

Study on the Interactivity of Controlled and Automatic Information Processing in L2 Reading

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L2 reading is not only an important channel for people to obtain information and knowledge, but also the main way for people to learn a foreign language. Reading information processing can be divided into controlled processing and automatic processing. Controlled information processing is a conscious and resource-intensive processing model, while automatic information processing is an unconscious and automatic processing model. This study investigates the characteristics and interactivity of controlled and automatic information processing in L2 reading, and explores the roles of controlled and automatic information processing strategies in improving L2 reading ability. The findings are as follows: (a) controlled and automatic information processing is interactive in L2 reading; and (b) the uses of controlled and automatic information processing strategies are beneficial to the improvement of the reading ability of L2 learners. This study has important theoretical and practical value in improving the efficiency of L2 reading teaching and learning.

Keywords: L2 reading, controlled information processing, automatic information processing, interactivity

Introduction

To learn English as a L2, English reading is very important in terms of both learning process and learning purpose (Yao, 2004). At present, many L2 learners have problems in reading. Many of them are used to reading word by word, thus turning reading classes into vocabulary or grammar classes. When reading, they even translate English texts into Chinese texts at first, and sometimes guess and probably misinterpret the meaning of the text. As a result, it is difficult for them to understand the meaning of the article, and even more difficult to feel the pleasure of reading. For some of the L2 learners, reading is time-consuming and labor-intensive, hard and boring, and difficult to persist. Therefore, how to improve the reading ability of L2 learners is currently a major challenge (Ni, 2014).

In order to help L2 learners improve their reading proficiency and gradually transform their controlled reading skills into natural and skillful automatic reading skills, this paper explores the influence of automatic and controlled interactive processing model on L2 reading by means of a scale survey, so as to effectively improve L2 learners' reading ability.

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Literature Review

Controlled and Automatic Processing Theory

Schneider and Shiffrin (1977) put forward two information-processing forms, i.e., controlled processing and automatic processing, and believe that controlled processing requires conscious attention, while automatic processing can be completed automatically without subjective conscious control. When we improve our information processing skills, the automation proficiency will gradually increase and the required control amount will gradually decrease (Best, 2000, p. 71). Automatic reading processing refers to the natural and smooth reading process without excessive stimulation and attention resources. Controlled reading requires attention and conscious mobilization of cognitive resources (Zhang, 2021). The mark of success in English learning is not the mastery of language rules and the correct use of them, but the eventual rendering of these rules unnecessary. When the attention required in the reading comprehension process is gradually reduced through repeated reading training, until some difficult processes do not even need much attention, the automation of English reading is achieved (Chen, 1999).

According to Schneider and Shiffrin (1977), automatic processing and controlled processing are two different forms in human information processing. Automatic processing is activation of a learned sequence of elements in long-term memory that is initiated by appropriate inputs and then processes information automatically, without subject control, without stressing the capacity limits of the system, or without necessarily demanding attention. On the other hand, controlled processing is a temporary activation of a sequence of elements that can be set up quickly and easily but required more attention, is capacity-limited (usually serial in nature), and is controlled by the subject.

Reading Information Processing Strategies

Ni (2014) believes that the core issue of reading strategy is whether reading comprehension is processed from bottom to top, from top to bottom or interactively. The interactive reading strategy is an organic combination of the bottom-up reading strategy and the top-down reading strategy. Gough (1972) applied the information processing model to the study of the cognitive process of reading, which is vividly described as a “bottom-up” process, that is, the reader constructs the meaning of the text through step-by-step recognition of letters, words, phrases, and larger language units (such as sentences). Goodman (1967) regarded the whole reading process as a “psycholinguistic guessing game”. This model seems to pay more attention to the guidance and driving role of high-level knowledge (such as semantic knowledge, background knowledge, contextual knowledge, etc.) in reading, so it is called “concept-driven” process. Therefore, some scholars, such as Anderson (1978), call this “Model Top-Down Reading Model” (Chen, 2008). The interactive reading model holds that reading is not simply a “bottom-up” or “top-down” process, but an interactive processing process between the two, and that there is interaction between all levels of the reading process (Chen, 2008).

Zhang (2021) thought that information-processing strategies could also be divided into the automatic processing strategy and the controlled processing strategy. In daily life, familiar information can be unconsciously perceived and reproduced. For example, some information can be automatic unconsciously or subconsciously (such as driving while listening to music); automatic response and processing can also be achieved for skilled movements, and the activation of automatic perceptual information, semantic information, and contrast process can be regarded as automatic processing process. The controlled reading processing strategy can adjust the linguistic and non-linguistic factors that affect reading ability, thus promoting the improvement of

learners' reading ability. For example, the controlled processing strategy are used to control and adjust learners' reading attention, observation, and memory, or to control and adjust their reading emotion, motivation, or interest, so as to improve their automatic reading processing ability (Zhang, 2021).

Previous studies on reading information processing have focused on the top-down reading model, the bottom-up reading model, the interactive reading model, the controlled processing reading model, and the automatic processing reading model, but few scholars have studied the interactivity between the latter two, that is, the interaction between the controlled processing and the automatic processing. Therefore, the author of this paper chooses this interactivity as the breakthrough point, putting forward an interactive study of controlled and automatic L2 reading information processing, and studying college students' agreement degree on the relationship between controlled and automatic reading information processing and L2 reading ability by means of a scale survey, and then draws corresponding conclusions based on the collected information.

Research Design

Contents and Subjects

The present study investigates the interactivity of controlled and automatic processing in L2 reading by means of a scale survey. The subjects are college students, including English majors and non-English majors, totaling 160 people.

The statements of the scale survey include: (a) the characteristics and interactivity of controlled and automatic information processing in L2 reading; and (b) the effects of the interactive information processing strategy on the improvements of English learners' L2 reading proficiency. The purpose of this study is to investigate the relationship between controlled and automatic information processing, and to realize the transformation and development of L2 reading proficiency from controlled processing to automatic processing, so as to effectively improve their L2 reading proficiency.

Methods

In this study, a scale survey was used to assess the agreement degree of L2 learners in the use of controlled processing, automatic processing, and their interactivity, as well as the use of the controlled and automatic processing strategy. The scale survey covers four parts: automatic reading information processing, controlled reading information processing, the interactivity between controlled and automatic information processing, and the correlation between controlled and automatic interactive processing strategies and L2 reading ability. The degree of consent is evaluated by Likert's 7-level scale. That is, the participants make judgments and choices according to the 7-level scale, and Values 1-7 indicate "Disagree", "Basically disagree", "Somewhat disagree", "Uncertain", "Somewhat agree", "Basically agree", and "Agree", respectively. Through the scale survey, we can obtain objective responses from the participants, thus understanding the reading processing methods and strategy choices of L2 readers, which reveal how they use controlled processing and automatic processing in the reading process, thus probing into the relationship between these processing methods and reading ability.

Methods of Data Collection and Statistics

This study uses Excel 2019 to analyze the data of the scale survey, by imputing the survey data into Excel tables, calculating the mean and standard deviation of each question, calculating R_1 (the percentage of people who choose Values 6 and 7 in each statement), R_2 (the percentage of people who choose Values 1 and 2 in each statement), and Z-value (the Z-test value of the difference between the overall ratios of R_1 and R_2), and then

discuss the interactivity between control and automatic information processing and the role of control and automatic information processing strategies in L2 reading.

Data Analysis and Discussion

The results of this study are shown in Tables 1-4. It is found that participants' agreement degree with most of the statements in the scale survey is more than Value 5. Among them, some of the values are negative, and the participants' choices of them are around Value 3, that is, "somewhat disagree".

A Z-test was conducted on the difference between the two overall ratios of the respondents' consent choices for each of the statements (see Tables 1-4), and it is found that, except for some negative Z-values of Statements 9, 16, 23, and 36, the ratio of choosing Value Points 6-7 was higher than that of choosing Value Points 1-2, that is, R_1 was significantly greater than R_2 . R_1 of all affirmative statements in the scale survey is greater than R_2 , while for Statements 9, 16, 23, and 36, R_2 is greater than R_1 , indicating that those who disagree or basically disagree with the statement are greater than those who agree or basically agree with the statement. The absolute values of all Z-values are also greater than the critical value ($Z_{0.05} = 1.645$), so it is inferred that the proportion of the participants who agree or basically agree with the positive statement is significantly different from the proportion of the participants who disagree or basically disagree with it.

Table 1

Results of Scale Survey of Automatic Processing of Reading Information

No.	Statements	Mean	SD	R1	R2	Z Value
1	When reading tasks that are equivalent to my L2 proficiency, I can unconsciously and quickly recognize and understand L2 reading vocabulary.	5.26	1.28	0.43	0.03	9.52
2	When reading tasks that are equivalent to my L2 proficiency, I am able to quickly and accurately identify and process the grammatical structures in L2 reading materials	5.26	1.38	0.49	0.04	10.65
3	When reading tasks that are equivalent to my L2 proficiency, I am able to quickly understand the meaning of the entire discourse without having to read word for word	5.13	1.62	0.44	0.08	8.23
4	When reading tasks that are equivalent to my L2 proficiency, I am able to quickly grasp the main idea and key information of the text	5.27	1.38	0.49	0.05	10.15
5	I am able to automatically understand the meanings of common vocabulary and phrases without having to think about it.	5.28	1.47	0.48	0.05	9.87
6	In L2 reading, I am able to automatically apply the knowledge I have learned to the text reading comprehension	5.19	1.48	0.47	0.06	9.28
7	Reading materials that are equivalent to one's L2 proficiency is an automatic understanding process not requiring excessive cognitive effort.	5.21	1.51	0.47	0.08	8.83
8	When reading a L2 reading task that is equivalent to my language proficiency, I can automatically utilize cultural background knowledge for reading comprehension.	5.14	1.50	0.48	0.09	8.54
9	I don't know what automatic reading information processing is	3.05	1.95	0.13	0.51	-7.99

Notes. (1) 160 valid participants; (2) Mean in the table is the mean of value point of each statement, SD is the standard deviation, R1 is the proportion of the number of people who choose Value Points 6-7 to the total number of participants, and R2 is the proportion of the number of people who choose Value Points 1-2 to the total number of participants.

This study conducts a Z-test, which is a statistical measure used to assess whether there is a significant difference between two proportions (R_1 vs. R_2) based on the agreement levels in the survey results (as shown in the Tables). According to Table 1, the highest Z-value is found for the statement “When reading tasks that are equivalent to my L2 proficiency, I am able to quickly and accurately identify and process the grammatical structure in L2 reading materials”, which means that L2 learners can keep reading naturally and smoothly without mobilizing too much attention resources during automatic reading processing. Specifically, the Z-test value for the statement “I don’t know what automatic reading information process is” was negative, indicating a significantly higher proportion of individuals disagreeing or basically disagreeing with this statement compared to those agreeing or basically agreeing. On the other hand, the Z-test values for the other statements were positive, which means that there is an astronomically higher proportion of people agreeing or basically agreeing with those statements than those disagreeing or basically disagreeing.

Table 2

Results of Scale Survey of Controlled Processing of Reading Information

No.	Statements	Mean	SD	R1	R2	Z Value
10	When the difficulty of reading tasks exceeds my L2 proficiency, I will mobilize more attention resources to understand new vocabulary, sentence structures, etc.	5.31	1.43	0.47	0.05	9.74
11	When the difficulty of reading tasks exceeds my L2 proficiency, I intentionally focus on key information.	5.44	1.36	0.51	0.04	11.58
12	When encountering difficult vocabulary or sentences during L2 reading, I will actively adopt the controlled processing strategy to solve the problem.	5.19	1.57	0.50	0.07	9.73
13	When reading a L2, I am able to flexibly adjust my reading speed to adapt to different difficulty levels of reading materials.	5.13	1.59	0.49	0.10	8.55
14	In L2 reading, I am able to flexibly use different reading strategies to adapt to different reading task requirements.	5.23	1.55	0.49	0.08	9.23
15	When reading in a second language, I am able to independently choose appropriate reading strategies to improve reading comprehension	5.23	1.46	0.48	0.07	9.17
16	When reading in a second language, I do not use controlled reading information processing techniques	3.09	1.96	0.15	0.54	-7.99

Note. The same as above.

According to Table 2, the highest Z-value goes to the statement “When the difficulty of reading tasks exceeds my L2 proficiency, I intentionally focus on key information”. Besides, the Z-tests for the differences in proportions between the number of participants selecting Values 6-7 and Values 1-2 are greater than the critical values ($Z_{0.05} = 1.645$), except for Statement 16. Hence, the researcher can infer that the proportion of participants agreeing or basically agreeing with the statements is significantly higher than the proportion disagreeing or basically disagreeing.

Similarly, based on the Table 3, the two higher Z-values are Statements 21 and 22, which are “When reading in a L2, I switch between using controlled and automatic information processing strategies based on the difficulty level of reading materials” and “When reading simple texts, I use automatic information processing methods. However, when new words, complex grammatical structures, etc., appear in the materials, I will use more

attention resources and adjust reading speed, adopt the controlled information processing methods, such as backreading to understand the reading material”, indicating that most of L2 learners agree and basically agree these statements.

Table 3

Results of Scale Survey of the Interactivity

No.	Statements	Mean	SD	R1	R2	Z Value
17	The cultivation of reading ability generally undergoes a development process from controlled information processing to automated information processing	5.23	1.59	0.51	0.08	9.65
18	After the establishment of automated information processing, the controlled processing process is liberated for higher-level reading information processing	5.19	1.52	0.48	0.08	9.09
19	The nodes in the automated reading information processing process are noticed, and their processing process is no longer unconscious, but will become a part of the controlled reading information processing	5.12	1.50	0.43	0.06	8.33
20	When reading a L2, I interact with both controlled and automatic processing strategies of reading information.	5.20	1.55	0.49	0.08	9.17
21	When reading in a L2, I switch between using controlled and automatic information processing strategies based on the difficulty level of reading materials.	5.29	1.46	0.49	0.06	9.82
22	When reading simple texts, I use automatic information processing methods. However, when new words, complex grammatical structures, etc. appear in the materials, I will use more attention resources and adjust reading speed, adopt the controlled information processing methods, such as backreading to understand the reading material.	5.25	1.48	0.49	0.06	9.68
23	The controlled information processing strategy and the automatic information processing strategy cannot switch back and forth or interact with each other.	3.17	1.92	0.16	0.49	-6.79

Note. The same as above.

According to Table 4, Statement 34 “Through the interactive use of controlled and automatic reading information processing strategies, my L2 reading ability has significantly improved” gets the highest Z-value, indicating that the proportion of individuals agreeing or basically agreeing with that statement is larger than those who disagree or basically disagree with that.

Above all, for Statements “I do not know what automatic reading information process is”, “When reading in a second language, I do not use controlled reading information processing techniques”, “The control information processing strategy and the automatic information processing strategy cannot switch back and forth or interact with each other”, and “The use of controlled and automatic interactive processing strategies is not related to learners’ L2 reading proficiency”, the differences in overall proportion yield negative Z-values, namely, -7.99, -7.99, -6.79, and -4.87, respectively. However, the absolute values of these Z-values are greater than the critical value ($Z_{0.05} = 1.645$). Therefore, it can be reasonably inferred that the number of people disagreeing or basically disagreeing with these statements is significantly greater than those agreeing or basically agreeing.

Table 4

Results of Scale Survey of Controlled and Automatic Interactive Processing Strategies and L2 Reading Ability

No.	Statements	Mean	SD	R1	R2	Z Value
24	When reading in a L2, I choose reading strategies based on the difficulty level of the reading task to flexibly apply control and automated processing strategies.	5.23	1.46	0.49	0.06	9.82
25	When the difficulty level of L2 reading tasks is higher than my L2 proficiency, I will use controlled information processing strategies to solve L2 reading difficulties.	5.18	1.43	0.49	0.06	9.82
26	When reading in a L2, I consciously adjust my reading strategies for controlled or automatic information processing.	5.11	1.61	0.47	0.09	8.21
27	I will improve my L2 reading ability through certain strategies to enlarge reading volume.	5.17	1.53	0.46	0.05	9.59
28	When reading in a L2, I sometimes feel confused about the use of automatic and controlled information processing.	4.94	1.65	0.41	0.11	6.49
29	I will improve my L2 reading skills through the interactive use of controlled information processing and automatic information processing strategies.	5.32	1.42	0.49	0.06	9.68
30	When reading tasks that are equivalent to my L2 proficiency, I use automatic information processing strategies to complete reading tasks.	5.12	1.42	0.42	0.06	8.43
31	By increasing the difficulty level of reading materials, continuously practicing reading activities, and adjusting reading speed in a timely manner, I can gradually achieve the level of automatic information processing for L2 reading materials.	5.25	1.50	0.49	0.08	9.37
32	Emphasizing the overall understanding and contextual inference of reading, as well as using guessing reading strategies can help achieve automatic processing of reading information.	5.20	1.55	0.48	0.07	9.64
33	When feeling difficult to understand the materials in L2 reading, I use controlled processing strategies to help complete reading comprehension tasks.	5.27	1.52	0.53	0.07	10.46
34	Through the interactive use of controlled and automatic reading information processing strategies, my L2 reading ability has significantly improved.	5.26	1.41	0.51	0.04	10.83
35	Interactive use of controlled and automatic reading information processing strategies can help improve L2 reading proficiency.	5.21	1.38	0.48	0.04	10.10
36	The use of controlled and automatic interactive processing strategies is not related to learners' L2 reading proficiency.	3.38	1.99	0.20	0.44	-4.84

Note. The same as above.

Controlled processing and automatic processing often occur alternately in L2 reading, and are influenced by many factors. Language learners' reading proficiency, reading time, reading mentality, as well as intellectual and non-intellectual factors will all affect the controlled processing and automatic processing. For the reading materials that are difficult as far as the reader's current reading proficiency are concerned, the reader can actively mobilize more attention resources and adopt the controlled processing strategy to comprehend them. If the readers are to improve their reading ability, for example, they need read a bit more difficult materials, or shorten reading time, etc., by adopting the controlled reading processing strategy, such as context speculation, word guessing, etc., thus enhancing their reading ability, and gradually realizing automatic reading processing.

By adopting the above strategies, language learners can balance controlled processing and automatic processing in L2 reading, and gradually realize the improvement of automatic processing ability in reading. This will help to improve reading fluency, comprehension, and reading efficiency, thus promoting the progress of L2 acquisition.

Conclusion

Based on a review of previous studies, this study explores the use of controlled and automatic processing in L2 reading by language learners, and the influencing factors that influence L2 learners' choices of different information processing methods. The findings are as follows: (a) controlled and automatic information processing is interactive in L2 reading; and (b) the use of controlled and automatic information processing strategies is beneficial to the improvement of the reading ability of L2 learners. By controlling these factors, L2 learners can adopt corresponding processing strategies to help them improve their reading speed, reading quality as well as L2 reading proficiency. This study has great theoretical and practical values for helping L2 learners gradually realize the transition from controlled processing to automatic processing in the process of L2 reading, thus greatly improving their L2 reading proficiency.

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