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The Role of Working Memory and Memory Strategies in Adolescent Second Language Learners' Listening Performance

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Abstract

This study examines how the amount of memory and memory techniques influence adolescent students who learn English as an L2 while they are listening. Specifically examining the correlation between L2 listening ability and working memory (WM) capacity, memory strategies, as well as some other influences such as TOEFL Listening task experience for participants and the age when they started to learn English as an L2. There were 24 participants of grade 11 students from Shanghai, China. They participated in two kinds of listening tests according to TOEFL®Junior Comprehensives, did cognitive tests about their working memory capability, and filled out questionnaires regarding demographic information as well as the use of memory strategies. And it's confirmed that the positive correlation between working memory capacity & listening comprehension ability of adolescents learning English as a second language. Participants who scored higher on both the verbal and auditory working memory span tasks tended to score higher on the listening tests, especially in the more complex lecture test. However, some exceptions have occurred. A small number of learners who reported using memory strategies relatively little still performed well in listening, possibly because they had abundant experience answering TOEFL listening questions and were familiar with the format of the TOEFL listening test. And it means that even when someone has an advantage by working memory capacity in listening comprehension; there are other experience based reasons as to why different students perform differently. This study makes a contribution to the area of cognitive factors in second language listening but for adolescents. As far as we know, there has been no study that investigates young listeners' listening performances together with individual differences on both working memory and use of strategy. This research fills this gap by integrating the listening comprehension items of a standardised test tailored for adolescent L2 learners with cognitive span tasks assessing working memory capacity and questionnaires probing learners' demographic information and strategy application. According to combining cognitive and experience variables, this study brings a novel perspective on the effect of personal variables in adolescence on second language listening ability.

Keywords

Working memory; Second language listening; Memory strategies; Adolescent learners; Individual differences

1. Introduction

The acquisition of English listening skills is important but difficult for most second language learners, especially for adolescents in the context of learning who have a higher demand for comprehension. The cognitive load of listening comprehension is that learners need to decode the spoken language, remember the relevant information, and integrate the linguistic clues at the same time. More and more studies find out that working memory (WM) is an important cognitive ability for successful listening to the L2 because it helps us keep hearing information and also seeing things at once [1]. Working memory is a sort of cognitive system that may keep and work over data for complicated cognitive actions, like language comprehension or logical reasoning. According to Baddeley's model, WM comprises a number of interacting parts such as the central executive, phonological loop, the visuospatial sketchpad, and episodic buffer [2]. Phonological loop, store and repeat verbally or auditorily input information; the central executive is in charge of coordinating the attentional control, distributing cognitive resources for information processing. In previous work on second language acquisition it has been demonstrated that working memory capacity is important for adult L2 listening comprehension [3]. Learners who have a higher WM capacity can usually retain the segments of spoken input when they are processing syntactic and semantic information. As a result, those with higher working memory capacities are better able to understand complex spoken discourse that lasts long, such as in an academic lecture. Most of these studies have been conducted on the adult population, leaving a lack of exploration on how WM and related strategies affect relatively young learners with their still-developing cognitive abilities.

Another possible reason for the impact on listening comprehension could be the application of memory strategies. Memory strategies are deliberate cognitive ways that learners use to code, categorize and recall info better [4]. Such as rehearsal, group information, forming associations, using context cues to help remember. These strategies can possibly enable students to handle the constrained capacity of working memory, and have the entered linguistic material arranged favorably for retention. While potentially significant in L2 learning, few have delved into how memory strategies are linked to listening ability among adolescent second-language pupils.

Cognitive ability and strategy, in addition to language learning experience, may also affect the development of L2 listening. Factors such as whether learners have been exposed to standardized listening tasks before, how long they prepared for the test, and what age they started learning a second language can all influence their language proficiency outcomes. These sorts of experiences may interact with cognitive capabilities and the approaches utilized in assessing listening comprehension outcomes. This study therefore aims to further illuminate the aforementioned relationships through an investigation of working memory capacity and memory strategy utilization in relation to the listening performance of adolescent L2 learners. And most especially on those two working memories, verbal and auditory as well as the self-reported learning strategies and the various kind & difficulty standards of listening tests will be checked.

There are mainly three goals of this study. And then the biggest purpose would be trying to see how working memory capacities affect the listening ability of teenagers studying English as a second language. A second aim will be to explore how different types of memory strategies impact L2 listening comprehension for teenage students. In addition, this study attempts to investigate the possible impact of certain variables such as having experience in TOEFL listening and age of second language acquisition, on students' listening performance. We would use listening comprehension scores from a shortened standardized test for adolescents' second language listening and span tasks to assess working memory capacity as well as a questionnaire on participants' demographics and memory strategy use to investigate the effect of cognitive capacity on listening performance. According to theoretical models of working memory and prior studies on second language listening, it was predicted that the scores of adolescent L2 learners on listening comprehension tasks would be positively related to their working memory capacity [5]. Specifically, learners who have more WM resources available for storing, processing and executing should score better on the listening test. And also expect that using memory strategies more often would have a positive relation to listening as well. Language learning experience includes prior preparation for TOEFL listening tasks and the age of onset of English language learning, which may also lead to differences in listening results.

The results of this study have a guiding role for research and application. Theoretically, this study supplements existing cognitive models of listening in a second language (L2) by investigating how working memory capacity and memory strategy utilization jointly affect the listening performance of adolescent learners, who have received less attention than other age groups in past studies. Practically, it can provide a certain reference for all parties involved. Conclusions for students on how to improve memory skills in developing listening comprehension ability are drawn.

Teachers, the study can provide empirical evidence for teachers to design listening exercises based on learners' cognitive processing ability. Curriculum designers and policy makers may find the results valuable, as they indicate the potential for curriculum integration of working memory-informed instruction practices and strategy training for language learning listening improvement.

2. Research Methods

2.1 Particpants

We recruited twenty (16-17years of age; 10 female) students from a high school in Shanghai, China. All participants were learning English as an L2 and had no diagnosed hearing or cognitive problems. To control for confounding variables, all students were from the same socioeconomic status within the same school district and had received formal English instruction for seven years or more. All participants were enrolled in an international curriculum where English was the primary language of instruction for academics. As such, the participants had an intermediate to upper-intermediate level of English and were used to hearing academic content in that language. With the students' consent before participating. Participation was voluntary, and the students were told that the data they provided would only be used for research.

2.2 Instruments

To measure the student's listening comprehension, the research employed three sorts of devices: listening comprehension, working memory ability, and learners' background characteristics. The study includes three main parts: two TOEFL listening parts, two working memory span tasks, and a questionnaire made up of 13 questions looking at demographic backgrounds and memory strategy usage.

2.2.1 Span Tasks for Measurement of WM Capacity

Subjects completed the following two working memory tasks: reading span task and auditory span task. Reading span tasks had sentences being presented one at a time. While remembering a particular word at the end, participants rated how true each sentece is. Then at the end of every group of sentence, they will be asked to remember the last word. A total of 6 groups of sentences, and the number of sentences in each subsequent group increases by one from the previous group. Reading span tasks are often used to measure the size of complex working memory because people need to deal with information and hold it at the same time [6]. In the present study, first determine whether each sentence is logically true or false, which needs to be processed semantically and understood. At the same time, they were asked to remember the last word presented after each sentence. After completing a set of sentences, they were asked to recall all the last words in the right sequence. The sum of all correctly recalled items served as the reading span score. Reading span, also known as the classic measurement of complex working memory span and mainly refers to the central executive component in Baddeley's working memory model. And this task is showing us the central executive by asking to divide attention between determining what sentences mean and remembering words. And so the dual-task structure is able to capture the processing-and-storage interaction that characterizes working-memory operations in language understanding.

Referring again to Baddeley's model, the storage part of this task would be mostly phonological or semantic for the short-term store. Auditory span tasks had the participants remember a word that they heard spoken sentences. The sentences are immediately followed by the target word, which is also in audio format. Participants would type the targets that could be recalled after hearing all the sentences in a set. There are 6 groups of sentences, and the number of sentences in each group is increasing by one. The Auditory Span Task is applied so as to find out the temporary keeping and remembering of verbal word data. In each trial, participants heard a sentence played through the headphones, and then immediately after, the target word appeared in the same audio stream. The participants were requested to recall the target word and continue listening to the following sentences in the set. Finish each sequence and instruct them to write down every word that they could recall on the list. Number of correctly recalled items in all the sets is taken as the auditory span score. This mainly tests the phonological loop and it's a portion of working memory that deals with acoustic and speech data. In particular, the amount of information that can be stored in the phonological store, which temporarily holds auditory verbal information until it disappears or moves on to long-term memory. In this task, the processing element is not obvious: The main cognitive task is storing and recalling. This is because there is no request for a judgment based on the audio, but only listening to the sentence and the target word.

2.2.2 TOEFL Listening Tasks

The participants took a short form of the TOEFL junior listening comprehension test. This included 8 questions according to the following two audio passages: a dialogue, an academic lecture. The dialogue lasted 2 minutes and 17 seconds, and it is considered to be simple by XXX, but the lecture that last for 4 min and 19 sec is more difficult. Four corresponding questions were set after each paragraph. Hearing part of an audio passage on the headphones and answering in digital format. The dialogue passage was a conversation that might happen in our daily life and the lecture passage was like listening to something in an academic setting where a lot of information would be presented systematically. There were two different listening contexts in the study to find out if working memory capacity affects comprehension differently based on how complicated or information-heavy a listening task is.

In order to create the official test environment again, I will set an answer time limit based on the question type after hearing the audio. There was a forty-five second time limit on the main idea questions, one minute and fifteen seconds per detail question, and one minute thirty seconds per inference question. These time restrictions were set to create real test scenarios and make the subjects depend mainly on their immediate understanding and memory of the audio content, rather than prolonged thinking or external help.

2.2.3 Questionnaire on Language experience and memory strategy use

The questionnaire is divided into two parts, they are all digital surveys. The first part would be on participants' demographic info such as age, gender, how long they have prepared for TOEFL, and also how many years they studied English. To this end, some background variables were collected, whether there are differences in language learning experiences that affect listening comprehension. Especially information related to preparation time for TOEFL, as well as the age at which English learning began, was used to explore how past experience and learning background may have shaped listening results.

The second one is about the ratings concerning using memory strategies before learning. Strategies described are not only the term used in science but also have a short explanation of each memory strategy for participants to easily recall their own past experience; no need to understand scientific terms. The people named how frequently they used what are common memory techniques for studying languages, such as repeating things, grouping info together, and making connections. Each strategy was followed by a brief explanation to help participants understand the meaning of each strategy so as to answer. The responses used the likert type scale and thus it was possible to get a total strategy use score per person. The questionnaire is all in English, and the data is collected online.

2.3 Procedures

Four pieces of data were collected: Questionnaire data on memory strategies, TOEFL listening score, reading span score, auditory span score. All data collection process programs and presents using PsychoPy so that the precision and consistency. The experiment was carried out in the same environment on a single device. Participants were tested individually, completing all tasks successively. The sequence of the experiments was unified. Participants completed the questionnaire on demographic background and memory strategy use at first. And then they did the two working memory span tasks and then the listening comprehension tasks. The questionnaire was selected so as to exclude the influence of participants' performance in the listening test immediately before answering the questionnaire.

All subjects gave their informed consent before participating. All ethical norms for research involving humans were strictly followed in this study, such as the right to withdraw at any time, and were also explained to the subjects. The research was done on a nameless basis, so no personal information of the subjects was obtained.

All analyses were done through jamovi. Pearson correlation analysis was carried out to explore the correlations between WM scores (reading span, auditory span) and TOEFL listening scores; listening score and memory strategies used; Between listening scores and language experience. Pearson correlation analysis was chosen as it was primarily intended to explore the degree and direction of the relationship between continuous variables such as working memory span scores, listening comprehension test scores, and ratings of strategy use. Statistical means for trying to find some kind of link between cognitive ability and listening ability.

3. Results

The data of the 20 subjects was analyzed in order to examine how there exist relations among working memory, use of memory strategies, and scores for TOEFL listening test. Descriptive statistics, correlation analysis were conducted to describe the basic situation of the data in order to investigate the relationship between the measured indicators.

The mean, standard deviation, and correlation coefficient were calculated based on the dataset.

Such descriptive statistics give us an idea about how the subjects performed in each task. The average score indicates that the participants did better in the conversation listening test than in the lecture. This difference is in line with the relative level of difficulty between the two listening parts: The conversational dialogues are generally short and have a common mode of conversation; there is more information contained in academic lectures, and their length is also longer.

Table 1. Descriptive statistics of the main variables

Variables	Mean	SD
TOEFL Total	5.35	1.73
Conversation	3.20	0.89
Lecture	2.15	1.18
Reading Span	4.05	1.10
Auditory Span	4.55	1.28

3.1 The function of working memory in listening ability

To perform Pearson correlation analysis on TOEFL listening scores with the working memory span task. A high positive correlation (correlation coefficient r = 0.61) was found between reading span scores and the total score of listening. Like the auditory span scores, they have also shown a significant positive correlation with the total listening score, and their correlation coefficients were 0.56. These results show that the participants with stronger working memory capabilities also scored higher in the listening comprehension test. That is to say, both verbal working memory (assessed by the reading span task) and auditory working memory (evaluated by the auditory span task) seem to be related to one's ability to handle spoken input successfully. This finding suggests that those learners who can store and manipulate a large amount of information in their working memory may have an advantage when dealing with the continuous stream of language in listening. Looking at the listening tasks individually had different strength correlations depending on the type of task. Both of the span task scores were more strongly correlated with the more difficult lecture than with the easier conversation. This pattern may be due to the higher cognitive requirements of academic lecture comprehension. When listening to lectures, learners need to maintain the information for a long time and integrate new information into the old one. As such, the burden of long pieces of information would fall more upon working memory during completion, thus intensifying the connection between working memory capacity and listening skills.

We found that one participant (Participant #14) scored a high score in the auditory span (6), but had a low score in the lecture task (1 out of 4). Such individual differences show that although working memory capacity is a key variable in the process of listening comprehension, it cannot account for all the variation. Other factors that may influence the performance are familiarity with what is heard, changes in concentration during exercise, and different ways of listening to it, etc.

3.2 The Role of Memory Strategies in Listening Performance

The participants' self-reported frequencies of using memory strategies were compared with their listening performance. There was a positive correlation between the sum of all memory strategies and the total TOEFL listening score. However, this connection was just ordinary with a connection coefficient of 0.48. This indicates that the listeners who said they used memory strategies more often also obtained somewhat higher listening scores. Memory strategies such as repetition, grouping information and making associations can help learners organize and remember the incoming audio information better. To structure the language input in a more meaningful way so as to reduce the burden of comprehension on working memory.

Two participants who scored moderately low in terms of overall strategy use (2.3 and 2.1) had very good scores on the listening test: score 7 out of 8 and 8 out of 8 respectively. Further analysis of the questionnaire answers showed that both subjects had rich TOEFL preparation experience before. The implication being that having experience with tests and questions may account for the reduced number of reports on general memory strategies. That is to say,

learners who have practiced standardized listening tasks intensively might have developed task-specific strategies that allow them to perform successfully even though they reported using broad memory strategies relatively little.

3.3 Influence of Language Experience

Analysis of the background questionnaire found other influencing factors related to language learning experience. First, participants that stated their TOEFL preparation lasted more than 6 months tended to get higher scores in listening compared with those not preparing or prepared for a lesser duration. This suggests that whether one has undergone standardized listening exercises may be a key factor affecting listening ability. The learners with a great amount of time preparing for the TOEFL listening task could be more focused on the usual question pattern, listening frame and timing rule. This is familiar, can lower the cognitive burden of understanding task guidance, as well as the attention focused on listening.

At the same time, age of onset, that is, the age at which participants started learning English, was not significantly correlated with listening performance in this sample. One possible explanation is the relatively limited variation in the age of onset among the participants. Most learners had started learning English in primary school and had several years of formal learning by the time of the study. Due to the limited range of age at acquisition, there is a lower chance that such a relationship will be statistically evident from this variable and listening outcomes.

4. Discussion and conclusion

Currently, research about how the working memory, strategy on memory, and listening comprehension of adolescent students who learn English as their 2nd language are connected has been conducted. To achieve the above research goals, participants performed standardized listening tests based on TOEFL junior materials; Completed two working memory span tasks measuring verbal working memory and auditory working memory capacity; Fill in the questionnaire about demographics and memory strategies. Correlational analyses done to see how the aforementioned cognition/experience variables correlated with what was listened to.

The results confirmed our primary theory: working memory capacity does have a relationship with L2 listening for adolescents but significantly so for more complex academic talks. This conclusion is also consistent with the cognition of listening comprehension theory on working memory and its role in understanding spoken language. While listening, learners have to put away pieces of the auditory input as they integrate syntax, semantics and context. Learners who have higher working memory capacities can thus hold onto the coherence for a greater span of time, and this is most necessary in academic listening contexts [7].

The positive relationship between overall memory strategy application frequency and listening performance was less strong than expected. Memory strategies are beneficial to improve listening comprehension, but cognitive ability may be more important to the listening ability of adolescents. One possible reason is that adolescents have not yet fully developed metacognitive awareness of their strategy use, so it will reduce the precision of self-reporting strategy measures. In addition, some learners may use effective strategies naturally without clearly identifying them as specific learning strategies.

Language experience also seemed to impact listening results. Participants who have more TOEFL preparation experience usually performed better in the listening tasks, as these participants are more familiar with task structure and question type and can allocate cognitive resources more efficiently while listening.

From a theoretical standpoint, the findings of this study contribute to the extension of the current research on working memory and second language listening at the adolescent learner level with empirical data. The result shows that cognition, strategy, and learning experience might all play together for listening comprehension right now. In terms of implementation, there are references for the language teaching. Educators might take into account when designing listening activities, gradually increasing cognitive difficulty while simultaneously promoting the application of effective memory strategies [8]. Training learners to be able to store the auditory information in a more well organized will help them with the mental strain of complicated listening.

Several limitations need to be stated. There are only 20 subjects in the sample, and it lacks universality. In addition, all participants came from only one educational context in Shanghai, and this may limit the generalizability of the results to other learning contexts. In the future, through the help of a large and various sample in order to verify this study results can further understand cognition factors affecting adolescents L2 listening ability.

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