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Verb-Object Movement Processing in CSL

Gender differences in processing by Uygur students

Abstract: The study of gender difference is an important sub-branch of linguistic research, especially for language acquisition, such as vocabulary acquisition, grammar acquisition, and syntactic acquisition. In the teaching of Chinese as a second language, some studies found that students from the Uygur areas had difficulty in learning sentences containing component movement, and gender differences also exist to make this mechanism more intricate. In this paper, we use the self-paced reading experiment to investigate both the ability of Uygur students to process Chinese V-O movement structures and gender differences in real-time processing. We found: Females process "Yijing" V-O movement structure better than males, and while males do better in simple movement sentences, females performed faster in most phases of processing. Interaction effects of gender and movement type, and of sentence type and movement type, as long as main effects of gender, sentence type, and movement type contribute to these differences in accuracy and response time of components in Chinese V-O movement structure. This study will benefit the theoretical study of Chinese V-O movement structure and its acquisition, and the study of acquisition of gender differences by non-native Chinese speakers.

Keywords: gender difference; processing; V-O movement

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1 Introduction

The study of gender differences has caused great interest among researchers in the field of linguistics, and a large number of gender-difference studies (including vocabulary, sentence, discourse analysis, language learning, recognition, and memory) have appeared. Behavioral and neuroimaging techniques such as event-related potentials (ERPs) and functional magnetic resonance imaging (fMRI) provide new research methods for the study of gender differences in language processing. This paper will study gender differences at the sentence level, to examine the process of verb-object movement within sentences using behavioral experiments.

2 Literature review

The differences in language processing between males and females are extensive and include almost all the aspects of language processing: lexical level, sentence level, discourse comprehension and language learning, recognition and memory.

In the aspects of phonology, McHenry (2011) found no gender differences in behavioral experiments with a task of judgment of the voice of the sentence comprehension. However, in the dichotic listening test of Ikezawa et al. (2008), Japanese syllables were presented to the subjects and the results showed that as the syllables changed, a left-sided scalp distribution of the speech-matched negative wave appears in males, while the females had a bilateral distribution.

There are many lexical studies of gender differences, such as Kim (2013), which investigates English vocabulary acceptance and output of behavioral experiments by 106 male and 103 female participants (Korean EFL students in Kyungsung University and Kwandong University). Female learners were found to perform receptive vocabulary extraction better than male learners immediately after and a week after the test. Also, Fa-Kaji, Nguyen, Hebl, and Skorinko (2016) explore gender differences in English vocabulary in practical use, especially words for only males or females in our daily life. Hartanto and Suárez (2016) investigated representational changes in different gender-specific vocabulary by bilinguals in different languages, and found that the concept of English is changing, and language ability leads to similar mother tongue conceptual representation.

The study of gender differences in syntactic is an area of concern to many scholars, and the previous syntactic processing research can be divided into understanding processing studies and output processing studies. Output studies such as Holmes (1984) randomly selected 100 people, men and women, and made a special survey. Results showed that women use disjunctive question sentences more than men. The study of gender differences in syntax is an important aspect of syntactic study, and it can also be divided into many sub-branches such as, movement, locality of selection, and control and binding. Movement can also be divided into many sub-branches, for example head movement, wh-movement, and V-O movement.

Many syntactic studies of gender differences have been published in academic journals and other publications, but there are few V-O movement studies among them, especially from the perspective of experimental studies. This paper tries to determine the gender differences in the process of V-O movement behavioral experiments in accuracy and response time (Verb, Object, Ending component, $RT_{v\&o}$ RT_{total}). Two research questions will be answered：1）What is the gender difference in the process of V-O movement? 2) What causes the gender difference in the process of V-O movement?

3 Research methods

3.1 Subjects

The subjects of the study are from a university in Nanjing. Their native language is Uygur and their second language is Chinese. All subjects had uncorrected vision or corrected visual acuity normal, and had no experience in participating in a similar experiment. Since this is was a voluntary participation study, there was no payment for it.

A total of 60 subjects were divided into male and female groups (male: 26, female: 34). Each subject was between 20 and 24 years old and began to learn Chinese from age 9 to 10.

3.2 Design

The study used a mixed design of 2 (gender) × 2 (sentence type) × 2 (movement type), with the independent variables being gender (male vs. female), the sentence type (including "Yijing" vs. no "Yijing"), and the moving type (normal sentence vs. moved sentence). Among them, the sentence type and movement type are the variables within groups, and gender type is the variable between groups. The dependent variables are the accuracy and response time of the subject.

3.3 Stimuli

This paper investigates V-O movement structure of Chinese through behavioral experiments by changing the location of verb and object in a sentence, taking into account the acceptability of individual sentences (contextless sentences) and the operability of experiments. All stimuli are in the form of simple interrogative sentences: (A) simple V-O interrogative sentences, (A') simple sentences with V-O movement, (B) "Yijing" V-O interrogative sentences (B') V-O moving "Yijing" sentences with V-O movement. Here, A' and B' are the target sentences, and A and B are the control sentences.

E.g. (3).

A: 你看电影了吗？（简单动宾疑问句）
Ni kan dianying le ma?
You see movie? ('Did you see the movie?')

A': 你电影看了吗？（简单移位句）
Ni dianying kan le ma?
You movie see? ('Did you see the movie?')

B: 你已经看电影了吗？（"已经"疑问句）
Ni yijing kan dianying le ma?
You have see movie? ('Have you seen the movie?')

B': *你已经电影看了吗？（"已经"移位句）
* Ni yijing kan dianying le ma?
*You have movie see? ('Have you seen the movie?')

Four types of sentences were presented, 20 sentences for each type, and in total 20 × 4 = 80 sentences. The number of filler sentences was also 80 (including the wrong statement 60, and the correct statement 20). In this way, each subject was tested 80 + 80 = 160 sentences.

In order to avoid the possible duplication of the stimuli, we dealt with these four types of sentences in Latin square design, and arranged 16 sets of sentences with 20 sentences in one structure but word orders were different in other sets, such as (3). In order to avoid the effect of left-handedness and right-handedness and the presentation order on the results, we cross-balanced the reaction hand and presentation order for the subjects.

3.4 Procedure

This experiment was carried out in a special language lab, using a sentence-based judgment task of self-paced reading. Before the experiment, the subjects were to first read the experimental instructions, sign the experimental letter of intent, and then do practice to become familiar with the keyboard and tasks. The sentences in practice periods were not repeated in the formal periods.

The main task of the subjects was to read the sentences presented on the screen. At the beginning of the experiment, a "+" appears in the center of the screen, suggesting that the sentence is about to appear. Then the subject presses the buttons, and the sentence is presented in the center of the screen. The screen background is white and the text that appears in the center of the screen is black. Each time a key is pressed, a word (or a cluster of words) appears, and the previous part disappears until the sentence ends. At the same time, the computer automatically records the time (i.e. the presentation time of each part) of the two adjacent key actions, which is used as the response time data for each part after the experiment. Each sentence is divided into four parts, with the fourth part of the sentence marked with a question mark, indicating the end of the sentence. When the fourth part is displayed, the subjects are asked to make judgments. The subject needs to press the "yes" or "no" key for the question as soon as possible and accurately according to the meaning of the sentence. The computer automatically records the accuracy and response time. Experimental procedures are shown in Figure 1. The whole experiment lasts about 20 minutes.

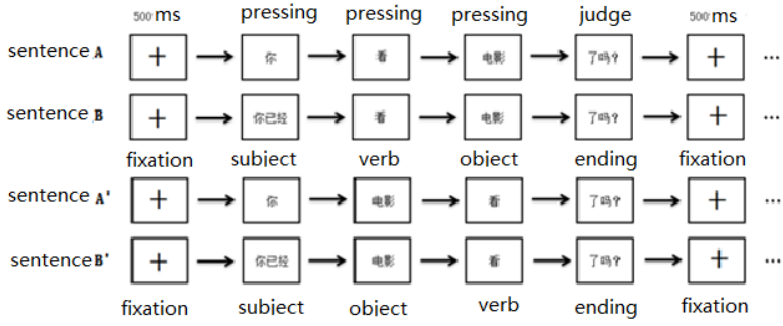

Figure 1: Experiment flowchart

3.5 Data collection and analysis

The accuracy and response time were input into the SPSS software for analysis. According to the research requirements, we compared the data from the following dimensions to the distinction between males and females: (1) sentence type; (2) movement type. In terms of response, because the subjects of the sentences are the same, we only compared the verb, object, verb + object / object + verb, ending component, and sentence response time as a whole.

According to the sentence type and the movement type, the data of the gender difference was mainly analyzed from four aspects: (1) simple sentence; (2) simple movement sentence; (1) "Yijing" sentence (2) "Yijing" movement sentence.

According to the statistical data, the accuracy and the response time of the components are as follows (see Figure 2 and Table 1):

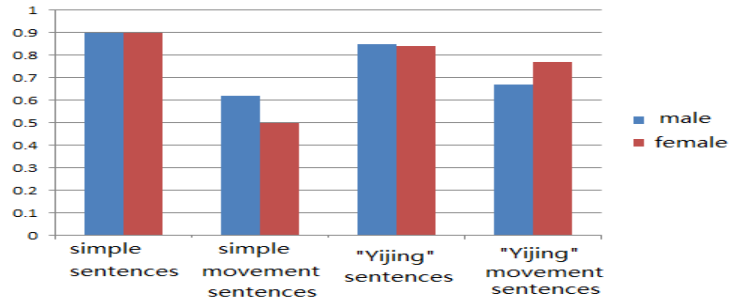

Figure 2: Gender difference

Table 1: Mean RTs of components in four types of sentences

		verb		object		ending		V+O		Total	
	sex	RT	(SD)	RT	(SD)	RT	(SD)	RT	(SD)	RT	(SD)
simple sentence	male	1103.04	447.197	850.41	318.251	1450.95	521.062	1953.45	731.921	3404.4	1101.401
	female	993.55	275.531	816.85	194.842	1633.11	872.072	1810.4	434.175	3443.51	1026.311
simple movement sentence	male	857.4367	369.6981	925.764	321.9545	1993.38	1079.366	1783.201	632.2582	3776.581	1479.649
	female	816.3853	218.1078	863.3843	226.5697	1960.193	764.186	1679.77	423.285	3639.962	970.2663
"Yijing" sentence	male	937.774	395.6657	812.2551	310.1135	1517.985	676.0862	1750.029	672.6972	3268.014	1200.262
	female	846.557	252.1935	774.0289	222.8963	1680.121	943.8439	1620.586	462.9779	3300.707	1192.837
"Yijing" movement sentence	male	806.6491	393.3258	927.4618	787.1914	1503.419	506.3319	1734.111	1163.69	3237.53	1494.315
	female	708.8325	220.9771	785.8106	253.0728	1356.557	597.3926	1494.643	433.3903	2851.2	875.1562

3.5.1 Male vs. female:

(1) Simple sentence

Accuracy: The mean accuracies of both male and female are 90%, and there is no significant difference between the two groups, F (1,58) = 0.031, p = 0.930;

RT: Significant differences exist in the following phases: RT_{verb} (F (1,58) = 13.912, p = 0.006; RT_{object} (F (1,58) = 13.888, p = 0.024; RT_{V+O} (F (1,58) = 20.249, p=0.001; and no significant difference was found in RT_{ending} (F (1,58) = 3.909, p = 0.122; RT_{total} (F (1,58) = 0.306, p = 0.650.

(2) Simple movement sentence:

Accuracy: The mean accuracies of males is 62% and of females is 50%, and there is a significant difference between males and females, F (1-58) = 41.969, p < 0.001;

RT: Significant differences exist in the following phases: RT_{verb} (F (1,58) = 10.863, p = 0.025; RT_{V+O} (F (1,58) = 3.891, p= 0.044; and no significant difference was found in RT_{object} (F (1,58) = 0.818, p = 0.229; RT_{ending} (F (1,58) = 0.028, p = 0.744, RT_{total} (F (1,58) = 0.062, p = 0.516.

(3) Yijing sentences:

Accuracy: The mean accuracies of males is 85% and of females is 84%, and there is no significant difference between males and females, F (1-58) = 0.743, p = 0.668;

RT: Significant differences exist in the following phases: RT_{verb} (F (1,58) = 9.643, p = 0.019; RT_{object} (F (1,58) = 7.302, p = 0.022; RT_{V+O} (F (1,58) = 9.863, p = 0.004; and no significant difference was found in RT_{ending} (F (1,58) = 4.950, p = 0.145; RT_{total} (F (1,58) = 0.041, p = 0.750.

(4) Yijing movement sentences:

Accuracy: The mean accuracies of males is 67% and of females is 77%, and there is a significant difference between males and females, F (1,58) = 48.118, p <0.001;

RT: Significant differences exist in all the phases: RT_{verb} (F (1,58) = 20.199, p = 0.001; RT_{object} (F (1,58) = 13.723, p = 0.001; RT_{V+O} (F (1,58) = 24.553, p < 0.001; RT_{ending} (F (1,58) = 1.239, p = 0.043; RT_{total} (F (1,58) = 18.203, p <0.001.

From the data of gender differences in the above four structures, we can see that the accuracies between male and female are similar in simple sentences and "Yijing" sentences, but different in simple movement sentences and "Yijing" movement sentences. Females process verbs and objects more quickly than males in all the structures, but are slower than males to process ending components in simple sentences, "Yijing" sentences, and simple movement sentences, but not "Yijing" movement sentences. Overall, females process all the structures more quickly than males.

3.5.2 Effect test of gender, sentence type, and movement type

(1) Accuracy: Main effect for gender is not significant, F (1,58) = 0.565, p = 0.453, η_p^2 = 0.001; main effect for sentence type is significant, F (1,58) = 20.816, p =0.000, η_p^2 = 0.018; main effect for movement type is significant, F (1,58) = 390.490, p = 0.000, η_p^2 = 0.259; gender and sentence-type interaction effect is significant, F (1,58) = 15.234, p < 0.001, η_p^2 = 0.013; gender and movement-type interaction effect is not significant, F (1,58) = 0.005, p = 0.944, η_p^2 = 0.000; sentence-type and movement-type interaction effect is significant, F (1,58) = 66.972, p < 0.001, η_p^2 = 0.057; and interaction effect of sentence

type, movement type, and gender is significant, F (1,58) = 21.640, $p < 0.001$, $\eta_p^2 = 0.019$.

(2) Verb: Main effect for gender is significant, F (1,58) = 20.225, $p < 0.001$, $\eta_p^2 = 0.018$; main effect for sentence type is significant, F (1,58) = 34.883, $p < 0.001$, $\eta_p^2 = 0.030$; main effect for movement type is significant, F (1,58) = 66.304, $p < 0.001$, $\eta_p^2 = 0.056$; gender and sentence-type interaction effect is not significant, F (1,58) = 0.108, $p = 0.742$, $\eta_p^2 = 0.000$; gender and movement-type interaction effect is not significant, F (1,58) = 0.225, $p = 0.635$, $\eta_p^2 = 0.000$; sentence-type and movement-type interaction effect is significant, F (1,58) = 6.461, $p = 0.011$, $\eta_p^2 = 0.006$; and interaction effect of sentence type, movement type, and gender is not significant, F (1,58) = 1.201, $p = 0.273$, $\eta_p^2 = 0.001$.

(3) Object: Main effect for gender is significant, F (1,58) = 18.264, $p < 0.001$, $\eta_p^2 = 0.016$; main effect for sentence type is not significant, F (1,58) = 2.347, $p = 0.126$, $\eta_p^2 = 0.002$; main effect for movement type is significant, F (1,58) = 9.877, $p = 0.002$, $\eta_p^2 = 0.009$; gender and sentence-type interaction effect is not significant F (1,58) = 1.306, $p = 0.253$, $\eta_p^2 = 0.001$; gender and movement-type interaction effect is not significant, F (1,58) = 3.591, $p = 0.058$, $\eta_p^2 = 0.003$; sentence-type and movement-type interaction effect is not significant, F (1,58) = 0.078, $p = 0.780$, $\eta_p^2 = 0.000$; and interaction effect of sentence type, movement type, and gender is not significant, F (1,58) = 1.196, $p = 0.274$, $\eta_p^2 = 0.001$.

(4) Ending component: Main effect for gender is not significant, F (1,58) = 0.283, $p = 0.595$, $\eta_p^2 = 0.000$; main effect for sentence type is significant F(1,58)=21.364, $p < 0.001$, $\eta_p^2 = 0.019$; main effect for movement type is significant, F (1,58) = 6.966, $p = 0.008$, $\eta_p^2 = 0.006$; gender and sentence-type interaction effect is not significant, F (1,58) = 0.722, $p = 0.396$, $\eta_p^2 = 0.001$; gender and movement-type interaction effect is significant, F (1,58) = 6.184, $p = 0.013$, $\eta_p^2 = 0.006$; sentence-type and movement-type interaction effect is significant, F (1,58) = 26.473, $p < 0.001$, $\eta_p^2 = 0.023$; and interaction effect of sentence type, movement type, and gender is not significant, F (1,58) = 0.511, $p = 0.475$, $\eta_p^2 = 0.000$.

(5) Verb+Object: Main effect for gender is not significant, F (1,58) = 26.786, $p < 0.001$, $\eta_p^2 = 0.023$; main effect for sentence type is significant, F (1,58) = 24.584, $p < 0.001$, $\eta_p^2 = 0.022$; main effect for movement-type is significant, F (1,58) = 7.620, $p = 0.006$, $\eta_p^2 = 0.007$; gender and sentence-type interaction effect is not significant, F (1,58) = 1.104, $p = 0.294$, $\eta_p^2 = 0.001$; gender and movement-type interaction effect is not significant, F (1,58) =1.215, $p = 0.271$, $\eta_p^2 = 0.001$; sentence-type and movement-type interaction

effect is not significant, F (1,58) = 3.218, p = 0.073, η_p^2 = 0.003; and interaction effect of sentence type, movement type, and gender is not significant, F (1,58) = 2.116, p = 0.146, η_p^2 = 0.002.

(6) Total sentence: Main effect for gender is significant, F (1,58) = 5.370, p = 0.021, η_p^2 = 0.005; main effect for sentence type is significant, F (1,58) = 38.536, p < 0.001, η_p^2 = 0.033; main effect for movement type is not significant, F (1,58) = 0.420, p = 0.517, η_p^2 = 0.000; gender and sentence-type interaction effect is not significant, F (1,58) = 1.464, p = 0.227, η_p^2 = 0.001; gender and movement-type interaction effect is significant, F (1,58) = 6.636, p = 0.010, η_p^2 = 0.006; sentence-type and movement-type interaction effect is significant, F (1,58) = 12.083, p = 0.001, η_p^2 = 0.011; and interaction effect of sentence type, movement type, and gender is not significant, F (1,58) = 1.876, p = 0.171, η_p^2 = 0.002.

According to the effect tests, we can see that in an effect test of accuracy, main effect of gender is not significant, but significant in sentence type and movement type, and gender has an interaction effect with sentence type, but no interaction with movement type. There are main effects of gender in RT_{verb}, RT_{object}, RT_{V+O}, and RT_{total}, but not RT_{ending}; there are main effects of sentence type in RT_{verb}, RT_{ending}, RT_{V+O}, and RT_{total}, but not RT_{object}; and there are main effects of movement type in RT_{verb}, RT_{object}, RT_{ending}, RT_{V+O}, but not RT_{total}. Significant interaction effects of gender and sentence type are not found in all the RTs; however, significant interaction effects of gender and movement type are found in RT_{Ending} and RT_{total}, and the same applies to interaction effects of sentence type and movement type. No interaction effects of gender, sentence type, and movement type are shown in all the RTs of the components.

4 Discussion

4.1 How sentence type affects gender difference in processing V-O structures

There are two sentence types, simple sentences and “Yijing” sentences, for which movement forms are grammatical for the former and ungrammatical for the latter. According to the experimental data, for simple sentences and “Yijing” sentences, both males and females process them easily, and they are similar in accuracy but different in speed of verb and object processing. This

results from there being an extra "Yijing(已经)" before the verb in "Yijing" sentences in contrast to simple sentences, which can affect the processing of verbs, and can further affect the processing of objects, because in collocational words and phrases, the change of one component can cause a difference in other words. As Osokina (2015: 358) points out, "fixing correlation between a certain word and a certain fragment of reality is not an absolute requirement for forming knowledge of the word. The main requirement is the existence of regularly repeated word surroundings, or word collocations." For simple movement sentences and "Yijing" movement sentences, both males and females showed difficulty in processing; however, males better understood simple movement sentences, while females did better in "Yijing" movement sentences, which corresponds to the response time of the ending components in the two sets of sentences. Results showed that the lower the RTending, the higher the accuracy. However overall, females can process all the sentences more quickly than males, and this perhaps was elicited by sentence type. That processing of ending components differs based on gender has been proved by many studies. For example, Lattner and Friederici (2003) point out that in the case of mismatch of words, males and females would produce different utterances. Also, the P600 effect (Molinaro, Vespignani and Job 2008) can elicit distinct end-of-sentence wrap-up effects, consistent with the different roles the ending parts of the sentences play in the processing of the whole sentence. The evidence of a study of the latter also confirms the difference in males and females who have cranial lesions. (Rymarczyk and Grabowska 2007) showed that lesion location can produce differential effects on the performance of men and women. Frontal lesions were more detrimental to women, whereas subcortical lesions led to stronger impairment in men.

4.2 How movement type affects gender difference in processing V-O structures

This study focuses on input processing of V-O movement structure by Uygur Chinese learners. According to the experimental data, for simple sentences and simple movement sentences, both males and females show obvious difficulties in processing movement structures, for the accuracy decreased from 90% to 62% (male) and 50% (female). Movements cause processing difficulty but gender differences in processing also exist. Franck, Soare,

Frauenfelder, and Rizzi (2010) investigate the interference of objects in the sentences of V-O movement as follows:

J'ai rencontré tous les acteurs
I have met all the actors
Je les ai rencontrés tous
I them have met all
Je les ai tous rencontrés
I them have all met

The results show that interference is caused by object movement, and more particularly by the intervention, on agreement, of the intermediate trace of the moved object postulated in theoretical syntax to account for independent phenomena. Also, examples here are similar to the movement of the Chinese sentences in this study. Objects in both of the sentences move from the after-verb position to the before-verb position, "them" moves to the position before "have met," and "电影" moves to the position before "看" in this study.

For "Yijing" sentences and "Yijing" movement sentences, both males and females show difficulties in processing "Yijing" movement structures, but females are better than males both in accuracy and in RT. But females spend much more time on "Yijing" sentences than on "Yijing" movement sentences, which may be caused by "Yijing." If an additional word ("Yiying") is put between the subject and the verb in a sentence, it will of course cause more effort to process the structure. This can be proved by many studies, such as that by Rispens and de Amesti (2017), which employs an ERPs experiment to investigate two types of factors potentially affecting the level of complexity of processing subject–verb agreement, (i) distance between the subject and the critical verb (0, 1 or 2 constituents) and (ii) type of intervening constituent between the subject and the verb (adverb versus an NP within a PP), and found that a typical P600 effect served the agreement violations. This finding also suggests that the intervening movement, or movement of the constituents, to the position between S and V is a syntactic phenomenon.

4.3 Functions of gender difference in V-O structure

Gender differences affect the processing of V-O movement structure, but they do not work by themselves. The interaction of gender and movement type

also contributes to the distinctive process of movement, which operates in almost all the phases of the components.

The accuracy of males and females in the movement sentence is significantly different; females have lower accuracy in simple movement sentences but have higher accuracy in "Yijing" movement sentences. Females process most of the components more quickly than males except ending components in simple sentences, simple movement sentences, and "Yijing" sentences, in which males are faster than females.

Gender differences can affect the speed of processing of verbs and objects, but not that of ending components. Meanwhile, sentence type can affect the processing of verbs and ending components but not that of objects, while movement type can affect verbs, objects, and ending components.

4.4 Future study of gender difference of V-O structure

There are many studies of S-V and V-O structures of different languages, either theoretical or experimental, and movement of verbs or objects are very common in this area. Extensive experimental study of NP and V movement in English offers us a comprehensive view of movement studies, and a lot of Chinese V-O theoretical studies can be found in journals concerning Chinese linguistic areas, but there are few experimental studies of Chinese V-O movement structure. Hence, there are many research projects that should be developed in the Chinese V-O experimental study field, and though this study offers a new look at Chinese's V-O movement with behavioral experiments, compared to the study of V-O movement structure abroad, many limitations in this area still exist: 1) lack of evidence from native speakers of other languages, no patients of different Chinese proficiency, and sample range is not enough; 2) factors such as age, background of major, learning years of Chinese are still very simple in this study; 3) only Chinese V-O movement structures are examined here, lacking comparison to other languages. Also, only behavioral experiments are implemented in this study so we need to combine evidence using other techniques.

Hence, a lot work should be done in the future for the development of V-O movement study. Native speakers of different languages and subjects of different Chinese proficiencies should be employed to investigate Chinese V-O movement structure and principles of V-O movement between different languages so as to establish a more extensive corpus supporting better and more precise data in this area. Other factors (age, major, learning years, etc.)

will come to the attention of researchers for better analysis, and the utilization of new technologies would satisfy the broader needs of science nowadays to offer more accurate and advanced processing data for study of V-O movement structure so as to make the findings more available, and make our study more competitive.

5 Conclusion

Through the behavioral study of movement of V-O structure by Uygur students using a self-paced experiment, it is found that there are differences in processing simple and "Yijing" sentences and the corresponding movement sentences between male and female Uygur students; main effect of gender in response time, main effect of sentence type and movement type both in accuracy and in response time cause the differences, with the interaction effects of the parameters.

Uygur people are a special group of Chinese. The study of this ethnic group is very significant for linguistic research, and gender differences should be an important part of Chinese language study and promotion in the Xinjiang area. This study will benefit syntactic processing research, the study of Chinese grammar acquisition in ethnic minority areas, and provide a useful reference for Chinese teaching and research for foreigners.

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