A COMPARATIVE LOOK INTO HOW TO MEASURE THE EFFECTIVENESS OF VOCABULARY LEARNING STRATEGIES: THROUGH USING PERCENTAGES OR CORRELATION COEFFICIENTS

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Abstract

   This study aims to compare the appropriateness of two statistical procedures for measuring the effectiveness of vocabulary learning strategies: percentages and correlation coefficients. To do this a group of 20 learners of English were asked to study 12 words in a written list, with their pronunciations, dictionary definitions, and example sentences. Data was collected through introspection where students were asked to verbalize their mental processes as they studied the target words. A pre-test and post-test were given to measure the task achievement. The qualitative data was transcribed verbatim and content-analysed for tokens of strategy use as well as by noting whether each use of strategies led to successful recall of the words on which they were used. To calculate the strategy effectiveness, both simple percentage calculation and correlation coefficients were employed for comparison. The findings indicated that percentage calculation can give a more realistic picture of strategy effectiveness than correlation coefficients.

   Keywords: vocabulary learning strategies; strategy effectiveness; percentage calculation; correlation coefficients

Özet

   Bu çalışmanın amacı, kelime öğrenme stratejilerinin etkililiğini ölçmek için kullanılan iki istatistik yönteminin (yüzde hesaplama ve korelasyon katsayıları) uygunluklarını karşılaştırmaktır. Bunun için 20 İngilizce öğrencisinden yazılı bir liste halinde telaffuzları, sözlük anlamları ve örnek bir cümleleriyle sunulan 12 yeni kelimeyi öğrenmeleri istenmiştir. Veri, öğrencilerin çalışmaları esnasında kafalarından geçenleri seslendirdikleri bir içgözlem yöntemiyle toplanmıştır. Öğrenme çıktıları ön-test ve son-test ile ölçülmüştür. Toplanan nitel veri olduğu gibi yazıya dökülmüş, kullanılan stratejileri tespit etmek için, bir stratejinin kullanıldığı kelimenin daha sonra hatırlanıp hatırlanmadığı da kontrol edilerek, içerik analizine tabi tutulmuştur. Strateji etkililiğini ölçmek için hem basit yüzde hesaplaması hem de korelasyon katsayılarına başvurulmuştur. Bulguların karşılaştırılması, yüzde hesaplamanın korelasyon katsayılarına bakaya kıyasla strateji etkililiği konusunda daha gerçekçi bir betimleme yapabileceğini göstermiştir.

   Anahtar kelimeler: kelime öğrenme stratejileri; strateji etkililiği; yüzde hesaplama; korelasyon katsayıları

1. INTRODUCTION

One important objective of studies into language learning strategies is often to determine effective ways of learning a new language (O'Malley and Chamot, 1990). The field of vocabulary learning strategies is no exception as the effectiveness of strategies for learning new words has been under scrutiny for several decades now (e.g. Cohen and Aphek, 1981; Brown and Perry, 1991; Ellis and Beaton, 1993, Lawson and Hogben, 1996; Gu and Johnson, 1996; Schmitt, 1997a; and Fan, 2003).

With an immediate interest in finding out which strategies can be of practical value for language learners, researchers seemed to adopt different approaches to explore the effectiveness of strategies. Broadly speaking, there seem to be three main trends in this field. Firstly, there are studies that investigate the effectiveness of the strategies on real vocabulary learning tasks (e.g. Cohen and Aphek, 1981; Lawson and Aphek, 1996; Erten, 1998). Secondly, some other studies explore strategy effectiveness through correlation coefficients between the frequencies of use of vocabulary earning strategies from self-report strategy questionnaires and some achievement scores such as vocabulary size and language proficiency (e.g. Ahmed, 1989; Gu and Johnson, 1996; Fan, 2003). A third group of studies employs students' reports on how effective they perceive strategies based on their past learning experiences (i.e. Schmitt, 1997a; Fan, 2003).

A closer examination of data collection and analysis procedures pursued in these studies reveals that they do not subscribe to a commonly accepted statistical procedure to calculate the effectiveness of strategies. For example, Cohen and Aphek (1981) and Erten (1998), in their studies with real learning tasks, employ simple descriptive statistics such as percentage calculation. Alternatively, Lawson and Hogben (1996) use correlation coefficients between the overall frequency of the use of each strategy and overall number of words recalled by individual students in a real learning task. Further, Gu and Johnson (1996) and Fan (2003) resort to correlation

coefficients between reported frequency of use of vocabulary strategies and some achievement indicators such as language proficiency and vocabulary size. Finally, Schmitt (1997a) and Fan (2003) report results of a ranking procedure according to students' reports of how effective they find the strategies given in a questionnaire.

It is perfectly acceptable, of course, to employ different statistical procedures on sets of data of a different nature. However, this raises concerns about the comparability of findings as different statistical procedures could easily give very different results when applied to the same set of data and thus lead to somewhat different conclusions and interpretations of the research findings (Hatch and Lazaraton, 1991).

This article intends to explore the appropriateness of the two commonly employed statistical procedures in the calculation of strategy effectiveness: calculating percentages and correlation coefficients. The article will firstly review the nature of strategy use reported. The nature of different statistical procedures and their appropriateness for the validation of the effectiveness of vocabulary learning strategies will then be discussed. Finally, a small scale study will be described and its findings will be presented.

2. SOME OBSERVATIONS ON THE USE OF STRATEGIES

Some interesting patterns of strategy use have been noted in the literature. Firstly, it has been illustrated that learners tend to use several strategies at once (Erten, 1998). Erten's analysis of his qualitative data revealed that the participants often tended to use more than one strategy together on the same vocabulary item. The participants used an average of 2.1 strategies on each word they were supposed to study. For example, some students used sound associations and repetition together. The following extract illustrates this clearly:

> S10: ... Bulk, *it is a noun, most of majority of* Bulk, uh-huh `*I have finished*
> *analysing the bulk of my data'* ... the most... the most things ...the ...bulk
> bulk bulk ... bulk ......
> R: What are you thinking?
> S10: The bulk the ball bulk ball sounds similar. It means it (is) not finished all
> but mostly most of the things but not all of them.
>
> (Erten, 1998: 219)

In this extract, S10 is trying to learn the word *bulk*. She obviously is using several strategies to learn it. Firstly, she is trying to modify the definition to make it more comprehensible by saying "the most... the most things ... [and later] it means it [is] not finished all but mostly most of the things but not all of them." Secondly, she is repeating the word. And thirdly, she is trying to form a sound association between the *bulk and* the *ball.* To summarize, S10's introspective protocol reveals the use of three different strategies on the word *bulk*.

The use of several strategies was also observed by Ellis and Beaton (1993). In their controlled experiment where they compared different strategies for vocabulary learning, they noticed that their participants used several strategies at once even when they were assigned to use a fixed strategy. This is interesting because it simply implies that the outcome of such a learning situation cannot be attributed to a single strategy. To refer back to the example given above, it is almost impossible to decide which of the three strategies contribute most to the learning. This is even more intriguing if we speculate that this particular student might also have used some other strategies that she did/could not report. However, it should also be noted that use of multiple strategies may not be universal. It was argued that students may be forced to employ several strategies due to intensive mental efforts as a result of possible backwash effect of the recall tests administered after the experiments (Schmitt, 1997b). Nevertheless, it seems to be a fact that subjects do tend to use more than one strategy in learning tasks. Further, students often feel pressurized in many learning contexts for attainment as a part of their assessment in their courses. So it can be suggested that backwash effect can be a natural by-product of natural school learning,

with frequent intensive mental involvement to achieve high scores and employment of several learning strategies en route to success.

Another characteristic of the strategy use in such studies is that learners do not employ the same strategy to learn all the words. They use different strategies which they choose from their personal strategy repertoires depending on several factors including their personal experiences (Von Glaserfeld, 1996), general task (Nyikos, 1990), and specific word requirements as each word is mnemonically rich (Erten, 1997). Learning strategies are task-specific procedures to promote learning (O'Malley and Chamot, 1990 & Oxford, 1990) and a vast number of strategies has been reported to be used by language learners (e.g. Ahmad, 1989, Cohen, 1990, Nation, 1990, Schmitt & Schmitt, 1993, Schmitt, 1997a). From this angle, each case of vocabulary learning is unique and should be treated as such. For example, an affix word (e.g. recur) may easily encourage students to concentrate on the meaning of the prefix or suffix and to keep this part of the word in their mind as a cue for remembering the whole word later on. To give another example, the spelling of a word may easily trigger the associating of the meaning of the word with its spelling (e.g. sibling: a general term for brothers and sisters: SI of sisters and B of brothers, [Erten, 1998]).

3. CALCULATING THE EFFECTIVENESS OF STRATEGIES

Two statistical procedures are often used to calculate the effectiveness of vocabulary learning strategies (O'Malley and Chamot, 1990). These are calculating percentages and correlation coefficients.

3.1 Calculating Percentages

Percentage refers to how large one quantity is compared to another quantity. The first one is regarded as a part while the second denotes a whole or a larger quantity. Percentage then refers to the proportion of the smaller quantity in the larger.

Calculating percentages is a simple procedure which most of us have tried in our everyday lives. The following simple formula is used to calculate

Percentage = (# of X/ total) * 100

Calculating percentages are often used in vocabulary learning studies where students are given real learning tasks (Cohen and Aphek, 1981, Erten, 1998). The *total* in such studies represents the total frequency of use of a given strategy by all participants. The *# of X* represents the number of times each strategy led to the recall of the word it was used for. The total frequency of a strategy can be obtained by observing each time it is used. This can be done by several means of data collection such as self-report, diary, think aloud, etc. The # of X can be done by noting whether the words on which a given strategy was used were recalled later on. This can be done by using a post-test. Then, by applying the above formula it is easy to calculate the effectiveness rate (recall rate) in percentages.

Let us assume that a particular strategy (e.g. sound association) was used a total of 20 times (i.e. on 20 different words) in an exploratory task by all the students and it led to the recall of 15 words on which it was used. If we apply the formula;

Percentage: (15/20) * 100
: .75 * 100
: 75%

then the effectiveness rate of this strategy would be found as 75%, which can be seen as a fairly effective strategy.

The main advantage of using the percentages here is that it allows us to treat each use and outcome of a strategy individually. That is, it takes account of each case of strategy use. As discussed above, each case of learning a word and/or the use of a strategy is unique. Thus, by examining discreet cases of vocabulary learning, one can confidently observe the effectiveness (or otherwise) of a particular strategy.

Furthermore, it is easy to calculate and interpret. However, it is not without its limitations.

The limitation comes from the use of several strategies to learn a single word (see above). The fact that several strategies might be/are used makes it difficult to determine which one of the strategies that is used on a single word contributes more to the learning and eventually to the recall of the word. It is quite possible that all the strategies used might equally contribute to the learning and the recall of the word. It is also possible that some of the strategies might be benefiting from the effectiveness of the others they were used together with.

One way of overcoming this problem is calculating an accumulated effectiveness rate of each strategy over many cases of vocabulary learning. This would reduce the ambiguity of the proportion of contribution made by a single strategy on a single case of vocabulary learning. However, this could still cause problems with less frequently used strategies. This is because, with such strategies, each case of use will correspond to a larger percentage and thus the fluctuation in the calculated effectiveness rate will be enormous in cases of successful or unsuccessful recall of a single word. It is, therefore, safer to work on fairly frequently used strategies. Effectiveness figures of low frequency strategies, then, need to be taken cautiously and compared with the relevant findings in the literature for confirmation.

3.2 Correlation coefficients

These are statistics of covariance. In other words, they are the representation of whether different sets of figures vary together in the same or opposite direction (Brown, 1988 & Nunan, 1992). The main purpose is to find out if there is an association between two or more variables. The relationship between variables is usually presented on a continuum of correlation coefficients ranging from -1.00 to 1.00. At the one end, -1.00 represents perfect negative correlation and at the another, 1.00 represents perfect positive correlation.

In the studies of vocabulary learning strategies, this procedure is usually performed by comparing the frequency of use of each strategy by individual students to the students' overall scores from the recall tests (Lawson and Hogben, 1996), vocabulary size (Fan, 2003), or language proficiency (Gu and Johnson, 1996). This procedure can provide us with a clear picture of whether the frequency of a strategy is associated with the test scores of the students. These correlation coefficients are sometimes interpreted as indicators of the effectiveness individual strategies (i.e. Lawson and Hogben, 1996). This is where the problem starts.

The way correlation coefficients are calculated and the way strategies are used do not always seem to be compatible. Correlation coefficients, as defined above, are the statistics of covariation. They exhibit the extent that two or more different sets of numbers vary together in the same direction. The problem is caused by the nature of the use of strategies. Students tend to use different types of strategies for learning different words. If, however, they had used only one type of strategy to learn all the words, this procedure could have been perfectly satisfactory. Intriguingly, this does not seem to be so. We cannot, therefore, assume that the correlation coefficients obtained from a holistic approach which ignores the individual cases of strategy use and vocabulary learning can reflect the real effectiveness of a given strategy. What correlation coefficients really reflect is whether high scoring students use particular strategies with high frequencies or vice versa, regardless of whether strategies used on discrete vocabulary items led to successful recall of these words.

Having briefly outlined the nature of these two statistical procedures, one can speculate that they may yield quite conflicting results. This is simply because they are completely different ways of treating the data and explain different aspects of the phenomena. The percentage calculation takes account of the use and outcome of each strategy at individual word level. On the other hand, the correlation coefficient concentrates on the relationship between the overall frequencies of the use of each strategy by each student and students' overall scores (proficiency, learning task,

achievement tests, etc.), ignoring individual cases of vocabulary learning where strategies are used.

4. STUDY

The main aim of this study is to explore the suitability of percentage calculation and correlation coefficients in the validation of the effectiveness of strategies. The only hypothesis of this study was;

> The procedures of calculating **the correlation coefficients** for the purpose of validating strategy effectiveness yield conflicting results compared with those obtained from the calculation of the **percentages**. Therefore, these procedures may lead to different interpretations of strategy effectiveness.

The effectiveness of individual strategies is not of primary concern for the present study as it is beyond the scope of this paper to discuss strategy effectiveness.

4.1. Setting and Participants

The study was conducted at two private language schools in Devon, UK, where a large group of international students was registered on an "English for Academic Purposes" course. 20 students responded positively to an invitation to participate in this study. The participants were preparing for further studies at a British university. They had a different L1 background and had intermediate to advanced level of self-perceived language proficiency. Table 2 displays the distribution of students by nationality, gender, and language level.

Table (1): Distribution of participants according to nationality, gender and language level

Nationality		Gender		Language level	
	N	F	M	Int.	Adv.
Japanese	7	6	1	4	3
Swiss	7	5	2	3	4
Spanish	3	2	1	2	1
Italian	2	2	--	1	1
Turkish	1	1	--	1	--
Total	20	16	4	11	9

4.2 Materials

Each student was given a written list of 12 words to study. Dictionary-like definitions and phonological information were provided along with example sentences. Some necessary stationary (i.e. pen and paper) was also provided. The sessions were recorded using a tape recorder with a built-in microphone.

4.3 Procedures:

Data collection: Data was collected using an immediate introspection procedure. Students were asked to report what they did to learn words as soon as they finished studying them. Some students did not wait until they finished and tended to report their strategies concurrently.

The familiarity of the vocabulary items was tested by administering a pre-test. Task achievement was measured by an immediate post-test. A dichotomous scale was used to mark the post-test responses although multi-scale assessment systems have been proposed by several researchers (Wesche and Paribakht, 1993, 1996). A dichotomous scale was found suitable as the study was concerned with whether a strategy led to the retention of the words rather than the depth of vocabulary knowledge that was retained. The answers in the post-test were marked as either correct or false.

Coding: Recordings of the sessions were transcribed verbatim. It is beyond the scope of this article to discuss the taxonomy of the strategies used to analyse the data. Suffice to say that the transcripts were content-analysed and coded for strategies by using different types of strategies drawn from the existing literature (e.g. Cohen, 1990, Nation, 1990; O'Malley and Chamot, 1990; Oxford, 1990; Schmitt and Schmitt, 1993; Schmitt, 1997a), as well as those strategies identified from the introspective data.

Statistical analysis: Both percentage calculation and correlation coefficients were applied on the same data set. To calculate the effectiveness rates in percentages,

individual incidences of the use of each strategy type and whether the word on which that particular strategy was used was later recalled in the immediate post-test. (there is no main verb in the preceding sentence) Later, using the percentage formula, the rate of effectiveness was calculated. For correlation coefficients, the frequency of the use of each strategy by the participants and their test scores were taken as two interdependent variables. Coefficients were computed on SPSS (Statistical Package for Social Sciences) using Pearson Product Moment Correlation Coefficients. This procedure is commonly used for analysing interval data (Brown, 1988 & Hatch and Lazaraton, 1991).

5. FINDINGS AND DISCUSSION

The qualitative analysis of the data revealed that the participants used a total of 22 different types of vocabulary learning strategies with a total of 451 tokens of strategy use on 220 cases of learning a new word. Apparently, as also mentioned earlier, the participants tended to use multiple strategies together to learn new words. An average of 2.05 strategies was used to learn each word.

Hypothesis: The hypothesis was supported. The procedures gave differential figures for the strategy effectiveness. There was a big discrepancy between the statistical outputs. While percentage calculation showed that some strategies resulted in 100% recall of the words, according to correlation coefficients obtained, they did not have a statistically significant correlation (p< .05) with task scores. Table 2 presents the results yielded by these two statistical procedures

The second column displays the overall frequency of the strategies. Column three is for the effectiveness rates in percentages and has two sub-columns. **No of Recall** presents the number of recalled words when a particular strategy was used, and **%** stands for the percentage of **No of Recall** out of **Overall frequency** of that strategy. The fourth column is for the **Pearson-product moment correlation coefficients** between strategy frequency and the task scores and has two sub-columns.

Cor. is the correlation between the frequency of the use of each strategy by individuals and their test scores while **Sig.** is the statistical probability of the correlation. The asterisked strategies under column four are marked as having significant correlation (p<.05) with the test scores of the students.

Table (2) Strategy effectiveness yielded by the percentage calculation and the correlation coefficients.

Strategies	Freq.	Effectiveness in Percentages		Correlation with Recall Total	
		No of Recall	%	Cor.	Sig.
Keyword technique	6	6	100	.392	.078
Create a mental picture of learning situation	4	4	100	.248	.278
Associate word to its location	10	10	100	.282	.216
Learn the word as L1/L3 cognate	23	21	91.3	-.205	.373
Recap words in the task	30	26	86.6	.483*	.027
Create personal interaction with the word meaning	21	18	85.7	.128	.579
Associate word to its spelling	6	5	83.3	.057	.806
Create a mental picture of the word meaning	20	16	80	.364	.105
Associate word to the example sentence	9	7	77.7	.104	.653
Create a physical/affective sense of the word	8	6	75	.374	.095
Attend to different parts of the word	4	3	75	.275	.227
Use word in a sentence	7	5	71.4	-.129	.577
Look for a distinct feature of the word	23	16	69.6	-.008	.973
Recognise parts of speech of the words	12	8	66.7	-.143	.537
Concentrate on affixes	18	11	61.1	.406	.068
Create sound association with another word	61	35	57.3	.471*	.031
Modify the definition	79	40	50.6	.045	.848
Associate with a synonym or antonym	8	4	50	.164	.476
Use repetition	54	22	40.7	.155	.502
Assess the difficulty of the word	5	2	40	.136	.556
Shorten the definition of the word	29	9	31	-.117	.613
Replace word with short definition in the example sentence	14	3	21	-.288	.205

Recall: The number of cases where a particular strategy led to the **recall** of the word with which it was used.
%: Percentage of recall in cases where a strategy was used.
Cor.: Correlation coefficient between the frequency of strategies and the score of recall of each student
Sig: Whether this finding is statistically significant.

If we subjectively draw a threshold of the effectiveness at the 75% level in percentages, only one strategy (Recap words) can be defined as an effective strategy

in both percentage calculation and correlation coefficients procedures. Moreover, 'Learning a word as L1/L3 cognate' seems to have a negative correlation with task scores and can be seen as a less effective strategy whereas it has an effectiveness rate of 91.3% in percentages. Another striking example is `Create sound association with another word'. The frequency of use of this strategy seems to be significantly correlated with test scores ($p<. 031$). However, it got only a recall rate of 57.3%. It is clear from the findings that there is not a proper match between the results of these two procedures. The controversial figures of effectiveness obtained above are rather striking and clear indications of incompatibility between these two statistical procedures. The nature of the use of strategies and these two statistical procedures obviously combined to yield different results.

The correlation coefficients (as they are used for example in Lawson and Hogben, 1996) do not seem to be true indicators of the effectiveness of the strategies in real vocabulary learning tasks. On the other hand, the results of the percentage calculation seemed more realistic in terms of validating the strategy effectiveness. It has a clear advantage over correlation coefficients in the sense that it accommodates the complex use of vocabulary learning strategies and allows us to examine the use and outcome of the strategies each time they are used. Thus it helps us to treat each case of vocabulary learning separately. However, it is not without its limitations and the results, especially with the low frequency strategies, should be interpreted carefully.

6. CONCLUSION AND IMPLICATIONS

This study aimed to investigate the suitability percentage calculation and correlation coefficients in measuring strategy effectiveness. The current study showed that employing percentage calculation as an indicator of strategy effectiveness can be a more realistic measure of the effectiveness. Its superiority comes from the fact that

it allows researchers to treat discreet cases of vocabulary learning separately as opposed to the holistic treatment in correlation coefficients.

This study is not, however, without limitations. Firstly, the present research involved a group of students with diverse L1 background. A more homogenous group of students could have helped to clarify the issue better. Secondly, the study does not aim to discredit correlation coefficients. The main focus of the current research was the effectiveness of strategies in a real learning task. Other procedures of statistical analysis with a wide range of research designs may be more appropriate and fruitful for the analysis of other types of data such as self report data from questionnaires.

There are two main implications of this research. Firstly, the study indicates that investigating strategy effectiveness can generate more useful results in order to better explore the effectiveness of different strategies. Therefore, further studies incorporating such tasks are needed to further our understanding of vocabulary learning strategies. It could be more fruitful in such studies to threat the effectiveness of vocabulary learning strategies on individual cases of learning. For the time being using percentages seems to be a better descriptor of the strategy effectiveness. Secondly, it is safe to suggest that we should be sensitive to our data when we are choosing what statistical procedures we are basing our analysis on. Otherwise, our calculations of strategy effectiveness can easily be based on inaccurate estimations. This may have an extended influence on helping our learners become more successful language learners. By referring to the results of inappropriate procedures, we may easily end up by relegating some potentially effective strategies while promoting those that are seemingly related to success but in fact less effective in real vocabulary learning.

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