On the Impact of Multimedia Information Input on English Listening Decoding Based on Cognitive Load Theory

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Abstract. Based on cognitive load theory, this paper aims to study how multimedia information input, a combination of audio information, pictures and graphs, in contrast with pure audio information input, has influenced English listening decoding, and then put forward some practical training strategies, such as strengthening learners′ way of thinking in English to improve their cognitive learning levels, constructing multi-schema of learners to enrich listening teaching design, as well as maintaining reasonable cognitive load based on learners′ different cognitive styles.

Introduction

When Language category related signals are processed by the cognitive function of the brain, previously non-structured language signals may turn into structured information, and language forms translated into language contents, this is known as language information decoding[1][2].In multimedia English listening teaching environment, after the deconstruction and annotation of language signals such as phonetics, semantics and culture, foreign language learners may translate English listening signals into a neural system that can be used[3]. and then after further decomposition and classification in language central nervous system, the hearing signals are converted into meaningful listening contents. Nowadays, the research of language decoding has become the focus of many scholars [4][5][6][7].

Some scholars have pointed out that language decoding is affected by the size of individual cognitive load; to a certain extent, cognitive load determines the speed and efficiency of the decoding [8]. And some scholars believe that there is a close relationship between language decoding and the change of cognitive load, but the input of language information functions as the greatest impact. Scholars both at home and abroad have explored language decoding from the perspective of information input and cognitive load. Due to the logical priorities and the unity of information input, cognitive load and language decoding, the exploration of language decoding should also include examining the effects of information input on language decoding in accordance with the changes of cognitive load. However, the study of the three parties is not much. In view of this, this paper takes English listening decoding as the research object, try to clarify the relationship between cognitive load and English Listening decoding, by studying multimedia information input which consists of pictures, images and other auxiliary audio input, explain the influences of cognitive load on listening decoding and then put forward some strategies of improving English listening level of learners.

English listening decoding

Some scholars believe that, in the same context, language decoding is the process of language thought where the second body of communication tries to interpret, understand and obtain language information of that of the first body of communication[9]. In terms of English listening, the decoding process includes two methods: top-down and bottom-up. The bottom-up decoding method is mainly composed of a series of information decoding processes, from low to high, from single English words to sentences, paragraphs and chapters. While the top-down decoding process focuses

on the identification of the whole structure and content of chapters, which is a process of prediction, inspection and verification. These two processes seem to be the opposite, however, they are essentially intertwined and interactive to each other, the two together committed to the completion of the decoding task [10].When a specific decoding process is concerned, the decoding of it includes three steps: Step 1: speech decoding. Listeners are familiar with pronunciation, after hearing language signals, they try to identify and judge the syllable composition and rules of each pronunciation, then figure out the elements of each composition and the number of speech sounds. Step two: semantic decoding. Listeners try to sort the received speech sounds by the segmentation symbols, i.e, phonemes, which are composed of syllables. After a semantic deconstruction, information fragments become meaningful semantic units. Step three: cultural decoding. Culture is the core of language, and language is the shell of culture. Without culture, language is not only soulless, but also pale and meaningless. Therefore, cultural decoding is more complicated and implicit than speech decoding and semantic decoding, which is often related to foreign language learners' knowledge structure and linguistic competence and is influenced by cultural background, value orientation and thinking mode.

Cognitive load theory and English listening decoding

Cognitive load is the main factor which influences English listening decoding. Research shows that English listening decoding is in inverse proportion to the consumption of the cognitive load, namely, the more individual consumption load, the more difficult the decoding; similarly, the less cognitive load, the easier the decoding. Due to the dynamic nature of the cognitive load, listening decoding usually gets very complicated. According to the cognitive load theory, cognitive load is the total amount of mental workload of the working memory system of the human brain after processing a specific cognitive task, which includes three parts: internal cognitive load, external cognition load and related cognitive load [11]. Internal cognitive load is produced by the brain memory system, focusing on the makeup of tasks and their levels of difficulties. External cognition load focuses on the function and role of outside load produced by processing in different ways. Much of the rest is Schema-related. The load total is the addition of the three. When the three exceed the brain load, information process will be impeded, and cognition will be difficult for learners, thus it is not easy to decode information. And when the three come to a certain point, cognition will hardly ever happen, and it is not easy to decode information too.

Decoding Examination in Different Information Input

About the measurement of cognitive load size, at present one of the most widely used methods is the use of Paas′ cognitive load test Quantity model scale[12] (see Table I).

TABLE I. MEASUREMENT OF COGNITIVE LOAD

index	Contents of measurements		
	low level	intermediate level	advanced level
Mental effort	efforts of task completion	mental devotion	Mental stress
difficulty	levels of difficulty	ways of input	study environment
Eye movement	Data(fixation time, fixation frequency, saccade distance, pupil diameter) are collected by eye movement data processor. Method: first use E-Prime software to edit stimulus process after clipped pictures and graphs, present them on the screen, then ask the subjects to predict the information, finally make a contrastive analysis.		
Response time	Ask learners to make an oral report based on the short conversation or long conversation they have heard, and calculate the average score.		
Task accuracy	The percentage of correct answers in proportion to all tested items.		

The researchers ask subjects to complete particular tasks in a closed laboratory. They are asked to wear eye tracking system to record their fixation time, fixation frequency, saccade distance and pupil diameter etc. According to the changes recorded in the completion of tasks, subjects should make an evaluation about their mental efforts and task difficulty by qualitative description and quantitative analysis,and then make a final calculation of the individual's cognitive load.

As indicated above, different levels of decoding, no matter they are speech decoding, semantic decoding or cultural decoding; each is closely related to external information input. Different information input influences the changes of individual cognitive load and accordingly influences the speed and efficiency and other indicators of listening decoding. Early in 2003, Pass, Renk and others studied this influence. Pure audio listening information and multimedia information input are tested. The experiment found that there was a significant correlation between multimedia listening input and the changes of subjects' cognitive load. After the calculation of the value of the classification card, multimedia information input is significant among total amount of cognitive load consumed by pure audio listening. The cognitive load of the subjects was significantly lower than that of the pure audio input. Follow-up experiment also shows that the task accuracy in the open migration test question is significantly higher than the pure audio information input(see Table II).

TABLE II. T-TEST CHANGES OF COGNITIVE LOAD RESULTED FROM PURE AUDIO LISTENING INFORMATION INPUT AND MULTIMEDIA INFORMATION INPUT

	Mental effort		Task difficulty		Eye movement		Fixation time		accuracy	
	M	SD	M	SD	M	SD	M	SD	M	SD
pure input	4.62	1.54	5.14	2.15	6.81	3.00	3.07	1.87	4.88	2.65
multimedia input	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	

Statistics shows that in mental effort, task difficulty, and time required, there is no significant difference in learner's cognitive load between pure audio input and multimedia input($p>0.05$),while in eye movement and task accuracy aspects, multimedia input data is significantly higher than that of the pure input data($p<0.05$).The increase of pictures and graphs into listening input does not increase the cognitive load of the subjects, but it significantly influences the accuracy of task completion. The explanation is: the total amount of cognitive resources in the brain working system is limited, with additional pictures and graphs integrated into the brain working system, the mental process cognitive load is reduced, which then increases the accuracy of the task completion. Later studies show that with long time continuous same type listening input, learners may get bored and have fear because the time consumed surpasses that of the brain working capacity, and then it is difficult to decode listening information. Also if learners can not capture useful information and think related information is redundant, the same boredom will appear too. And in the process of decoding, learners have to interact with computers, if they have not got a good command of computer skills, additional cognitive load will appear, thus the decoding becomes slow. Finally, the complexity of the structure of listening information, individual cognitive habits and cognitive abilities all will contribute to the reception of the information, and in turn affects the changes of cognitive load and the difficulties of decoding.

Training Strategies

Strengthening learners′ ways of thinking in English

Whether it is the adjustment of the cognitive load, or the optimization of the decoding process, they can not be separated from the role of cognitive processing of the learners; therefore, to improve the student's cognitive level has become the focus of listening teaching. Teachers need to guide students to memorize and understand listening materials, to encourage students to contact background knowledge, to make full analysis, evaluation and creation by themselves, and to train their ability of critical thinking, in order to effectively improve their level of cognitive processing.

For example, students are given a listening passage "Why the IS attacked Paris and other places?" Teachers may present a theme-related PPT, ask students to search information on the internet about the IS, and associate background information to analyze and evaluate the question. Such leading questions will mobilize students, making them to get information construction and reconstruction, and the decoding will become easier.

Constructing of multi-schema

Teachers should find out the critical value of learners′cognitive load, try to reduce their mental stress, and arouse their study interests, so that cognitive load can play a positive guiding role in multimedia teaching design. In addition, teachers should consciously organize students to obtain relevant schema, making use of schema, voice, tips and graphs skilfully, so that students will not be distracted by those contents to reduce their cognitive load.

For example, on 30th December, 2015, in the VOA special English program—words and their stories, there is a story called “Achilles' heel”. Before presenting the listening materials, teachers may show the video of “The Iliad”, the movie adaptation from the famous story written by Greek poet Homer to let them get familiar with the story and the relationship between each character. After the lead-in, teachers can ask students to do role-play, or act out the drama in cosplay. Then teachers present new words and expressions with interesting pictures and ask students to fill in the blanks. In this way students have learned new words like “immortal”, “ruthless”, “warrior”, “tough”, “heads over heels”, etc.

Maintaining reasonable cognitive load

Cognitive style is the behavioural patterns of learners in the cognitive process and their attitude, ways of expression and skills of problem-solving, which includes many types, such as aggregation-divergence type, field independent-field dependent type, integrated-sequence type. Different learners have different cognitive styles, thus different consumption of cognitive load. Teachers need to find out the factors which affect learners′ cognitive styles, evaluate the critical value of individual cognitive load, and make sure their consumption of cognitive load within control, so that listening decoding may become easier. For example, for those divergence type learners, before listening, teachers should provide them with reading assignments, design some leading questions, let students learn to browse listening materials first, and try to answer certain questions. Then teachers play the listening materials. In this way, mental stress of students becomes lower, and their cognitive load becomes lower too. Accordingly, their speed of listening decoding becomes faster. Teachers need also make good use of multimedia classroom teaching facilities and the self-generating capacity of computers, so that computers can generate related listening activities and exercises based on different cognitive styles. Students can study by themselves independently out-of-class without worrying the barrier of extra cognitive load.

Conclusion

English listening decoding directly affects listening teaching and learning effects. Traditional pure listening input will be replaced by multimedia information input. Different information input will lead to the changes of cognitive load and finally will have great impact on listening decoding. This paper only examined the effect of two ways of information input on cognitive load and listening decoding and then put forward some training strategies. As a matter of fact, a great many other factors also affect English listening decoding, such as students levels, development of education levels in different regions, English curriculum design, teachers levels, hardware status, computer skills, metacognitive listening monitoring abilities and so on, all of which have directly or indirectly affect learners listening abilities. Further discussions and explorations are needed to prove their effects on English listening decoding, which might as well be systematic and empirical studies. Only through multiple perspective comprehensive analysis can we provide scientific cognitive tools and methods of decoding.

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