed slowly. However, when

related words such as active, inactive, activity and activities are taken into account, the family frequency of inactivity is 10,000 times as great as the frequency of this individual member. (p. 264)

3. Method

3.1 Participants and Procedure

A convenience sample of adult students enrolled in a reading course at a four-year state college in the southeast United States was used for this experiment. Each semester was eight weeks in duration, a pretest was administered during the first day of class followed by five weeks of instruction, and a posttest was administered one week after the completion of the final exam. A post-posttest was then administered to available students on average five and a half months later. The instructor, test instrument, and all materials were the same throughout the 14, 8-week semesters totaling 27 sections of instruction.

3.2 Test Instrument

The pre/posttest instrument consisted of a two-sided sheet totaling 40 questions. The first side had 10 roots followed by 10 prefixes, and both parts used samples taken from the workbook—two roots and two prefixes from each of the five units. The reverse side had twenty vocabulary items—four items from each of the five units. An attempt was made to minimize the inclusion of word parts on one side that made up vocabulary items on the reverse side; otherwise, astute test-takers might cross-reference the two to derive the meaning from either.

Word grade-level, hence relative difficulty, was determined by referencing The Living Word Vocabulary (Dale & O'Rourke, 1976), which yielded an average grade of 13.2 (Table 1). On all sections of the multiple-choice test, the stem was simply the word part or vocabulary item, while the four responses displayed the distracters and correct answer in the form of single words or brief phrases. To minimize guessing and resultant score inflation inherent in multiple-choice test formats, students were given explicit instructions before the administration of each of the tests. If they knew the word part or word, answer accordingly, but if not, simply move on to the next item. They were told that if two or more items from either of the word part sections, or if three or more of the items from the vocabulary section were marked by the student but found to be incorrect, the test would be deemed invalid and results purged. Approximately 4% of the tests from the entire dataset had to be purged due to students either incorrectly following instructions or from meeting the specified elimination criteria.

Table 1. Word difficulty level (test instrument)

Grade Level Equivalent	Number of Words
8	2
10	1
12	4
13	6
16	7
13.2	20

Standard Deviation: 2.5

To obtain a general feel for the guessing effect, a total of twenty students from two sections (ten each) took the pretest per instructions, but were then asked at the conclusion of the pretest to take the test once again. This time they were allowed to guess. I explained to them that the intention was to see the impact of guessing and that I would share the results with them. For the sake of brevity, I report here solely the grand total results. On the pretest, the overall score without guessing was 19.75%; these results became part of the complete dataset used for this study. When students guessed, the overall score more than doubled to 43.83%.

Finally, demographic data were collected at the onset of the test administration. Included were age, gender, and student self-report on the perceived degree of prior knowledge of roots and affixes. A Likert scale ranging from 0 to 4, ascending in proficiency, documented word part proficiency.

3.3 Course Workbook

An original workbook was created that explained each of the weekly word parts and vocabulary derived from those parts; this booklet served as the principal means of instruction. Each unit opened with approximately a dozen word parts and their definitions atop the page, categorized as either a root, prefix, or suffix. Immediately below was a word

generation actively whereby students wrote down whatever words came to their mind based on the morpheme heading each row. For example, for the root *anim*, students might write down animal, animated, animation. They would then analyze their personal word selections based on the meaning of the word part as defined in the workbook. Thus, for *anim*, "mind, soul, spirit," students may deduce that an "animal is something which possess a mind, soul…" as distinct from plants, which are alive and 'breathe' but do not possess a mind. This activity afforded students with an opportunity to connect existing knowledge with new knowledge.

After word generation, each of the word parts is taught in turn with emphasis on how the morpheme plays a key role in understanding specific vocabulary items introduced as part of the curriculum. Students are then responsible to know those words, along with the selected word parts that comprise them. One paragraph discussing solely the root *anim* would lead to, in this case, seven distinct words students were responsible to learn. Words were seldom of an immediate family, but were close in relation based on the mnemonic aid of the morpheme (e.g., animation, unanimous, animism, inanimate…). Each of the target words was then used in a sentence for students to read and understand them in context. A section at the end of each unit entitled, "Add to what you know" provided students with an opportunity to extend what they just learned to novel tasks, and a section completing the instructional component of the unit, "Above and beyond," afforded students with an opportunity to apply critical thinking skills.

The unit ended with a vocabulary review in the form of sentence completion. Student responses to this homework assignment were later reviewed in class, which allowed the instructor to elaborate and draw students' attention to morphological and semantic relationships. A follow-up homework assignment entailed a crossword puzzle—included in the workbook—that covered a mixture of word parts and vocabulary from the unit. At the end of each week students took a unit quiz. Papers were swapped and items were immediately graded. This allowed for further time on task and for a critical teaching moment while the material was fresh in the students' minds.

Beginning with the second quiz, each of the remaining unit quizzes had a review section comprising a sample of words and word parts from previous units to allow for multiple retrievals and employ distributed practice. Since students never knew which items would be used in the review, they were encouraged to go over all preceding units. Each quiz, except the first, had 50 questions. At the conclusion of five weeks of instruction, students had covered 29 prefixes, 20 suffixes, and 35 roots, which together, produced over 150 distinct words they were required to learn, not including inflections or subtle derivations that merely change the part of speech. As illustrated in the earlier example using *chron* and *synchronize*, the 150 directly instructed words have a multiplying effect whereby students could cognitively access many closely related words without having to cover them in class. Shortly after the completion of the final unit test, an overall review was given in the form of a Jeopardy game. This provided an engaging way to prepare students for the 200 item comprehensive multiple-choice final exam. This additional time on task allowed for further retrievals to strengthen memory links, an important pedagogical factor (Folse, 1999; Joe, 2010). During the final week of the semester, an 'unexpected' posttest was administered to the students.

4. Results

4.1 Overall Data

Gain scores on all portions of the test instrument demonstrated robust improvement from pretest to posttest (Table 2). Since guessing was virtually nullified, results closely represent the students' true knowledge on each section of the assessment.

Table 2. Pretest/Posttest comparisons - all participants (n = 360)

Test Sequence	Word Parts			Vocabulary	Overall	Time
	Roots	*Prefixes*	*Average*			
Pretest	20.31	36.40	28.40	12.85	20.63	
Posttest	90.46	88.83	89.65	76.31	82.98	7.0 weeks

Looking at the word part *averages* from pretest to posttest (28.40 vs. 89.65), students demonstrated near mastery of the morphemes by the end of the semester. In comparison, the vocabulary posttest score was notably lower. However, improvement from pretest to posttest was far greater on the vocabulary section of the test. The pre/post gains on word parts roughly tripled, while the vocabulary increase was nearly six fold.

4.1.1 Overall: Long-Term

Results from the long-term posttest revealed that students lost very little retention over the intervening months (Table 3). Studies incorporating long-term posttests seldom span more than several weeks, but here we see strong retention

nearly half a year later. Of course, no controls were in place after the conclusion of the semester; hence, the extent of variance attributed solely to the mnemonic value of morphemes is unaccounted for. Notwithstanding, students' scores from the original posttest to the long-term posttest revealed that the intervening time did not impede their retention.

Table 3. Long-term participants only (n = 68)

Test Sequence	Word Parts			Vocabulary	Overall	Time
	Roots	Prefixes	Average			
Pretest	20.59	41.47	31.03	14.85	22.94	
Posttest	92.06	92.06	92.06	82.00	87.03	7.0 weeks
Long Term Post	85.74	84.85	85.29	75.22	80.26	5.44 mos.[1]

[1]*Average time from original posttest to long-term posttest.*

4.2 Gender

Women on average entered the semester with slightly more knowledge of prefixes and vocabulary than their male classmates (Table 4). When recall was assessed at the end of the semester, a knowledge-gap between the genders was now evident on the word part section, and differences in vocabulary retention were significant. Demographics were fairly uniform when comparing median age, age range, and previous study of word parts.

Table 4. Gender; n = 360 (male 138; female 222)

Test Sequence (Gender)	Word Parts			Vocabulary	Overall	Time
	Roots	Prefixes	Average			
Pretest (male)[1]	20.58	35.00	27.79	12.25	20.02	
Pretest (female)[2]	20.14	37.34	28.78	13.22	21.00	
Posttest (male)	86.67	84.78	85.72	70.25	78.00	7.0 weeks
Posttest (female)	92.82	91.35	92.08	80.07	86.08	7.0 weeks

[1]*Avg. (Med.) age = 23.0 (20) yrs.; Range = 17-52 yrs.; avg. previous root/affix study (0 – 4) = 1.46*

[2]*Avg. (Med.) age = 24.2 (20) yrs.; Range = 17-64 yrs.; avg. previous root/affix study (0 – 4) = 1.45*

Comparing long-term posttest results based on gender (Table 5), displayed a measure of decline over time, as expected, yet losses were not significant. Time did not appear to serve as a strong deterrent in recalling the meaning of both morphemes and vocabulary. A separation of roughly half a year between posttest administrations discounts the likelihood of test familiarity.

Table 5. Gender, long-term participants only (n = 68)

Test Sequence (Gender; no.)	Word Parts			Vocabulary	Overall	Time
	Roots	Prefixes	Average			
Pretest (male; n = 16)[1]	25.63	35.63	30.63	15.31	22.97	
Pretest (female; n = 52)[2]	19.04	43.27	31.15	14.71	22.93	
Posttest (male)	86.88	87.50	87.19	70.63	78.91	7.0 weeks
Posttest (female)	93.65	93.46	93.56	85.48	89.52	7.0 weeks
Long Term Post (male)	80.00	76.88	78.44	65.94	72.19	5.31 mos.
Long Term Post (female)	87.50	87.31	87.40	78.08	82.74	5.84 mos.

[1]*Avg. (Med.) age = 24.9 (21) yrs.; Range = 18-43 yrs.; avg. previous root/affix study (0 – 4) = 1.59*

[2]*Avg. (Med.) age = 23.4 (20) yrs.; Range = 17-48 yrs.; avg. previous root/affix study (0 – 4) = 1.47*

Men and women entered the semester with nearly identical overall scores, separated by only 4/100ths of a percent (second to last column: 22.97 M; 22.93 W). Posttest scores tell a different story. Women scored higher than men on both sections of the word part posttest, and significantly higher on the vocabulary posttest (70.1 M; 85.5 F) and long-term posttest (65.9 M; 78.1 F). Demographics would suggest that males might perform better as they have an

older mean and median age (a factor to be discussed in the next section). Their self-report on prior knowledge of word parts was higher, too, but not enough to influence results. Notwithstanding, women outperformed men on all sections of both the posttest and long-term posttest, doing so significantly on the vocabulary portion of the tests.

4.3 Age

In order to provide a roughly equal distribution among participants—particularly for the smaller sample of long-term participants—demographics were not homogeneously grouped by age. Instead, students were placed into contrived groupings. Classifications were established by general maturity levels in the following manner: 17-18 year olds can be viewed as older adolescents—those recently exiting from high schools. The next group, 19-20 year olds, would possess a maturity level slightly distinct from their younger classmates. Ages within 21-27 possess maturity and life experiences beyond the two previous groups. Finally, those 28 and above are mature adults with enhanced life experiences.

4.3.1 Pretest and Short-term Posttest

As age group increases there is not a uniform, corresponding increase in score throughout the categories. Where a distinction is noted, however, is in the most mature age group. Here, in particular, the most evident difference pertains to vocabulary mastery from pretest to posttest (Table 6).

Table 6. Age (n = 359[1])

Test	Age (n)	Word Parts			Vocabulary	Overall	Prior Know.[2]
		Roots	*Prefixes*	*Average*			
Pretest	17-18 (103)	20.19	41.17	30.68	12.57	21.63	1.85
	19-20 (111)	19.37	35.41	27.39	10.59	19.20	1.62
	21-27 (73)	19.86	31.92	25.89	10.68	18.29	1.11
	28 + (72)	22.50	35.97	29.38	18.89	24.14	0.97
Posttest	17-18	90.78	87.77	89.27	76.12	82.70	
	19-20	87.61	87.84	87.73	70.50	79.12	
	21-27	89.18	87.12	88.15	75.14	81.64	
	28 +	95.56	93.47	94.51	86.53	90.52	

[1]*Female (n = 221); Male (n = 138); missing an age demographic for one female student.*

[2]*Previous knowledge of Roots/Affixes (self-report, 0-4).*

4.3.2 Pretest, Posttest, and Long-Term Posttest

In breaking down groups by age among long-term posttest participants (Table 7), the evident limiting factor is the sample size for each of the subgroups. Sample sizes run as low as 14 participants. However, the general trend held true as the eldest group performed notably better on the vocabulary portion of all three test administrations. Distinctions that were evident in the short-term posttest became more pronounced on the long-term posttest. The eldest cohort outperformed all other groups on each section of the test, and significantly so on the vocabulary portion.

Table 7. Age, long-term participants only (n = 68[1])

Test	Age (n)	Word Parts			Vocabulary	Overall	Prior Know.[2]
		Roots	*Prefixes*	*Average*			
Pretest	17-18 (16)	17.50	46.88	32.19	12.81	22.50	2.13
	19-20 (24)	23.75	40.42	32.08	13.54	22.81	1.67
	21-27 (14)	20.71	32.86	26.79	13.93	20.36	1.36
	28 + (14)	18.57	45.71	32.14	20.36	26.25	0.64
Posttest	17-18	91.88	90.00	90.94	82.81	86.88	
	19-20	87.08	90.00	88.54	75.42	82.00	
	21-27	97.14	95.71	96.43	85.71	91.07	
	28 +	95.71	94.29	95.00	88.57	91.79	
Long-Term Posttest	17-18	85.00	84.38	84.69	72.50	78.60	
	19-20	80.42	84.17	82.29	70.00	76.15	
	21-27	90.00	82.86	86.43	76.79	81.61	
	28 +	91.43	88.57	90.00	85.71	87.86	

[1]*Female (n = 52); Male (n = 16).*

[2]*Previous knowledge of Roots/Affixes (self-report, 0-4).*

5. Discussion

This investigation sought to determine the efficacy of morphemes as mnemonic aids in facilitating short-term and long-term recall of directly instructed words as part of an adult reading program. A well-sized sample allowed for disaggregating data based on gender and age to note possible differences in gains and relative degrees of retention.

The overall positive results add support to the usefulness of direct instruction of vocabulary and their composite morphemes, with the latter used to deepen associations and facilitate recall. Gain scores across all measures increased significantly from pretest to posttest—regardless of age or gender. Additionally, a long-term posttest demonstrated that gains remained robust months after the semester ended. When isolating results based on age, it was found that older students outperformed their younger peers, with the oldest group (28 and above) performing notably better. Different outcomes were also noted when controlling for gender. Women outperformed men in short-term recall and long-term retention, particularly with regard to vocabulary in contrast with specific morphemes.

Students entered the semester knowing almost twice as many prefixes as roots. The ubiquity of prefixes and their initial position in words make them readily available for recall, whereas roots tend to be embedded within words and can be less transparent. Interestingly, on the posttest students performed slightly better on the root section relative to the prefix section, though a near ceiling effect prohibits any differences from being meaningful. Vocabulary scores were lower than word part scores on both the short-term and long-term posttests. This is understandable because for each word accessed once, its word part is accessed five to seven times more often across a range of words, allowing for better recall of the ubiquitous word parts in comparison to the words themselves. On average students correctly knew between two and three of the twenty vocabulary items on the pretest. This suggests that the items were a good stretch for them and sufficiently difficult.

Regarding results based on age, it might be expected that greater life experiences, thus enhanced schemata, would be evinced by greater scores on the pretest, which was borne out on the vocabulary portions of Tables 6 and 7. Additionally, the oldest students significantly outperformed each of the younger age groups on the vocabulary portion of the posttest, and performed better than all age groups on *all measures* of the long-term posttest. Factors related to maturity that could enhance older students' results would include study habits; another could be their more highly developed schemata. Richer background knowledge and potentially expanded life experiences would afford more

'pegs' with which to reference and summon recall, post instruction. On a different issue of interest, students' self-report on their degree of previous word part knowledge decreased with each successive age group. This may suggest that high schools either introduced, or increased, word part study as part of their curriculum in recent years.

6. Implications

6.1 Classroom Considerations

Having noted the advantages that gender (female) and age (mature, 28+) played in facilitating the recall of morphemes and their associated vocabulary, how might we leverage this knowledge in practice? For one, instructors can be intentional when putting students together for vocabulary assignments. Pair work and small groups offer ways to bolster student engagement and provide a change of pace in the classroom. Instructors can pair or form groups ensuring that there is a mixture based on age and/or gender. For example, pair or group older students with younger classmates; likewise, females—regardless of age—can be paired or grouped with the younger males in class. Similarly, with technology ever expanding its influence in the classroom, pairs or teams using their electronic devices in competitive online games could also follow this principle. Should instructors incorporate peer tutoring, assigning pairs in light of gender and age can help determine who to pair with whom. Furthermore, in-class discussion affords students an opportunity to share what works for them; thus, eliciting testimony from females and older students of either gender gives these students an opportunity to provide helpful insights to their peers.

6.2 Investigate Causation

This study presented evidence of superior recall (posttest) and retention (long-term posttest) exhibited by women over men. What has not been addressed, nor was it the purpose of this study, was causation. *Why* do women appear to have this advantage even though both genders began the semester with near identical pretest scores? Such an investigation might take on an ethnographic approach, and for more quantifiable insights, brain research and the cognitive sciences may make greater inroads into causality. Alternately, how might practitioners design action-research to study potential variables associated with causation? To expand on this present research, future investigations will want to use tighter controls, and ideally, incorporate a random sample.

6.3 Comparative Analyses

Other vocabulary acquisition strategies might be quantified and compared with this study to determine the pros and cons among the varying interventions. Word lists derived from various corpora are finding their application in higher education, but there appears to be a dearth of evidence pertaining to the effect of this approach with regard to recall. Furthermore, the studies become fewer when the investigation shifts to long-term retention. Having noted the gain scores and long-term retention effects of morphemes and their vocabulary, how might the strategy used in this investigation fare in comparison to the use of word lists? Studies should consider including a long-term posttest to measure the degree of retention over time, and to disaggregate the data to examine results based on age, gender, and/or other demographic variables of interest.

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