



Learning Styles and Keyword Association Variations on Vocabulary Retention

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Authors' contributions

This work was carried out in collaboration between all authors. Author GCC designed the study, performed the statistical analysis, wrote the protocol, and wrote the first draft of the manuscript, whereas. Author CCL managed the literature searches. Both authors read and approved the final manuscript.

Research Article

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ABSTRACT

The present study investigates the effect of learning styles and keyword method associations on English vocabulary retention of EFL learners. The study addresses the following questions: a) Does learning style of EFL learners affect EFL vocabulary retention performance? b) Are words of similar suffix presented in groups better retained than those presented randomly? c) Are words with keyword associations made by teachers better retained than those made by students? d) Do various keyword associations of English words affect vocabulary retention of learners? A total of 48 intermediate EFL learners joined the study. The independent variables include group vs. rote presentation, the learning styles (using VARQ questionnaire) as well as various keyword associations (teacher-made vs. student-made), whereas dependent variables are instant and delayed vocabulary retention measures. Results indicate some keyword associations are found distinct from others, and the interactions among independent variables were also found, yet failing to find any significance on learning styles.

Keywords: Keyword method; learning style; vocabulary retention.

1. LEARNING STYLES AND KEYWORD ASSOCIATION VARIATIONS ON VOCABULARY RETENTION

How to help students acquire the optimal amount of vocabulary with the least amount of time and effort has long become the challenging task for most native and EFL teachers [1,2]. Most recognized approaches for vocabulary acquisition are focused on learners' guessing through contextual cues [3-7]. Yet, Schatz & Baldwin [8] state that contextual clues are not reliable in predicting meanings of words, and it is necessary to re-examine some of the traditional assumptions about teaching contextual clues. In 1970s, an approach based on pictorial memory, keyword method, was developed to expand vocabulary [9]. This keyword method involved two phases: first, associate the keyword (learned parts of a target word) with the target word, and then create a mental picture in which the keyword and the target word are associated. For instance, in the target word 'carta' (a Spanish word, meaning 'letter'), learners are asked to associate the first four letters of 'carta' with English word 'cart' (as the key word), and then create a mental picture: *a letter in the cart, or a letter chasing the cart*. In this way the Spanish word 'carta' is associated with English word 'letter', which may facilitate its next recall as long as the keyword 'cart' is spotted. This keyword method, has, in reality, been applied for centuries. The development of keyword method has its theoretical basis. In the framework of information processing theory, Robert Gagne [10] has indicated that successful learning relies heavily on cognitive association between what has been learned and what has yet to be learned, rather than on rote memory. In addition, combining pre-existing information in long term memory with the new information through keyword associations helps future recall; finding some element already in the mental lexicon to relate the new lexical information helps future retrieval [11]. Some researchers criticize the keyword method on grounds that it adds additional burden to the memory in that the keyword and imagery has to be created and processed in addition to the target word, which criticism conflicts with the fact that words to be learned are encoded with the help of different memory traces (e.g., the keyword itself, imagery and pronunciation) with the keyword method, and When retrieval is needed, this process is reversed and the word found [12].

Many latest studies have also proved effectiveness of the keyword method [13-18], though this method is anything but a panacea since there are many other factors (e.g. different thinking styles), as indicated by Rose [19], involved in the whole process of recall. Inconsistencies of studies on the effect of instant versus delayed memory of keyword method were found; positive effect of keyword method on both instant and delayed memory situations was found in Merry's study [20], whereas negative evidence was found in studies by Wang, Thomas, and Ouelette [21]. Another problem comes from the application of keyword method in the case of EFL Chinese learners, since between any two different languages (L1 and L2), there are shared and separate language stores, with both stores interdependent on the phonological and morphological levels [22]. This implies the possibility of adopting either phonemes or morphemes of a target word when applying keyword associations (especially for EFL Chinese learners of English). Thus, to explore these two types of associations in consideration of different learning styles is necessary. The first question of the present study is: Do learners of different learning styles (e.g., auditory, visual, kinesthetic, and reading/writing) benefit differently from various keyword associations (e.g., phonemic-morphemic)?

Besides, as Morgan, Meier, and Newport [23] indicated, learning can be most successful if language input consists of grouped and structured input; that is, words to be learned can be made easier if presented or arranged according to their similar structures (e.g. same word

suffix) when applying keyword method through either the phonological or the morphological associations. Morgan, Meier, and Newport's contention corresponds to that of Miller's [24] observations concerning limited short term memory capacity. Miller suggested that the short term memory cannot process more than 7 ± 2 single items of information, and one way to increase this limited capacity is through chunking, i.e. grouping information. In this regard, words to be grouped together in terms of similar structures (such as common suffix) helps reduced the load in short term memory. The second question of the present study is: Are words of with similar suffix presented in groups better retained than those presented randomly?

Further, Craik & Lockhart [25] assumed, in their 'Levels of processing model', three qualitatively different levels of processing. That is, the lowest level is that of sensory processing at reception, the intermediate level consists of phonological (acoustic structure) processing, and the third, semantic processing. They suggested that the 'depth' at which information is processed determines its long-term retention, which implies, in the situation of keyword associations, better retention can be expected if stimulus information is presented or processed actively by the learners (e.g., keyword associations made by the students). Such a contention also parallels to the self reference effect that learners have the tendency to remember something better when they can relate it to themselves [26]. Yet there are inconclusive results in the studies of the issue of teacher vs. learner-generated keywords. Hall et al. [27] found provided keywords better than self-generated ones. Other equally inconclusive results can be found in subsequent studies [28-30]. The inconsistency can be partly attributed to the fact that necessary conditions in these studies were not kept in equal quality (such as degree concreteness, and vividness, etc.). One way to solve the problem is to create a repeated measure design in which both teacher and learner-generated keywords can be experienced by the same participant. Thus, the third question of the present study is: Are words with keyword associations made by teachers better retained than those made by students?

The *keyword method* is probably one of the most researched strategies for vocabulary learning. Most studies have compared the keyword method with other learning strategies such as learning in context, or learning by without taking students' individual differences (such as learning styles), and various types of keyword associations (such as phonemic, and morphemic) into account. People tend to have their own particular ways of processing and learning new information; that is, individual differences are involved in learning. Learner differences can be classified under three different areas: learning styles, learning strategies, and affective variables [31]. Learning styles should be closely related to keyword associations in that imagery (visual) and pronunciation (auditory) are deeply ingrained in the mental links. Among the four learning styles (auditory, visual, kinesthetic, and reading/writing), auditory and visual learning styles have much to do with the processing of phonemic (pronunciation) and morphemic (spellings) aspects of the keyword in the target word. One can always create two different mental links (one based on pronunciation, the other on spelling) on the same target word. For example, the target word 'Armageddon,' can be phonemically associated as 'Arma-' sounding like "A-ma," grandmother, in Taiwanese; 'geddon-' sounding like Gya-dio, being scarred, in Taiwanese; thus, *the grandmother is scarred when in Armageddon*. It can also be morphemically associated as 'Arm + aged + don(e)'; thus, *when Armageddon comes, one's aged arms will be done away with*. It will be practical in terms of vocabulary teaching and learning to explore whether these two different kinds of keyword associations make any differences in general and whether students of different learning styles (auditory or visual) will be affected by these two different keyword associations in specific, since no other studies have taken such combinations into account.

In the present study, an experiment is designed to test the effects of different keyword associations (i.e., phonemic and morphemic,) processing of keyword associations (teacher-made and student-made,) and presentation of words to be learned (grouping and without grouping) on instant and delayed recalls of vocabulary retention measures for students of different learning styles (auditory, visual, kinesthetic, and reading/writing).

In keyword associations, learners create mental links between the meanings of what is learned (the keyword) and that of the target word. There are roughly three different kinds of key words for EFL learners (as in this study): phonemic, morphemic, and rote (PMR) associations by nature.

For phonemic associations, learners create mental links between the meaning of the pronunciation of the keyword and that of the target word. For example, the target word 'sycophant' (as in word group 2) pronounced /si, ko, fant/, the Mandarin sound correspondents being /si-, meaning 'suck' in Mandarin; ko-, meaning 'mouth' in Mandarin; fant, meaning 'excrement' in Mandarin,/ the mental link: *to suck the excrement in one's mouth, a typical 'sycophant.'*

Next, for morphemic associations, learners create mental links between the meaning of the spellings (morphemes) of the keyword and that of the target word. For example, the target word 'tallow (as in word group 1)', spelled /tall + ow/, with the keyword being 'tall', a mental link between the meaning of 'tall' and that of 'fat', the meaning of the target word being: *a 'tall' animal has a lot of 'fat.'* As to the rote associations (as in word group 5 and 7), students will have to learn the words simply through rote memory without either phonemic or morphemic association.

The keyword methods by either phonemic or morphemic associations can also be classified into two conditions (TS): teacher-made, and student-made. That is keyword associations made by the teachers (as in word group 1, 2, 6, and 8), or by students themselves (as in word group 3, 4, 9, and 10.) On the other hand, all the words in different word groups can be presented in terms of either grouping (G), with similar word suffix (as in word group 1, 2, 3, 4, and 5) , or randomizing (R), without similar word suffix (as in word group 6, 7, 8, 9, and 10.)

The combinations of PMR, TS, and GR can be summarized below (See the Appendix 1 for the seven words of each group):

- Group 1: Morphemic keyword associations (Teacher-made)/ Group;
- Group 2: Phonemic keyword associations (Teacher-made)/ Group
- Group 3: Morphemic keyword associations (Student-made)/ Group;
- Group 4: Phonemic keyword associations (Student-made)/ Group
- Group 5: Rote Memory/ Group
- Group 6: Morphemic keyword associations (Teacher-made)/ Random;
- Group 7: Rote Memory/ Random;
- Group 8: Phonemic keyword associations (Teacher-made)/ Random
- Group 9: Phonemic keyword associations (Student-made)/ Random
- Group 10: Morphemic keyword associations (Student-made)/ Random

The contentions of the present study are manifolds. Firstly, our main concern is the interactions between different learning styles and different keyword association methods. It is predicted that students of auditory learners will prefer the phonemic keyword associations

since they are more sensitive to phonemic cues, thus performing better on such words as presented or processed by such associations, and that students of visual learners will prefer the morphemic keyword associations as they are more sensitive to morphemic cues, thus performing better on words presented by such associations.

As to students of kinesthetic and reading/writing learners, no predictions can be made at the present stage when the logical connections are yet to be established, and thus not the focus of the study.

Secondly, on PMR in repeated measure variables, it can be predicted that students will recall better on the words processed through either phonemic or morphemic keyword associations than on those without associations of any kind (words to be learned through rote memory) on the basis of the contention held by most cognitive psychologists such as Gagne (1978).

Next, on TS, it is also our assumption that words presented with keyword associations made by the students will be recalled better, which is based on the contention of the theory of deep processing, as propounded by Craik and Lockhart (1972).

Last, on GR, it is predicted that words presented in groups (with similar suffix) will be better recalled than those presented randomly without similar suffix, which corresponds to the theory by Morgan, Meier, and Newport (1987) in that similar suffix of words could offer a useful cue during recall of these words. In order to consolidate either Merry's study (1980), both instant and delayed (2 weeks after the experiment) measures were given, and both multiple choice as well as blank filling formats in these two measures were used.

2. METHOD

The independent variables in the present study include four learning styles, and various keyword association presentations, whereas the dependent measures were the first measure (given right after the instruction and learning sessions) and the second measure (given two weeks after the experiment) of a 60-item vocabulary retention test, as well as the learning styles measure through The VARK Questionnaire).

3. PARTICIPANTS

A total of 50 students (35 females, 15 males) enrolled in an intermediate- advanced level reading course offered at a university in Taiwan. Prior to the experiment, these 50 subjects were assigned to different learning style groups on the basis of their results of the VARK Questionnaire, with 23 students in Auditory learning style group, 17 in Visual learning style, 5 in Kinesthetic style, and 3 in Reading/writing style. There were two missing data, so there were totally 48 students joining the experiment. Since The VARK Questionnaire is a preference measure, the number of Kinesthetic and Reading/writing style learners is much smaller as compared with that of Auditory and Visual learners. Thus, the study adopted a repeated measure design to, first of all, cope with the insufficient number of certain groups (i.e., kinesthetic and reading/writing), and to reduce the carryover effect of the treatment variables (e.g., keyword associations).

4. MATERIALS

The vocabulary (70 words in total) used for instruction is selected from The American Heritage College dictionary (3rd edition) (1993). These 70 words were divided into 10 groups (with each 7 words) according to following categories:

1. phonemic, morphemic, and rote (PMR) keyword associations
2. teacher-made and student-made (TS) keyword associations
3. grouping and randomizing (GR) of word suffix.

The combinations of these categories and the 7 words of each group are listed in the Appendix 1.

The VARK (auditory, visual, kinesthetic, and reading/writing) Questionnaire was originally developed by Neil Fleming [32], which is a questionnaire that provides users with a profile of their learning preferences. These preferences are about the ways that they want to take-in and give-out information. 'VARK' is about one preference, our preference for taking in and putting out information in a learning context'. There are a total of 13 questions with each four optional statements, each of which reflects the learning style of auditory, visual, kinesthetic, and reading/writing respectively. A comprehensive study of reliability and validity of the questionnaire is not without difficulty. It is unlikely that the VARK questionnaire will ever be statistically validated because of its structure. VARK replicates how decisions are made using many preferences and the multiple answers for each question prevent statistical analysis. We do await somebody to test VARK's reliability by following a group of users through several months or years. However, there is a considerable amount of statistics concerning its applications as well as administrations that have been uncovered on the VARK website: <http://www.vark-learn.com/documents/general.pdf>). The study also serves the purpose of enriching the research literature concerning the application of the VARK Questionnaire under the permission of Neil Fleming.

5. THE INSTRUCTIONAL PROCEDURE

A total of 5 sessions for 10 groups of words (with each session 15 minutes on average, working on the 14 words in the two groups) were given prior to a retention test of words of the two groups. In the beginning of each session, students were given a handout in which the fourteen words together with their Chinese correspondences of the two target groups were listed. In the first session, the instructor simply asked all the students to memorize the 14 English-Chinese pairs within 5 minutes, and told them there would be a brief retention test for these pairs. In session two and three, students were given a handout in which the morphemic (e.g., Group 1, 7 words) and phonemic (e.g., Group 2, 7 words) keyword associations together with their Chinese correspondences of the two target groups were exemplified. The instructor spent 10 minutes elaborating how keyword associations can be established with examples attached, while another 5 minutes were given to the students to memorize these target pairs, the same procedures were also applied in session 3 (for Group 6, and Group 8). In session 4 and 5, students were only given the list of English-Chinese pairs. Next, they were asked to create their own keyword associations either based on morphemic (as required in Group 3), or phonemic (as in Group 4) keywords, and 10 minutes were given for doing so. The instructor collected all the students' self-made keyword association to check whether the rules were properly followed. Lastly, another 5 minutes were given to memorize these target words, and then a retention test was given. Note that in

all the sessions, except session 1, the time for instruction and memorization were kept equal, though it was somewhat hard to be so. Thus, the study chose to adopt the repeated measure (within subjects design). Further, in order to avoid the possible carryover effect of session 2 and 3 on other groups (e.g. Group 7, and 5), the sequence of different sessions were carefully arranged in that Group 7 and Group 5 were presented in the first session.

The data for the study came from a Learning Style Test, an abbreviated version of The VARK (visual aural read/write kinesthetic) Questionnaire, which is available on the website: <http://www.vark-learn.com/documents/general.pdf>, the first measure of vocabulary test (right after a two-hour session of instruction), and the second measure (two weeks after the experiment) vocabulary test. All the data will be analyzed by 4 x 3 x 2 x 2 ANOVA repeated measures on SPSS 9.0.

6. STATISTICAL RESULTS

The results of the present study encompass two stages (on the first and the second measures of vocabulary retention tests), with each three conditions (on overall, multiple choice items, and blank filling items). The statistical results for each stage can be listed below:

6.1 First Measure

- a. Overall: there are significant within subjects differences of performance on phonemic, and morphemic, and rote (PMR) associations ($F=25.92$, $p<.000$ on the difference between phonemic and rote associations; $F=25.19$, $p<.000$ on the difference between morphemic and rote associations), and on random and grouping (RG) lists ($F=22.956$, $p<.000$). Significant differences were also found on interactions between PMR & RG ($F=16.96$, $p<.000$), and interactions between teacher-made and student-made (TS) associations ($F=24.15$, $p<.048$). No significant between group differences were found (Table 1).
- b. Multiple choice items: there are also significant within subjects differences of performance on phonemic, and morphemic, and rote (PMR) associations ($F=5.37$, $p<.025$) on the difference between phonemic and rote associations; $F=7.83$, $p<.008$). No significant differences were found on between-subjects as well as other interactions (Table 1).
- c. Blank filling items: there are also significant within subjects differences of performance on phonemic, morphemic, and rote (PMR) associations ($F=31.29$, $p<.000$ on the difference between phonemic and rote associations ($F=19.08$, $p<.008$) on morphemic and rote associations,) and on random vs. group lists ($F=28.38$, $p<.000$). Significant differences on interactions of PMR x TS ($F=5.13$, $p<.028$), PMR x RG ($F=22.34$, $p<.000$), TS x RG ($F=5.75$, $p<.021$) and PMR x TS x RG ($F=4.23$, $p<.046$). No significant differences were found on between-subjects as well as other interactions (Table 1).

Table 1. Tests of Within-Subjects Contrasts (The first measure)

Source	PMR	TS	RG	Type III SS	df	MS	F	Sig.
Overall								
PMR	P vs. R			36.902	1	36.902	25.922	.000
	M vs. R			31.258	1	31.258	25.199	.000
RG			R vs. G	8.290	1	8.290	22.956	.000
	M vs. R		R vs. G	40.979	1	40.979	16.968	.000
Multiple Choice								
PMR	P vs. R			3.202	1	3.202	5.378	.025
	M vs. R			4.586	1	4.586	7.834	.008
Blank Filling								
PMR	P vs. R			18.363	1	18.363	31.295	.000
	M vs. R			11.898	1	11.898	19.085	.000
RG			R vs. G	5.433	1	5.433	28.388	.000
PMRxTS	P vs. R	T vs. S		3.975	1	3.975	5.139	.028
	M vs. R		R vs. G	28.287	1	28.287	22.342	.000
TS x RG		T vs. S	R vs. G	1.817	1	1.817	5.752	.021
PMRxTSxRG	P vs. R	T vs. S	R vs. G	6.998	1	6.998	4.234	.046

6.2 Second Measure

- Overall: there are significant within subjects differences of performance on teacher-made vs. student-made (TS) associations ($F=12.44$, $p<.001$), on PMR x TS interactions ($F=9.95$, $p<.003$, phonemic vs. rote, and $F=10.18$, $p<.001$), morphemic vs. rote,) as well as on PMR x TS x GR x Group ($F=3.4$, $p<.025$.) No significant differences were found (Table 2).
- Multiple choice items: there are also significant within subjects differences of performance on PMR x TS interaction ($F=4.99$, $p<.030$) for phonemic and rote associations, on PMR x TS x Group interaction ($F=3.97$, $p<.014$) also for the phonemic and rote associations, and on PMR x TS x RG x Group interactions ($F=4.53$, $p<.007$). No other significant differences were found on between-subjects as well as other interactions (Table 2).
- Blank filling items: there are also significant within subjects differences of performance on teacher-made vs. student-made (TS) associations ($F=10.55$, $p<.002$), on interactions of PMR x TS ($F=5.54$, $p<.023$) for phonemic and rote associations, and ($F=9.83$, $p<.003$) for morphemic and rote associations. No significant differences were found on between-subjects as well as other interactions (Table 2).

Table 2. Tests of Within-Subjects Contrasts (The second measure)

Source	PMR	TS	RG	Type III SS	df	MS	F	Sig.
Overall								
TS		T vs. S		5.146	1	5.146	12.477	.001
PMRxTS	P vs.	T vs. S		16.506	1	16.506	9.958	.003
	R. M	T vs. S		14.612	1	14.612	10.186	.003
PMRxTSxRG	vs. R	T vs. S	R vs. G	54.319	3	18.106	3.440	.025
	M vs. R							
Multiple Choice								
PMRxTS	P vs. R	T vs. S		2.979	1	2.979	4.999	.030
PMRxTSxRG	M vs. R	T vs. S	R vs. G	29.852	3	9.951	4.531	.007
Blank Filling								
TxS		T vs. S		3.158	1	3.158	10.55	.002
PMRxTS	P vs. R	T vs. S		5.461	1	5.461	5.548	.023
	M vs.R	T vs. S		11.034	1	11.034	9.831	.003

7. DISCUSSION

As indicated from the statistical results of instant recall on within-subjects, words with both phonemic and morphemic associations are better retained, on the overall, multiple-choice, and blank-filling measures, than those through rote memory, but no difference between phonemic and morphemic associations is found. As to the RG variable, words presented in random are significantly superior to those presented in groups, which contradicts our prediction. Possibly, words presented in groups, as in this study, may also cause confusions when taking the retention measure in which words with similar suffix appear together. Another possibility is that different spellings among words (i.e., salience) could be good retrieval cues for recall.

Next, a significant interaction effect between PMR and RG was found in overall and blank-filling measures. In specific, least difference between R and G can be found on words with morphemic associations; that is, equal retention can be found between words presented in groups and those in random when they are processed through morphemic associations. Such a result may imply that if words are processed through morphemic associations, then it matters little whether they are presented in random or in groups.

Another interaction effect between PMR and TS was found in blank-filling measure; words with keyword associations made by students are much superior to those made by the teacher in phonemic, mild superior in morphemic, but not on the rote memory. It is sensible that phonemic associations offer more flexibility for students to create mental imagery than do morphemic associations since the latter rely exclusively on spellings, the meaning of which is often more limited than that of Chinese phonemic (pronunciation) correspondences.

Besides, an interaction effect between TS and RG was found; in the words with teacher-made associations, those presented in random were much better recalled than those in groups, but for the words with student-made associations, the superiority of words presented in random decreased.

Moreover, there is another interaction between PMR, TS, and RG. Specifically, on phonemic, teacher-made associations, words presented in random were better recalled than those in groups, and slightly better recall is found on student-made associations. Next on morphemic, teacher-made associations, words presented in random were better recalled than those in groups, but words with student-made associations were recalled better when presented in groups. Third, on rote memory, words presented in random were simply better recalled, regardless of whether they are teacher-made or student-made. That is, words, when processed through morphemic associations made by students and presented in groups, were better recalled. One of the explanations is that students can more readily retrieve the target words through the cues from the similar suffix of the words presented together, since spelling is the focus of loci in morphemic associations.

No significant differences were found on TS, nor is there any significance on between-subject measure, and interaction in overall, multiple-choice, and blank-filling measures. First, no significance on TS implies that the cognitive efforts devoted to simply comprehending associations made by teachers and to creating associations on one's own will make no difference. This may partly attribute to students' personality. Passive students may prefer associations made by the teacher, while active students prefer associations created on their own. Second, no significance on between-subject measure suggests that students of different learning styles (auditory, visual, kinesthetic, and reading/writing) did equally well on overall instant measure. Again, such a finding contradicts with our predictions about the effect of learning style variable. Apparently, insufficient number of subjects with kinesthetic and reading/writing learning styles in the present study can be one of the causes. Other causes may include the validity and reliability of the VARK Questionnaire and the period of time for learning.

As to the delayed recall, the statistical results on within-subjects variables indicated that significances on TS (overall and blank-filling measures), PMR x TS (overall, multiple-choice, and blank-filling measures), PMR x TS x RG (overall measure only), PMR x TS x Group (multiple-choice measure only), and PMR x TS x RG x Group (multiple-choice measure only) were found.

For TS, Words of student-made associations were recalled much less than those of teacher-made. As mentioned earlier, students' being active (preference to student-made associations) or passive (preference to teacher-made associations) can be one of the causes of such results.

On PMR x TS, the fact that words of student-made associations were recalled much less than those of teacher-made appeared on phonemic and morphemic keyword associations, but not on rote memory. It sounds sensible that since words by rote memory were recalled least in instant delay, there would naturally not be much left for delayed recall (note that the data for statistic analysis on delayed recall were the subtractions between instant and delayed measures).

On PMR x TS x RG, words with teacher-made associations were recalled more if presented in random than presented together in groups on phonemic keyword associations, but such a phenomenon was reversed in words with student-made associations on morphemic keyword associations. As to the situation of rote memory, words presented in groups were always recalled less, which suggests that words presented in groups were least likely recalled if they were treated with rote memory. Obvious enough, extra confusion caused by the similar suffix should be the main reason.

On PMR x TS x Group (multiple-choice measure only), for both Auditory and Kinesthetic learning styles, words with teacher-made associations were recalled less than those with student-made associations. For visual learning style, words with teacher-made associations were recalled less than those with student-made associations on phonemic associations, but not on morphemic associations; that is, words with student-made associations were recalled less. Yet for reading/writing learning style, the situation is opposite to that of visual learning style; words with teacher-made associations were recalled more than those with student-made associations on phonemic associations, but not; that is, words with student-made associations were recalled more on morphemic associations. Lastly, the interactions among PMR, TS, RG, and Group are too complicated to be discussed here.

8. CONCLUSION

The present study investigates the effects of various keyword associations and learning styles on English Vocabulary retention for EFL Taiwanese learners. The findings of the present study are manifolds. First, between-subject main effects as well as interactions of Group x PMR were not found, the former of which implies the possibility that the four groups of subjects had to go through all the different keyword associations (repeated measure), the advantages on some associations and disadvantages on other associations were balanced. For example, auditory learners may benefit from phonemic keyword associations, while at the same time suffer from morphemic keyword associations. As to the insignificance on interactions of PMR and Group, validity of the assessment tool may not be good enough to cause any distinct differences. Besides, another possible cause is that there were very limited number of subjects in Kinesthetic and reading/writing learning styles; thus, more studies on validity research with more subjects are indispensable. Second, on within-subject measures, most significance has to do with PMR. This implies that both phonemic and morphemic associations are superior to rote memory, but no differences were found between phonemic and morphemic associations. It is possible that both spelling and pronunciations of target words were somehow processed in either phonemic or morphemic associations, which can be re-examined in future studies.

Next, on TS, significance is found on delayed recall (overall and blank-filling measures). It is suggested for future studies that personality factor (e.g., active, passive, independent, dependent, etc.) Such a finding is important since it, in some way, furnishes, if not challenges, the contention of the 'deep level of processing' model by claiming the inclusion of personality factors. Fourth, on RG, there is significant effect in instant recall (overall and blank-filling). It is beyond the prediction of the present study that words presented in random are significantly superior to those presented in groups. It is well worthy of further exploration to examine the extent of salience effect and chunking effect in the course of presentation of words in groups or in random. Last, this study adopts a repeated measure in which all the within-subject variables were included, which design is without its pros and cons. For one thing, while the number of subjects is not as strictly required as in most between-subject designs of the same purpose, the carryover effect from different within-subject treatments should be treated with great caution.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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APPENDIX 1

Words to be Memorized in the Experiment

Group 1: keyword associations (Teacher-made)/ Group

callow	→ Only the inexperienced will call.
fallow	→ Just fall down to have a fallow.
hallow	→ To show respect in the hall.
tallow	→ There is much tallow in the tall animals
wallow	→ To wallow along the wall.
billow	→ The bill drops into the billow.
bellow	→ The bell looks like bellowing.
litigant	→ The farming cow kicks the dog, causing litigation.
trenchant	→ Before the boat is the trenchant.
sycophant	→ One who sucks the dirt in others' mouth is a sycophant.
nonchalant	→ Women couldn't care less about men's boot.
gallant	→ Have it cut off, brave enough.
recreant	→ That tired coolie is a coward.
pageant	→ Carry the sword to the pageant.

Group 2: keyword associations (Teacher-made)/ Random

lucid	→ The road is washed lucid.
saunter	→ See her off by sauntering.
madrigal	→ The horse flirts the dog with madrigal.
condiments	→ Apply the condiment on the door of the ground.
perturb	→ The broken head perturbs people.
repugnant	→ The ass leaning on the man is repugnant.
acumen	→ The dummy standing at the door looks acumen.
novelty	→ The novel is of novelty.
moribund	→ Seeing oneself with more and more ribs is moribund.
meteoric	→ The meteor measures one meter.
pusillanimous	→ To push ill animals is pusillanimous.
redress	→ To wear red dress to redress.
fastidious	→ To ask me to be fast and tidy is fastidious.
capricious	→ The man with a cap of good price is capricious.

Group 3: Morphemic keyword associations (Student-made)/ Group

- maunder → _____
- girder → _____
- cinder → _____
- lavender → _____
- tinder → _____
- flounder → _____
- fodder → _____
- tourney → -sounds like- _____
- parley → -sounds like- _____
- lackey → -sounds like- _____
- jockey → -sounds like- _____
- barley → -sounds like- _____
- palfrey → -sounds like- _____
- volley → -sounds like- _____

Group 4: keyword associations (Student-made)/ Random

- shimmer → -sounds like- _____
- siesta → -sounds like- _____
- ventral → -sounds like- _____
- vertigo → -sounds like- _____
- indite → -sounds like- _____
- epitome → -sounds like- _____
- erratic → -sounds like- _____
- coppice → -spells like- _____
- anomaly → -spells like- _____
- apiary → -spells like- _____
- dolorous → -spells like- _____
- grandee → -spells like- _____
- neophyte → -spells like- _____
- spate → -spells like- _____

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