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Research into the Mental Lexicon Representation of Chinese English Learners Based on Spreading Activation Model[1]

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Abstract: Nowadays, the main idea regarding the organization of the lexicon is that words are stored in an organized intertwined semantic network. However, relatively little is known about the actual process that takes place during the course of activation production.

Therefore, in order to gain a deeper understanding of the problems in question, this study conducted word association test to 150 sophomores in Dalian University of Technology (DUT) and tried to show the internal relations of mental lexicon in data by calculating the word frequency between certain words through a computer program which is written based on the actual calculating steps. And the innovation of this study is to show the abstract lexicon relation in data and illustrate the mental lexicon representation in three-dimensional figures by Netdraw software.

Through the study we find:

(1) The responses with higher frequency in the first few positions may not ensure themselves high association strength to the stimuli. And the current research also proves that activation of mental lexicon is not a "one stop" process but a linear forward one.

(2) The data of association strength obtained from this study may help us convert the abstract lexicon relation into concrete statistical facts and establish representation of the mental lexicon network model.

At last, the mechanism of Spreading Activation Model is illustrated and the implications for future English teaching are provided.

Key words: Mental lexicon; Word association test; Mental lexicon representation; Association strength

1. INTRODUCTION

The study of the L2 (second language) mental lexicon has increasingly aroused the interest of linguists around the world and how the information is organized in mental lexicon is a key issue. There are two opposing ideas: one is the view of phonological organization and the other one is semantic organization.

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Nowadays, the main idea regarding the organization of the lexicon is that words are stored in a semantic network. And Chinese researcher Gui found that the mental lexicon of the Chinese subjects' was also organized around a semantic network (GUI, 1992). Therefore, the current research aims to explore the semantic links in Chinese English learners' mental lexicon. And the innovation of this study is to show the abstract lexicon relation in data and illustrate the mental lexicon representation in three-dimensional figures by Netdraw software. Word association test was conducted in this study to prove the internal relation between the stimuli and the responses, and the responses per se. Through the research we want to make it clear whether the association strength among different responses and the distance between each two words are different in people's mind; and whether the responses in the first few positions enjoy relatively high association strength with the stimuli; what role does part of speech play in the mental lexicon organization.

The first part of the paper explores the theoretical and empirical findings with regard to the bilingual mental lexicon, which is followed by the methods of data collection and analysis. The discussion of the results tries to illustrate the representation of Chinese English learners' mental lexicon. Finally, further research possibilities and implication for English teaching are discussed in conclusion.

2. THEORETICAL FRAMEWORK AND EMPIRICAL EVIDENCE

Although the significance of vocabulary acquisition in a second language is indisputable, relatively little is known about the actual process that takes place during the course of activation and actual production. Therefore, in order to gain a deeper understanding of the issues in question, in the first part of the literature review theoretical issues are to be addressed, followed by the findings of empirical research.

2.1 The Notion and Definition of Mental Lexicon

Psycholinguistics refers to the representation of words in permanent memory as internal lexicon which is also called mental lexicon.

Aitchison used to compare the mental lexicon to a book (Aitchison, 2003). However, there are great differences between words in human mind and words in a book dictionary with regard to content, organization and retrieval. With regard to content, the number of words in a book dictionary is fixed, but for mental lexicon it is by no means fixed and there are far more information about each entry. Second, as for organization, the words in book dictionaries are most likely to be organized in an alphabetic order: from A to Z. But evidence from speech errors indicates that human beings' mental lexicon is not in the same manner. As far as word retrieval is concerned, the main difference between the mental lexicon and a book dictionary lies in the frequency effect.

2.2 Organization and Structure of Mental Lexicon

Since so much information is stored in mental lexicon, how is it organized in mind is a key issue. And the large number of words in the mental lexicon and the high speed of word-retrieval indicate that the mental lexicon must be highly well-organized in human beings' minds.

2.2.1 Phonological organization vs. semantic organization

Some researchers announce that the organization of the mental lexicon is a phonology dominating world (Laufer,1997). The "bathtub effect" is a case in point. People always remember the beginning and the end of words better than the middle parts. Aitchison concludes that words with similar beginning, similar endings and similar rhythm are likely to be tightly bonded (Aitchison, 2003).

There is evidence from word association experiments in psychology that meaning relations are relevant to the way in which we store words in our mental lexicon. In another word, researchers nowadays agree that words in the mental lexicon are stored in a semantic network. Aitchison conducted researches on the semantic organization of mental lexicon from the perspective of semantic relations. According to his research, the words in the same semantic field tend to be stored together, while words in different semantic fields are loosely related (Aitchison, 2003). Other researchers have got the same conclusion; to cite only a few of the answers to the prompts: tree for flower, like for hate, nearly for late, husband for wife, red for black, etc (Fromkin,1971; Nooteboom, 1969; Carter,1998). These substitutions clearly indicate that words from the same semantic field are stored together. The research result obtained by Freedman and Loftus is also in favor of the opinion (Hotopf, 1983).

2.2.2 Semantic network and preading activation model

Currently the main idea regarding the organization of the lexicon is that words in mental lexicon are stored in a semantic network, but what they do not agree is how the network is organized. Among the various models of the lexical organization that have been proposed so far, the two most important types are the Hierarchical Network Models and the Spreading Activation Models.

(1) Hierarchical Network Model

As one of the earliest and the most influential models of L1 (first language) mental lexicon, the Hierarchical Model, was proposed by Collins & Quillian in 1969 (Collins & Quillian, 1969). Reeves, Hirsh-Pasek & Golinkoff, claims that the concepts of hierarchical network model are organized as “pyramids” with superordinate ones (e.g., plant) at the top, more specific ones in the middle (flower) and subordinate ones (e.g., rose) at the bottom; and each word is only linked to the closest concept (Reeves et al., 1998). Some typical features of the model include cognitive economy (the more typical a semantic feature is, the higher the level it is stored) and category size effect (the larger the category, the longer the time the search takes). Concepts (similar to the word) are represented as distinct nods in a network of category and property relations. (Biemiller, 1970).

Collins & Quillian also assumed that the principle governing the storage of words is cognitive economy. The space available for the storage of semantic information was limited and the information would be stored only at the highest possible node, so that it would be beneficial to store information only in one place in the network (Collins & Quillian, 1969); so according to the Hierarchical Network Model the words are stored in our mind based on strict rank rules; the words contain general information are always located in the higher position while the words in the lower position are the ones with specific information on most occasions.

(2) Spreading Activation Models

On the basis of Hierarchical Network Model, Collins and Loftus put forward another very powerful model, namely the Spreading Activation Model so as to overcome the problems of Hierarchical Network Model. In contrast to Hierarchical Network Model, the Spreading Activation Model sees concepts as connected nodes with differing lengths of line between different concepts, based on the degree of their association (Reeves et al., 1998). The Collins and Loftus’s model is regarded as a step forward from the overly rigid hierarchical network model, but it still has some limitations, for example, little attention is paid to phonological, syntactic and morphological aspects of words (Collins & Loftus, 1975).

A more recent Spreading Activation Model that incorporates lexical as well as conceptual aspects is presented by Bock and Levelt. The model is composed of three levels, that is, the conceptual level, the lemma level and the lexeme level. The conceptual level consists of nodes that represent concepts and various relations connecting those nodes. The lemma level consists of syntactic aspects of word knowledge, while the lexeme level captures phonological or orthographical properties of a word. This model appears to be particularly reasonable and useful in understanding lexical access in both comprehension and production (Bock & Levelt, 1994). Therefore, Carroll comments that spreading activation models of the lexicon seem to provide the most realistic picture currently available of the internal lexicon in that conceptual, syntactic, and phonological knowledge are all incorporated (Carroll, 2000).

Out of the two models we can find the Spreading Activation Model is the more well-organized one for the following two reasons. Firstly, although it is a network of association, its structure does not imply a rigid hierarchy, but allows words to be related to several others. Secondly, there is no need to distinguish between defining and characteristic features; because the stronger the association, the closer the connection between the two concepts.

2.3 Empirical Studies on Mental Lexicon in China

Compared with researches of other countries in this area, the Chinese researches concerning Chinese English learners' mental lexicon began much later. It was in the early 1990s when Gui Shichun and other researchers began to investigate Chinese English learners' mental lexicon. By conducting several priming experiments, Gui found that the mental lexicon of the subjects was organized around a semantic network and that activation could spread within this semantic network, which in turn helped the retrieval of words (GUI, 1992).

Recently Dong Yanping put forward a shared, distributed asymmetrical model for the bilingual mental lexicon based on her research findings from Chinese English learners (DONG, 1998).

Li found out that L2 vocabulary knowledge affects the efficiency with which Chinese learners of English process semantic information and the patterns of lexical networks influence the changes of efficiency in semantic processing (LI, 2003).

Following the leading study conducted by Wolter, Zhang compared the response types of 40 advanced Chinese English learners and those of 19 native speakers, from which she found that the majority of Chinese English learners' responses were phonological responses (ZHANG, 2003). The results of her study confirmed the view of Meara that L2 mental lexicon was mainly phonologically operated. In the later study, Zhang concluded from a word association test and found that both linguistic factors and non-linguistic factors would influence the L2 mental lexicon. On one hand, the L2 learners didn't build the meaningful semantic connection between large proportions of words; on the other hand, factors such as environmental, cultural, economic and religious factors were among the non-linguistic aspects, and some significant events would play a predominant role in L2 mental lexicon (ZHANG, 2005). Imitated the study of Freedman & Loftus (Freedman & Loftus, 1971), in the year 2008 Zhang delivered a longitudinal study to study the developmental course of the L2 mental lexicon and to investigate the process of how the L2 mental lexicon changes over time by analyzing the response patterns of the subjects (ZHANG, 2008). Results of the 33 second-year English major indicated that the increase of word knowledge and language acquisition made the L2 mental lexicon more and more semantic.

3. RESEARCH METHODOLOGY

3.1 Research Design

A total of 150 sophomores from different departments in Dalian University of Technology (DUT) in China were randomly chosen to take part in the word association test. All of them are native speakers of Chinese with English as their second language and have been studying English for at least eight years, which enables them to be eligible for the current study.

In this research, in order to find out the semantic links between stimuli and responses, we adopt "continuous association" approach, in which the subjects are instructed to produce one word after another continuously by certain stimulus.

Careful selection of stimulus words is essential to the validity to the present study. Therefore, 50 English words were taken as stimuli from the Kent-Rosanoff inventory of 100 frequently occurring, emotionally neutral English words. The test was conducted in about one class hour. Since it was the first time for the subjects to take part in such a special test, at the beginning of the test, the requirement of the test was introduced and explained carefully.

3.2 Data Treatment

After the test the responses of the subjects' were collected and classified for further analysis.

Step one: the invalid ones were excluded. The subjects who failed to produce responses to more than six stimulus words were treated as invalid. At last, there left 129 valid answer sheets.

Step two: all the answers were put in the form of different sheets in Excel documents. There are 50 Excel documents containing all the word association test data in total.

Step three: rank the responses according to the activation order and pick the responses with the highest frequency in each position.

In order to gain the association strength between the responses, we took the position of each response into consideration 50 $m \times n$ matrixes were got to do the following statistic work as listed in formula (1), in which m stands for the positions of the responses, and n means the number of different responses activated by the subjects. Based on all the responses shown in the matrix we could count the number of responses and then list them according to their frequencies in each position.

Set i as the position of the response in the table, and j as the most frequently responded responses in the test; And take the stimulus *table* as one example, $i = 7$ and $j = 18(i < m, j < n)$, actually, there were some subjects who activated 9 words, but only 11 subjects produced eight responses and 5 subjects gave nine responses, this could be seen as small probability events, so a 7×18 matrix with the frequency of each response in each position to *table* was formed.

$$X_{stimuli} = \begin{pmatrix} X_{11} & X_{12} & \cdots & X_{1j} & \cdots & X_{1n} \\ X_{21} & X_{22} & \cdots & X_{2j} & \cdots & X_{2n} \\ \vdots & \vdots & \vdots & \vdots & \vdots & \vdots \\ X_{i1} & X_{i2} & \cdots & X_{ij} & \cdots & X_{in} \\ \vdots & \vdots & \cdots & \vdots & \vdots & \vdots \\ X_{m1} & X_{m2} & \cdots & X_{mj} & \cdots & X_{mn} \end{pmatrix}. \qquad (1)$$

As we know the responses with strong link to the stimulus must be the easy one to be activated and ranked among the first positions, so we gave different weights to the responses in each position, namely $1, 0.8, 0.6, 0.4$ to the responses in the first, second, third and fourth positions. And in the current study we use the processed frequencies calculated as the measurement to check the association strength between each two mental lexicon.

The overall responses in each row could be calculated by the following formula (2) in which N_i meant the i th position, and n was the various responses in the first position. For *table*, the overall responses in the first row could be calculated as $i = 1$, and $j = 1,2,\cdots,n$, so it equaled to 129, the second row as $i = 2$, and $j = 1,2,\cdots,n$, which was 128, so in the same way, the overall responses for the other five positions were 123, 111, 84, 51 and 28 respectively.

$$N_i = \sum_{j=1}^{n} X_{ij}. \qquad (2)$$

$$F_j = \sum_{i=1}^{m} \frac{X_{i1}}{N_i} * W_i. \qquad (3)$$

In formula (3) F_j was the frequency for each response in various positions which also represented the association strength between certain words. Here m were the positions of the responses, and W_i the weight of the responses in the i th position. With the formula above, the association strength between responses and stimuli could be got. To get more accurate and quicker results a computer program was written to complete the whole complex calculation process with Visual C#.

In this study, the conditional probability between two adjacent responses would be calculated to represent the association strength between them, which would be used to compare with the association strength between stimulus and its responses. The conditional probability between the two adjacent responses was calculated according to the Association Rules of Data Mining to check the association strength between responses. Suppose there are two random events A and B, and given the occurrence of the event B with the probability $P(B) > 0$, then the probability of the occurrence of A is changed from the unconditional probability into the conditional probability given B, meant the probability of A under the condition B, and the conditional probability of A given B is $P(A|B) = \frac{P(AB)}{P(B)}$.

During the computation procedure, the conditional probabilities of responses to *table* were computed as the following. Since the association strengths of all the responses chosen were calculated, we may find there were altogether 53 desk appeared in the first place while taking *table* as the stimulus. Then a new 53×7 matrix was got with all the responses of the 53 subjects listed on it, then the responses of chair in the second position were counted, and found there were 17 subjects who first associated desk to *table*, and then chair as the second activated word; and since the response in second position had relatively weak connection with the stimulus than the response in the first position, the weight was 0.8. So the conditional probability of the activation of chair given desk in the first position was $P_1(chair|desk) = \frac{P_1(chair \cap desk)}{P_1(desk)} * W_1$. The same to the responses in the first position, the subjects who activated desk in the second position were counted and listed, and since there were 8 subjects whose second responses to *table* were desk, we got a 8×7 matrix here, and counted the subjects whose third responses were chair, and found only one response, since the weight in the third response was 0.6, the conditional probability of the activation of chair given desk in the second position was $P_2(chair|desk) = \frac{P_2(chair \mathrm{I}\, desk)}{P_2(desk)} * W_2$, and so forth, we got all the conditional probabilities of the activation of chair given desk in each position, and add these weighted conditional probabilities together to represent the conditional probability of the activation of chair given desk, that is $P(chair|desk) = \sum_{i=1}^{n} \frac{P_i(chair \mathrm{I}\, desk)}{P_i(desk)} * W_i$.

Table 1: The Association strengths of its responses to *table* and the association strengths between responses

				table					
responses	desk	chair	wood	food	cup	able	pen	bed	chairman
Association strength	0.4717	0.4430	0.0765	0.0751	0.0740	0.0508	0.0474	0.0401	0.0361
A.S between adjacent responses		0.7617	0.1787	0.0000	0.0000	0.1500	0.0000	0.0000	0.0000
responses	water	meal	dinner	student	family	tree	meat	floor	man
Association strength	0.0350	0.0346	0.0339	0.0333	0.0324	0.0320	0.0315	0.0304	0.0296
A.S between adjacent responses	0.0000	0.0000	0.0500	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Note: A.S here is the short form that stands for association strength.

From Table 1, we can see that the responses most closely related to *table* is desk, the association strength of desk to *table* is 0.4717. And the second most closely related word to *table* is chair, whose association strength is 0.4430. And the association strength of wood to *table* was 0.0765, much lower than that of desk and chair. There were 18 responses taken from all the responses to *table* as the study objectives, and they have different association strength to the stimulus, so all these responses were ranked according to the different link strength; for example desk had the strongest link with *table* with the association strength of 0.4717, while man had the weakest association strength of 0.0296 of all the 18 responses list above. Table 1 showed that the association strength of chair to *table* was relatively lower than chair to desk. And the association strength between the two adjacent responses of wood and chair was 0.1787, which was larger than that of wood to *table.*

4. FINDINGS AND DISCUSSIONS

After the presentation and analysis on the word association test data, the mechanism of mental lexicon representation network is to be discussed in the present section.

4.1 Association Strength between Stimuli and Responses and Responses Per se

4.1.1 Major findings

In order to explore the relationship between stimuli and responses, and to show the relation in a statistical way, the concept of association strength was introduced in this study.

Firstly, after calculating the association strength between responses and the stimuli based on the frequency of each response in various positions, it can be easily found that the association strength between stimuli and different responses were very different. Some correlations were high and significant at the same time, and some with lower correlations to the stimuli. Some interconnection are strong, and some are weak. In one word, the fact that both the strength and accessibility between responses and stimuli are different means each response has its own particular relationship with the stimulus.

Secondly, we may take it for granted that high frequency responses in the first or second position must have high association strengths to stimuli. But after the current research, we find it may not be true.

Thirdly, through unveiling the representation of some words in Chinese English learners' mental lexicon, we can say most words are stored in our mind based on concept(a certain kind of internal semantic relation), although some syntagmatic or phonological responses still exist.

4.1.2 Association strength between responses and stimuli

In Table 2, the responses light (0.2867), black (0.2546), night (0.2078), white (0.1865) and sun (0.1550) were all highly correlated to *dark*, while sky（0.0183）, earth（0.0216）had relatively low correlation with *dark*.

In the similar way, the association strengths of the responses to *black* were listed in Table 4.2. From the table, we can see that white was the most closely related to *black* (0.5950), and then were dark (0.1853), red (0.1211), yellow (0.0743) and blue (0.0743). The responses like color, green, night, light and eye were relatively less correlated to *black*, the association strengths were 0.0724, 0.0610, 0.0580, 0.0392, 0.0380 respectively.

From the data in the table 2 and 3, it can be realized that most words are stored based on concept, although few phonological responses still exist as we have mentioned previously. In another word, for the easy/frequently used words the representation or storage of Chinese English learners' mental lexicon is reasonable on the whole. So in the following days, our English teacher should make full use of the current mental lexicon system to add new words so as to increase the students' vocabulary and enlarge the mental lexicon.

Table 2: The Association strength of its responses to *dark* and the association strengths between responses

dark									
responses	light	black	night	white	sun	moon	bright	star	day
Association strength	0.2867	0.2546	0.2078	0.1865	0.1550	0.1237	0.1191	0.0827	0.0697
responses	darkness	red	blue	evening	color	ghost	green	earth	sky
Association strength	0.0565	0.0517	0.0383	0.0367	0.0326	0.0242	0.0224	0.0216	0.0183

Table 3: The Association strength of its responses to *black* and the association strengths between responses

black							
responses	white	dark	red	yellow	blue	color	green
Association strength	0.5950	0.1853	0.1211	0.0748	0.0743	0.0724	0.0610
responses	night	light	eye	color	blackboard	sun	moon
Association strength	0.0580	0.0392	0.0380	0.0285	0.0207	0.0194	0.0169

4.1.3 Association Strength between Responses Per se

During the association strengths calculation process, it can be found that some of the responses had very low correlation to the stimuli, then how could such kind of responses be activated as responses? Keep this question in mind we tried to calculate the association strengths between the responses and its adjacent ones to find the link strength between the responses.

Table 4: The Association strengths of the responses to *white* and the association strengths between responses per se

white							
responses	black	snow	dark	red	yellow	green	blue
Association strength	0.4935	0.1010	0.0858	0.0641	0.0550	0.0511	0.0508
A.S between adjacent responses		0.0275	0.0000	0.0000	0.4666	0.2000	0.0000
responses	color	sun	sunshine	light	night	ghost	
Association strength	0.0488	0.0300	0.0278	0.0263	0.0257	0.0164	
A.S between adjacent responses	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	

Note: A.S here is the short form that stands for association strength

Since there exists connection between the responses themselves, we started to calculate the association strengths between the adjacent responses. With the conditional probability in mathematical statistics, we calculated the conditional probability for each adjacent responses to see how strong the association strength was between them.

In Table 4, the association strengths between the responses and the stimulus *white* and the adjacent responses were listed. The association strength between snow and black was 0.0275, which was relatively low compared with snow to *white*, which meant snow was stimulated by *white*, rather than by black. In another word, the latter responses were not stimulated by their anterior ones.

So using the data shown in Table 4 we may manage to illustrate the organization of the stimulus *white* in Chinese English learners' mental lexicon by Netdraw in Figure 1. Figure 1 could be seen as the representation of mental lexicon network of *white*. According to Figure 1, during the mental lexicon activation process, black, snow, dark, red, yellow, green ... would be stimulated sequentially; it also indicates that it is the preceding responses like red, yellow and sun that activate yellow, green and sunshine.

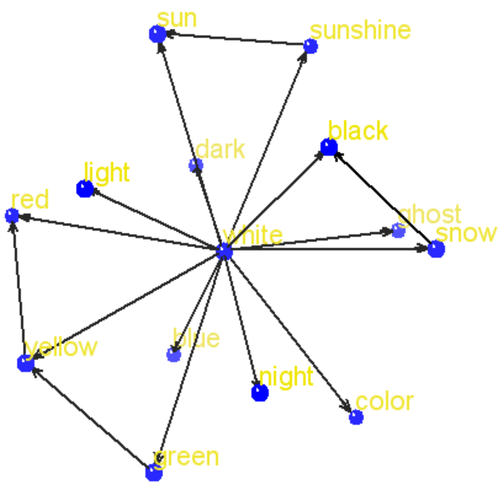

Figure 1: Network of the responses to the stimulus *white* (according to the association strength)

Table 5 listed the comparison between the association strengths of the responses and *dark*, and the responses themselves. Of all the 18 most frequently activated responses calculated here, the association strength between sun and moon was 0.6549, between moon and the stimulus *dark* was 0.1237, which indicated that moon was stimulated by sun instead of by *dark*. From Table 5 we may notice that for the stimulus *dark* several pairs of responses had association strength (light-black, black-night, night-white, and sun-moon) between the two adjacent responses. But the association strength of each repair was inferior to that of the stimuli.

Table 5: The Association strengths of its responses to *dark* and the association strengths between responses

				dark					
responses	light	black	night	white	sun	moon	bright	star	day
Association strength	0.2867	0.2546	0.2078	0.1865	0.1550	0.1237	0.1191	0.0827	0.0697
A.S between adjacent responses		0.1923	0.1900	0.0500	0.0000	0.6549	0.0000	0.0000	0.0000
responses	darkness	red	blue	evening	color	ghost	green	earth	sky
Association strength	0.0565	0.0517	0.0383	0.0367	0.0326	0.0242	0.0224	0.0216	0.0183
A.S between adjacent responses	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Note: A.S here is the short form that stands for association strength

In the same way the representation of other words in Chinese English learners' mental lexicon can also be shown in the three-dimensional pictures of *dark* in Figure 2. As is shown in the figure there were 266 different responses activated by the subjects, eighteen of them were selected as the nodes. *Dark* first stimulated light and then black….

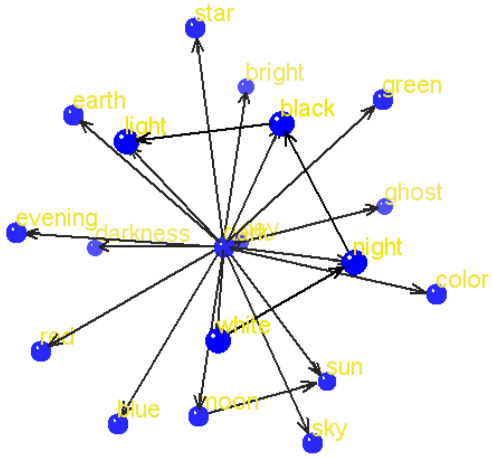

Figure 2: Network of the responses to the stimulus *dark* (according to the association strength)

Based on the figures above, we can try to answer the question “Why in terms of position the first or second responses may not ensure the highest association strength?” or another question “why some responses seem to have nothing to do with the stimuli on surface can still be activated?” That is because some words are not activated by the stimuli only but accessed by the other words (preceding responses). So from this we can see how the content of our mental lexicon can grow. Not only the words related to the stimuli directly can be added or retrieved, but other words have closer semantic links to responses can also be added into the whole network, which can ensure the high efficiency of the mental lexicon organization and retrieval.

From these figure, we can also easily find that the majority of the responses are organized based on concept. They all have some semantic relation to the stimulus, no matter of the similar or opposite meaning or what other semantic relation.

In general, from the association strengths between the responses and stimuli and between the responses themselves, the correlations between different responses to the same stimuli and the two adjacent responses can be got, and then we can draw out the representation of mental lexicon in Chinese English learners’ mind. It can be found that the association strengths between responses and stimuli are different, which means each response has its own particular relationship with the stimulus. We also find some high frequency responses in the first or second position have high association strengths to stimuli, but this logic does not work all the time. Sometimes the connection between responses is even stronger than that with stimuli, which can explain why the responses of relatively low association strengths to stimuli can be activated. It also demonstrated and proved that the mental lexicon in our brains were arranged in a certain way, and when we want to activate the mental lexicon, some words were not stimulated or associated only by the stimuli, but caused or stimulated by its preceding responses or the nearby words stored in mind. It may be the mechanism how our mental lexicon activation network comes into being. And another aspect should not be neglected from the current study is that most words are stored in our mind based on concept (a certain kind of internal semantic relation), although some syntagmatic or phonological responses still exist.

4.2 Mechanism of Mental Lexicon Network

4.2.1 Major findings

As has been discussed, all the words in our mind can form one mental lexicon network. This network must be a large and complex one with the increasing vocabulary. Through the current study we find that the correlation or the strength between each two words is not fixed, which may vary according to different stimuli. Therefore we can regard the mental lexicon activation as a two-direction work that the process can not be traced back. And if the learners acquire enough words, the mental lexicon process will have no ending. So our English teachers should try to take advantage of the feature to enlarge the students’ mental lexicon effectively so that the learners can access the proper words with least energy especially doing some productive work like speaking and writing.

4.2.2 Mechanism and components of mental Lexicon activation network

Current researches proved that in mental lexicon, words were not stored in our brains unsystematically or isolated, on the contrary, they were stored in an organized and intertwined network. The organization of mental lexicon was mainly by semantic networks, in which words were denoted by nodes, and the nodes were connected by semantic links. Collins & Loftus put forward the spreading activation model, which pointed out that organization of mental lexicon was like an intertwined network with nodes representing the words in the network. The spreading activation model abandoned the concept proposed by hierarchical network model that nodes had different grades in mental lexicon (Collins & Loftus, 1975). In spreading activation model, the distance between nodes considered not only the structural characteristics in hierarchical network, but also considered such circumstances like typicality effect, and verified that mental lexicon activation was a process that spread from the nodes to their surroundings. From this study we may also find some clues of the mechanism.

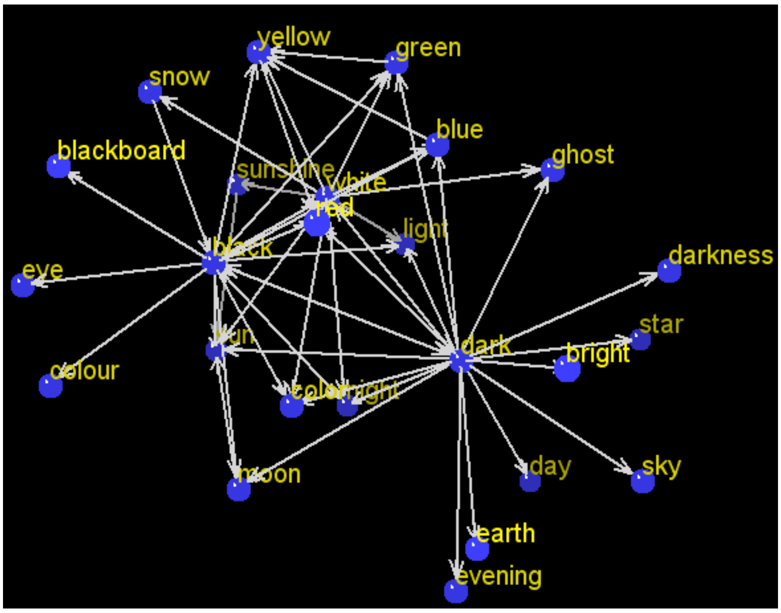

Figure 3: Mental lexicon networks composed by stimulus *black*, *white* and *dark*

Since the three stimuli *black*, *white* and *dark* would stimulate one another as well, we may try to combine the three networks of the three stimuli together and get a more comprehensive network in Figure 3. This figure showed that *black*, *white* and *dark* stimulated 14, 13 and 18 responses respectively, and the three stimuli could also stimulate each other. When this mental lexicon network was formed, *dark* played as the stimulus, not only the responses to *dark* would be activated, but also some words activated by other stimulus would be retrieved as well. The cubic mental lexicon networks composed by the vertical as well as horizontal networks indicated that almost all words can be connected in direct or indirect ways. Given adequate stimulus, the networks formed in the study would become more real to reflect the actual representation of our mental lexicon activation networks.

5. CONCLUSIONS AND IMPLICATIONS

5.1 Conclusions

The aims and major objectives in this study are to: (1) study structures and organizations of L2 mental lexicon so as to explore the internal semantic relations; (2) reveal the formation of mental lexicon activation network.

Finally the following conclusions can be drawn:

1) The association strength between some words has been got; and we also managed to show the link strength between mental lexicons in data which is a significant trial in the field of mental lexicon research. These useful data may help us convert the abstract lexicon relation into concrete statistical facts and establish the mental lexicon network model.

2) Both the link strengths and degree of accessibility between responses and stimuli are different. We may take it for granted that high frequency responses in the first or second position must have high association strengths to stimuli, but the current research fails to prove this.

3) Through unveiling the representation of some words in Chinese English learners' mental lexicon, we can say most words are stored in our mind based on concept(a certain kind of internal semantic relation), although some syntagmatic or phonological responses still exist.

4) Through the current study we find the working mechanism of mental lexicon activation and the association strength between each two words is not fixed. Therefore, the mental lexicon activation can be a two-direction work, but the process can not be traced back. And if the learners acquire enough mental lexicons the activation process will have no ending.

5.2 Pedagogical Implications

As has been discussed above, the network of mental lexicon is a very large and complex one. The association strength between words is not fixed. New words can be added and the seldom activated word can be lost. These findings can provide suggestive guidance for future EFL teaching in China.

First, since the strength between each two words is different, the English teacher should try to strengthen the connection. The teacher should encourage students to read/listen or speak more so as to have enough chances to activate the words stored in students' mind. Given more chances to activate the words on different occasions the students' mental lexicon can become more flexible and solid, as a result to make the weak connection strong.

Second, from our study we can say most words are stored based on concept but some words are still organized by its pronunciation or the word form even different grammatical variation. The research indicated that not every student can place the commonly used words in the proper position, so a demanding task for our English teacher is to help students to build a reasonable and effective way of organizing the mental lexicon. Of course memorize a new word by knowing its root is an effective way. But it should be regarded as the primary stage because acquiring a new word does not only mean just understand its root and other varied form of it. After learning the words for a while, teachers should instruct the students to build semantic system of the certain words by creating more opportunity for the students to encounter it under different semantic background.

Thirdly, the improvement of the students' mental lexicon ability is both a comprehensive and systematic project. Reading and listening seem to be a little passive way in English learning. But improve the metal lexicon by these two ways can help the students learn to predict the next words or context by activating the related mental lexicon to advance their lexicon organization continuously. Writing and speaking is productive learning. It can improve learners' ability in seeking the proper words out in the least time by activating the words in a scientific way. In one word, the improvement of mental lexicon should be done by the comprehensive advancement of the four skills.

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