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Input of Multimedia Information, Cognitive Load & EFL Listening Decoding

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Abstract
This paper clarified the concepts of cognitive load and combined EFL listening decoding as well as the relationship between them, and examined the change of learners' cognitive load and its impact on their EFL listening decoding which were caused by input of pure audio information and that of combined audio information with mixtures such as pictures and images. Based on this, the author proposed some effective strategies to improve learners' EFL listening decoding, including strengthening the training of learners' English thinking, increasing their cognitive level, enriching the design of EFL listening teaching, creating multiple schemas and maintaining the reasonable cognitive load according to individual learners' cognitive styles.

Key words: Input of multimedia information; Cognitive loading; EFL listening decoding

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INTRODUCTION

When the messages related to linguistic category is processed cognitively by the brain, the previous non-structured linguistic message will become structured linguistic message. In other words, linguistic forms are converted into linguistic contents, which is actually decoding of linguistic message (Krashen, 1981). In the context of multimedia-assisted EFL listening teaching, EFL learners deconstructed and annotated the English listening message that has been input at the phonetic, semantic and cultural levels so that it can be converted into the linguistic postcode that is suitable for the use of learners' nerve system. After it has been further decomposed, distinguished and categorized by the linguistic central nervous system, listening message is converted into meaningful content. At the present researches with regard to linguistic decoding are being paid great attention to (Sweller, 2004; Slava, 2007). Some scholars pointed out that linguistic decoding was mainly affected by individual cognitive load, which to some extent played a decisive role in linguistic decoding and directly affected its speed and efficiency (Slava, 2007). Some other scholars suggested that linguistic decoding was indeed related to the change of cognitive load but mostly affected by the way in which linguistic message was input (He, 2005). Researches both at home and abroad have already been made from the perspectives of message input and cognitive load. Nevertheless, when linguistic decoding is discussed, the change of cognitive load caused by message input and its impact on linguistic decoding has to be examined, since message input, cognitive load and linguistic decoding have logical precedence relationship and cognitive consistency. However, there have been few researches with regard to the combination of the three respects. Hence this research intends to focus on EFL listening decoding, clarify the concepts of cognitive load and combined EFL listening decoding as well as the relationship between them and examine the change of learners' cognitive load and its impact on their EFL listening decoding which are caused by input of pure audio information and that of combined audio information with mixtures such as pictures and images. Based on this, the author proposes some effective strategies to improve Chinese learners' EFL listening decoding.

1. COGNITIVE LOAD AND EFL LISTENING DECODING

1.1 EFL Listening Decoding

Sweller et al. (1998) believed that in the same context, linguistic decoding refers to the thinking and operating process during which people interpret, comprehend and understand the message sent by the second communicative subject to the first one so as to obtain the linguistic message (Sweller et al., 1998). In the communicative context of ESL, as code switching between two languages is involved, the decoding process is usually more complicated in comparison with the same context. Previous researches indicated that when linguistic message was input into EFL learners' brain, speech stimuli caused the continuous cognitive response in learners' linguistic nervous centralise, and the response included the cognitive processing of the message, its converting and recognition, and also the clarification and construction of the meaning of the message. After repeated stimuli-response activities, the newly constructed linguistic message will be stored in learners' working memory system. When the message is further processed cognitively and integrated, the previous disorderly linguistic message will be converted into orderly linguistic contents so that learners can extract, interpret and comprehend according to their own needs. Then linguistic decoding will be indeed completed. As far as EFL listening is concerned, its decoding process consists of the patterns of bottom-up and top-down. The decoding of bottom-up refers to the series process of message decoding from lower levels to higher levels, such as from single word to sentence, paragraph and passage while the top-down decoding focuses on the identification of the whole structure and contents of the texts, being a process of prediction, verification and confirmation. The two processes appear to be similar but intertwined and interact with each other in reality and together contribute to the task of decoding (Ding, 1998). As for a specific decoding process, decoding is usually made up of three procedures. Firstly, phonetic decoding. On the premise that learners are familiar with the pronunciation system, they distinguish and identify the phonetic message they have heard, rapidly judge the syllable composition and pronunciation rules of each sound and calculate its elementary composition and numbers. Secondly, semantic decoding. Listeners arrange the meaning of the phonetic message they have heard, semantically deconstruct the phonetic units which are independently composed of phonemes and syllables by segmenting the message symbol so that the broken message segments can become meaningful semantic units. Thirdly, cultural decoding. Culture proves to be the core of a language which turns out to be the shell of culture. A language without culture has no soul and proves to be insignificant and meaningless. Therefore culture decoding is more complicated and implicit than phonetic and semantic one, habitually related to EFL learners' knowledge structure and linguistic capacities and affected by their cultural background, value orientation and mode of thinking (Wang, 2008).

1.2 Cognitive Load and EFL Decoding

The size of cognitive load is the direct cause that affected learners' EFL listening decoding (Ma, 2003). Previous researches revealed that learners' EFL listening decoding is negatively correlated to the consumption of cognitive load. In other words, the more cognitive load the individuals consume, the more difficult it will be to decode and vice versa. Due to the dynamics of the cognitive load, listening decoding is complicated most of the time. According to the theory of cognitive load additivity, cognitive load refers to the total amount of the psychological load beard by the working memory system of human brain when it processes a specific cognitive task, including the internal cognitive load, the external cognitive load and the relevant cognitive load (Gong, 2005). The internal cognitive load refers to the load that is produced when working memory system processes the cognitive task and emphasizes the impact that the element composition of the task itself and difficulty level exert on cognitive processing, and the impact is mostly caused by the element recomposition or interactivity of the task itself. The external load refers to the load when inappropriate cognitive processing produces impact on the working memory system and emphasizes the effect that different cognitive processing methods or cognitive means produce on cognitive processing, and the effect is due to the different presentations of messages. The relevant cognitive load refers to the load board by the brain's working memory system when it cognitively and substantially processes the cognitive task. It is closely associated with brain's schema structures and automation and is caused by knowledge structure and storage at deeper levels. The sum of the external load, the internal load and the relevant cognitive load means the total amount that cognitive load consumes, and when the sum of the three surpasses the capacity of the working memory system, information processing will be hindered. In addition, when the sum of the three is lower than or equal to the working memory capacity, it will be smooth for cognitive processing and easy for decoding. But when the sum of the three is lower than a certain boundary point of working memory capacity, it will be almost impossible for cognitive processing and difficult for decoding. General speaking, the lower the internal load and the external load, the higher the relevant load and when the sum of the three is lower than the boundary point of working memory capacity, it will be more rapid for cognitive processing and easier for decoding. Otherwise it will be more difficult for cognitive processing and impossible for decoding. As for the measurement of the size of cognitive load, the

most frequently used is Paas' scale (2003) for cognitive load measurement. The participants were urged to finish a specific cognitive task in the closed lab according to the instructions. Then with eye tracking system, the researcher observed and wrote down the change of the time and frequency of their fixation, twitching of the eyelid and pupil diameter. The researcher also recorded the response time and accuracy of the task. After the experiment, the participants were required to make a self-evaluation of their psychological effort and the difficulty level of the task and measure the individual cognitive load via qualitative description and quantitative statistics.

2. INVESTIGATION OF THE DECODING IN THE CONTEXT OF DIFFERENT MODES OF INFORMATION INPUT

As the above mentioned, the series of rules for EFL listening decoding divide decoding into three levels, including linguistic decoding, semantic decoding and cultural decoding, and any of them can not be separated from the input of the external information. Different input modes of external information directly cause the change of individual cognitive load so as to affect the speed and efficiency of EFL listening decoding (Shi, 2011). As early as 2003, Paas et al.（2003）employed multiple factor experiment to explore the change of learners' cognitive load and its impact on their EFL listening decoding which were caused by input of pure audio information and that of combined audio information. The experiment took input of pure audio information, input of combined audio information and the change of participants' cognitive load as the between variables and listening decoding as the dependent variable. The experiment subjectively managed and arbitrarily changed the mode of information input, or the participants so that they might arbitrarily move within the group, the change of their cognitive load could be measured and the speed and efficiency of their listening decoding be examined. It was found that the input of combined audio information was significantly correlated to the change of participants' cognitive load. After chi-square test of individual classification, it was found that the combined audio information contributed most to the total significance and that the cognitive load that the participants consumed was significantly lower than the total cognitive load that the pure audio information consumed. The latter experiment validated that there were significantly more correct answers for the input of combined audio information in the open transferred test items than those for the input of pure audio information (see Table 1).

Table 1
***T*-Test for Change of Participants' Cognitive Load Caused by Input of Pure and Combined Audio EFL Listening Information**

	Psychological effort		Difficulty level of the task		Data for eye movement		Response time for the task		Accuracy for the task	
W	***M***	***SD***	***M***	***SD***	***M***	***SD***	***M***	***SD***	***M***	***SD***
Y	4.62	1.54	5.14	2.15	6.81	3.00	3.07	1.87	4.88	2.65
W	4.02	1.81	5.25	2.61	8.54	3.04	2.95	1.67	5.32	3.75
t value	-0.213		-0.15		3.242*		0.212		0.195	
p value	0.853		0.657		0.012		0.453		0.044	

Note. W=input of pure audio EFL listening information; *Y*= input of combined audio EFL listening information.

Table 1 revealed that there were no significant differences between participants' cognitive loads for both input of pure audio EFL listening information and that of combined audio EFL listening information in the aspects of psychological effort, difficulty level of task and response-time for the task ($p<.05$). As for the data for eye movement and accuracy for the task, it was higher for the input of combined audio information than the input of pure audio information ($p<.05$), while there was no significant difference for psychological effort and difficulty level of task, and the cognitive load consumed, indicating that adding the mixed information such as pictures and images did not significantly increase participants' cognitive load but affected their accuracy for the task completion. Hence there might be the following explanation for the experiment result. As there is a limitation to human brain's working memory system and the total cognitive resources, the extra information with pictures and images effectively integrated the information amount which entered the working memory system so as to decrease learners' cognitive resources needed by psychological processing and their cognitive load and increase the accuracy for the task completion. Based on Paas' experiment, some scholars made experiments with regard to the relationship between cognitive load and listening decoding (Feldman et al., 2005) and arrived at the following conclusion. Firstly, the input of combined audio information could more greatly decrease learners' cognitive load than the input of pure audio information, and the less the consumption of cognitive load was, the easier the listening decoding would be. In addition, continuous and long-time input of listening information of the same category might result in the fact that learners easily got fed up with it and cognition became difficulty and the difficulty level of listening difficulty would increase, as the duration of information input surpassed

the time limitation of learners' attention and the cognitive load consumed was lower than certain boundary point of working memory capacity. Secondly, if learners failed to find the instantaneous relations between the listening information that had been input and the task to be completed, they would deem it to be extra and also get bored so that it would be impossible for listening decoding. Thirdly, when cognitively processing the information, listening learners had inevitably to interact with multimedia environment. If they failed to master the computer operation skills, they would have to consume some psychological energy to think over it so that cognitive load would be increased and decoding become slow. Finally, due to the complexity of the listening information structure itself, learners' original cognitive habits and abilities would affect the reception level of information so as to affect the consumption and change of cognitive load and the difficulty level of decoding (Lin & Chen, 2007).

The information input which aimed at decoding, no matter whether it is pure audio input or combined audio input, cognitive consumption and decoding undergoes a continuous cognitive processing process. As the process goes, the assimilation mechanism of brain's cognitive processing is continuously adjusted and releases the cognitive load and continuously divides, recombines and integrates the information that has been input so that learners repeatedly and culturally induce, associate, interpret, understand and comprehend it from pronunciation to form, from form to meaning, from word to sentence and from sentence to text until they can catch it (Paas et al., 2003). Therefore EFL listening decoding process is actually an active and dynamic cognitive linguistic process. Hence without brain's cognitive mechanism, listeners will not be able to memorize and process the sound message so that meaningful topic will be impossible, decoding will not be completed and listening difficulty will be inevitable. In addition, compared with the pure audio listening information, combined audio listening information proves to be obviously superior, indicating that the "schema" information such as pictures and images in the combined audio information can produce significantly effect upon EFL listening decoding. Xin and Lin (2002) conducted experiments and concluded that the schema information such as pictures and images played a crucial role in listening decoding. In other words, the more efficient the schema was, the less cognitive load consumed there was in the cognitive process, the more practical the prediction would be and the easier it would be for listening decoding. In contrast, if there was not sufficient schema, the greater cognitive load there consumed in the listening decoding, understanding would become slow and decoding more difficult. Hence in order to improve the efficiency of listening decoding, listeners may subjectively add or increase schema, decrease the internal and external cognitive load in the cognitive process so as to ensure that the total sum of the three elements in the process is lower than the total amount of the working memory system and that decoding will become easy. In the listening process, the total amount of psychological resources consumed by the continuous input of pure audio listening information or combined audio information surpasses that of the cognitive system itself possesses, or when the cognitive load it consumes is greater than the capacity of the working memory system, it will be overloaded, any extra load will not be dealt with. Listeners will be highly nervous, information reception or understanding will be affected and listeners will not be able to decode. In addition to the above, when listeners lack meaningful background knowledge, techniques for testing and listening experience, they will be afraid of difficulties, consume extremely low cognitive load and listening decoding becomes slow. Researches have confirmed that man's working memory can merely store 5-9 basic information or information chunk at a time (Sweller, 2004), which means that the cognitive load that cognition consumes can either surpass or be less than the range, since reasonable cognitive load has obvious positive transfer effect on listening decoding. When the cognitive load that learners consumption is too high or too low, they usually become extremely nervous or tired and the decoding proves to be the worst. When cognitive load is medium, decoding will be the best. Gong's (2006) research suggested that the amount of the cognitive load that had been consumed was significantly correlated to the error rate of listening decoding. In other words, when it was too low or too high, the error rate for listening decoding would be the highest. Hence when cognitive load is reasonable, the error rate for listening decoding will be low.

Accordingly it might conclude that there should be three crucial elements for EFL listening decoding. Firstly, decoding ought to possess the variable of the intermediate effect. Without cognitive processing as a bridge, it will be impossible for listening decoding. Secondly, compared with pure audio information, combined one has its incomparable superiority and can more activate the schema in the cognition. The more schemas there is, the less cognitive load it consumes, and the easier it will be for listening to decoding and vice versa. Thirdly, the cognitive load can neither be too high or too low, and reasonable cognitive load has obviously positive effect on listening decoding.

3. HOW TO IMPROVE LEARNERS' STRATEGIES FOR EFL LISTENING DECODING

In the context of multimedia-assisted EFL teaching, it is always teachers' duty to improve students' communicative abilities such as listening and speaking (S. R. Wang & H.

X.Wang, 2011). Teachers ought to intentionally train their thinking in English, improve their cognitive processing efficiency to deal with communication events in English. With the rich multimedia information resources, teachers are supposed to perfect their listening teaching design, create multiple schema so as to improve listening teaching efficiency. In addition, teachers also need to practice small-size class or hierarchical teaching according to different students' different cognitive styles so as to maintain their strong interest in EFL learning and form good listening habits.

3.1 Strengthening EFL Thinking Abilities and Improving Cognitive Processing Level

Either the adjustment of cognitive load or the optimization of decoding process can not be separated from the effect of learners' cognitive processing. Hence it is crucial to improve students' cognitive processing level in the EFL listening teaching. Teachers need to contrapuntally guide students to memorize and comprehend the listening materials, encourage them to refer to the background knowledge, make enough analysis, evaluation and creation so as to improve their critical thinking ability and effectively improve their cognitive processing abilities.

For example, when students listen to an introduction to the present American President, the teacher may use PPT to reveal a reading passage related to the topic, guide students to become familiar with the material before it is played, urge them to search it on the internet and with the background knowledge, analyze and assess it. Why can Barack Hussein Obama become the 44th and current President of the United States? With the opening and inspiring questions of this kind, the teacher may activate students' enthusiasm and provide decoding support for the next information deconstruction and recreation of the listening material. By means of prediction, correction and making up, learners may obtain sufficient meaningful elements to train their thinking in English and gradually improve their cognitive proficiency.

3.2 Enriching EFL Listening Design and Creating Multiple "Schema"

Firstly, teachers ought to take students' maximum cognitive load as the boundary point of listening teaching design, decrease their psychological pressure as much as possible, activate their interest, decrease their cognitive load and make the cognitive load play the teaching effect on multimedia teaching design (Cheng & Zhou, 2008). On the other hand, the teacher should intentionally organize activities that are favorable for students' obtaining of relevant schema and skillfully make use of schema, phonetics, cues and graphics (Wang, 2003) so as not to distract students' attention because of the disorderly contents, decrease the unnecessary mental integration due to the scattering information source and make it possible for the new and meaningful schema to be gradually formed in the brain to effectively decrease cognitive load and improve listening efficiency.

For example, students will listen to a passage about Nelson Mandela. The teaching process may be designed like the following. Firstly, the teacher may play a video about Mandela's activities before he became South Africa's President. After the introduction to the topic, the teacher may ask a student to play the role of Mandela and communicate with the whole class. Then the teacher introduces key words with pictures and urged the students to fill in the blanks. For example, if the filled word "embarrassed" is a new word, the teacher may refer to the picture and explains like the following: "Being boys, Mandela and his fellows had to play on their own. One day, he learned a lesson from a donkey, which embarrassed him in front of his friends……", indicating that Manndela was embarrassed indeed. The teacher may urge the students to complete the cognitive process of the word embarrassed according to the context via fast reading or simply searching reference materials on the internet. Through such design of teaching activities, the schema in students' brain will be made up and related background knowledge be created so that their cognitive load will be decreased and listening efficiency naturally improved.

3.3 Maintaining Reasonable Cognitive Load According to Learners' Cognitive Styles

Cognitive style proves to be the habitual behavior mode during the cognitive process and the attitude and expression ways in the process of problem solution, including polymerization- divergence, field independence-dependence, globality and sequence (Richard & Stephen, 1998). Different learners have different cognitive styles and consumption level of cognitive load in the cognition (Sweller, 2004). The teacher may make every effort to find out the variables that affect the individual differences of students' cognitive styles, observe and make an analysis of each individual student's differences of cognition, evaluate the boundary point of individual cognitive load so as to ensure the consumption of cognitive load within the control and the listening decoding comparatively easy. For example, for learners of divergence, the teacher may assign them some reading materials, put forward some guided questions, urge the students read through the materials first and try to answer the questions before pre-listening so that listening pressure and cognitive load will be decreased and decoding speed naturally faster in order to obtain better listening results. As for the learners of concentration, the teacher may employ some other design, offer them listening materials with pictures to make up for the lack of experience, effectively decrease cognitive load and increase the efficiency of listening decoding. In the context of multimedia-assisted teaching, the teacher may employ the cognitive activities and exercises automatically formed in the computer system according

to students' cognitive styles, knowledge structure and feedback of listening achievement, allow students to have autonomous learning use technology to complete their learning tasks without perceiving the barriers brought by it (Fan & Jin, 2006). Thus the cognitive load may be maintained at a relatively low level and students do have interest and self-confidence in listening course and persist in that for quite a long period of time until their listening proficiency is effectively improved.

CONCLUSION

EFL listening decoding is directly associated with the result of EFL listening teaching. The traditional unitary teaching approach of playing tapes and checking the answers will be absolutely replaced by systematic listening training with focus (He, 2003). This research merely examined the change of cognitive load caused by two different categories of information input and how it affected EFL listening decoding and put forward some effective strategies that might improve students' EFL listening proficiency. In reality, there are numerous factors that mat affect EFL listening decoding, such as the areas from which the students come from and the EFL education development level of each area, the different design of their EFL listening courses, teachers' EFL proficiency, the local teaching infrastructure, students' proficiency of information technology and meta-cognitive monitoring abilities, etc., which all directly or indirectly affect their EFL listening efficiency. Nevertheless, it ought to make a deeper and more systematic discussion in order to validate how these factors produce influence on EFL listening. It will be more effective to make empirical researches. Only when factors that may affect EFL listening decoding are analyzed from an all-around way and from various perspectives can scientific cognitive instruments and methods be provided for the learners so as to improve the EFL teaching efficiency.

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