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Mobile Assisted Language Learning: Cognitive Load and Task Motivation

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Abstract: This study explores the relationship between cognitive load and task motivation of three listening-based tasks via mobile assisted language learning (MALL). The investigation was conducted with 65 English language learners in three WeChat groups in China. A cognitive load questionnaire and a task motivation questionnaire were administered to the participants. Using a quantitative method approach to the study, we have found that the participants' perceived low cognitive load did not necessarily have an inverse relationship with task motivation, which depended on the germane cognitive load and a balance between the intrinsic and extraneous cognitive load. Only when there was a certain amount of germane load and intrinsic cognitive load, and the amount of the intrinsic and the extraneous cognitive load was in a balance, was the task motivation predictable. This study can shed light on task designers and future research to plan and integrate a mobile language learning pedagogical framework.

1. Introduction

Abundant prior research has shown the positive effects of motivation on language learning [1, 2]. It is crucial to understand what learners' motivations are in second language learning [3]. Learners' motivations include learner-related factors, context-related factors, and task-related factors; task motivation (TM) refers to task characteristics (e.g., task type, task format, task structure, etc.) that serve as incentives to successful completion of the task [4, 5]. The learners' motivations vary with different tasks and their moment-to-moment task interaction processes [5].

Cognitive load (CL) refers to the amount of working memory resources used by the learners. According to the Cognitive Load Theory, our working memory is exposed to certain types of CL, and learning is hindered if working memory is overloaded [6]. CL can be categorized into (1) intrinsic cognitive load (ICL), which is caused by the intrinsic nature of the task; (2) extraneous cognitive load (ECL), which can cause havoc on working memory by including irrelevant information in the learning process or task design; and (3) germane cognitive load (GCL), which comes from the deep processing of new information by organizing and connecting it with prior knowledge [7]. The GCL can enhance learning and should be encouraged in task design [8, 9].

Past literature in the related fields has revealed an inverse relationship between CL and language learners' TM [10, 11]. In other words, the learners are more likely to be discouraged by tasks that

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entail higher CL. However, [12] postulated in his Recursive Hierarchical Recognition Theory that temporal tension, a measure of CL [13, 14], can improve listening and speaking skills, thus engaging and motivating the learners since it "leads to attention, efficient practice, and language automaticity". [15]'s tension-to-learn theory has also suggested that motivation results from the cognitive disequilibrium or tension between learners' attempt to assimilating new information and their current mental networks. The heterogeneous conclusions across these previous researches are due to their "broad brush" nature: they have yet to investigate the relationship between motivation and specific types of CL mediated by different language tasks, which is a gap the current study aims to fill. Specifically, we narrow our focus on listening and listening-to-speaking tasks integrated with mobile devices when interest in mobile-assisted language learning (MALL) was brought to the fore in the past decades. MALL refers to the utilization of mobile technologies in language learning [16]. It is believed to motivate the learners to earn autonomy in their studies and become the mappers of their learning journey [17]. Moreover, learner pacing with the aid of mobile applications might mitigate CL and improve motivation [10]. Since little empirical work has been conducted in the field of language learning to examine the relationship between TM and CL, an investigation under the context of MALL is essential to get a deeper understanding of this relationship because the context-related factors affecting learners' motivation in a classroom are removed.

Based on previous literature, this study aims to answer the following research questions (RQs):

1) What are the relationships between the students' perceived cognitive loads and task motivations?
2) How can this relationship be explained?

2. Methods

2.1. Participants

Sixty-five Chinese (25 males, 40 females) with an average age of 24.83 participated in the study. They were randomly selected from three WeChat groups of an AI-driven English learning mobile application. WeChat is a platform for users to send messages, communicate with each other, and share information. The participants were rewarded with "red envelopes", a way of distributing cash through electronic payments, if they actively participated in the study.

The participants differed in their proficiency levels as measured by the mobile application before lessons. After the placement test, they could buy courses tailored to their abilities and needs and joined the WeChat groups. No matter what levels they were at, in each lesson, they had to listen to a lifelike dialogue presented with pictures and to complete a combination of three listening-based tasks including (1) three-option multiple-choice questions (MCQs) with the options written; (2) repeating what they had heard in the aural input aided by a theme-related picture;(3)a human-computer dialogue task, where the learners had to respond to pieces of information they heard before. Their spoken outputs in both task 2 and task3 were graded according to the quality of pronunciation and whether their utterances were matched exactly to the prescribed sentences. Each lesson required the learners to study for at least 30 minutes.

2.2. Instruments

Each participant completed a consent sheet, a background questionnaire about his or her age and gender, and two seven-point Likert scale questionnaires measuring TM and CL. The task motivation questionnaire (TMQ) was adapted from [5]'s Motivational Variables on the Post-Task Motivation Questionnaire, which comprises task enjoyment, reported effort, result assessment, and perceived relevance. The cognitive load self-report questionnaire (CLSRQ) was adapted from [18]'s questionnaire. The first two items were related to ICL, the third and fourth items related to GCL,

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while the last three items related to ECL. All items were rated on 7-point Likert scales from "completely disagree" to "absolutely agree". The items in both questionnaires were written in English and the learners' first language (L1).

2.3. Data Analysis

After the data collection, two questionnaires were found to contain more than two unanswered questions, so we eliminated the two subjects from the survey. Thus, we have 63 questionnaires to be analyzed. We initially analyzed the reliability of the two questionnaires. Subsequently, we conducted a Pearson product-moment correlation analysis to determine the connection between different types of CL and motivation. Multiple linear regressions were also carried out to examine the contribution of different types of CL to TM.

2.4. Results

The Cronbach α for the TMQ was 0.75. The Cronbach α for the CLSRQ was 0.86, and it was 0.61 to 0.82 (mean = 0.72) for the three subscales, i.e., ICL, ECL, and GCL. Table 1 presents the descriptive results of all the variables of the three tasks. Generally, the participants reported the most motivation in task 2, and the least in task 3. Regarding cognitive load, task 3 caused the most ICL, ECL, and total cognitive load (TCL); task 2 caused the most GCL and the second most TCL. All data were normally distributed since the absolute values of skewness and the kurtosis were less than 3 and 10 respectively [19].

Table 1: Descriptive statistics of the three tasks

	Task1		Task2		Task3	
	M	SD	M	SD	M	SD
ICL	3.32	0.758	4.16	0.846	4.49	1.176
ECL	3.54	0.502	3.90	1.073	5.87	0.707
GCL	3.75	0.842	5.33	0.898	3.19	0.592
TCL	10.60	1.47	13.40	2.07	13.56	1.38
TM	3.56	0.929	5.05	1.128	3.02	0.707

A Pearson product-moment correlation test was conducted to explore the relationship between the CL and the TM. As demonstrated in Table2, the total CL, ICL, and GCL significantly correlated with the TMs. In Task 1 and task 2, the total CL correlated positively with the TM. In contrast, in task 3, the total CL is negatively correlated with TM. Unlike in task 3, the ECL did not show significant correlation with the TM in task 1 and task 2.

Table 2: Correlation matrix between different types of cognitive load and task motivation

	TM (Task 1)	TM (Task 2)	TM (Task 3)
Task 1			
ICL	.66**		
ECL	-.24		
GCL	.82**		
Total	.73**		
Task 2			

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ICL		.60**	
ECL		.16	
GCL		.78**	
Total		.67**	
Task 3			
ICL			-.79**
ECL			-.51**
GCL			.84**
Total			-.57**

**p<.01 (2-tailed)

Subsequently, multiple linear regressions were performed to predict the TM (dependent variable) based on different types of CL (independent variable). Table 3 presents a summary of the results. In task 1, a significant regression equation was found ($F(2, 60) = 73.085$, $p<0.001$), with an R^2 of 0.709. Both the ICL and GCL had significant ($p<0.05$) effects in the full model. Similarly, in task 2, only ICL and GCL had significant ($p<0.05$) effects in the model. The two predictors were able to account for 65.3% of the variance in the TM, $F(2, 60) = 56.358$, $P < 0.001$, $R^2 = 0.653$. However, in task 3, each predictor variable had a significant ($p < .05$) effects in the model. The three independent variables were able to account for 81.30% of the variance in TM, $F(3, 59) = 85.768$, $P < 0.001$, $R^2 = 0.813$.

Table 3: Summary of multiple regression model results for task motivation (N=63)

Measure	Variable	β	P value
TM (task 1)	ICL	0.305	0.007
	GCL	0.711	<0.001
	Constant	-0.184	0.571
TM (task 2)	ICL	0.332	0.008
	GCL	0.810	<0.001
	Constant	-0.651	0.237
TM (task 3)	ICL	-0.293	<0.001
	ECL	0.179	0.025
	GCL	0.742	<0.001
	Constant	0.911	0.156

3. Discussion

The finding of the current study was only partly in line with previous researches. First, it showed that the total CL of language tasks did not necessarily have an inverse relationship with task motivation as previous literature indicated. This phenomenon might be explained by the nature of the settings of this study. Unlike previous studies which were conducted in classrooms, where external influences on language learning motivation included the interaction between the learners and the teacher or peers, or the homogeneous teaching materials to each learner, etc., this study narrowed its focus on task motivation with the aid of an AI-based mobile application. It can expand our understanding of MALL-based language learning and task designs.

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Second, the TM depended on the subsets of CL, especially the GCL. This result lends empirical support to the previous researches [20, 21, 22] that highly motivated learners had higher levels of GCL.

However, it should be noted that the results concerning the role of ECL and of ICL in TM were less clear-cut than that of GCL. The ECL did not have a significant correlation with the TM in task 1 and task 2 but did in task 3. A possible explanation might be related to the nature of the tasks. As table 1 shows, the ECL in both task 1 and task 2 were too low to identify their effects on the TM. Another possible explanation might be the additive and interactive nature of ICL and ECL. Whether the ECL poses a problem to the learners depends on the ICL and their interaction. First, a proper amount of ICL is needed "to connect new information to already existing schema and eventually contribute to germane load" [23]. This view can help us to explain why ICL correlated with TM but contributes differently to the TM in the three tasks. Second, the interaction between ICL and ECL was important in that when ICL is small and medium in task 1 and 2 respectively, it correlated positively with the TM, despite the ECL. In other words, as long as the sum of ICL and ECL did not surpass working memory limits, the TM will be at a medium to high level. If the ICL is low, a high ECL will not be harmful because the total CL is within working memory limits [23]. Thus, the sum of the ICL and ECL in task 1 and task 2 did not surpass working memory limits, making it difficult to identify a strong correlation between the ECL and the TM. However, in task 3, there were no sufficient cognitive resources for the GCL because the sum of ICL and ECL were big enough to yield overload. In other words, the ICL and ECL have a synergize effect that the more ECL and ICL, the less GCL. When the GCL is not induced because the working memory capacity is overloaded, the learners are less motivated.

There are several limitations to the current study. First, the aforementioned explanation of the interaction effect between the three types of CL was adopted in fields other than language learning, especially in MALL studies. We also did not zoom in on the proficiency levels of the participants and the characteristics of the tasks such as task complexity and their multimodal nature which may serve as moderators between CL and TM. A strong model is needed to represent, estimate, and test the relationships among all variables. Second, as the sample size is small, the statistical power of the analysis is limited. New additions to similar research include observation and interview which helps enhance the credibility of the study.

4. Conclusion

The present study examined the relationship between different types of cognitive load and task motivation within the context of mobile-assisted language learning. Dissimilar to past studies, the findings of the study indicated that the learners' perceived low cognitive load did not necessarily lead to high task motivation, and vice versa. Though the results demonstrated that germane cognitive load could serve as a robust predictor of task motivation, the roles of intrinsic and extraneous cognitive load in task motivation were inconclusive. This study expands the scope of MALL-related research and may shed light on future studies to explore the role of cognitive load in task motivation.

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