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Semantic-related Word Root Sets: To Work, or Not to Work

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***Abstract*—The study investigates whether semantic-related word root sets, such as *-graph-* & *-scrib-*, meaning *to write*, assist learning and analysis of morphological complex academic words in the EFL middle high setting. Two intact classes of 88 EFL learners (L1: Mandarin) were treated with two varied word lists grouped under semantic-related word root sets vs. alphabetical-ordered ones individually. Learning gains were measured on two levels of sensitivity, including two form recognition tests (target words and new words) and one form recall test. Although the effect of semantic-related word root sets seems negative on the form recall test, semantic-related word root sets may assist learners with the form recognition of new words. The study provides specific information to researchers, education practitioners and publishers fascinated with form-focused morphological awareness vocabulary instruction.**

***Index Terms*—semantic sets, morphological awareness, morphological analysis, English word roots**

I. Introduction

Presenting vocabulary based on the interrelated semantic networks of associations in the mental lexicon is under considerable debate due to the interference and competition that might occur in the learning process (e.g., Gairns & Redman, 1986; Laufer, 1990) while using instruction on morpheme analysis to assist learners to reflect on and manipulate morphological structure of complex words has proven to be one of the most efficient ways of vocabulary learning (e.g., Hashemi & Aziznezhad, 2011; McCutchen & Logan, 2011; Nagy & Anderson, 1984; Scott & Nagy, 1997; Zhang & Koda, 2012). The inquiry comes up as to whether presenting morphological complex academic words using semantic word root sets such as *-graph-* & *-scrib-*, meaning *to write* can assist the learning and analysis of morphological complex academic words. In particular, the focus is on EFL learners' initial instruction on analyses of morphemes.

II. Literature Review

A. Lexicon Development

The process that children develop L1 word meanings differs greatly from that of adults acquiring L2 word meanings (Aitchison, 1994; Bousfield, 1953). A child acquires an L1 word meaning through cognitive mature biologically, undergoing three stages: *labeling*, *packaging* and *network building* (Aitchison, 1994, pp. 170-180). Through these stages, children associate a word form with a particular real world object or event, look for clusters of properties under a word, and then fit the word into an interrelated network of associations comprising numerous nodes and links. Each node represents a lexical item with a set of lexical information to distinguish it from or associate it with other nodes around a number of meaning areas. The size of the networks increases as a number of nodes are linked in meaningful ways (Gairns & Redman, 1986; Ma, 2009; Stevick, 1976).

Yet, the way adults/ESL/EFL acquire a L2 word meaning is a reconstruction process of their L1 conceptual system through three tasks, including "*lexical association*", "*L1 lemma mediation stage*", and "*the integration stage*", where a L2 word form is connected with an existing meaning in the mind, normally a L1 translation, then registered in the lexical entry through sufficient retrievals, and finally integrated all the lemma and the lexeme information into the lexical entry for retrieving automatically (Jiang, 2000, pp. 51-53). Apparently, the whole process is no easy task and suggests a long time and great effort when acquiring a new language.

B. Semantic Sets

Based on the processes of lexicon development mentioned above, our L1 mental lexicon is highly organized and efficient (Gairns & Redman, 1986). The organized nature of vocabulary in the mind seems to allow language learners to facilitate and speed up the learning process by grouping and presenting vocabulary in semantic sets and clusters (Gairns & Redman, 1986; Laufer, 1990; Rumelhart, 1984; Seal, 1991). However, for L2 and ESL/EFL learners, presenting semantic-related words may take a risk of confusing learners with the similarity among words, especially at the initial stage of word learning in formal educational settings, where authentic L2 exposure is limited, let alone the building of the interrelated lexical networks for new L2 lexical items to attach and retrieve autonomously (Al-Jabri, 2005).

Hence, the effectiveness of semantic sets and associations on vocabulary acquisition is under consistent debate. Several theories were in justification of facilitating vocabulary acquisition using semantic sets, including *Field theory* (Lehrer, 1974), further divided into 12 types of semantic relations such as *topics*, *activities*, *similar meaning*, and *word families* (Gairns & Redman, 1986), the *semantic fields*, also known as *lexical sets* (Stevick, 1976), *schema theory* (Rumelhart, 1984), and *clustering model* (Solso, 1998). These theories explain the process of how new words are best learned through their associations with known words due to the human nature that tends to add and adjust new information to the existing interrelated network of associations, known as conceptual fields and schemata.

In sharp contrast, the *Interference Theory* (McGeoch, 1942), explaining why people remember or forget information, contended that presenting vocabulary items grouped in semantic clusters may create two-way competition among words within the same category, called *retroactive* interference and *proactive* interference. *Retroactive* interference occurs when newly-learned information inhibits previously-learned information, while *proactive* interference appears when previously-learned information disrupts the learning or the recall of subsequent information. In like manner, the *Distinctiveness Hypothesis* (Waring, 1997) proposed that unique and distinct information is easier to remember or retrieve than non-distinct one. Moreover, a number of recent experimental research have also suggested the negative effect on presenting and learning words semantically grouped, especially in the initial stage of word learning (e.g., Bolger & Zapata, 2011; Erten & Tekin, 2008; Finkbeiner & Nicol, 2003; Higa, 1963; Khoii & Sharififar, 2013; Nation, 1990, 2000 & 2001).

Consequently, the study assumes that, based on previous year-long English learning experience, largely starting from age 9 or even younger, Taiwanese middle high school EFLs may have built the interrelated lexicon networks of English language in the mind, where a number of words are linked in meaningful ways. Thus, presenting morphological complex academic English words organized under semantic-related word root sets may help anchor those words to the existing organized mental lexicon, where words can be memorized and retrieved with more ease and efficiency. However, it is also likely that the similarity among those morphological complex academic words, carrying semantic-related word root sets, would cause competition and interference and confuse the majority of the EFLs.

Additionally, concerning the competition and interference among words, the present study, expanding current two ways of interference, known as *proactive* and *retroactive* interferences (McGeoch, 1942), suggested a new type of interference called *coactive* interference by the researcher herself to emphasize and explain the type of interference that occurs when all newly-learned words competes and interferes *simultaneously* with one another to cause competition and confusion, leading to a detrimental effect on the learners' ways of absorbing and retaining new words.

C. Lexical Inferencing Ability and Morphological Awareness Instruction

The term lexical inferencing refers to the use both morphological and contextual clues available in words to unlock and infer the meaning of unknown words (Haastrup, 1991; Wysocki & Jenkins, 1987; Zhang & Koda, 2012). Morphological clues focus on analyzing the parts of the target word such as roots and affixes to derive the meanings of unknown words, while contextual clues refer to guess the meaning of unknown words according to its surrounding co-text (Haastrup, 1991; Wysocki & Jenkins, 1987). According to Eskey (1988), using morphological clues by analyzing roots and affixes to derive the meanings of unknown words can better provide learners of varied English proficiency with a certain degree of help, especially less proficient ones, while context clues may be of help for more skillful readers who have become automatic at word decoding.

Studies on monolingual native speakers in late elementary and middle school grades have suggested morpheme analysis instruction as a useful and systematic way to expand learners' vocabulary size for school success (e.g., Anglin et al., 1993; Hashemi & Aziznezhad, 2011; McCutchen & Logan, 2011; Nagy & Anderson, 1984; Zhang & Koda, 2012). A number of morphological awareness instruction have been developed considering learners' need, and the instructional potential (e.g., frequency, appropriateness and utility) for native English learners to cope with the increasing load of new words in the school curriculum (Blachowicz et al., 2006; Helman, 2009; Nagy & Anderson, 1984; Nation & Webb, 2011; Rasinski et al., 2007), since around 60% of novel words they encounter carry transparent structures of familiar morphemes that allow them to make reasonable guesses for the word meaning. A more recent study (McCutchen & Logan, 2011), examining 162 native English children' lexical inferencing ability using a cross-sectional design, including two grade levels (grades five and eight) and two reading skill levels (more and less skilled), suggested that morphological awareness not only directly contribute to older learners' vocabulary growth but also indirectly support their reading comprehension. Although such contributions are not clear for younger learners, the learning of morphological constituents for lexical inference in the regular classroom to contribute to the automatic analyses of morphological structure for future vocabulary learning was highly recommended.

In the EFL context, specific factors that may affect learners' ability to recognize English morphemes, such as learners' native language, L2 language proficiency level, and cognitive maturity, have been examined (Hancin-Bhatt & Nagy, 1994; Jiménez et al., 1996; Nagy et al., 1993; Zhang & Koda, 2013). More recently, some positive relations were found between morphological awareness training and learners' lexical inferencing ability. Zhang and Koda (2012) suggest a better word-root identification and lexical meaning inferencing ability through advanced learners' insights into morphological structure. Another study (Prior et al., 2014) also finds basic word decoding skills as the predictor of learners' ability at inferring the meaning of novel words embedded in text.

With the mindset to explore more of the potential of semantic sets in assisting the learning and analysis of

morphological complex words in the EFL middle high setting, the research question was generated as follows: *Does the use of semantic-related word root sets create statistically significant differences comparing with that of alphabetic-ordered word root sets among EFL middle high school learners in varied morphological awareness related vocabulary learning tasks?*

III. Method

A. Design and Participants

The present research is a quasi-experimental study. The experimental variable is specifically designed instructional materials assigned to two treatment groups. The dependent variables are three criterion tests, including the word root knowledge test, the word spelling test, and the lexical inferencing ability test.

Two intact classes of 88 Chinese-speaking eleventh graders from a typical vocational high school in southern Taiwan participated in the experiment for one semester. One of the classes employed the instructional material organized in alphabetical-ordered word-root sets (AG) (N = 39) while the other used the one grouped in semantically-related word-root sets (SG) (N = 49). The design of randomly selecting participants from a typical school allows the induction of the findings. Threats to validity due to the lack of random assignment were reduced by administering SPSS to adjust the results of the criterion measures showing non-significant statistic differences in the dependent variable of interest (Shadish at al., 2002). All participants are with a range of relevant factors, including age, gender, major (International Trade), background knowledge, English proficiency, and motivation of English learning for pursuing higher education. The content of the concepts taught to both of the treatment groups was also the same since they all involve in the same English course hours, use the same English text edition and are instructed by the same instructor, the researcher herself.

B. Instruments

Two types of instruments are utilized in the present study: The instructional materials and three criterion tests, including the word-root knowledge test, the word spelling test, and the lexical inferencing ability test.

The instructional materials

When it comes to the teaching of semantic sets, the most difficult part of the instruction is developing the semantic sets of word list (Marzano & Marzano, 1988; Rasinski et al., 2007). In the present study, two word lists were constructed as the instructional materials employed to set learning goals and guide the design of all the tests to evaluate the effect of two types of inputs – the target academic words organized under both semantically-related and alphabetically-ordered word-root sets (Appendix). Both of the inputs included exactly the same content and number of words. The only difference was the way of grouping the words. All the target words selected were under strict verification concerning the etymology of words by consulting several etymology dictionaries (Ayto, 1990; Harper, 2001; Shipley, 1969) and numerous resources.

Although several previous studies (Bolger & Zapata, 2011; Finkbeiner & Nicol, 2003; Tinkham, 1993, 1997; Waring, 1997) suggested non-existent words to rigorously control over the meaningfulness of the word forms to increase the internal validity, it is, as Helman (2009) mentioned, difficult to generalize the findings to real languages since non-existent words differ from those in natural languages. Furthermore, according to Nation and Webb (2011), the higher frequency the words are, the better chance the words will be met with, and the time involved in learning high-frequency words will get better repaid. For Taiwanese middle high EFLs, who learn English mostly for the preparation for the college entrance exam, the words to be learned in the present study were built by counting the frequency of various words appearing in English subject in the Joint Technological College Entrance Exam (JTCEE) (2002-2012), which is the most crucial exam that every vocational high student in Taiwan must take to apply for higher education.

The three criterion tests

1. The word root knowledge test (RT)

In the present study, the word root knowledge test (*Cronbach's alpha* =. 848) was served as the pretest and the immediate posttest, conducted in the week before and right after the treatments to determine what had been gained from the treatments. The format of the test is a researcher-designed multiple-choice test consisting of 24 items with five options each. The design was based on previous studies, suggesting that the decontextualized receptive test may be better to test the students who have not yet had much exposure to the new language (Kirby et al., 2012; Read, 2004; Schmitt, 1994). The total number of the items tested was decided based on the total number of the target word roots in the instructional materials. Each tested item was composed of a single target word without context, simply requiring testees to choose the most appropriate Chinese definition from the five options and write down the word root of the target word tested. Moreover, Chinese test instructions were used to minimize the potential confound of students' decoding ability on their performance (Nation & Webb, 2011). Additionally, the 24 items in the word root knowledge test were arranged according to their level of difficulty to assist the testees to complete the test with more confidence. Furthermore, the five options were designed in a quasi-random order, with the equal frequency of the correct answer in the first four positions over the whole test, and a "I don't know the answer" option always appeared in the fifth option to discourage a wild guess. Lastly, to avoid giving clues to the right answer, the Chinese definitions for both the correct answer and distracters were all selected from the word list.

The reliability of the test was established by inviting 42 twelfth graders from an intact class to review and complete

the questions. The results were then calculated item by item. Accordingly, all 24 selected items were vetted and judged as being appropriate and effective to be included in the test. Finally, several follow-up interviews were done for minor modification of the test.

2. The word spelling test (ST)

Each week, by the end of the treatments, both groups of participants studying their word lists were tested with 12 productive word spelling tests exactly following the instructional material, included 10 target words per unit. The test was administered along the training process during the normal class hours in the regular classroom.

In each test, the teacher, firstly, provides the Chinese definition of the 10 target words taught in the previous unit one by one randomly and asks the participants to spell the whole words, and then underline the target word root within each word spelt. The estimated time for each test is around 5-8 minutes at the very first beginning of the very first course hour. The number of the target words being correctly spelt and the target word roots being correctly underlined were scored independently to provide detailed information in explicating the learning outcomes.

3. The lexical inferencing ability test (LT)

In the study, the primary concern of the lexical inferencing ability is on how learners use morphological clues to refer the meaning of unknown words. The participants' lexical inferencing ability was examined by asking them to break a novel word down into its root and affixes, analyze the novel word for word root and affixes recognized, and finally infer the meaning of the novel word based on the word root and affixes recognized (Haastrup, 1991; Wysocki & Jenkins, 1987).

The reliability of the novel words tested was built by consulting several dictionaries of the word origin and three veteran teachers, who major in English learning and teaching, to control over the meaningfulness of the word forms to make sure that the participants would have the least knowledge about the novel words selected. Then 68 twelfth graders from two intact classes were invited to review the novel words selected. Each reviewer was asked to write down the Chinese definition for each novel word. The results were then calculated word by word (*Cronbach's alpha* =. 124).

Each week, the participants were tested with 12 lexical inferencing ability tests, involving two novel multimorpheme complex words in each test. Totally 24 multimorpheme complex novel words were included in the test. The test was administered right after the word spelling test (ST) mentioned above. The estimated time for this test is around 2 minutes. In each test, the teacher provides two multimorpheme complex novel words, carrying the weekly target word roots taught in the previous unit, and then asks the participants to underline the target word root within each novel word and write down the Chinese definition of the two novel words tested. For the scores of the test, the target word roots being correctly underlined and the meaning of the novel words being correctly inferred were scored independently.

C. Treatments

After the researcher got permission from the participants and their guardians, the treatments for both groups were incorporated into the normal English class practice with a fixed format: Introduction to the weekly set of the two target word roots, explicit morphemic analysis of the 10 target words chosen, the spelling test of the target words taught in the previous unit, and the lexical inferencing ability test for 2 unknown words, carrying the target word roots taught in the previous unit. Nevertheless, the participants were not informed that it was a part of an experiment but simply a regular classroom activity for vocabulary learning to reduce the "Hawthorne effect" (Landsberger, 1955), according to which learners may vary their behavior after noticing they are part of an experiment.

IV. Results and Discussion

A. Descriptive Statistics

Name of all tests used in this study, their full scores, means, and standard deviations in the proportion of correct response of items are presented in Table 4.1. In viewing descriptive statistics of the test battery, the average mean score of word root knowledge test (RT) increases drastically in the immediate posttest (IPT) and the target word root identification (IPT/RI) for both groups. In IPT, M of SG raised from 6.55 to 15.65 and M of AG from 8.36 to 18.85. In IPT/RI, M of SG raised from 0.4 to 17.88 and M of AG raised from 0.31 to 21.18. The data indicate the benefit of direct explicit instruction to morphological awareness and academic vocabulary learning in EFL high school setting. The results comply with a good deal of previous L1 and EFL/ESL research, suggesting that appropriate regular morphological awareness instruction may foster morphological consciousness for learners of various English proficiency levels (Blachowicz & Fisher, 2000; Carlisle, 2010; Flanigan at al., 2012; Jeon, 2011; Hashemi & Aziznezhad, 2011; Kieffer & Box, 2013; Kieffer & Lesaux, 2010; Newton & Newton, 2005; Stahl, 1999; Zhang & Koda, 2013).

However, the participants' performance on inferring the correct meaning of the novel words (LT/WM) is far behind satisfactory, with a mean of .55 (SG) and .64 (AG) out of 24. Clearly, the data indicate that lexical inferencing for the meaning of novel words requires more complex actions than the conscious awareness of the morphemic structure of words (Baddeley, 1986; Carlisle, 1995; Clarke & Nation, 1980; Ku & Anderson, 2003).

TABLE 4.1
DESCRIPTIVE STATISTICS OF THE SCORES OF ALL THE CRITERION TESTS IN THE STUDY

Test Name	RT (PT)	RT (PT/RI)	RT (IPT)	RT (IPT/RI)	ST (RI)	ST (WS)	LT (RI)	LT (WM)
Full Score	24	24	24	24	120	120	24	24
SG								
Total	6.55	.4	15.65	17.88	92.33	83.00	15.53	.55
SD	(3.398)	(0.200)	(4.136)	(4.772)	(19.986)	(21.278)	(5.709)	(.792)
AG								
Total	8.36	.31	18.85	21.18	103.90	99.31	12.49	.64
SD	(2.924)	(.468)	(4.699)	(4.025)	(19.889)	(21.402)	(8.476)	(.986)

Note:
RT (PT) = the word root knowledge pretest
RT (PT/RI) = the word root knowledge pretest for the target word root identification
RT (IPT) = the word root knowledge immediate posttest
RT (IPT/RI) = the word root knowledge immediate posttest for the target word root identification
ST (RI) = the word spelling test for the target word root identification
ST (WS) = the word spelling test for the target word spelling
LT (RI) = the lexical inferencing ability test for the word root identification of the novel words
LT (WM) = the lexical inferencing ability test for the meaning of the novel words

B. The Research Question

Does the use of semantic-related word root sets create statistically significant differences comparing with that of alphabetic-ordered word root sets among EFL middle high learners in varied morphological awareness related vocabulary learning tasks?

Regarding the research question, first of all, the overall performance of SG and AG of varied treatments in the word root knowledge test is examined. Table 4.2 shows that the adjusted mean score of AG is higher than that of SG in both word root knowledge immediate posttest (IPT) (18.058 > 16.281) and the target word root identification (IPT/RI) (20.510 > 18.411). The adjusted means made by SG and AG are further analyzed by repeated measure analysis to determine which group has reached the threshold of statistical significance (Table 4.3).

TABLE 4.2
THE ADJUSTED MEAN SCORE AND STANDARD DEVIATION OF SG AND AG IN THE WORD ROOT KNOWLEDGE TEST

	Group	*N*	*Mean*	*Std. Deviation*	*Adjusted Mean*	*Std. Error*	95% Confidence Interval
RT(IPT)	SG	49	15.65	4.136	16.281	.528	[15.231,17.330]
	AG	39	18.85	4.699	18.058	.594	[16.876,19.240]
RT(IPT/RI)	SG	49	17.88	4.772	18.411	.620	[17.178,19.644]
	AG	39	21.18	4.025	20.510	.701	[19.116,21.903]

Covariates appearing in the model are evaluated at the following values: the total score of RT (PT) = 7.35.
Note:
RT (IPT) = the word root knowledge immediate posttest
RT (IPT/RI) = the word root knowledge immediate posttest for the target word root identification

TABLE 4.3
THE REPEATED MEASURES BETWEEN SG AND AG IN THE WORD ROOT KNOWLEDGE TEST

	Source	*SS*	*Df*	*MS*	*F*	*p*	η^2	Post Hoc Comparison
RT(IPT) (ANCOVA)	RT(PT)	539.260	1	539.260	40.892***	.000	.325	AG > SG
	Group	63.455	1	63.455	4.812*	.031	.054	
	Error	1120.919	85	13.187				
	Total	27518.000	88					
RT(IPT/RI) (ANCOVA)	RT(IPT/RI)	207.742	1	207.742	11.762**	.001	.122	AG > SG
	Group	83.112	1	83.112	4.706*	.033	.052	
	Error	1501.267	85	17.662				
	Total	34864.000	88					

n.s. $p > .05$ *$p < .05$ **$p < .01$ ***$p < .001$
Note:
RT (PT) = the word root knowledge pretest
RT (IPT) = the word root knowledge immediate posttest
RT (IPT/RI) = the word root knowledge immediate posttest for the target word root identification

The data in Table 4.3 suggest that after varied treatments, the AG participants score higher than SG participants in the word root knowledge immediate posttest and the target word root identification ($F = 4.812$, $p = .031 < .05$, $\eta^2 = .054$ and $F = 4.706$, $p = .033 < .05$, $\eta^2 = .052$, respectively). The data indicate that presenting a list of morphological complex academic words categorized under semantic-related word root sets may impede rather than facilitate word root and morphological complex academic word learning. In other words, the performances of SG and AG reported by repeated measure analysis suggest that grouping and presenting morphological complex academic words carrying word root sets with synonyms and similar meaning may lead to a detrimental effect on learning.

The outcomes contradict the organized nature of the mental lexicon, *Semantic Field Theory*, *Schema Theory and*

Clustering Model, suggesting that words in the mind are highly organized and efficient with interrelated networks of lexical nodes, where semantically related items are stored and recalled together. Thus, grouping vocabulary in semantic sets allows language learners and users to facilitate learning process with the help of the highly organized mental lexicon (Brown & Perry, 1991; Channell, 1981; Craik & Lockhart, 1972; Freedman & Loftus, 1971; Gairns & Redman, 1986; Laufer, 1990; Lehrer, 1974; Levelt, 1993; Lyons, 1977; Ma, 2009; Miller & Fellbaum, 1991; Nattinger, 1988; Rumelhart, 1984; Schmitt, 2000; Seal, 1991; Solso, 1998; Stevick, 1976; Tulving, 1962). Nevertheless, the results echo the *Interference Theory*, the *Distinctiveness Hypothesis* and a growing body of latest research, contending that when it comes to the presentation of new words, it seems unwise and ineffective to present a set of new words semantically related, since the learners need to simultaneously learn and avoid the interference caused by the similarity among those items (Bolger & Zapata, 2011; Erten & Tekin, 2008; Finkbeiner & Nicol, 2003; Henning, 1973; Higa, 1963; Khoii & Sharififar, 2013; McGeoch, 1942; Nation, 1990, 2000 & 2001; Tinkham, 1993; Waring, 1997).

The possible explanations might be, first of all, learning the word list grouped under semantically-related word root sets may require the participants with more attention and engagement and, thus, increase the burden in the mnemonic process, especially in the initial stage of word learning (Bolger & Zapata, 2011; Erten & Tekin, 2008; Finkbeiner & Nicol, 2003; Higa, 1963; Nation, 1990, 2000, 2001; Tinkham, 1993, 1997; Waring, 1997). Moreover, according to Khoii and Sharififar (2013) and Tyler et al. (1979), learners who devoted more to the learning material would lead to better learning outcomes. In the present study, the participants' performance in the word spelling test (ST) provides deeper insights into the participants' engagement in the instructional material (Table 4.4), since ST is a productive test that conducts along the treatments to require the participants to not only underline the target word roots but spell the whole target words accurately which, according to Schmitt (1994), demands more control over the language.

TABLE 4.4
THE REPEATED MEASURES BETWEEN SG AND AG IN THE WORD SPELLING TEST AND THE LEXICAL INFERENCING ABILITY TEST

	Source	*SS*	*Df*	*MS*	*F*	*p*	ω^2	Observed Power	Post Hoc Comparison
ST (RI) (ANOVA)	Between Groups	2907.453	1	2907.453	7.310**	.008	.068	.726	AG > SG
	Within Groups	34204.365	86	397.725					
	Total	37111.818	87						
ST (WS) (ANOVA)	Between Groups	5775.147	1	5775.147	12.690**	.001	.118	.941	AG > SG
	Within Groups	39138.308	86	455.097					
	Total	44913.455	87						
LT (RI) (ANOVA)	Between Groups	201.143	1	201.143	4.029*	.048	.034	.510	SG > AG
	Within Groups	4293.948	86	49.930					
	Total	4495.091	87						
LT (WM) (ANOVA)	Between Groups	.176	1	.176	.225 n.s.	.636	.009	.076	–
	Within Groups	67.097	86	.780					
	Total	67.273	87						

n.s. $p > .05$ *$p < .05$ **$p < .01$ ***$p < .001$

Note:
ST (RI) = the word spelling test for the target word root identification
ST (WS) = the word spelling test for the target word spelling
LT (RI) = the lexical inferencing ability test for the word root identification of the novel words
LT (WM) = the lexical inferencing ability test for the meaning of the novel words

Based on the data in Table 4.4, the AG participants score significantly higher than the SG participants in both ST (RI) ($F = 7.310$, $p = .008 < .01$) and ST (WS) ($F = 12.690$, $p = .001 < .01$), which indicates that the AG participants devoted more to the learning of the instructional material than the SG participants did and thus yielded better learning results. In addition, according to Laufer and Shmueli (1997), learners who work hard also tend to employ various mnemonic techniques on their own to reinforce their learning process when facing memorization tasks, which may also contribute to better learning outcomes.

Interestingly, however, the result in the lexical inferencing ability test for the word root identification of the novel words (LT/RI) overturns the results of all the other criterion tests in the study, showing that the SG participants outperformed the AG participants ($F = 4.029$, $p = .048 < .05$) (Table 4.4). It suggests that grouping and presenting morphological complex academic words with semantic-related word root sets can help middle high EFLs be more consciously aware of the morphemic structure of words and better identify the word roots within novel words.

V. CONCLUSIONS

Although the data suggest negative effects on semantic-related word root sets for morphological related vocabulary

learning tasks in the present study, positive statistical results for explicit morphological awareness instruction were found among middle high EFL learners in word root awareness and morphological complex academic vocabulary learning. Moreover, it is worth mentioning that grouping and presenting morphological complex academic words with semantic-related word root sets helps middle high EFLs better identify the target word roots within novel words. Furthermore, the study expands two-way interference (McGeoch, 1942), known as *retroactive* and *proactive* interferences, by proposing a new type of interference, named *coactive* interference, to refer to the type of interference that occurs when all newly-learned information competes and interferes *simultaneously* with one another, leading to detrimental effects on the learning process. Additionally, the study provides deeper insights into the degree of learners' active involvement in the learning process by collecting the data of the participants' weekly performance to get detailed information in explicating the results.

VI. Implications and Limitations

As the first of its kind, the current study opens a new area for researchers who show interest in the inquiry into morphological awareness instruction and semantic associates for vocabulary development. The present study would call for EFL teachers around the world to start with a list of carefully selected words of high frequency carrying grade-level appropriate word roots as a useful strategy for learners' vocabulary development. Introducing and analyzing core word roots intentionally and consistently as part of regular classroom instruction may assist language learners in figuring out how words in English were formed and how the meaning of those words can be connected and raise their interest in word learning. Furthermore, the results advise that participants' active involvement would greatly affect the learning results and deserve a primary consideration. Additionally, the findings provide information for textbook compilers and publishers regarding morphological analysis and vocabulary development. Still, some issues that are not yet dealt with in the study might warrant further inquiry.

First of all, a larger sample size would be desirable to get unbiased estimates of parameters for future research. Second, EFL young adults with varied English proficiency levels and across age groups could be recognized as a gap for further studies. Third, the study used English word root sets, carrying *synonyms* (Higa, 1963) and *similar meaning* (Gairns & Redman, 1986) types of relations. Various semantic associates, such as *antonyms* and *coordinates* (Higa, 1963) and *topics* and *activities* (Gairns & Redman, 1986), may well deserve for further studies. Lastly, the word root knowledge test and lexical inferencing ability measure in the present study did not show adequate reliability with the sample. More reliable measures would allow more confidence in the conclusions.

Appendix

The alphabetic-ordered word root list (excerpt)

Treatment 1 (Week 2)

act, ag = to do "做"
actually adv. 實際上地;真實地
agency n. 代理處
exactly adv. 精確地
inactive adj. 不活躍的;無生氣的
react v. 反應

cap, ceive, cept = to take, to hold "拿，握"
capable adj. 有能力的
capacity n. 容量;才能
capture v. 逮捕;捉拿
concept n. 觀念;概念
receive v. 接受;收到

Treatment 2 (Week 3)

ceed, cess = to walk "行走"
access n. 入口
ancestor n. 祖先
process v. 加工處理 n. 過程
recession n. 蕭條;萎縮
succeed v. 成功

The semantic-related word root list (excerpt)

Treatment 1 (Week 2)

cogn, gno(r) = to know "知"
diagnosis n. 診斷
ignore v. 忽視;不理睬
ignorance n. 無知;愚昧
recognize v. 認出
recognizable adj. 可辨認的

sci = to know "知"
conscious adj. 有意識的;自覺的
unconscious adj. 失去意識的
science n. 科學
scientific adj. 科學的;合乎科學的
scientist n. 科學家

Treatment 2 (Week 3)

spec(t) = to look, to see "看"
respect v./n. 尊敬
special adj. 特別的
specialize v. 使專門化;使特殊化
species n. 種類;物種
unexpectedly adv. 令人驚訝地

cogn, gno(r) = to know "知"
diagnosis n. 診斷
ignore v. 忽視;不理睬
ignorance n. 無知;愚昧
recognize v. 認出
recognizable adj. 可辨認的

vis, vid, view = to see "看"
evidence n. 證據
provide v. 提供
review v./n. 複習
revise v. 修訂
supervisor n. 監督者

Treatment 3 (Week 4)
dict, dic, dit = to say, to declare "說"
addict v. 沉溺;上癮
condition n. 條件;狀態
dedicate v. 致力於;獻身於
indicate v. 表示
prediction n. 預言

fact, fect, fic, fit = to do "做"
factor n. 因素;要素
benefit n. 好處;利益
manufacture v./n. 製造(業)
effect n. 影響(力);效應
sufficient adj. 充足的

Treatment 3 (Week 4)
dict, dic, dit = to say, to declare "說"
addict v. 沉溺;上癮
condition n. 條件;狀態
dedicate v. 致力於;獻身於
indicate v. 表示
prediction n. 預言

log, logu = to say, to speak "說"
apology n. 道歉
apologize v. 道歉
catalogue n. 目錄
dialogue n. 對話
logical adj. 符合邏輯的

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