CHINESE EFL LEARNERS' USE OF ONLINE READING STRATEGIES

by

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To my grandma, Wenli Zhang,
for the family legacy you left to us.

To my parents, Qibo Wu and Qing Zhang,
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ABSTRACT

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Based on Afflerbach and Cho's (2009) theoretical model of Constructively Responsive Reading on the Internet (CRRI model), this study aims to explore the patterns of reading strategies that 40 proficient, college-level, Chinese English as a Foreign Language (EFL) learners use while reading online. It also seeks to identify the strategies' relations to reading comprehension.

This study utilized an exploratory research design. During the study, the participants were required to complete a 30-minute reading task on a pre-selected website, followed by a comprehension assessment with 20 multiple-choice questions. During the reading task, the participants were asked to verbalize their thinking process. Both their verbalization and online actions were recorded by Camtasia. These recordings served as the primary data and then were coded using Afflerbach and Cho's (2009) four strategy categories as the coding scheme.

Following this, the coded primary data were analyzed quantitatively. The results first indicated that participants' meaning-making strategy use dominated the whole reading process. Both the self-monitoring and text location strategies served as a supporting role in this reading task; however, the information evaluation strategy was used least often. Additionally, based on the sequential patterns of the participants'

strategy use, three different types of readers were identified: uncertain readers, exploratory readers, and strategic readers. Lastly, the examination of the relationship between strategy use, reader types, and comprehension outcome revealed that both the meaning-making and self-monitoring strategies had a strong effect on the comprehension outcome. The results also showed that the comprehension outcome was significantly different among all three reader types. The comprehension outcomes of the strategic readers ranked highest, followed by the exploratory readers and the uncertain readers.

This exploratory study not only provides a quantitative assessment of Afflerbach and Cho's (2009) theoretical framework, but also extends our understanding of online reading to a different cultural context. The findings of the study have important implications for both practice and research.

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LIST OF ABBREVIATIONS

ESL	English as a second language
EFL	English as a foreign language
CRR model	Theoretical model of Constructively Responsive Reading
CRRI model	Theoretical model of Constructively Responsive Reading on the Internet
IE	Information evaluation
MM	Meaning-making
SM	Self-monitoring
TL	Text location

CHAPTER ONE

INTRODUCTION

The present study investigates reading strategies used by proficient, college-level Chinese EFL learners while reading online as framed by the model of Constructively Responsive Reading on the Internet (CRRI model) (Afflerbach & Cho, 2009; Cho & Afflerbach, 2017). This chapter serves as a general introduction to the study and consists of five sections: motivation for the study, background of the study, purpose of the study, significance of the study, and definitions of key terms.

Specifically, this chapter begins with a discussion of the factors present in both native and foreign language English-learning contexts to explain the motivation of the study. It then briefly overviews the literature that informs the objectives of the present study. Based on these considerations, this chapter outlines the purpose of the study. The study is further evaluated in terms of its potential implications and importance. Finally, it shares a list of key terms foundational to understanding the research as a whole.

Motivation for the Study

Rapid changes in the traditional literacy field have been caused by the emergence of new technologies in the 21st century, namely the rapid growth of the Internet (Coiro, 2003; Coiro, Knobel, Lankshear, & Leu, 2008; Leu et al., 2005; O'Byrne et al., 2008). Based on statistics gathered by the U.S. Census Bureau (2014), there has been a huge growth in dependence on computers and the Internet for today's Americans to complete schoolwork, to find jobs, to enjoy entertainment, and to access various kinds of information. Specifically, in 2013, 83.8% of U.S. households reported computer ownership and 74.4% of all households reported Internet use. Furthermore, as the

National Center for Education Statistics (2016) indicated, the Internet has been increasingly integrated into classroom settings during the past years. As argued by Prensky (2001), "today's students – K through college – represent the first generations to grow up with this new technology" and they are the "Digital Natives," the "native speakers of the digital language of computers...and the Internet" (p. 1). A variety of new information and communication technologies have provided these "Digital Natives" with new platforms for literacy and learning (Coiro et al., 2008). The concept of traditional literacy has indeed been expanded due to the prevalence of technology. As Coiro (2011) concluded, the "Internet continues to transform and define literacy in the 21st century" (p. 353). These changes demand new literacy skills if readers are to process text effectively (Leu et al., 2008). Therefore, the ability to acquire information by reading, understanding, and evaluating online texts has become essential for the literacy development of today's learners (Coiro, 2011).

As discussed above, although the complex digital reading environment has provided learners with new opportunities, it also has posed unique obstacles and challenges (Cho, 2011; Cho, 2014). Unlike traditional print text, which is "linear, static, temporally and physically bounded" (Dalton & Proctor, 2008, p. 297), the landscape of digital text is typically nonlinear, multimodal, and unbounded. As Coiro (2003) explained, "[t]he Internet, in particular, provides new text formats, new purposes for reading, and new ways to interact with information that can confuse and overwhelm people taught to extract meaning from only conventional print" (p. 458). Therefore, the changing contexts of Internet reading call for active readers who are able to use critical, analytical, and constructive reading strategies in their attempts to understand and meaningfully process Internet texts (Cho, 2014; Leu, Kinzer, Coiro, & Cammack, 2004;

Leu et al., 2011; Leu, Kinzer, Coiro, Castek, & Henry, 2013; Leu & Zawilinski, 2007). A better understanding of such a "dynamic set of strategies learners need" (Coiro, 2012, p. 412) will provide valuable insights into how readers construct meaning during online reading.

As Anderson (2003) pointed out, this changing learning context also is applicable to English as a Second Language (ESL) and English as a Foreign Language (EFL) learners, offering an important learning resource to both groups. China, for example, implemented a drastic curriculum reform in the field of college English education to acknowledge the increasing role of technology and its importance in various types of learning. In 2007, the Chinese Ministry of Education updated the *National College English Curriculum Requirements* to include a new requirement that Chinese EFL learners make use of the Internet to facilitate their language learning and to grasp the skills of online reading. Based on that curriculum, colleges and universities began to change the design of their English courses by adding a new component: online English reading and learning. However, as Coiro (2012) mentioned, even classroom teachers of native populations often face challenges while "integrating digital texts and tasks into their literacy curriculum" (p. 412). This issue is especially applicable to ESL and EFL populations. Chinese college EFL readers often experience disorientation in this vast and fluid web-based reading environment, which requires the ability to use reading strategies to construct and examine meaning (Li, Li, Zhong, Xiong, & Liu, 2006). Students need guidance from teachers, such as suggestions of practical reading strategies. However, the lack of a research foundation on strategies leaves teachers similarly without sufficient guidance and they therefore cannot effectively inform and model to students. Further

research of this topic is greatly needed to facilitate more individualized and empirically supported instruction.

Background of the Study

As Coiro (2012) indicated, "research in the acquisition of new literacies is rapidly expanding in ways that can support classroom teachers" (p. 412). Over time, various studies have attempted to use different approaches to identify reading strategies. As Afflerbach and Cho (2009) concluded, our conceptualization of reading strategies "is always subject to modification and revision, evolving as our understanding of cognition, literacies, and the contexts in which they operate contribute new information" (p. 71). This section provides an overview of research relevant to the current study by summarizing important studies, analyzing themes that have emerged from them, and reflecting on weaknesses or deficits that the present research might avoid or fill. The studies evaluated are presented in the following section in chronological order.

Hill and Hannofin (1997) conducted a qualitative study to examine the strategies used by four adult learners in an open-ended hypermedia information system. While participants were completing an online search task, the think-aloud method was used to record the verbalizations of their thinking processes. Findings indicated that participants used a variety of strategies, such as selection of search engine, application of different keywords to the search, selection of online resources, etc. However, Hill and Hannofin's study only focuses on the search engine context and therefore their findings may apply differently to other contexts.

In 2003, Schmar-Dobler summarized and compared seven comprehension strategies used consistently for both print text reading and online reading: activate prior knowledge, monitor comprehension, repair comprehension, determine important ideas,

synthesize, draw inferences, and ask questions. Schmar-Dobler also proposed an additional strategy, navigate, to describe the skills needed in online reading. This suggestion identifies an important difference between the two reading contexts, one which poses many challenges to readers.

Next, Coiro and Dobler (2007) expanded our understanding of strategy use to different online environments: a website context and a search engine context. Specifically, they examined the online reading comprehension strategies used by 11 skilled sixth-grade readers in these two contexts. Their findings showed that successful online reading requires the use of three kinds of strategies: prior knowledge sources, inferential reasoning strategies, and self-regulated reading strategies.

Following Coiro and Dobler's (2007) study, which focused on differences between environments, Zhang and Duke (2008) conducted a study to explore reading strategies used to accomplish three different Internet reading tasks with different purposes. The 12 participants were undergraduate students, graduate students, and employees at a large Midwestern university. Participants' reading processes were videotaped. Immediately after finishing the three tasks, participants watched the video and used a stimulated recall procedure to verbalize their thinking as it had occurred during reading. Findings suggested more than 50 strategies and indicated that readers apply different patterns of reading strategies for different reading purposes.

Unlike the studies discussed above, which examined online reading strategies used by skilled readers, Chen (2010) explored the online reading strategies of 58 fifth- and sixth-grade students with and without learning disabilities. Data were collected from a questionnaire about students' reading strategies, individual online reading activity, individual online search-engine tasks, and interviews. Results indicated that students

were easily disorientated by the non-linear nature and unfamiliar structure of online texts and had weak before-reading strategies as well as difficulty distinguishing before- and during-reading strategies.

More recently, Goldman, Braasch, Wiley, Graesser, and Brodowinska (2012) conducted a study also aimed at understanding the processes that better and poorer learners engaged in during a web-based inquiry task using multiple Internet sources. The participants were 21 undergraduates (10 better learners and 11 poorer learners) from a Midwestern public university. Using the think-aloud method, the researchers found that participants used eight types of processing patterns and that reading from multiple resources involves interplay among sense-making, monitoring, and evaluation processes.

Through significant diversity in purposes, methods, and means of interpreting findings, the literature on learners' online reading strategy use produced a rich sample of strategies. The results show that online reading still involves many strategies similar to those of traditional print reading (Afflerbach & Cho, 2009; Cho, 2014; Coiro & Dobler, 2007). In fact, as suggested by many qualitative findings, online reading demands that traditional print reading strategies be employed in a more complex way (Afflerbach & Cho, 2010). However, findings from many studies also proposed an additional strategy unique to the online environment, navigate, to reference the new skills needed in online reading. Despite the rich sample of strategies identified in prior work, there are some deficits in generalizability, practicality, and methodology in prior work.

First, although the research on native English learners' use of online reading strategies has offered a specialized understanding of the online process, few studies focus on ESL and EFL populations. Certain specific groups, such as EFL learners from mainland China, have received especially little empirical attention. This absence limits

the generalizability of the prior work and restricts our understanding of strategy use in different cultural contexts.

Second, the body of research indeed lacks an established set of terms and definitions for strategy categories. Different researchers use different terms to describe the strategies. This makes it difficult for reviewers to take advantage of and to derive meaning from the long list of strategies produced by research though the connotation of many of them are the same. It also makes it difficult for researchers to identify important similarities and differences among their works. It is to mitigate these issues that the present study adopts a theoretical model that categorizes the strategies in a more concise and comprehensive way.

Third, the problems with existing research also extend to methodology. The existing literature suggested that the think-aloud method has been supported as an effective, comprehensive, and flexible way to gain an understanding of participants' strategy use (Cho, 2014; Pressley & Afflerbach, 1995). However, while the think-aloud method is commonly applied to native populations, it has been incorporated in only a few relevant studies on ESL and EFL populations, despite its widely acknowledged credibility. Therefore, the current study's application of this method will not only help the researcher generate rich and detailed data, but will also help inform future research about how to employ this approach to second or foreign language contexts.

Fourth, while analyzing verbal report data generated from the think-aloud method, most studies adopted qualitative analysis. However, the reliance on qualitative data represents a weakness in the current body of research on online reading strategies. This is not to imply that qualitative data is inherently inferior to quantitative data, but only to suggest that it is limited to a more descriptive rather than numerical perspective. More

quantitative analysis will allow researchers to measure and to examine the data based on objective statistics, thereby providing opportunities to better observe the patterns and relationships among strategies and other variables.

Lastly, as Coiro (2011) indicated, "the absence of measures to assess online reading comprehension leaves the reading community with no means to evaluate progress or help diagnose the challenges some students face when reading on the Internet" (p. 353). Therefore, the present study attempts to develop a comprehension measure individualized to its unique context and to identify the relationship between strategy use and comprehension within it.

Purpose of the Study

To address the above-discussed deficits in the current body of literature on this topic, the present research employs a quantitative approach to investigate patterns of online reading strategy use among an understudied population, Chinese EFL readers, incorporating the think-aloud method, which has yet to be applied to the target population. Furthermore, this study seeks to offer especially practical information by identifying strategies that are more and less likely to lead to optimal comprehension. Conducting a study that avoids these gaps will expand our understanding of online reading strategies to a different cultural context.

Significance of the Study

It has been widely recognized in a considerable body of literature that the use of strategies plays an important role in online reading comprehension (Afflerbach & Cho, 2010; Coiro, 2011; Park, Yang, & Hsieh, 2014). Both native and non-native language learners are encouraged to test and to evaluate reading strategies that may facilitate their reading success. However, as discussed above, relevant research on the latter population

has been comparatively neglected. Informed by this need, the present study first extends prior research on online reading strategies by examining how this previous research applies to Chinese EFL learners, an under-studied population, in their unique learning context. Moreover, it adds to existing definitions of strategy categories, perhaps incorporating strategies that are unique to this particular population.

Second, although the think-aloud method has been valued as an effective tool to observe people's mental activities and to investigate their cognitive processes, it is rarely used in studies on reading strategy use among ESL and EFL populations. Therefore, utilizing this method in the present study helps to inform future studies of cognitive processes of the ESL or EFL populations, providing practical suggestions to ensure the validity of using the think-aloud method, including training, choices of prompts and language, and analysis of verbal report data.

Third, the patterns of online reading strategies identified in this study address the empirical need for quantitative validation of important prior work. It contributes to the field as a whole by providing a unique and more detailed analysis of the established strategies. A specific relationship to be studied is that between strategy use and comprehension outcomes, the empirical examination of which has been lacking, namely in non-native populations. Results found from these quantitative analyses, therefore, inform teachers about strategies that can lead to better comprehension success.

Ultimately, such investigation helps educational researchers and practitioners to better understand EFL learners' reading processes within the Internet environment. As discussed previously, instructors recognize the importance of strategy use but often lack credible support and literature to inform their efforts. By suggesting strategies that better facilitate students' online reading comprehension, this study's exploration provides

teachers with access to an empirically supported foundation to inform their suggestions to students, parents, and peers. In this way, study findings can be used by classroom teachers and policy makers to address the challenges of how to effectively integrate online texts into their literacy curriculum.

Definitions of Key Terms

ESL learner: a learner of the English language who is living in a place where English is the first language. Examples include America, England, and Australia.

EFL learner: a learner of the English language who is living in a place where English is not the first language. Examples include China, Japan, and Italy.

Simple English Wikipedia: an online encyclopedia website written in basic English to cater to readers whose first language is not English.

Relatively closed online environment: a reading setting in which participants are only allowed to use the hyperlinks and search box available within a particular website. In this study, the term refers to the designated website, *Simple English Wikipedia*.

Open-ended online environment: a reading setting in which a search engine can be used to find Internet texts and in which readers can access any self-selected hypertext.

Internet: in this study, the term refers to the general conception of the Internet but excludes websites that are not catalogued and that one cannot search for, such as those on the dark web.

Online reading strategies: comprehension strategies that readers use deliberately to achieve the goal of constructing meaning through reading in the Internet environment. In this study, this definition includes the following four types of online reading strategies, as conceived by the CRRI model (Afflerbach & Cho, 2009).

1. Text location strategy: the means by which readers navigate, search, locate, and overview to choose relevant websites and information.
2. Meaning-making strategy: the means by which readers understand the text. This strategy type includes both meaning-making within individual texts and synthesizing across different texts.
3. Self-monitoring strategy: the means by which readers apply awareness of their strategy usage and of the effectiveness of their information management. This is a metacognitive process, during which readers detect navigation and comprehension problems and apply solutions in the form of other strategies.
4. Information evaluation strategy: the means by which readers assess the usefulness or the credibility of Internet sources.

Clicks: readers' physical action of using a mouse to click links while reading online. In this study, this definition includes two types of clicking actions.

1. Hover type of clicks: clicks that allow readers to hover over a link to get a preview of the content.
2. Hyperlinks type of clicks: clicks that require readers to actually click on a link to load a new page.

CHAPTER TWO

LITERATURE REVIEW

The current study was inspired by important trends in the literacy field, namely the popularity of the Internet use, particularly in educational settings. Because of the non-linear and unconventional structure of online texts, today's readers often experience disorientation in this web-based environment, which requires the ability to use reading strategies to search for and locate texts, as well as to construct and examine meaning (Cho, 2014; Coiro, 2011; Dalton & Proctor, 2008). These changes in learning context are also applicable to English as a Second Language (ESL) and English as a Foreign Language (EFL) learners (Anderson, 2003). Therefore, the present study on patterns of online reading strategies aims to expand the existing literature's discourse on this topic to Chinese EFL learners.

This chapter presents a theoretical basis for the study and reviews literature relevant to online reading strategies of both native English learners and ESL and EFL learners. Specifically, this chapter addresses the following topics: theoretical framework, online reading strategy types, previous studies of relevance, and how the gaps and strengths identified in past research will inform the current study.

The first part of this chapter introduces different theoretical constructivist perspectives that contribute to our understanding of text processing. Building on these theories, Afflerbach and Cho's 2009 theoretical model of Constructively Responsive Reading on the Internet (CRRI model), which was updated recently (Cho & Afflerbach, 2017), is then presented, serving as the primary theoretical framework for this study.

The second part begins by describing the four types of online reading strategies that are proposed by Afflerbach and Cho in their 2009 and 2017 CRRI model and revision, respectively, and then presents connections between the strategy types and the findings of previous relevant research.

The third part reviews Cho's (2014) study, which is the only empirical research conducted thus far on the validity of the CRRI model. This section discusses the support that this research offered to the model as a whole, as well as the deficits revealed in this study, which inform the design of the present study.

The fourth part discusses previous studies relevant to the ESL and EFL populations in terms of research method and research findings. This allows the researcher to identify the gaps in the current literature and support the need for the present study, which inform the research goals and methodology as specified in the following section.

Theoretical Framework

Describing how readers process information is an important topic of literacy education. Over time, cognitive psychologists, linguists, and educators have all contributed to our growing understanding of this process. Researchers from different fields with various backgrounds have proposed a variety of models to explain this phenomenon. Each model represents a particular perspective and emphasizes different aspects of text processing, enriching our perception of reading (Alexander & Fox, 2004; Pearson & Stephens, 1992). This section will focus on the constructivist perspective, the basis for the CRRI model (Afflerbach & Cho, 2009; Cho & Afflerbach, 2017), which provides the primary theoretical foundation of this study. Three constructivist theories will be discussed first, followed by the CRRI model.

Constructivist Perspective

In the field of education, constructivism is a learning theory that explains the nature of knowledge and the process of knowledge acquisition. It stresses that learning is an active, constructive process (Anderson & Pearson, 1984; Bartlett, 1932; Brown, 1978; Flavell, 1976; Goodman, 1967; Rosenblatt, 1969). Most importantly, constructivism suggests that learners build their own understanding of new knowledge by relating it to their existing knowledge (Anderson & Pearson, 1984; Bartlett, 1932; Rosenblatt, 1969). That is, learners' prior knowledge serves as an important foundation for new learning and subsequent actions. Another emphasis of the constructivist perspective is that "the integration of new knowledge with existing knowledge can only occur when the learner is actively engaged in the learning process" (Tracey & Morrow, 2012, pp. 57-58). In other words, constructivism presumes that learners are "active, natural builders of knowledge" (Tracey & Morrow, 2012, p. 58) and that engagement is central to effective reading. Besides these primary aspects, three further propositions are presented by Tracey and Morrow (2012) as characteristics of constructivism. First, they point out that learning in the constructivist perspective is usually "unobservable to the external viewer" (p. 58). Indeed, learning is an internal mental process that occurs inside people's minds and that is often invisible. Second, Tracey and Morrow (2012) state that, in constructivism, "learning often results from a hypothesis-testing experience by the individual" (p. 58). This means that, to figure out the meaning of new concepts, learners commonly make hypotheses and then test them by using their guesses with newly encountered information. During this process, learners make adjustments based on their hypothesis-testing results, thereby achieving their learning goal. Third, Tracey and Morrow (2012) indicate that, from a constructivist viewpoint, "learning results from a process known as

inferencing" (p. 58). That is to say, learning occurs when learners identify messages and themes that are implied but not directly stated in the text. To sum up, constructivism strongly emphasizes the learner's active role in knowledge construction. It holds that learning is an internal mental process, which is characterized by hypothesis-testing and inference-making (Tracey and Morrow, 2012).

The above-mentioned general concepts of constructivism have a broad impact on learning theories and educational practices. In particular, these constructivist perspectives have been largely applied to the field of reading education to describe how readers construct meaning from texts. The following sections present three influential constructivist theories of reading–schema theory, reader response theory, and metacognitive theory–that highlight different aspects of constructivism and serve as the foundation for the CRRI model (Afflerbach & Cho, 2009; Cho & Afflerbach, 2017).

Schema theory. The concept of schema was introduced into education by Bartlett in 1932, when he coined the term and applied it to the field of reading. It was then expanded into schema theory by Anderson and Pearson (1984), who applied this framework to the reading process. Primarily, this theory explains how knowledge is structured and used by learners. It highlights the significance of existing knowledge for new knowledge acquisition. From the perspective of schema theory, knowledge is organized into different units, or schemata, and "people have schemata for everything in their lives" (Tracey & Morrow, 2012, p. 62). Put differently, schema theory asserts that knowledge is structured into different categories and that people use these schemata to organize existing knowledge, thereby guiding their understanding of new knowledge (Anderson & Pearson, 1984; Bartlett, 1932; Rumelhart, 1980).

As Tracey and Morrow (2012) state, schema theory features two characteristics. Firstly, "everyone's schemata are individualized" (p. 62). That is, people with different past experiences have different schemata for a subject or event. For instance, a person who has attended college for years will have a much more complex schema for the higher education system than would a person who has never taken a college class. It would be impossible for two individuals to have the same schemata for a certain concept, and these differences can have a great influence on a person's learning. Further, the richer a person's schema is, the more easily he or she will be able to acquire new knowledge related to that particular schema (Anderson, 1978; Anderson & Pearson, 1984; Bartlett, 1932). This reflects the importance that schema theory places on existing knowledge, especially in facilitating learning. By acknowledging the unique nature of each person's schema and attributing this distinction to his or her past experiences, the theory implies that existing knowledge has a permanent effect on schemata and thus on future learning. Secondly, schema theory suggests that a person's schemata are adjustable, expandable, and constantly changing in response to outside input such as text reading (Tracey & Morrow, 2012). While acquiring knowledge, the existing and relevant schemata will be modified and expanded to accommodate new information. In this way, the relationship between schema and text is reciprocal. The more people know regarding a topic, the broader and more complex their schemata become (Anderson, 1978; Anderson & Pearson, 1984).

In applying schema theory to the field of reading, Anderson and Pearson (1984) argue that readers' individualized schemata are not only related to text content, but also to the genre of the text and the stages of the reading process, such as decoding, monitoring, evaluating, etc. They further note that differences in readers' existing

schemata result in variances in comprehension. Readers who have more intricate schemata for a topic and more knowledge of effective reading and text structure will be at an advantage when comprehending new reading. Since readers bring prior knowledge to their reading, their text processing and comprehension will be impacted once they activate the schema (Pressley & Afflerbach, 1995). This idea has been supported by the findings of many think-aloud studies summarized in Pressley and Afflerbach's (1995) study.

In summary, schema theory underscores the essential role of existing knowledge in people's reading and learning. From the schema theory perspective, readers actively initiate and construct their schemata as they read new information. Therefore, this theory is compatible with the constructivist perspective. It has also been incorporated into the CRRI model (Afflerbach & Cho, 2009; Cho & Afflerbach, 2017), which acknowledges the importance of prior knowledge in skilled reading.

Reader response theory. Based on the main concept of schema theory that each individual's schemata are distinct, Rosenblatt (1978) proposed another important literacy theory called the reader response theory or transactional theory, which was intended to expand on schema theory's implications for the reading process. From Rosenblatt's point of view, the inherent diversity among schemata implies an inherent diversity in reading experiences (Rosenblatt, 1978, 1994). In other words, readers with distinct prior knowledge and perspectives would react differently to the same text, thereby creating their unique understanding and influencing their responses to text.

While other perspectives assume that text has a single objective meaning, reader response theory argues that it is the knowledge and experiences brought by the reader that endow meaning to the text. Reader response theory holds that the meanings of the text

vary from reader to reader because the meaning construction results from a transaction between reader and text and is thus related to the reader's unique schemata. Put differently by Rosenblatt, reader response theory proposes that the text meaning "is something that resides neither [solely] in the head of the reader nor [solely] on the printed page" (as cited in Tracey & Morrow, 2012, p. 67); instead, the individual reader creates his or her own meaning through a transaction with the text based on their own personal schemata. Under this above-mentioned assumption, reader response theory claims that readers play an active and essential role in creating meaning based on factors which have influenced their schemata, such as their interests, their prior knowledge, their personality, cultural background, etc. (Pressley & Afflerbach, 1995; Rosenblatt, 1978, 1994). In brief, reader response theory stresses the significance of the reader's active role in interpreting text, and the primary assumption of this theory is that readers' interpretations of a text are influenced by their reactions to the text, which will vary depending on their particular schemata.

Since reader response theory focuses more on the reader's reaction to a particular text than on the text itself, it has provided a different perspective for understanding text processing and was widely applied to the reading field in the early 20th century. However, as Pressley and Afflerbach (1995) state, results from various studies using protocol analyses suggest that reader response theory is only applicable to certain stages of text processing. It does not acknowledge that readers tend to engage in monitoring as part of the reading process. Indeed, "readers do not just respond to texts," but also use their perceptions of effective and ineffective techniques to make adaptations to their strategy use (Pressley & Afflerbach, 1995, p. 86). That is, readers are aware of their reading behaviors and revise plans accordingly while constructing the meaning of the text. The

reader response theory's non-applicability to the monitoring process decreases the validity of any understanding reached by the reader using this approach. This is because it is not sufficient to simply construct meaning from text; one must also strive for awareness of their strategy use and revise their practices based on this evaluation. Otherwise, any comprehension reached lacks "warranted assertibility" (McEneaney, Li, Allen, & Guzniczak, 2009), meaning that the understanding lacks objective justification.

To sum up, reader response theory emphasizes the role of readers and their reactions to a particular text, rather than that of the author and the text content. Unlike other text-based perspectives, which argue that the meaning of the text is objective and is contained solely within the text, reader response theory claims that the meaning of the text is not formed until it is read. From the reader response theory perspective, readers play an active role in making meaning from the text rather than passively consuming information. In this way, the theory builds on the constructivist premise that readers are active in the construction of knowledge. Though it offers a solid foundation for the development of the CRRI model (Afflerbach & Cho, 2009; Cho & Afflerbach, 2017) CRRI model, the reader response theory lacks in specificity of explanations for many of the comprehension monitoring processes (Pressley & Afflerbach, 1995). Therefore, to provide a more comprehensive picture of the reading process, the metacognitive perspective should be considered.

Metacognitive theory. As discussed above, it is imperative to have a holistic view of how readers process text and specifically of how readers monitor their comprehension. To gain a thorough understanding of these components, the metacognitive perspective needs to be considered. The concept of metacognition was first introduced into the field of reading by Brown in the mid-1970s, when she investigated

children's development of metacognitive abilities in reading. It was then expanded into metacognitive theory by Baker and Brown in 1984. Later in 1989, Baker further updated this model by specifying seven monitoring standards, enriching our understanding of text processing with the broader cognitive psychological perspective.

Generally, metacognitive theory is a theory about cognition. Baker and Brown (1984) define metacognition as "an awareness of what skills, strategies, and resources are needed to perform a task effectively; and the ability to use self-regulatory mechanisms to ensure successful completion of a task" (p. 354). In short, metacognition refers to thinking about one's own thinking (Baker, 1989; Baker & Brown, 1984; Brown 1978). Baker and Brown (1984) further argue that metacognition is involved in successful reading; in which case, it refers to readers' awareness and active control of their cognitive processes as they engage in reading. Comprehension monitoring activities, such as planning and evaluating reading progress, are all metacognitive in nature and can inform adjustments needed to complete the reading task. Such monitoring is critical to readers' effective and appropriate use of strategies during reading. As indicated in a large number of empirical studies, a reader's metacognitive knowledge and control of the reading process are associated with more effective reading (Afflerbach & Cho, 2009). Also, applied research has largely confirmed the practical impact of facilitating metacognition in the classroom (Pressley & Afflerbach, 1995). Thus, to ensure successful reading, readers need to not only activate relevant prior knowledge and deploy appropriate strategies, but also actively monitor their comprehension throughout the entire process.

Furthermore, as Pressley and Afflerbach (1995) note, "[k]nowing strategies was one thing, but knowing when to use them appropriately was very different" (p. 87). This statement emphasizes the subtle but important distinction between possession of

knowledge and effective usage of that knowledge based on context. In a landmark study, Baker and Brown (1984) proposed two distinct forms of metacognitive knowledge, static knowledge and strategic knowledge, which, respectively, fit the above-mentioned distinction. Static knowledge is an understanding of when and why to apply various cognitive actions, while strategic knowledge refers to metacognitive activities that help regulate one's thinking and reading. Only when readers apply both components of metacognitive knowledge to their processing of information can they achieve optimal reading.

To sum up, consistent with the tenet of the constructivist perspective, metacognitive theory reinforces the importance of readers' active monitoring and conscious regulation of their comprehension processes. Relevant research has supported its assumptions, such as by demonstrating that skilled readers have the ability to monitor their comprehension and take corrective measures based on actions they find to be effective or ineffective (Pressley & Afflerbach, 1995). Metacognitive theory has advanced our understanding of the monitoring process in comprehension, and therefore has long been recognized and advocated by researchers in the field of reading (Alexander & Fox, 2004; Pearson & Stephens, 1992). It is also a key component in the foundation of the CRRI model (Afflerbach & Cho, 2009; Cho & Afflerbach, 2017). However, as Pressley and Afflerbach (1995) indicated, certain research findings have noted metacognitive theory's failure to reflect important text processing steps, such as making meaning of text and evaluating the usefulness of the text. This theory may overlook such steps because it focuses primarily on monitoring: the self-evaluation that takes place while completing such steps. Hence, this theory needs to be considered in conjunction with other theories when seeking to understand the reading process as a whole.

Theoretical Model of Constructively Responsive Reading on the Internet

In combination, the three theories mentioned above frame reading as an individual's active meaning-construction process. Each theory highlights different facets of text processing from the constructivist perspective, contributing to and expanding our evolving understanding of the reading process (Alexander & Fox, 2004; Pearson & Stephens, 1992). However, as Pressley and Afflerbach (1995) note, "none of the models alone can account for the rich mix of strategies, monitoring, and evaluative processes that constitute skilled reading" (p. 97). Therefore, it is necessary to establish a more inclusive model of text processing that aligns all the above-mentioned theoretical components. Informed and motivated by the previous theories, the model of Constructively Responsive Reading on the Internet (CRRI model) was proposed by Afflerbach and Cho in 2009 with the goal to present a more complex description of reading than do the existing models. This model was built upon Pressley and Afflerbach's (1995) model of Constructively Responsive Reading, which examines the use of reading strategies in the print reading context. To thoroughly understand the assumptions and validity of the original Constructively Responsive Reading model and its subsequent expansion to Internet reading, it is important to discuss the central concept of constructively responsive reading.

Constructively responsive reading. Based on existing constructivist theories and a synthesis of 38 reading strategy studies, which used think-aloud protocol data, Pressley and Afflerbach (1995) proposed the concept of constructively responsive reading to describe the processes involved in reading. Their analysis of the findings of these 38 studies shows that the purpose of reading is to construct meaning from the text and that, to achieve this, proficient readers both reflect on and respond to these constructions based

on their prior knowledge. These behaviors of construction and response are repeated throughout their reading process. That is, the whole reading process, is "highly constructive" (Cho & Afflerbach, 2017, p. 111).

In addition, Pressley and Afflerbach (1995) assume that, in constructively responsive reading, the application of reading strategies is situated in the reading context. In other words, readers' strategies vary in form and function according to the materials and the complexity of the task. In brief, the researchers conclude that skilled reading is a result of a constructively responsive process in which strategy use is central and that this process is influenced by external factors such as the text format or assignment (Afflerbach & Cho, 2009; Le Bigot & Rouet, 2007; Pressley & Afflerbach, 1995, Cho & Afflerbach, 2017).

Pressley and Afflerbach's (1995) model of Constructively Responsive Reading. Built on the notion of constructively responsive reading, Pressley and Afflerbach (1995) proposed the model of Constructively Responsive Reading (CRR model), which aims to describe and categorize the strategies used in the conventional print-based reading context. The development of the CRR model was accomplished by synthesizing the findings of 38 publications, including journal articles and book chapters from various perspectives such as cognitive psychology, reading, writing, linguistics, etc. These studies all applied verbal protocol analysis and focused on reading strategy use in the print-based reading context.

First, Pressley and Afflerbach assembled a relatively large body of relevant studies through their own empirical searching and recommendations from other researchers. They then attempted to limit their target articles to 38 research studies, which varied in many aspects, including the characteristics of readers, the form of the text, the

reading tasks used in protocol analyses, as well as the detailed implementation involved in collecting verbal protocol data. Also, the focuses of the 38 articles were diverse, emphasizing various aspects of text processing. Since the goal of the CRR model was to reflect as many available strategies as possible, the diversity of the target sources served as an advantage to the model's development.

After the initial selection process, Pressley and Afflerbach (1995) synthesized the identified data, following the protocol established by Strauss and Corbin (1990). Through this systematic analysis, Pressley and Afflerbach (1995) identified three general categories of strategy use that they then used to form the CRR model: 1) identifying and learning text content; 2) monitoring; and 3) evaluating.

The first strategy category of the model reflects the belief that, regardless of reading goal, the ability to identify important information in a text and to make sense of the text's meaning are essential to effective reading. Generally, identifying and learning text content is a meaning-making process, which consists of meaning identification, meaning construction, and coding of text meaning. Examples of the first type of strategies include skimming/overviewing the text, decoding only particular sections, activating prior knowledge, making inferences and predictions, and summarizing (Pressley & Afflerbach, 1995; Afflerbach & Cho, 2010).

Typical examples of the second category of strategy use – monitoring – consist of methods by which readers determine whether they understand what they are reading, identify difficulties in comprehension, and find appropriate strategies to address them (Pressley & Afflerbach, 1995; Afflerbach & Cho, 2010).

The third category of strategy use – evaluating – requires the reader to take on the role of textual critic, considering the quality of knowledge demonstrated in the work,

noting the text's usage or failure to use sufficient argumentative support, and gauging the overall effectiveness of the text in meeting the readers' needs and goals (Pressley & Afflerbach, 1995; Afflerbach & Cho, 2010).

Pressley and Afflerbach (1995) emphasize that the three types of reading strategies are interrelated and work jointly throughout the reading process. There is no definitive starting point of the process, and every strategy can lead to any other strategy; the process can then continue in any one of an infinite number of sequences.

Additionally, though two of the central tenets of the CRR model – monitoring and evaluating – were already established in the reading field, their definitions and relationship were somewhat ill defined and even controversial (Pressley & Afflerbach, 1995). The analyses of the 38 verbal protocol studies found that some demonstrated differences in definition of these categories. Certain research suggested that they be combined into one due to their perceived similarities. These studies seem to have interpreted evaluating as being directed at the reader's own strategies (which would constitute monitoring) instead of at the text itself. Pressley and Afflerbach (1995) resisted such proposals to group monitoring and evaluating together in their CRR model. They distinguished these two concepts based on the object of evaluation: the reader themselves or the text. They clarified that "monitoring is focused on making processing decisions and is future oriented – what to do next" as a reader; "evaluation focuses on the worth of what has been processed" (p. 79), which refers to the text.

This first comprehensive and systematic method of categorizing strategies based on detailed definitions has contributed substantially to the research base. To construct the CRR model, Pressley and Afflerbach (1995) relied solely on protocol analyses to identify and describe reading strategies. They characterized reading as a constructive, responsive

process and stressed that, successful reading necessitates both construction of meaning by the reader and responses to the particular text, from which the meaning is derived. By acknowledging this reciprocal and variable relationship, Pressley and Afflerbach's (1995) CRR model offers a highly flexible system describing the strategies utilized while reading print text.

Afflerbach and Cho's (2009) model of Constructively Responsive Reading on the Internet. Though Pressley and Afflerbach's (1995) CRR model is informative to both theory and practice, its research base is situated in the context of print reading, specifically of a single text, and, furthermore, focuses on accomplished readers. Along with the development of technology and the Internet, the literacy environments of today's readers have changed significantly. The Internet reading environment demands new strategies to respond to its unique characteristics. As Afflerbach and Cho (2009) acknowledge, readers in a traditional paper-based reading environment usually interact with only one single text. However, in the Internet or hypertext reading environment, these scholars pointed out that readers often face multiple texts, which are most likely presented in a different format and linked in a hypertext structure. This contextual transition calls for the use of different strategies in order for readers to search for, locate, select, and evaluate the texts. Given the greater complexity of the Internet, Afflerbach and Cho (2009) proposed an expansion of the original model that would be conducive to this distinct context.

Following the same method that Pressley and Afflerbach (1995) used to develop the initial CRR model, Afflerbach and Cho (2009) collected 46 recent think-aloud protocol studies that examined reading strategies for both Internet reading and multiple text print reading. First, they synthesized the findings of these studies and identified

strategies that fit into the original three categories of Pressley and Afflerbach's 1995 model. This comparison between strategies in the two contexts reveals that accomplished readers apply the original three strategy types (identifying and learning text content, monitoring, and evaluating) to both print and Internet reading. In order to account for the wealth of new information indicated in the studies, Afflerbach and Cho (2009) followed a recursive process to fully develop the CRRI model, continuing to add to and revise the descriptions of strategies as new studies were reviewed and incorporated in each stage of the analysis. Afflerbach and Cho (2009) made the existing three categories broader and thus more inclusive to account for the diverse requirements of Internet reading (Cho, 2014). By introducing updated characteristics of the original categories, they not only built a bridge between traditional print-based reading strategies and Internet reading strategies, but also demonstrated the modifications of traditional strategies that readers make while reading online.

Then, Afflerbach and Cho (2009) focused on studies of Internet reading strategies and compared them to those on traditional reading strategies. This investigation identified one new type of strategy that does not occur in traditional reading: realizing and constructing potential texts to read. The researchers felt this type merited an entirely new strategy category unique to Internet reading. Detailed descriptions of the four categories and their specific subcategories will be discussed separately in the following section.

To sum up, built upon the CRR model, which investigates strategy use in the traditional print reading context, Afflerbach and Cho's (2009) study demonstrates a strong correspondence between the strategies used by skilled readers in traditional and Internet reading environments. Afflerbach and Cho's 2009 model provides valuable insights into online reading strategies. However, due to the complexity of conscious

processing of Internet text, it does not "exhibit all possible strategic acts of reading entailed in diverse tasks and contexts" (Cho, 2011, p. 32). As Afflerbach and Cho (2009) mention, the constant changing of online reading environments demands that the CRRI model be "regularly revisited and updated" (p. 85). Hence, more empirical studies are expected to investigate online reading strategies used in different content domains and in different cultural contexts.

An update to Afflerbach and Cho's (2009) model of Constructively Responsive Reading on the Internet. Based on research conducted since the first edition of Afflerbach and Cho's (2009) CRRI model, in 2017, Cho and Afflerbach published an article in the second edition of *Handbook of Research on Reading Comprehension,* which offered new insight into the evolving perspective of online reading comprehension strategies. While conceptualizations from the 2009 model are affirmed in this new text, Cho and Afflerbach (2017) offer revised and expanded descriptions of the original strategies. They emphasize that, since reading strategies are heavily dependent on situation and goal (Pressley & Harris, 2006), these strategies must be considered in terms of changing materials and contexts.

Cho and Afflerbach's 2017 article argues that print and online reading share a common purpose: to form a coherent understanding of the text (Kintsch, 1998). However, because of the vast amount of sources presented in many different forms, online readers often encounter difficulties in reaching this goal. Therefore, the online reading environment demands not only more rigorous use of strategies but also grouping of these strategies into different levels for the purpose of creating coherence from variety of sources and accounting for the many interrelated components of the online environment (Cho & Afflerbach, 2017).

Cho and Afflerbach (2017) identified three levels of coherence building for online reading: "(1) information comprehension, (2) intertextual connection, and (3) construction of reading paths" (p. 115). The first level of coherence building focuses on the reader's construction of meaning from a single online text. Though online reading usually involves multiple texts presented in various forms, using strategies to construct meanings of each individual text is an essential initial step for readers to understand the material. Furthermore, it lays the foundation for future reading in the second level by allowing for assessment of subsequent texts based on whether each is conducive to a coherent overall understanding (Cho, 2014; Coiro & Dobler, 2007).

When readers move from constructing meanings of single texts to creating a coherent understanding of multiple texts, they reach the second level of coherence building: intertextual connection. Online reading often requires the "identif[ication] and building [of] intertextual linkages" (Cho & Afflerbach, 2017, p. 118) through comparison and contrast of different resources and thoughtful combination of knowledge offered by various documents (Anmarkrud, Bråten, & Strømsø, 2014). The ultimate goal of this level of coherence building is to determine how each text fits within the comprehensive understanding obtained from all sources, with an assessment of the function, relevance, and usefulness of each source (Cho & Afflerbach, 2017). Therefore, the second level of coherence building is vital to multi-text online reading.

Lastly, because of the "flexibility and complexity" (Cho & Afflerbach, 2017, p. 123) of the Internet structure and resources, readers tend to establish and follow an "individualized reading path" (Cho & Afflerbach, 2017, p. 114), which refers to their choice of texts as well as the sequence in which they approach these texts based on their strategies. As suggested by the findings of McEneaney, Gillette, Farkas, and Guzniczak's

(2016) study, reading paths vary from reader to reader. In this research, the participants were asked to search on the Amazon website for a digital camera as a present for a relative. The researchers sought to identify and categorize reader types based on sequential patterns observed across the online reading process. The results revealed that some readers tend to process text at a surface level, relying largely on general information presented on easily accessible pages and rarely going further into the available options to seek more details. Conversely, others are more likely to read in a more strategic and systematic way; like the surface-level readers, they begin by gaining general information but then take the next step of diving in and exploring more details and links, such as product descriptions. In short, while accomplishing online reading tasks, different readers present different paths to accessing information. Ultimately, an effective reading path will facilitate an accurate understanding of the focus topic that reflects an effective evaluation and combination of all chosen texts.

It is important to recognize that the three levels of coherence building are not strategies themselves but categories that reflect the potential goals of the strategies within. Unlike the 2009 model, which discusses the four types of online reading strategies in an action-oriented manner, in the 2017 CRRI model, Cho and Afflerbach grouped the strategy types specifically based on the potential goals each can accomplish. The strategies assigned to the first level of coherence building – information comprehension of a single digital text —include three types of strategy use: meaning-making, monitoring, and evaluation. It is because this category's goal focuses on a single text that these strategies share many similarities with print text reading strategies. Similarly, the strategies used at the second level of coherence building – intertextual connection – still involve meaning-making, monitoring, and evaluation. However, to

reflect the multiple-text nature of the Internet, these three original definitions are expanded to "identifying intertextual links and making meaning from across texts"; "monitoring the construction of intertextual relationships"; and "evaluating and sourcing multiple digital texts," respectively (Cho & Afflerbach, 2017, pp. 120-121). Lastly, the strategies that make up the third level of coherence building – construction of reading paths – include the three above-mentioned strategy types as well as a new category: "managing information space and navigating toward useful texts" (Cho & Afflerbach, 2017, p. 125). This new category contains strategies to search for, locate, and navigate relevant information on the Internet.

To sum up, though Cho and Afflerbach discuss the strategy types from the perspective of three levels of coherence building in their updated 2017 CRRI model, their strategy categories still retain the general meanings of the original four in their 2009 version. Additionally, the new grouping method indirectly provided more details to describe each strategy type, as each is now associated with a specific purpose, as indicated by the level of coherence building in which it is situated.

Four Types of Online Reading Strategies

This section first presents operational descriptions of the four categories of online reading strategies proposed in Afflerbach and Cho's 2009 CRRI model and updated in their 2017 publication. It then discusses connections between the strategy types and the findings of previous relevant research.

In the CRRI model, Afflerbach and Cho (2009) present a long list of subcategories to detail the four types of online reading strategies. However, a review of the subcategories indicates that their descriptions are rather complex and there is a considerable degree of overlap. Since the present study will classify readers' actions

based only on the four main strategy types, it is not necessary to distinguish between the various subcategories. All of these subcategories will be captured in a much simpler framework to include the key ideas of each strategy type. The corresponding coding scheme will use Afflerbach and Cho's framework as a foundation but will revise it to offer simpler and clearer operational definitions, which will capture the most distinguishing features of each strategy type. This will assist in reliability by giving the coders concise and specific instructions.

Realizing and Constructing Potential Texts to Read

Afflerbach and Cho's 2009 CRRI model proposes that, to meet the demands of Internet reading, readers rely on a strategy unique to the online environment: "realizing and constructing potential texts to read" (p. 83). This type of strategy refers to readers' means of navigating, searching for, locating, and overviewing to choose relevant websites and information. For clarity, the researcher will follow Cho (2014) in referring to this strategy as "text location."

Because of the nonlinear nature of Internet hypertexts, readers face more possibilities and choices while constructing meaning online (Afflerbach & Cho, 2009, 2010; Afflerbach, Cho, & Kim, 2014; Cho 2014). As concluded by Cho (2011), Internet readers often engage in "exploration of uncertain information in a virtually unbounded space" (p. 97). In other words, unlike in traditional print text reading, which involves one text already presented to the readers, Internet reading often requires readers to choose from multiple texts inter-connected with hyperlinks. To initiate Internet reading, readers must first use strategies to examine what texts are available in the Internet hyperspace and where they are located, and then to determine the order in which they will access and process the texts (Castek et al. 2008; Cho, 2014; Coiro, 2003; Duke, Schmar-Dobler, &

Zhang, 2006; Leu et al., 2008; Sutherland-Smith, 2002). These navigation actions become an important element for online reading (McEneaney et al., 2009) and are crucial to effective online reading (Amadieu, Tricot, & Mariné, 2010; Afflerbach & Cho, 2010; Cho & Afflerbach, 2015; Goldman et al., 2012; Zhang & Duke, 2008).

Many of the previous studies of online reading strategies (e.g. Braasch et al., 2009; Cho, 2014; Coiro & Dobler, 2007; Salmeron & Garcia, 2011) recognize these information-searching and source-locating strategies as the feature that most clearly distinguishes Internet reading from traditional print reading. Previous studies also revealed many challenges associated with realizing and constructing potential texts to read on the Internet (Lawless & Kulikowich, 1996; Lawless, Mills, & Brown, 2002). As McEneaney (2001) stated, there is a consensus among the existing literature that, without use of the appropriate strategies, even proficient readers of print also experience disorientations while reading online. Specifically, Fidel et al.'s (1999) study, which investigated high school students' web searching behaviors, indicated that many of the participants didn't utilize the strategies needed to search for and locate information on the Internet. Most of the search terms used by these readers came from the original task prompt; these participants rarely generated their own terms. This reflects a lack of flexibility in the Internet context, which is also demonstrated in their search strategies. Studies also reveal that non-strategic readers seldom use multiple search engines, even when they have failed to find useful information using their originally chosen engine (Schacter, Chung, & Dorr, 1998).

To sum up, the review of the literature shows that the context of the Internet reading is unlike that of traditional print text reading, as the restricted nature of the latter correspondingly limits the range of strategy options available to readers (Cho, 2011). The

Internet reading process demands greater flexibility and scope. While it offers more freedom and access to information, the breadth of the Internet often overwhelms readers who fail to adapt to its unique challenges. Effective readers must use strategies to plan their navigation and to evaluate and construct potential texts to read among the large number of available websites and hyperlinks.

Identifying and Learning Important Information

Afflerbach and Cho's 2009 CRRI model defines readers' use of meaning-making strategies as "identifying and learning important information" (p. 83). This strategy is conducted with the goal of understanding the text. In addition, this strategy type includes both meaning-making within individual texts and synthesizing across different texts. For clarity, the researcher will follow Cho (2014) in referring to this strategy as "meaning-making."

Afflerbach and Cho's (2009) previously-mentioned synthesis of 46 studies has shown that proper use of meaning construction strategies is crucial to effective reading in both print and Internet environments. However, unlike traditional print text reading, which typically requires reading a single text, Internet reading usually calls for the reading of multiple texts. Therefore, these different contexts require readers to employ different meaning construction strategies (Afflerbach & Cho, 2009, 2010; Cho, 2014). Internet reading necessitates the reader's capacity to understand each separate text as well as to make connections among these texts (Cho & Afflerbach, 2015; Cho & Afflerbach, 2017). In fact, studies have shown that a reader's ability to do so is correlated with important reading outcomes. Coiro and Dobler's (2007) study indicated that participants who could relate one text to another demonstrated some evidence of more accurate understanding and better comprehension than those who could not. Conversely, as

Hoffman, Wu, Krajcik, and Soloway's (2003) study suggested, participants who utilized fewer of these meaning-construction strategies showed partial and inaccurate understanding of the texts.

In addition, the Internet environment is complicated by not only the sheer number of texts accessible but also by the variety of formats that online information can take. These formats include pictures, text, videos, etc., all of which must be synthesized when making meaning. According to Cho (2011), "combining disparate forms of information into a coherent meaning" (p. 103) is an essential step in Internet reading. Previous research (e.g. Chen, 2010; Coiro, 2011; Hill & Hannofin, 1997; Wiley et al, 2009) has shown that strategic Internet readers have an awareness of the multimodal nature of web structure. Effective readers make connections and generalize themes across different modes while making meaning of the online texts (Barton & Lee, 2013; Dunser & Jirasko, 2005; Salmeron, Canas, Kintsch, & Fajardo, 2005)

To sum up, studies have shown that failure to use the meaning-making strategy hinders readers' comprehension of the text, resulting in misleading and unproductive Internet reading (Balcytiene, 1999; Goldman & Scardamalia, 2013; Schmar-Dobler, 2003). However, research on meaning-making strategy use is currently lacking in certain areas. Cho (2011) indicates that "the importance of meaning construction strategies was indeed underrepresented in [previous] studies" (p. 104). That is, the current body of research has yet to provide adequate descriptions to operationalize this strategy type or sufficiently rigorous analysis to validate its importance. More studies on meaning construction strategies in the Internet reading environment are needed.

Monitoring

In their CRRI model, Afflerbach and Cho (2009) define readers' awareness of their strategy usage and of their information management effectiveness as "monitoring" (p. 84). This is a metacognitive process, during which readers detect navigation and comprehension problems and apply solutions in the form of strategies. For clarity and to distinguish this strategy type from the "evaluating" type, which connotes a similar meaning but in which the action of evaluating is directed toward the text material, the researcher will follow Cho (2014) in referring to it as "self-monitoring."

As Cho (2011) points out, "the intertextuality and multiplicity of the [Internet] information structure yield both potential benefits and drawbacks in reading and learning Internet materials" (p. 107). Indeed, a body of literature has shown that, compared with traditional print text reading, the nonlinear and sophisticated Internet reading context presents additional problems with disorientation, which becomes the major reason for readers' frustration (Cho, 2011, 2014). Therefore, effective Internet reading demands from readers greater awareness and more stringent regulation of both their reading and navigation processes (Coiro & Dobler, 2007; Zammit, 2011). Such metacognitive imperatives refer to the monitoring strategy. In addition to using the above-mentioned meaning-making strategies, Internet readers must simultaneously apply monitoring strategies, such as establishing and revising reading goals, determining whether they understand what they are reading, identifying difficulties in both navigation and comprehension, and finding appropriate strategies to address these challenges, etc. (Anmarkrud, McCrudden, Bråten, & Strømsø, 2013).

Previous studies have supported the importance of this strategy by showing that proficient readers often demonstrate the ability to effectively monitor their Internet

reading across multiple texts (Azevedo & Cromley, 2004; Azevedo, Guthrie, & Seibert, 2004; Cho, 2011, 2014) and do so more frequently (Coiro & Dobler, 2007). When they get disoriented, they know how to prevent further disorientation problems by noting landmarks, clicking the "home" button, refocusing task goals, checking hyperlink selections, etc. However, less strategic readers often experience information overload and consistent disorientation in this vast context due to their failure to apply these monitoring strategies. In most cases, they are unable to locate useful materials or to build a thorough understanding of the materials they read. Consequently, as Coiro and Dobler (2007) conclude, monitoring is another element decisive in fruitful Internet reading. Effective use of this type of strategy may enhance readers' use of other online reading strategies, such as meaning construction strategies and evaluation strategies.

Evaluating

Afflerbach and Cho's (2009) CRRI model defines readers' use of strategies employed to assess the usefulness of Internet sources as "evaluating" (p. 84). This is a critical process, during which readers judge both internal and external features of text. For clarity and to distinguish this strategy type from the "monitoring" type, which connotes a similar meaning but in which the action of monitoring is directed toward the reader himself, the researcher will follow Cho (2014) in referring to it as "information evaluation."

Evaluation of Internet texts is another component vital to successful Internet reading (Cho, 2014). Internet sources are noted for their variety and often questionable credibility (Bruce, 2000). Internet sources can take a large variety of formats, such as official websites of governments, schools, public organizations, and companies, individual and periodical journals, etc. Because of the nature of Internet publishing, the

credibility of information on the Internet is frequently unknown. In any given situation, it is somewhat likely that the information found by the reader is not reliable or accurate. Therefore, using a strategy to critically assess the quality of a text's information and its sources is necessary for Internet reading.

Previous studies (e.g, Barzilai & Zohar, 2012; Biddix, Chung, & Park, 2011; Brand-Gruwel & Stadtler, 2011; Coiro, Coscarelli, Maykel, & Forzani, 2015; Wopereis & van Merrienboer, 2011) have shown that the ability to assess the reliability of online sources is rare among Internet readers. That is, a majority of Internet readers used the online information for their tasks without critically evaluating the quality and credibility of the sources. In Leu et al.'s (2005) study, the participants expressed a lack of knowledge about how to evaluate Internet sources. Likewise, in Cho's 2011 study, the researcher found that even most proficient adolescent readers assess online information using only a few basic considerations: author reputations, site URLs, or webpage properties. Though these methods of evaluation only reach the surface level, readers "tend to rely on these superficial markers, rather than systematic evaluation of text content" (Cho, 2011, p. 112). In addition to these basic evaluation strategies, further and more in-depth assessment on the perspectives of diverse sources is necessary.

To sum up, assessing a source's credibility and argument presents a notable challenge for online readers. As Goldman et al.'s 2012 study indicates, the strategy of evaluating Internet reading may not be naturally developed by readers without appropriate instruction. More guidance and support from instructors are necessary and decisive in the development of readers' effective use of evaluation strategies while reading online. Therefore, more investigations on how strategic readers evaluate texts will provide practical implications for teaching and instruction.

Online Reading Strategy Research Based on the Theoretical Model of Constructively Responsive Reading on the Internet

This section describes a relevant empirical study by Cho (2014) and details how the researcher offered tentative validation of the CRRI model by demonstrating the comprehensive nature of its original categories. This study is the first to perform an empirical evaluation of the model, which serves as the theoretical foundation of the current study.

Guided by the framework of Afflerbach and Cho's 2009 CRRI model, Cho (2014) conducted a study that supported the original four strategy categories as being sufficient representations of the various strategies employed by online readers. While this study can only offer preliminary support of the model's empirical validity, it is important in that it provides clarification of the model's essential elements. The purpose of this study was to examine types and patterns of strategies that readers use while constructing meanings online. Specifically, Cho's 2014 study investigated proficient high school readers' use of online reading strategies while attempting a critical questioning task in both open and relatively closed online environments. The participants, seven proficient female readers from two AP social studies classes at a high school in the United States, were asked to complete two stages of Internet reading: first, Open Website Searching and second, Focused Website Learning. In the first stage, they were instructed to choose a topic of interest to them from a pre-approved list. They were then told to conduct an open Web search to identify three websites that provided information relevant to this topic; these sites would serve as the focus of their later reading. In the second stage, participants were asked to read on their pre-selected websites. After completing the reading, they were

assigned to construct a critical question that could be answered using information in the sources and to provide rationale in written form.

Requiring the participants to read in both open and relatively closed online environments enabled Cho's comparison of strategy use between two reading contexts: reading search engine-generated materials and reading self-selected Internet texts. This research involved both qualitative and quantitative analysis of categories and patterns of online reading strategies, respectively.

For the qualitative analysis, participants' verbal reports were first transcribed and analyzed using grounded theory analysis, following Corbin and Strauss's (2008) protocols. Findings from this stage, which included open coding and subsequent axial coding, indicated four major types of constructively responsive strategies: text location, meaning-making, self-monitoring, and information evaluation. These are consistent with the four types of online reading strategies generalized in Afflerbach and Cho's (2009) CRRI model. The most significant findings drawn from the qualitative analysis are as follows (Cho, 2014): 1) Readers initiate their Internet readings by exploring and navigating the online space. Instead of immediately reading on a particular webpage, readers first use strategies to identify potential texts to read; 2) Internet reading is distinguished by participants' engagement in connecting meanings across multiple sources. In other words, while making meanings of the online texts, the participants demonstrated efforts to comprehend individual texts as well as to build connections across multiple texts; 3) Participants demonstrated awareness of the reading action through subsequent adjustment and control of their reading processes. This suggests that self-monitoring is applied during use of both the aforementioned strategies: text location and meaning-making. Therefore, these three strategies are inter-related, working together

to enhance reading efficacy. These monitoring behaviors revealed that "successful Internet reading demands a reflective reader" (p. 274); 4) Evaluation strategy also interrelates with the other three types of strategies. It involves the reader making judgements about how well the text is serving their purpose, a decision which may be based on factors such as credibility, organization, logic, etc. Meaning-making is necessary to evaluate these factors, and monitoring helps the reader determine how well the text's characteristics fit with their unique reading process. Finally, based on their evaluation, they may choose to locate alternative texts. In brief, Cho's (2014) qualitative examination of the data offers comprehensive descriptions of each type of online reading strategy, enriching our empirical understanding of the CRRI model.

Additionally, quantitative analysis of the descriptive data in Cho's (2014) study revealed a statistically significant relationship between the type of online reading environment (open or closed) and the types of strategies employed. Specifically, the Rao-Scott chi-square tests suggested that participants in this study showed an adjustment in strategy use between the open-ended website searching context and the closed, narrowly focused context of previously chosen texts ($\chi^2_{RS}(3, N = 1{,}784) = 10.01, p = .0185, p < 0.5$). Furthermore, as shown in Table 2.1, the distribution of strategy use across reading contexts indicates that: 1) Participants' use of text location and meaning-making strategies is adjusted based on the online reading environment. Text location strategy is the most frequently used technique in the open-web searching environment, whereas focused web reading seems to encourage more frequent use of meaning-making strategies; 2) Monitoring strategies are used throughout the reading process. Participants in this study tended to be consistently aware of their strategy use and to regulate their strategic actions accordingly across all reading stages; 3) Evaluation strategy is used

Table 2.1 Strategy Distribution across Reading Contexts

	Strategy Type									
	Text Location		Self-Monitoring		Information Evaluation		Meaning-Making		Total	
Session	*f*	%	*f*	%	*f*	%	*f*	%	*f*	%
Open website searching	340	28.8	266	22.5	236	20.0	338	28.7	1,180	100
Focused website learning	108	17.9	138	22.8	91	15.1	267	44.2	604	100
Total	448	25.1	404	22.7	327	18.3	605	33.9	1,784	100

Note: From "Competent Adolescent Readers' Use of Internet Reading Strategies: A Think-aloud Study" by B-Y. Cho, 2014, Cognition and Instruction, 32(3), p. 277. Copyright 2014 by Taylor & Francis Group, LLC. Reprinted by permission.

more frequently in the open-ended website searching context than in the focused context. This indicates that the task of searching for, locating, and identifying potential texts to read demands more examination of the usefulness of web sources; 4) Print-based reading strategies (meaning-making, self-monitoring, and information evaluation) account for 75% of the strategy use reported throughout both sessions. This indicates that print-based reading strategies remain of great importance in Internet reading. Above all, these quantitative results suggest that the use of reading strategies evolves in response to the online reading environment.

Meanwhile, Cho created visual representations of two participants' sequences of strategy use that took place during the first 20-minute segment of reading. Cho's analysis indicates that the participants' sequences of strategic actions vary based on the individual. Cho (2014) states that two distinctive patterns were observed: Internet reading driven by meaning-making and Internet reading driven by text-location. Readers guided by meaning-making tend to focus more on comprehending the text, while readers guided by

text-location were more engaged in searching for and locating materials to read. However, since Cho's (2014) study only analyzed two participants' sequences of strategic actions, without any quantitative analysis, the process is not sufficient to justify the assumption that these represent typical reading patterns. Therefore, more rigorous quantitative analysis should be conducted to identify the reading patterns used by a greater number of participants and to observe strategy use across the whole reading process. One of the goals of the present research is to first employ statistical analysis to identify patterns among a greater sample size of readers and to use this information to categorize readers into various types.

To sum up, Cho's (2014) study is of great importance to both the field as a whole and to the current research study. The qualitative perspective of Cho's (2014) study not only offers empirical evidence to support the CRRI model but also provides detailed descriptions of online reading strategies, which serve as the coding scheme for the present study. However, as Cho (2014) acknowledges, his study includes some limitations, which are minor but which signify room for improvement in future research. One of these is his findings' potential lack of generalizability to other contexts, such as various types of learners, tasks, and reading goals. The small number of participants in Cho's study also calls into question the results' applicability, as his sample size was appropriate for qualitative purposes but insufficient to establish quantitative significance. Furthermore, the study utilized only limited statistical analysis, which provides a basic foundation but still raises questions about the validity of the findings. Because of these weaknesses, it is possible that some strategy use patterns were not identified. These issues highlight a deficit in the current body of research on online reading strategies. To address this gap, the present research is designed in part to provoke results that can be

related to Cho's (2014) quantitative findings and to investigate a greater number of participants using more complex levels of quantitative analysis in order to enrich our understanding of this topic. Also, the present study seeks to expand the earlier study's generalizability to non-native learners. In these ways, it will contribute to addressing the empirical need for quantitative validation of Cho's (2014) tentative findings and will establish the extent to which Cho's results can be extended to more populations, tasks, and contexts.

Previous Research Regarding Online Reading Strategies Used by ESL and EFL Populations

This section reviews prior research on the unique strategies of ESL and EFL learners in the context of informing the current study.

The review of literature found very few studies that focused on the online reading strategies of ESL and EFL populations. In 2003, Anderson conducted the first study investigating non-native readers' online reading strategy use. In this study, Anderson developed the Online Survey of Reading Strategies (OSORS), which was adapted from Sheorey and Mokhtari's (2001) Survey of Reading Strategies (SORS), and used it as the major instrument by which to measure 247 ESL and EFL readers' use of online reading strategies. The adapted OSORS included 38 items grouped within three categories: global reading strategies, problem-solving strategies, and support strategies. Findings showed a high rate of use of problem-solving strategies and a low rate of use of support strategies among both the ESL and EFL readers. However, the results indicate that the EFL participants demonstrated a higher rate of use of problem-solving strategies than did the ESL participants. Though Anderson's (2003) work is very significant as the first study of online reading strategies that exclusively highlights the ESL and EFL populations, there

are many limitations of this research. First, the publication did not explicitly define any of the three categories of strategy use. By neglecting to operationalize these key concepts, the study made the results difficult to validate. Another primary deficit is that the findings were based on self-report data and the OSORS survey only focuses on examining participants' use of metacognitive strategy and therefore does not acknowledge many other components of the reading process. Therefore, the findings only depict a limited perspective on online strategy use by the ESL and EFL populations. Most importantly, though this study's purpose was nominally to focus on online reading strategies, it failed to represent any components unique to online reading, namely navigational strategies. In this way, this study overlooks one very important aspect of online reading strategy use: how readers utilize the vast information on the Internet.

Using a different method, Huang, Chern, and Lin (2009) conducted a quantitative study to explore EFL learners' use of online reading strategies and the effects of these strategies on reading comprehension. The participants were 30 applied English-major sophomores from a university in northern Taiwan. They are divided into two groups based on their proficiency level (either high or low). In this study, a website with 15 embedded strategy buttons was designed to collect data and to provide an online reading environment. The 15 strategy buttons were grouped under four strategy types: global strategies, problem-solving strategies, support strategies, and socio-affective strategies. Results showed that the support strategies were the most frequently used by all participants and that, of all types, these strategies were most highly correlated with comprehension. Huang et al. (2009) defined global strategies as strategies that are "intentional and carefully planned by learners to monitor their reading" (p. 14). However, in their examples of this type of strategy, they also included some meaning-making

strategies, such as previewing the text and predicting the text meaning, contradicting the original definition. In addition, though Huang et al. (2009) stated that their study focuses on ESL learner's metacognitive strategy use, the four categories they employed actually included many non-metacognitive strategies, which shows a lack of a strong theoretical foundation for defining and categorizing the strategies. Lastly, similar to Anderson's (2013) study, Huang et al.'s (2009) study doesn't capture the participants' use of navigation strategies, which is a unique feature of online reading.

Furthermore, Park and Kim (2011) administered a qualitative study aimed at identifying the types of reading strategies that college-level ESL learners use to read online text. This case study focused on three college-level ESL learners from an urban research university in the southeastern part of the United States. The researchers used think-aloud method to collect the primary data. The results revealed seven main strategy types: using hypermedia, using computer applications and accessories, dialoguing, setting up reading purposes and planning, previewing and determining what to read, connecting prior knowledge and experiences with texts and tasks, and inferring. Though Park and Kim's (2011) research utilized different definitions of the various strategy types compared to those employed by Afflerbach and Cho (2009) in the CRRI model, the online reading strategies identified by Park and Kim (2011) fit within the four categories of the CRRI model; no new type of online reading strategies emerged.

Recently, Park et al. (2014) conducted a qualitative investigation of seven Asian graduate-level ESL learners' online reading processes. It was found that prior knowledge of the structure of both print and online texts plays a significant role in assisting non-native students' online reading. Meanwhile, consistent with the results of many studies on native language readers, Park et al.'s (2014) study indicated that ESL readers use

monitoring strategies recursively throughout the reading process. This helps to validate the results of many other studies on monitoring and, most importantly, emphasizes the monitoring strategy type as a very important but often overlooked factor that is repeated consistently throughout the reading process.

To sum up, this current research reviewed the above-mentioned texts as well as a number of other notable studies such as Chun's (2001) study of how ESL learners access information while reading online; Amer, Barwani, and Ibrahim's (2010) study of Omani EFL university student teachers' perceived use of online reading strategies; Ramli, Darus, and Bakar's (2011) study of adult ESL learners' use of metacognitive online reading strategies; and Huang's (2013) study of Taiwanese EFL learners' use of online reading strategies. This review of the literature indicates the following themes: 1) There is a lack of rigorous quantitative studies investigating ESL and EFL learners' use of online reading strategies; 2) None of the existing studies focused on EFL learners from mainland China; 3) Among the small number of studies regarding online reading strategies used by the ESL and EFL populations, only a few used the think-aloud method, which often generates richer and more comprehensive data; and 4) There exists among the research studies a wide range of definitions for the strategy categories. This inconsistent categorization reveals a lack of theoretical support; 5) Most of the prior research focused primarily on the metacognitive strategies but indicated a lack of understanding of the difference and potential overlap between meaning-making strategies and monitoring strategies; 6) There is a lack of studies investigating navigation strategies, which is distinctive to online reading. In this way, the body of research fails to provide a holistic representation of EFL learners' online reading strategy use; 7) Although a few studies investigated the relationship between strategy use and comprehension, most only vaguely

explained the measurements used to gauge comprehension. In general, these themes represent important deficits among an otherwise promising body of research. Ultimately, more rigorous studies are needed to provide a comprehensive, inclusive, and detailed description of non-native learners' online reading strategy use.

Implications for the Present Study

As discussed above, the review of the literature on online reading strategies used by native English learners, as well as ESL and EFL learners validated the CRRI model (Afflerbach & Cho, 2009; Cho & Afflerbach, 2017). Though different researchers categorize the online strategy types in different ways, the strategies identified from these studies correspond with the four categories of the CRRI model (Afflerbach & Cho, 2009; Cho & Afflerbach, 2017). Therefore, as the model most in line with the comprehensive body of research, the CRRI model will be used as the theoretical framework to guide data analysis in the present study.

Additionally, much of the prior research on this topic was based on self-report data and qualitative analysis. Few of the previous studies investigated the pattern of online reading strategies used throughout the reading process. Though Cho's 2014 work tentatively examined two participants' reading paths, this is still not sufficient to establish typical reading patterns. Hence, the present study's goal of using more complex levels of quantitative analysis to identify a greater number of participants' reading patterns from beginning to end will contribute to the research base by providing a more comprehensive analysis.

Meanwhile, the review of the literature on online reading strategies reveals a lack of rigorous quantitative work focusing on ESL and EFL populations. Among the few existing studies on ESL and EFL learners, none provide a holistic examination of online

reading strategy use. There is also a failure to thoroughly examine the relationships between strategy use and comprehension within this particular population. Therefore, quantitative analysis involving the EFL population will offer a more generalizable perspective to extend this research to a previously understudied group.

In general, the present study will rely on the CRRI model (Afflerbach & Cho, 2009; Cho & Afflerbach, 2017), and seek to investigate online reading strategy use among a population that has not received adequate consideration: Chinese EFL learners. It aims to first provoke results that can be related to Cho's 2014 study and to then use higher-order quantitative analysis to explore the patterns of strategy use and their relationships with reading outcomes. In short, this study will extend the research base and enrich our understanding of this topic by addressing the empirical need for quantitative validation of prior work.

CHAPTER THREE

METHODS

To address the current lack of research on the topic, this exploratory, quantitative study investigated Chinese EFL students' online reading patterns and to describe the association between their use of online reading strategies and their reading outcomes.

This chapter first presents the research questions and outlines the design of the current study. It then discusses participant selection and recruitment as well as the process of planning and administering the reading tasks. Lastly, it describes the data collection and data analysis procedures.

Research Questions

Specifically, this study aimed to answer the following four major research questions and the corresponding sub-questions.

1. Do the relative proportions of usage among the four types of online reading strategies measured in this study differ from those reported by Cho (2014)?
2. Are certain strategies more likely to be associated with clicks?
3. What are the general patterns of strategy use in this reading task?
    1) What are the participants' reading patterns from beginning to end? Is there a developmental pattern across the reading task as a whole?
    2) What is the most common type of strategy used at each defined interval in the reading process?
    3) What types of readers can be identified based on their sequential patterns of online reading strategies across the reading process?

4. What relationships exist between the comprehension outcome measure, the types of readers, and their four types of online reading strategy use?
    1) Is the comprehension outcome measure influenced by the distribution of the four types of online reading strategies?
    2) Is the comprehension outcome measure influenced by the types of readers?

Research Design

For this study, an exploratory research design (Fraenkel, Wallen, & Hyun, 2014) was utilized to address the research questions. Fraenkel et al. (2014) defined exploratory research as a type of mixed-methods design based on its methodological composition. According to Fraenkel et al. (2014), in the exploratory research design, "researchers first use a qualitative method to discover the important variables underlying a phenomenon of interest and to inform a second, quantitative, method" (p. 558). However, this study relied on Cho's (2014) existing framework instead of seeking to discover any new variables in the form of strategy types. Instead, it operationalized and identified Cho's (2014) qualitative variables for the purpose of applying quantitative analysis to determine patterns and relationships. Therefore, Cho's (2014) first qualitative component and this study's quantitative perspective together fulfill the general requirements of exploratory research. In this way, the present study is solely quantitative and thus is more exploratory in its purpose than in its methodological construction.

Both descriptive statistics and association statistics were presented in this study. Firstly, using Cho's (2014) strategy categories as the coding system, protocol analysis (Afflerbach, 2000; Hilden & Pressley, 2004) was conducted to examine the primary data: participants' verbal reports. This analysis explored the types of strategies participants use while reading hyperlinked online materials. Furthermore, chi-square analysis was

administered to compare the researcher's observations of Chinese EFL students' online reading with the findings reported by Cho, which served as the theoretical foundation of the present study. Subsequently, this study explored participants' reading patterns sequentially across the documents in relation to a reading outcome measure. The data were then analyzed quantitatively using sequential analysis to identify general patterns, as well as using regression analysis and one-way analysis of variance (one-way ANOVA) to identify patterns of association between strategies, reader types, and reading outcomes.

Participants

Participant Selection

In this study, the purposeful sampling method (Maxwell, 1996) was used to guide the sample selection. Specifically, the sample selection adhered to the following criteria.

First, only Chinese college EFL learners were included because reading online and gathering information from the Internet are thought to be important in facilitating their language learning and because the skills of online reading are required by the *National College English Curriculum Requirements* (2007). Also, the reading field currently lacks empirical studies focusing on this population. Therefore, investigating this particular group will extend our understanding of the online reading process to a previously neglected cultural context.

Second, this study limited the sample to proficient EFL readers who demonstrated relatively high levels of knowledge, as well as experience, in reading in both print and Internet contexts. This choice was based on the following two considerations: 1) Proficient readers are considered "more likely to demonstrate a wider range of appropriate strategies when asked to complete reading tasks" (Coiro & Dobler, 2007, p. 221) and 2) experienced Internet readers demonstrate more knowledge and skill when

reading and navigating online texts (Leu et al., 2005). Thus, in this study, the participants were selected from among college sophomore EFL learners because, after one year of study, their English language proficiency is usually higher than that of freshmen. Limiting the participants helped the researcher to better identify patterns that are useful to apply to teaching and research.

Third, since this study used think-aloud method (Afflerbach, 2000), only participants with high verbal abilities were selected as participants' verbal competence is a significant factor. According to Pressley and Afflerbach (1995), students with proficient verbal abilities are more capable than those with poor verbal abilities of describing their thinking processes in an Internet reading task.

Lastly, a total of 40 undergraduate EFL students were included in this study. Since there is insufficient prior quantitative research to support a power analysis, the effect size is an approximation. This number was determined based on the sample size considered reasonable to fulfill the purpose of this study and because of the largely exploratory nature of this study. It is assumed to be sufficient to quantify the four types of strategies used based on Cho's 2014 study, to explore the general patterns of strategy use, and to examine the correlation between reading comprehension and reading strategy use.

Research Site

A public, comprehensive university, which is located in southwest China, served as the research site. This university has been in operation for more than 100 years. It is also one of the largest universities in southwest China, with a full-time enrollment of over 40,000 undergraduates. This university consists of 34 colleges featuring 137 undergraduate specialties in 11 branches of learning such as philosophy, liberal arts, science, engineering, and administration. Additionally, this university has nine campuses

situated in the city where it is located. In this study, the selected participants all came from the two main campuses: the North and New Campuses, where the administrative offices are located. At these two campuses, there are currently about 6,000 sophomore EFL learners studying in 122 different major-based English classes, which consist of multiple proficiency levels.

Recruitment Procedures

The following section presents the participant recruitment procedures.

1. The researcher contacted twelve classroom teachers and introduced the proposed research to them.
2. The researcher asked each of the classroom teachers to select four participants whom they consider to be proficient readers with high verbal abilities. The selection was based on the teachers' own observations and objective judgments. The pilot study preceding this research suggests that teacher evaluation is a reliable measure since their nominations demonstrates a high correlations with the nominees' proficiency levels.
3. After the tentative selections were made, the instructors informed the potential participants after class of an upcoming reading study and of their qualification as participants. Also, the instructors asked the potential participants for permission to share their email address with the researcher. If the potential participants agreed, the English instructors completed the nomination process by providing the researcher with corresponding email addresses. If any students declined to be nominated by the instructor, the instructor chose another student or even several other students so as to submit a total of four consenting potential participants. Then, the researcher contacted all consenting nominees through an initial contact email to briefly discuss the study,

emphasize voluntary participation, confirm continued interest, and introduce the first step of participation.

4. Because each of the 12 classroom teachers nominated four students, the total number of potential participants were 48. To reduce the number of participants to 40, a questionnaire was issued to assess nominated participants' reading experience in both print and Internet contexts as well as their level of comfort with think-aloud procedures (see Appendix B). This questionnaire was based on self-report data and was built upon the work of Coiro and Dobler (2007) and Cho (2011). The questionnaire was administered to the students by the researcher, who briefly introduced the questionnaire in the initial contact email. The questionnaire was completed by the nominees under the researcher's supervision after class on a chosen date and time. The 48 potential participants were ranked in order of cumulative score on the questionnaire. The goal was to include the 40 nominated participants who demonstrated higher reading experience in both print and Internet contexts and who showed greater comfort with the think-aloud method.
5. The researcher then contacted the potential participants again via email in the order in which they appeared on the ranking list. After 40 subjects had been enrolled, recruitment was complete.

Instrument Used in Participant Selection

As discussed above, a questionnaire, which is built upon the work of Coiro and Dobler (2007) and Cho (2011), was used for participant selection among the nominated students. This questionnaire included three sections, each of which will evaluate one characteristic of participants' reading background: print reading experience, Internet reading experience, and level of comfort with the think-aloud method. The print reading

experience section and the Internet reading experience section each used five questions to obtain the same information from both contexts. In these sections, questions had either three or four multiple choice options. The answers were scored on a scale of 1-3 or 1-4, respectively, based on the level of expertise indicated by the response. Appendix C indicates more specifically the score that was assigned to each possible response.

The third section, relating to the student's comfort with and aptitude for the think-aloud method, included only two questions, one of which offered two options and the other of which offered four options. This section was scored in the same way as were the responses to the first and second sections (see Appendix C).

In all three sections, the options were presented in varying orders in terms of which would receive high and low scores. This could alert the researcher to responses that were given at random and which lack internal validity.

Each participant's score was the total of the points that they received from all of their responses. Because the final section, regarding comfort level with the think-aloud method, only had two questions, it was weighted as less influential than the other sections. This was done purposefully because, even though the participants' ultimate verbal abilities are equally as important as the other two measures, their initial aptitude for verbalizing their thoughts was supplemented by pre-experiment training. Therefore, any differences that the measure indicated between the participants were likely to be decreased after the training process.

Reading Task

Procedures

The participants attended one data-collection session that lasted about an hour and a half. Before administering the Internet reading tasks, the researcher first introduced the

research purposes and procedures, then used a pre-made video to instruct the participants and model how to verbalize their thinking processes while reading online. The material used for think-aloud instruction is provided in Appendix D. The text chosen for the demonstration is in narrative form, which is very different from the text that the participants read in the study. Since the purpose of a think-aloud is to reveal the participants' understanding of the online text, using a different genre of text allowed participants to become familiar with this process while preventing the researcher from manipulating participants' actual strategy use. After instruction, participants were given an opportunity to receive answers to any questions regarding the think-aloud method. They were then instructed to complete a guided practice of the think-aloud process by verbalizing what they were doing and why they were doing it (see Appendix E). Before participants began the official reading task, the researcher again addressed any participant questions. The benefit of this approach is that the training occurs immediately before the study begins. If there is a gap between the training and the actual reading task, participants' knowledge of the think-aloud procedures may be diminished over time.

Directly after the modeling and training sessions, participants were asked to individually perform a reading task (see Appendix F), which involved reading from a pre-selected website source and completing an objective comprehension assessment about what they have read (see Appendix G). The description of the task was written in a general way to avoid overly influencing the participants' actions. However, it was intended to be clear enough to encourage participants to click on the links that would facilitate their achievement of objectives and their success on the assessment. In this task, participants were asked to read from the selected website for 30 minutes. Upon completion of the reading, participants were required to complete an assessment

including 20 multiple-choice questions concerning the topics they just read about. The task was designed to prompt participants to navigate, locate, evaluate, and learn information in more focused readings with limited sources, in order to strengthen their knowledge and expand their understanding of the topic and to evoke use of a wide range of strategies. Guided by the task objectives, the participants were more likely to expand their reading from the opening page to different pages within the website to locate specific facts.

To represent the unbounded nature of Internet reading, participants in this study were given choices about what to read, and therefore different readers had the ability to choose different texts. Participants were free to use any hyperlinks and search boxes within these webpages but were not allowed to use any external search engines to find more resources. In addition, the participants were not allowed to take notes or to copy and paste text since this may skew the results of their subsequent comprehension assessment.

Reading Materials

The participants read from a pre-selected website on the topic of global warming and climate change. This familiar topic was chosen because having prior knowledge would help the participants to engage in the task. The reading materials included informational text only.

Simple English Wikipedia. *Simple English Wikipedia*, which is an online encyclopedia written in basic English, was selected as the target website. This particular website was chosen because it is intended for people whose first language is not English and because it provides key features that represent the variable nature of the web. The *Simple English Wikipedia* website contains a local search engine, menu bars, multiple

embedded hyperlinks, and multimodal representations of information, such as pictures, diagrams, videos, audio, etc. On average, the articles on this website are relatively shorter than their counterparts on *English Wikipedia*. *Simple English Wikipedia*'s neatly labeled presentation style and its use of a simplified form of English make it an excellent online reading resource for both ESL and EFL learners.

In this study, the participants started reading from the "climate change" page of the website (https://simple.wikipedia.org/wiki/Climate_change). This fairly short page provided an overview of the topic, and its short length facilitated participants' prompt use of links. Also, its concise nature prevented the participants from becoming overwhelmed and from being tempted to stray from the target information.

The *Simple English Wikipedia* website is embedded with two types of links. Type 1 links provide further information about specific, relevant terms (sub-topics) embedded in the text. For example, the text says "Climate change means the difference in the Earth's global climate or in regional climates over time" and readers can click on the word "Earth" to find further information on the concept of Earth. The purpose of this feature is to offer further clarification on sub-topics. On the other hand, Type 2 links provide readers opportunities to expand their knowledge on more general related topics. For example, on the "climate change" page, there is a section called "Related Pages" which includes links to pages on deforestation, Earth Hour, and ecology, which can broaden the reader's knowledge of global warming or climate change.

Data Collection

The data collection occurred in a private office. The informed consent form was explained and given to the participants to sign. All participants were compensated with ¥100. Additionally, in order to fulfill the purposes of the study, multiple approaches were

used to collect data, including verbal reports, recordings of participants' computer screen moves, and comprehension measures. Each will be discussed individually in the following sections.

Verbal Reports

While participants were performing the reading task, their verbalizations of their thinking processes were recorded using the Camtasia computer program (TechSmith, 2016), and these recordings served as the primary data. Subsequently, protocol analysis was completed on the verbal reports provided. Based on Afflerbach and Cho's (2009) definition, verbal reports are "spoken records of things that readers do and think related to their reading" (p. 73), and protocol analysis is "the examination of verbal reports that allows us to describe reader behaviors, specifically their strategies, plans and goals" (p. 73-74). According to Afflerbach and Cho (2009), "reading comprehension strategies are invisible, and methodologies to investigate them must be designed to give us appropriate information from which we make inferences and hypotheses about strategy use and development" (p. 72). To qualify the reading process, researchers use various methods, including verbal reports and protocol analysis, recordings of eye movements, readers' self-reports, etc. This study chose verbal reports and protocol analysis because of their ability to provide detailed and comprehensive descriptions of the reading strategies.

According to Hilden and Pressley (2004), the procedures used in verbal protocol studies vary based on the designs of the studies. In some studies, participants are asked to verbalize their thoughts as they read, while in other studies, participants' verbal reports are collected retrospectively. Whether concurrent verbal reports are more accurate and complete than retrospective verbal reports remains controversial. However, this study used the concurrent form to address the research questions. Guided by Hilden and

Pressley's (2004) work, the researcher prompted participants if they paused or were silent for ten or more seconds while reading. According to Hilden and Pressley (2004), although prompts can be given, they should be nondirective. That is, the prompts should direct "the participants' processing as little as possible" (p. 317) because using leading prompts, such as "What don't you understand?" and "What drew your attention to that link?", may change the way the participants read and respond or introduce variability into their interactions with the text. Therefore, in this study, only generic prompts were provided, allowing the researcher to determine the strategies that the participants were naturally inclined to use. The prompts that were used for the think-aloud procedure included: "Can you tell me what are you doing and thinking?"; "Don't forget to tell me what you are doing and thinking"; "Please explain why you did that"; "Please tell me more about that"; and "Please try to keep talking." Using such prompts ensured more complete and valuable data collection.

Furthermore, the participants had the option to use either English or their native language of Chinese during the verbalization process; they could even incorporate both languages. This decision was based on observations made during the pilot study preceding this research; the preliminary findings suggest that verbalizing in one's native language decreases the overall cognitive load. During the pilot study, the participants were at first instructed to verbalize their thoughts in English, but this resulted in slow verbalizations, an apparent preoccupation with the linguistic structure of their responses, and expression of significant frustration; the reading process, in fact, seemed to halt completely as they struggled with the language issues. On the other hand, when the participants were permitted to express themselves in English, their native language of Chinese, or both, they produced much quicker and more fluent responses and also

demonstrated greater comfort and confidence; the main focus remained on the reading task, as the participants were not distracted by language issues. Therefore, since the focus of this research was on reading strategy use and not on the participants' ability to express themselves in a foreign language, allowing for flexibility in the language for the verbal protocol permitted the participants to use a language with which they felt comfortable, thereby producing more relevant data not skewed by outside factors.

Screen-recordings of Participants' Computer Screen Moves

In addition, throughout the reading process, participants' computer screen moves were video-recorded using Camtasia (TechSmith, 2016), a software that records user's onscreen activity and generates it into video form. These data were collected to record participants' clicks during reading.

Comprehension Measure

This study used an objective assessment (see Appendix G) with 20 multiple-choice questions, each with four options (A-D). The decision to utilize a multiple-choice format was based on its advantage of producing quantifiable results. Specifically, this format produced responses that were more easily analyzed and compared than a short answer format. Furthermore, this format made it less likely that students would skew the results by guessing, which would be a concern in a true or false format. The development of the questions was based on the criteria provided by Linn and Gronlund (2000). These questions consisted of both factual and inferential items. Some of the 20 questions were based on information from various sections of the two main pages of the website (the "climate change" page and the "global warming" page), while the remaining questions referred to information located on six other pages at varying levels away from the two main pages and in multiple media forms (e.g. images and video) within the site. These

pages were chosen based on their significance and high degree of relevance to the focus topic; it was hoped that proficient readers would tend to focus their time on these pages. The questions were ordered using Excel's randomization function in order to ensure an even distribution of questions in terms of type (factual or inferential) and topic location within the site. To avoid discernable patterns of answer sequencing, the placement of correct answer choices was also randomized using the Excel randomization function. This assessment was designed to measure not only participants' meaning-making abilities, but also their abilities to locate, evaluate, and synthesize information, which are three important aspects of comprehension from a new literacies perspective (Coiro & Dobler, 2007; Leu et al., 2004).

Since many Chinese learners are familiar with the topics of climate change and global warming, the effect of prior knowledge on their responses was a concern. To measure the influence of this factor, the researcher conducted a pilot test among 15 participants, including both Chinese English instructors and students. The participants were not assigned to read the focus texts; therefore, their responses were based only on their prior knowledge. The results showed that, on average, more than half of the questions could be answered by the respondents, even though they had not read the focus texts. This suggested that the original set of questions was too heavily influenced by prior knowledge common among the population to be studied. To address this issue, the researcher revised the question set to include more questions that cannot be answered with only prior knowledge and which are specific and based on the focus texts. Furthermore, those questions which had prompted many incorrect answers were assumed to be highly independent of prior knowledge and were thus kept on the assessment.

Question distribution among topics and question types is listed in Table 3.1. The first column lists the page name, the second column indicates the number of questions obtained from that page, and the third and fourth columns specify the numbers of factual and inferential questions, respectively, from that page.

The participants' responses were scored by the researcher. Each question had only one correct answer. Participants received one point for each correct choice and zero points for any incorrect choice. These scores were accumulated into a total score out of 20 possible points.

Data Analysis

In this study, coding of participants' verbal reports and computer screen moves was an essential step, which preceded the quantitative analysis that would indicate meaningful patterns and relationships. Therefore, this section first delineates the coding

Table 3.1 Question Distribution

Page	Number of Questions	Number of Factual Q's	Number of Inferential Q's
Climate Change	3	2	1
Global Warming	7	6	1
Deforestation	2	1	1
Earth Hour	1	0	1
Fossil Fuels	2	2	0
Kyoto Protocol	1	1	0
Greenhouse Gases	3	3	0
Greenhouse Effect	1	0	1
Total Number	20	15	5

procedure and then discusses the process and methods of quantitative analysis for the purpose of addressing the research questions.

Coding Procedures

During this process, the primary data, participants' verbal reports and screen-recordings of participants' computer screen moves, were categorized using Afflerbach and Cho's (2009) CRRI model as the coding system. Before the coders were presented with the total data responses, they were first trained using a small sample of responses to increase reliability. To ensure a high level of reliability during the process itself, an analysis of discrepancies was conducted to provide a reliability rate for the total data coded.

Research tool. The Eudico Linguistic Annotator (ELAN) was used to code and analyze the video data. ELAN is a program that helps capture the research subjects' verbal and non-verbal behaviors. It allows users to add annotations to the video file and generates reliable statistics in order to make video data analysis more effective. Therefore, ELAN was used in this study as the primary analytic tool for viewing and coding the participants' four types of strategy use and clicks. Participants' videos of both think-aloud verbalizations and computer screen moves were imported to ELAN.

Four stages of ELAN data coding. The video data were coded in four stages. The first stage was to use the pilot study data to develop coding rubrics, including clearer and more concise descriptions, from Afflerbach and Cho's (2009) original strategy categories. The second stage was to train the coders. The researcher explained the coding system to the coders. Then, the coders observed and coded three participants' pilot study videos together to develop familiarity with the video data and the codes. The third stage involved coding the video data and refining coder reliability by checking the coding

procedures and conventions. The fourth stage of ELAN data analysis was to generate secondary codes across coding tiers, which provided in-depth understanding of the strategy use.

Primary codes. Two coding tiers, the strategy tier and clicks tier, were created in ELAN. In both tiers, the coders recorded the codes at 10-second intervals. The first tier included four codes, which represent the four types of strategies. These were TL (text location), MM (meaning-making), SM (self-monitoring), and IE (information evaluation). The codes in the first tier were mutually exclusive. If more than one strategy was observed in one interval, the code would indicate the strategy that occupies the majority of the interval.

The second tier captured participants' physical actions of clicking. A click is a very important event in online reading as it shows a reader's attempt to look at something else, possibly reflecting an overt decision made based on a recently applied strategy. Earlier in this chapter, I focused on content when discussing the two types of links that appear in the *Simple English Wikipedia* website. Yet, function-wise, the *Simple English Wikipedia* website also provides two different ways to click a link. They are the hover type of clicks and the conventional hyperlinks type of clicks. The former type allows the readers to hover over a link to get a preview of the content, while the latter type requires readers' actual clicking to load a whole new page. Therefore, this tier included two codes, c-hover and C-hyperlink, to represent the two types of clicks. Additionally, in the second tier, codes were recorded only when the participants used the mouse to click. Therefore, it is possible that there were no codes during some intervals. Table 3.2 presents the coding tiers and the descriptions of the primary codes in each tier.

Table 3.2 Descriptions of the Primary Codes

Coding Tiers	Codes	Descriptions
1. Strategies	TL=Text location	In general, this type of strategy refers to participants' means of navigating, searching for, locating, and overviewing to choose relevant websites and information. Examples are as follows: 1. Skimming/overviewing texts to locate and choose relevant information 2. Deciding whether to read or reject an in-site link option, based on potential uses and relatedness to one's topic and goals 3. Using in-site search engines to look for more information 4. Selecting relevant and useful menus and links and sequencing the reading order within a website to access further information
	MM=Meaning-making	This process refers to how readers understand the text content. This strategy type includes both meaning-making within individual texts and synthesizing across different texts. Examples are as follows: 1. Scanning for useful information or looking for key words 2. Repeating, restating, paraphrasing, or translating text as it is read 3. Summarizing and clarifying one's current understanding 4. Making inferences and predictions about available text options 5. Forming questions to guide further reading 6. Interpreting text content using prior knowledge 7. Analyzing and synthesizing different parts of text 8. Interrelating information from different Web sources to construct a coherent and intertextual understanding 9. Incorporating multi-modal information (such as text, graphics, illustrations, embedded videos) into one's understanding

Table 3.2—Continued

Coding Tiers	Codes	Descriptions
1. Strategies	SM=Self-monitoring	This is a metacognitive process. The reader detects navigation and comprehension problems and applies solutions in the form of strategies. Examples are as follows: 1. Detecting problems in searching for and navigating toward relevant and useful information 2. Adapting search approach, such as by changing search terms 3. Recognizing problems with site's comprehensibility (in structure and content) 4. Recognizing meaning construction problems due to information volume and diversity 5. Restarting reading process after becoming disoriented 6. Revising reading goal if needed
	IE=Information evaluation	This is a critical process. The reader judges both internal and external features of text. Examples are as follows: 1. Evaluating relevance of material 2. Evaluating credibility of material 3. Evaluating clarity of material 4. Evaluating usefulness of material 5. Comparing usefulness of related sites 6. Evaluating subjective features of site (e.g. the general tone)
2. Clicks	c-hover	This refers to participants' use of a mouse to hover over a link to get a preview of the content.
	C-hyperlink	This refers to participants' actual clicking to load a whole new page. E.g., Click search button; click back button; click forward button; click hyperlink.

Adapted from Afflerbach & Cho (2009) and Cho (2011).

Secondary codes. To capture the association between clicks and certain strategies, the four-strategy tier and the clicks tier were ultimately merged into a new tier named SC-Overlap. The SC-Overlap tier generated eight new codes to indicate the associations between each particular strategy and the occurrence of clicks.

Reliability check. There are two primary coding tiers, each of which was coded by two different coders, and a third researcher checked the inter-coder reliability. A reliability tier was created and segmented into 10-second intervals to compare the codes provided by both coders in each tier. This assisted in ensuring nominal coding accuracy, which refers to "agreement between raters in the assignment of codes to specific segments in the video stream" (McEneaney et al., 2016, p. 228). In this study, "[r]eliability was examined by dividing the number of agreements by the total number of occurrences for each category" (Olswang, Svensson, Coggins, Beilinson, & Donaldson, 2006, p. 1059) to determine the reliability rate, which is reported in Chapter Four.

Quantitative Analysis

In this study, the primary data, participants' verbal reports and screen-recordings of participants' computer screen moves, were analyzed quantitatively. The data were examined to determine the relative proportions of strategies used by participants and to identify the general patterns of strategy use in this reading task. In addition, the data were examined using three different types of quantitative analyses to determine whether a relationship exists between strategies and any of the following factors: clicks, comprehension, or reader type. In general, the data analysis evolved through the following three stages.

Stage 1. Stage 1 focused on analyzing data related to research questions one and two. During the first stage, chi-square analysis was performed on the coded primary data

to answer the first and second research questions: 1. Do the relative proportions of usage among the four types of online reading strategies measured in this study differ from those reported by Cho (2014)? and 2. Are certain strategies more likely to be associated with clicks?

After coding the data, ELAN also generated raw counts of how many times each of the four strategies were used. Then, in order to answer the first research question, a chi-square analysis was conducted to determine whether the distribution of strategy types seen in this research is similar to or significantly different from the distribution shown in Cho's (2014) data. Chi-square analysis uses categorical predictors and outcomes, comparing the observed frequency of each cell to the expected frequency one would expect under the assumption of no relationship. Hence, this process provides the best analytic approach to this question.

However, the traditional Pearson chi-square test relies on an assumption that each observation is independent of every other observation. Such is not the case in the present analysis, since each participant used multiple strategies and thus can be counted in more than one strategy use category. Therefore, the Pearson chi-square test is not applicable to the nature of this study. Instead, the present research used Rao-Scott chi-square analysis (Rao & Scott, 1981), which is a "design-adjusted version of the Pearson chi-square test" (SAS Institute Inc., n.d., para. 1). The Rao-Scott chi-square analysis treats each individual participant as a cluster and relies on a design correction to account for data clustering. SAS (SAS Institute Inc., 2017), a statistical analysis software, was used as a research tool to conduct the Rao-Scott chi-square analysis.

In order to answer the second research question, whether certain strategies are more likely to be associated with clicks, it is vital to examine the relationships between

the four types of strategy use and the two types of clicks. Therefore, the SC-Overlap tier (which represents the merging of the strategy tier and clicks tier) provided statistics for the frequency of each type of clicks that occur during use of each strategy type. Then, because the data representation of clicks for each participant presented issues similar to those associated with the first research question, the relationship between these two variables was determined using Rao-Scott chi-square analysis (Rao & Scott, 1981). The 40 participants were treated as 40 separate clusters and the analysis relied on a design correction to account for data clustering. The expected frequency of clicks in each of the four types of strategies is .25.

In addition, the Rao-Scott chi-square analysis adopted .05 as the significance level, denoted as alpha. If the results produce a *p*-value greater than .05, the null hypothesis must be accepted; conversely, if the results produce a *p*-value smaller than .05, the null hypothesis must be rejected. This will ensure that any associations found, either between the present data and Cho's (2014) data or within the present data, meet the standard of credibility determined appropriate for research in the education field.

Stage 2. The second stage aimed to answer the third research question: What are the general patterns of strategy use in this reading task? Specifically, quantitative analysis was conducted to answer the following three sub-questions: 3.1) What are the participants' reading patterns from beginning to end? Is there a developmental pattern across the reading task as a whole? 3.2) What is the most common type of strategy used at each defined interval in the reading process? 3.3) What types of readers can be identified based on their sequential patterns of online reading strategies across the reading process?

Three sequential analyses were conducted to explore the general patterns of strategy use in this reading task. The data were analyzed and visually represented as a sequence by TraMineR (Gabadinho, Ritschard, Muller, & Studer, 2011), a statistical analysis software. The sequential analyses followed a 10-second interval, as in ELAN coding. Because this type of quantitative analysis is rarely described in the literature on reading literacy, this study represents a new line of exploration acknowledging and extending Cho's (2014) work.

Firstly, to answer question 3.1, transversal analysis was conducted to explore the participants' reading patterns from beginning to end. Secondly, to answer question 3.2, modal analysis was conducted to determine the most common type of strategy at each defined interval in the reading process (Gabadinho et al., 2011). Both transversal analysis and modal analysis focus on temporal patterns, which appear across time. These two forms of sequential analysis explored tendencies in strategy use, namely which were used earliest and which were used latest. Specifically, modal analysis sought to evaluate all strategy types in terms of their frequency of use, while transversal analysis examined patterns of association among different strategies. The latter began with a simpler analysis, recording patterns of each strategy in succession and then continued with a more complex analysis of the relationships among strategies. Essentially, transversal analysis tested for global patterns of strategy use across the reading episode and investigated whether there was a tendency for certain strategies to precede others (Gabadinho et al., 2011).

Lastly, to answer question 3.3, cluster analysis was conducted to examine what types of readers can be identified based on their sequential patterns of online reading strategies. More simply, cluster analysis investigated whether certain groups of readers

tended to rely on certain patterns. Cluster analysis, in fact, reflects behavioral patterns (Gabadinho et al., 2011). The purpose of cluster analysis is similar to that of factor analysis. Although Cho's (2014) prior work observed two distinct patterns of readers, it did not explicitly categorize the readers into various types. Meanwhile, this examination was based on investigation of only two participants, without quantitative analysis. Therefore, when performing cluster analysis for the current study, there was no prior framework guiding what reader types to establish. The underlying factor structure was unidentified, which is consistent with the exploratory nature of this study.

The optimal matching distance measure (Levenshtein, 1966), which is an algorithmic assessment of the dissimilarity between sequences, was used to create the clusters. However, this measure does not inherently identify the appropriate number of clusters to specify. Therefore, the researcher carried out multiple analyses testing different numbers of clusters. The researcher started by inputting a larger number of clusters, for instance, four clusters, then gradually decreased the number to two clusters. Each cluster produced must have a number of members sufficient to suggest that the cluster represents a pattern. The goal was to identify the number which could produce the most specific and clearly interpretable output.

Stage 3. The third stage aimed to answer the fourth research question: What are the relationships between the comprehension outcome measure, the types of readers, and the four types of online reading strategy use? Specifically, two different quantitative analyses were conducted to answer the following two sub-questions: 4.1) Is the comprehension outcome measure influenced by the distribution of the four types of online reading strategies? and 4.2) Is the comprehension outcome measure influenced by the types of readers? SPSS (Version 24) were used to perform both analyses.

Firstly, a multiple linear regression analysis (Lomax & Hahs-Vaughn, 2012) was initially proposed to determine whether Chinese EFL learners' online reading comprehension can be predicted based on their use of Cho's (2014) four types of online reading strategies. The regression analysis builds on the correlational association between two continuous variables, and uses calculus to solve the least-squares-distance estimation to find the best fitting line minimizing the distance between all observed points. As such, this analysis provides two critical points of information: 1) the strength of association (R) and its related amount of variance explained by the predictor (R^2); and 2) the amount of estimated linear relationship between predictor and outcome (β).

In this analysis, the independent variable included the four types of online reading strategies and the dependent variable was the participants' reading comprehension outcome. Specifically, a step-wise multiple linear regression was designed to explore whether there is a relationship between the comprehension outcomes and the way that readers use the four types of strategies. The assumptions of multicollinearity, normality, independence of error terms, linearity, homoscedasticity, and outliers were tested before the regression analysis. Adaptions were made when the assumption of multicollinearity was not assumed, which will be reported in Chapter Four.

Furthermore, the regression analysis involved testing the significance of both the overall regression model's results and of each regression coefficient. Therefore, I adopted the standard alpha level of .05 to argue for significance. However, I also considered the size of the relationship in an educational context (Cohen, Cohen, West, & Aiken, 2003), to consider the "educational" significance in a meaningful way.

Lastly, a one-way ANOVA (Lomax & Hahs-Vaughn, 2012) was conducted to determine whether there is a mean difference in Chinese EFL learners' online reading

comprehension among different types of readers. The one-way ANOVA compares the size of differences observed among means between groups (the mean square distance between groups) with the difference of each observation from its group mean observed within each group (the mean square distance within groups). As such, this analysis determines whether at least one group differs significantly from any of the others.

In this analysis, the dependent variable was the participants' online reading comprehension outcome and the independent variable included the types of readers, as categorized based upon the results of the sequential analysis performed prior. The null hypothesis is that there is no statistically significant difference in online reading comprehension among different types of readers. This analysis adopted .05 as the significance level, denoted as alpha. If the results produce a *p*-value greater than .05, the null hypothesis must be accepted; conversely, if the results produce a *p*-value smaller than .05, the null hypothesis must be rejected. In addition, due to the sample size (40 participants) being smaller than 50, the Shapiro-Wilk (SW) statistic (Shapiro, Wilk, & Chen, 1968) was calculated to test normality before checking the mean difference. Also, Levene's test was conducted to examine the assumption of homogeneity of variance.

CHAPTER FOUR

RESULTS

This study was designed to investigate how Chinese college EFL learners read online texts. It aimed to first elicit results regarding participants' online reading strategy use, which can be related to earlier works, and to then examine the patterns of strategy use and their relationships with reading outcomes. Specifically, this research sought to answer the following four questions and corresponding sub-questions.

1. Do the relative proportions of usage among the four types of online reading strategies measured in this study differ from those reported by Cho (2014)?
2. Are certain strategies more likely to be associated with clicks?
3. What are the general patterns of strategy use in this reading task?
    1) What are the participants' reading patterns from beginning to end? Is there a developmental pattern across the reading task as a whole?
    2) What is the most common type of strategy used at each defined interval in the reading process?
    3) What types of readers can be identified based on their sequential patterns of online reading strategies across the reading process?
4. What relationships exist between the comprehension outcome measure, the types of readers, and their four types of online reading strategy use?
    1) Is the comprehension outcome measure influenced by the distribution of the four types of online reading strategies?
    2) Is the comprehension outcome measure influenced by the types of readers?

To address the above-listed research questions, I first collected data from 40 college EFL learners who studied at a comprehensive university in southwest China. In this study, the participants were asked to complete a 30-minute online reading task on the *Simple English Wikipedia* website followed by an objective comprehension assessment. The participants were trained and required to verbalize their thinking process while reading. Both their verbalization and computer-screen moves were recorded by Camtasia, which served as the primary data representing strategy use and clicking action. Also, the participants' test scores from the comprehension assessment were calculated and used as the comprehension outcome data. After data were collected, I then conducted a series of quantitative analyses to answer the research questions, respectively.

This chapter reports the results of the data analyses. It first presents the findings of the preliminary data analyses, which include the participants' demographic information, the inter-coder reliability rate, and the descriptive statistics for major categorical variables. It then addresses the statistical results of the four research questions, respectively. Lastly, the summary section highlights the key points discussed in this chapter.

Preliminary Data Analysis

Preliminary analyses were conducted using SPSS software version 24 before any further quantitative analyses. After reviewing the data of both categorical and continuous variables, no unusual codes or unexpected values were found within each of the variables. Also, my inspection of missing data of all variables found no missing data. In total, 40 participants' data were all included in the following data analyses.

To provide a better picture of participants' background, this section first discusses their demographic information. It then presents the inter-coder reliability rate. Lastly, it reports the descriptive data for the major categorical variables discussed in this study.

Participant Demographic Information

In this study, all of the 40 participants were university sophomores ages 19 to 21. Among them, 27 (67.5%) were female and 13 (32.5%) were male. Their study areas consisted of 20 majors offered by 17 different schools of the university (see Appendix H). Also, the participants were from 18 provinces of China, which represent a cross-section of this Chinese college EFL population.

Inter-coder Reliability

In this study, the primary data are composed of the participants' verbal reports and computer screen moves, which were recorded by Camtasia and saved as video files for coding. There are two primary coding tiers for each participant's video data, each of which was coded independently by two trained doctoral students of this field. The two coding tiers are: the strategy tier, which represents the participants' use of four types of online reading strategies, and the clicks tier, which captures the participants' physical action of clicking.

To examine the inter-coder reliability, the two coders' coding files were merged. A new tier, named the reliability tier, was created after both the strategy tier and the clicks tier. As illustrated in Figure 4.1, the two new tiers followed the same 10-second coding intervals that were used in the two primary coding tiers. There were two new codes for this reliability tier: hit and miss. Code "hit" was applied when both coders had the same codes for a particular 10-second interval. Code "miss" was applied when the two coders had

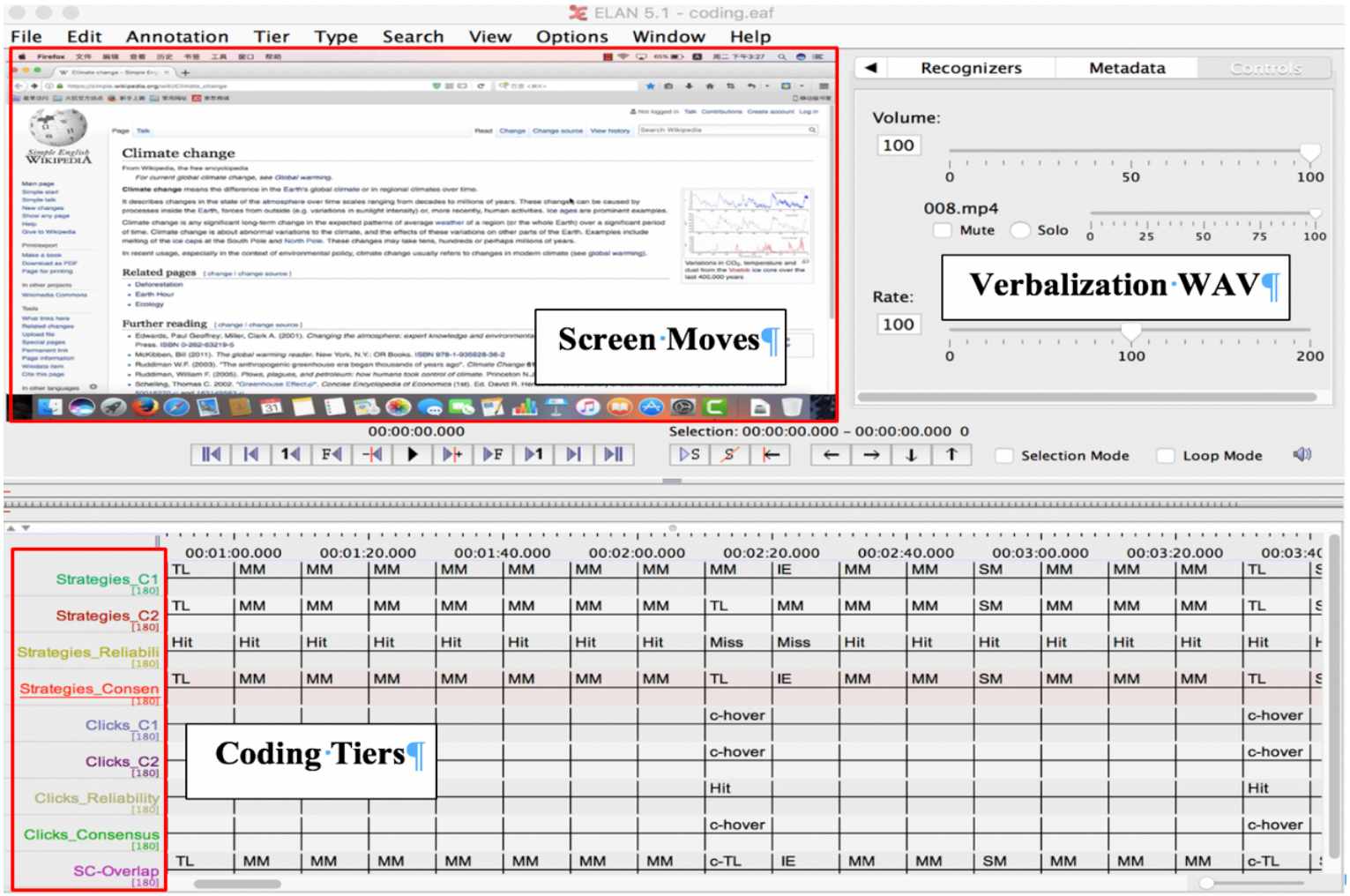

Figure 4.1. Screenshot of ELAN Coding.

different codes for the coding interval. The percentage agreement of coders for the strategy tier was 89% and for the clicks tier 99%. Also, Cohen's Kappa coefficient (1960) was computed by using SPSS to determine the inter-coder reliability rate for each coding tier. Based on the guidelines from Landis & Koch (1997), Cohen's Kappa for the strategy tier ($k = .805$, $p < .05$) represents a substantial agreement and Cohen's Kappa for the clicks tier ($k = .975$, $p < .05$) suggests a nearly perfect agreement. Since clicking is a very obvious action, and the coders were observing distinct clicks, it is reasonable that Cohen's Kappa for this tier has reached an almost perfect agreement. Therefore, it is concluded that the coding of the video data has a fairly good inter-coder reliability level between the two coders.

In addition, the comprehension assessment that was issued to collect the comprehension outcome data was composed of 20 multiple-choice questions with only one correct answer for each. It did not require subjective judgment and, therefore, was scored by one rater only.

Lastly, although the two coders reached a high inter-coder reliability rate, the data used for the subsequent statistical analyses were all drawn from the consensus codes that were obtained by the following process. First, another new tier, named the consensus tier, was created after both the above-mentioned reliability tiers. As depicted in Figure 4.1, the two new consensus tiers also adopted the 10-second coding intervals. After the independent coding for all 40 participants' data, the two coders met and compared their codes on the consensus tier. They reviewed the discrepancies and resolved the differences by detailed discussions based on an interchange of explanations. Then, they entered the consensus codes into the consensus tiers after reaching an agreement. These codes were used for the subsequent analyses.

Descriptive Statistics for Major Categorical Variables

This study includes two major categorical variables: the strategy variable, which incorporates four types of online reading strategies, and the click variable, which includes two types of clicking actions. This section presents the descriptive statistics for these two variables, respectively.

Four types of strategy use. Table 4.1 presents the number of occurrences and the percentage of the four types of strategies used by all 40 participants. The percentages were calculated by dividing the number of occurrences of each strategy type over the total number of occurrences. This analysis of the strategy variable led to three main findings.

1. The meaning-making strategy ranks the highest in strategy use. Across the reading task, participants spent more than half of their time on learning and constructing the meaning of the text. Meaning-making was the dominant strategy used by this population while reading online.

Table 4.1 Descriptive Statistics for the Four Types of Strategy Use

Strategy	Number of occurrences	Percentage
Information evaluation (IE)	93	1.3
Meaning-making (MM)	4458	61.9
Self-monitoring (SM)	1345	18.7
Text location (TL)	1304	18.1
Total	7200	100.0

2. Among the four types of strategy use, the information evaluation strategy places last, with only 1.3% of total strategy use. This indicates that most readers from this population rarely used any strategies to evaluate either the usefulness of or the quality of the reading resources while conducting online reading.
3. Participants' use of the self-monitoring and text location strategies are almost equal. The percentages of the self-monitoring and text location strategy use are close, only 0.6% apart, with self-monitoring slightly higher than text location. This indicates that the participants not only regularly monitored their reading when encountering difficulties, but also consistently used strategies to help locate additional texts in this new reading environment.

Two types of clicking actions. As discussed in Chapter Three, the *Simple English Wikipedia* website offers two different ways to click a link. The first is the hover type of clicks, which allows readers to hover over a link to get a preview of the content. The second is the conventional hyperlinks type of clicks, which requires readers' actual clicking to load a whole new page. The coding of the clicks tier identified and recorded both clicking actions.

Table 4.2 shows the number of occurrences and the percentage of the two types of clicking actions conducted by all 40 participants. Each percentage in the table was determined by dividing the number of occurrences of each click type by the total number of occurrences. This analysis of the click variable led to two main findings.

1. The percentages of participants' two types of clicking actions are close, only 1.9% apart, with the use of hover type of clicks slightly higher than the hyperlinks type of clicks. This indicates that when the clicking action was conducted, the participants

Table 4.2 Descriptive Statistics for the Two Types of Clicks

Types of clicks	Number of occurrences	Percentage
No clicks	5901	82.0
Clicks–hover	718	10.0
Clicks–hyperlinks	581	8.1
Total	7200	100.0

spent fairly the same amount of time on two different types of links. They did not express a preference for any particular type.

2. However, comparing the percentages of the clicking actions and the absence of clicking, one notable aspect is that the two types of clicks comprise 18% of the total occurrences. Although the participants were reading without selecting any types of links to locate further texts the majority of the time, the amount of time spent on clicking still suggests a substantial focus on links.

Statistical Results

Research Question One

The first research question explores whether the relative proportions of usage among the four types of online reading strategies measured in this study differ from those reported by Cho (2014). A Rao-Scott chi-square analysis was conducted to determine whether the distribution of the four types of strategy observed in both data sets are similar to or significantly different from each other. In this Rao-Scott chi-square analysis, each individual participant was treated as a cluster. The frequencies of the four types of

strategies identified in the present study served as the observed values, and the frequencies of the four types of strategies observed in the focused website learning session of Cho's (2014) study served as the expected values. The argument for significance for the chi-square statistic was set at $p < .05$.

The Rao-Scott chi-square statistic was computed by dividing the Pearson chi-square statistic with the computed design correction estimate. The Rao-Scott chi-square statistic, $\chi 2\ (3, N = 7{,}200) = 324.9$, $p < .001$, suggests that there is a statistically significant association between the four types of strategy use and the two groups of participants. That is, the distributions of the four types of reading strategy use between the two population groups are different.

As shown in Table 4.3, by examining the percentages of the four types of strategy use, it is clear that the rank of the strategy use is the same in both sets of data. Meaning-making is the most frequently used strategy, followed by the self-monitoring, text location, and information evaluation strategies. However, the comparison of the percentages indicates that the participants from the present study had more uses of the meaning-making strategy, yet their use of the information evaluation strategy was less than the participants from Cho's (2014) study.

Research Question Two

The second research question examines whether certain strategies are more likely to be associated with clicks. To answer this question, another Rao-Scott chi-square analysis was conducted. As noted earlier, two types of clicks were identified in this study: the hover type of clicks and the hyperlinks type of clicks. However, when clicks were associated with strategies, there were fewer than five occurrences of the hover type of clicks associated with the information evaluation strategy. This violated the expectation

Table 4.3 Percentages of Four Types of Strategy Use in Cho's Study and Present Study

Strategy	% in Cho's data (*Focused website learning session*)	% in present study
Information evaluation (IE)	15.1	1.3
Meaning-making (MM)	44.2	61.9
Self-monitoring (SM)	22.8	18.7
Text location (TL)	17.9	18.1
Total	100.0	100.0

Note: The data in column 2 are from "Competent Adolescent Readers' Use of Internet Reading Strategies: A Think-aloud Study" by B-Y. Cho, 2014, *Cognition and Instruction*, 32(3), p. 277. Copyright 2014 by Taylor & Francis Group, LLC. Reprinted by permission.

of chi-square analysis. Therefore, to ensure sufficient observations of each strategy category with clicks, the two types of clicks were combined into a single category and counted as a whole when examining the association between clicks and strategies.

In this Rao-Scott chi-square analysis, the frequencies of the strategies identified when clicks happened served as the observed values, and the frequencies of the four types of strategies used by participants across the reading process served as the expected values. The original design adopted .25 as the expected values. However, the frequencies of the four types of strategy use reported in Table 4.1 have already indicated that certain strategies were implemented more frequently than others in this reading task. Therefore, using these corresponding frequencies as the expected values offers a better way to scale the analysis in terms of time, providing a better reference for the examination.

The Rao-Scott chi-square statistic, $\chi 2$ (3, N = 1,299) = 2074.4, $p < .001$, indicates that there is a statistically significant difference between the distributions of the strategy used with clicks and that of the strategies used across the whole reading process. Table 4.4 presents the number of occurrences and the percentages of the four types of strategies used associated with clicks of all 40 participants' data. The percentages were computed by dividing the number of occurrences of each type of strategy-click by the total number of occurrences. It is evident that text location is the strategy most frequently associated with clicking, followed by self-monitoring, meaning-making, and information evaluation.

Figure 4.2 shows the comparison between the percentage of the strategies used with clicks and the percentage of the strategies used across the whole reading process. Comparing the two pie charts, it can be seen that the self-monitoring and information evaluation strategies have the same ranking in both pie charts with a slightly different

Table 4.4 Descriptive Statistics of the Strategy-associated Clicks

Strategy	Number of occurrences	Percentage
Clicks-IE (Information evaluation)	15	1.2
Clicks-MM (Meaning-making)	111	8.5
Clicks-SM (Self-monitoring)	225	17.3
Clicks-TL (Text location)	948	73.0
Total	1,299	100

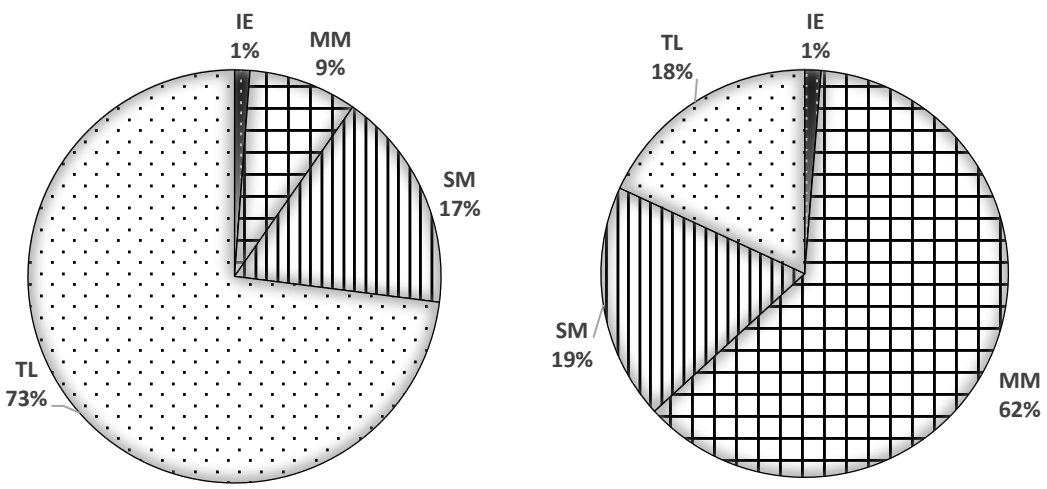

Figure 4.2. Strategy-associated Clicks and Strategy Uses across the Reading Process.

percentage. However, the text location strategy became the dominant strategy when participants were clicking on hyperlinks. Even though meaning-making was the most frequently used strategy across the reading process, it did not have a strong association with clicking. This is reasonable because one primary purpose of using the text location strategy is to locate and choose relevant information. When readers click on hyperlinks, they are, in fact, seeking further texts to read.

Research Question Three

The third research question investigates what general patterns of strategy use can be observed in this reading task. Specifically, three sequential analyses were conducted to answer three sub-questions.

First, transversal analysis was conducted to find out what the participants' reading patterns were from beginning to end. Figure 4.3 illustrates how each of the four types of

Figure 4.3. Proportions of Strategy Use of All Participants across the Reading Process.

strategies was used at the defined 10-second intervals by all participants across the whole reading process. Inspection of the graph indicates that the pattern of the strategy use was fairly regular. Meaning-making was the dominant strategy, as noted earlier in Table 4.1. Information evaluation strategy use accounted for a small portion, but was spread out throughout the reading process. The text location and self-monitoring strategies were representative, but they served more as a supporting role to the meaning-making strategy. The overall variations, however, did not follow any clear pattern. The only divergence shown on the graph was that initially the participants tended to implement the text location strategy more to orient themselves. In general, this suggests that the reading materials were rather familiar to the participants and the approaches that the readers applied to this reading task were fairly consistent.

Second, modal analysis was conducted to explore the second sub-question: What is the most common type of strategy used at each defined interval in the reading process? Figure 4.4 depicts the most frequently used strategy of all participants across the reading process. This graph suggests that the meaning-making strategy completely dominated the reading episode. Thus, there were no specific patterns to observe by examining all participants' data as a whole.

Third, cluster analysis was conducted to further explore the reading patterns of distinctive groups of participants instead of the overall patterns of all participants. In particular, this analysis aimed to explore what types of readers can be identified based on their sequential patterns of online reading strategies across the reading process. The categorization of the participants was based upon the similarity of their reading patterns. Because cluster analysis does not provide the optimal number of clusters, I started this

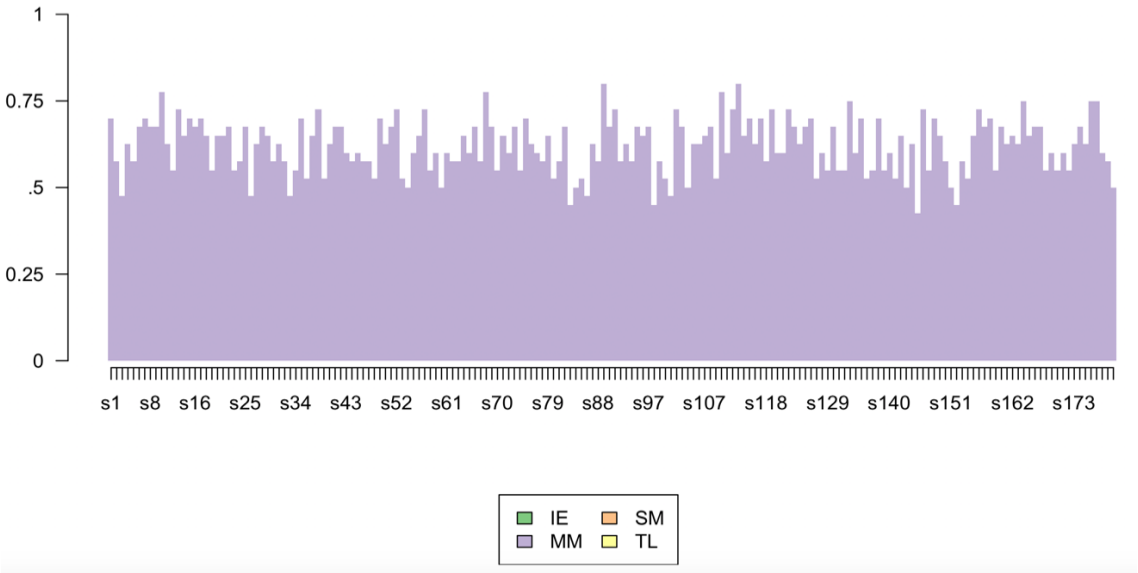

Figure 4.4. The Most Frequently Used Strategy of All Participants across the Reading Process.

analysis by testing four clusters, then gradually decreased to two clusters. The decision of choosing an appropriate number of clusters was based on the criteria that each cluster should have a sufficient number of participants to represent the corresponding pattern and the output should be interpretable. After examining different numbers of clusters, I then decided to adopt three clusters. As shown in Figure 4.5, the examination of the characteristics of each cluster led to three main findings.

1. The first cluster includes readers who heavily relied on meaning-making. For this group of readers, the self-monitoring and text location tended to act as equally supporting strategies, whereas the information evaluation strategy was rarely used across the reading process. The readers in this group generally followed the traditional print reading strategies.
2. Compared with the first group of readers, the second cluster represents readers who put more emphasis on text location. Although meaning-making was still the primarily used strategy, text location strategy use increased, becoming a clear secondary strategy. There was not much difference in self-monitoring strategy use between the first and second clusters, yet the information evaluation strategy was applied more consistently in the second cluster. These results suggest that this group of readers were more exploratory and willing to experiment. While reading, they were thinking as well as trying. They tended to take the initiative to find more texts to read.
3. Moreover, the third cluster indicates a wider variability with significant movement. This group embodies readers who were more strategic and critical. They tended to use strategies in a more dynamic way and were more likely to implement multiple strategies. They were more self-reflective and self-monitoring as they read. Comparing the three clusters, it also is notable that the information evaluation

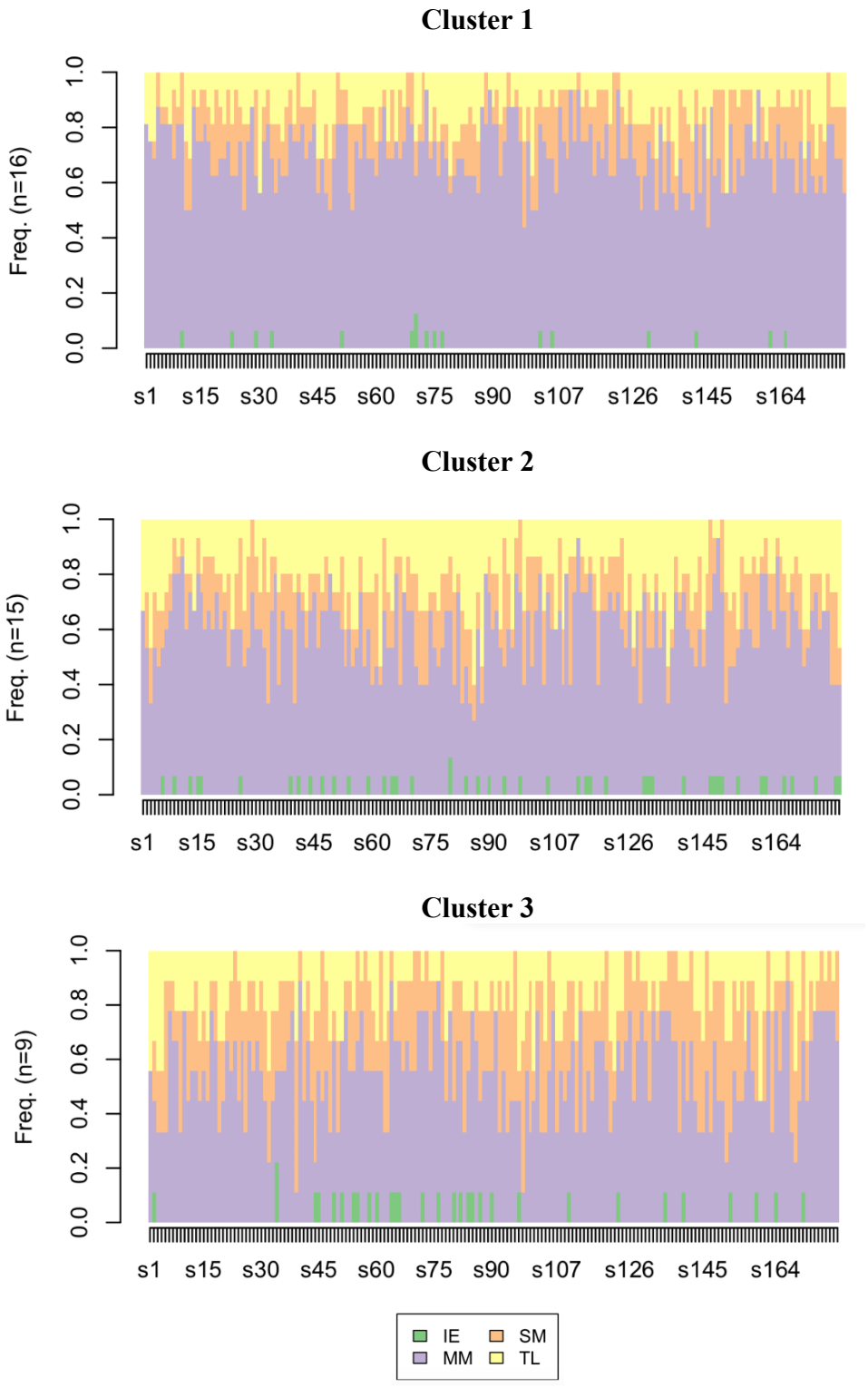

Figure 4.5. Reader Types.

strategy was used more times from beginning to end for both the second and third groups. However, one prominent difference is that the more strategic group started the evaluation a bit earlier.

As discussed above, all three groups used all four types of strategies. However, they applied them differently. Based on the cluster analysis results, I then named the first group as uncertain reader (*N*=16), the second group as exploratory reader (*N*=15), and the third group as strategic reader (*N*=9). The uncertain readers spent most of their time focusing on meaning as opposed to the process of actual reading. This indicates that they were struggling and concerned about their understanding. However, there is a shift to more variety in strategy use for the exploratory readers. Although they still spent a lot of time on the text, this group of readers tended to be more willing to explore. Lastly, the strategic readers apparently showed the most variety in strategy use. They applied more metacognitive strategies and therefore were more reflective.

Since no specific reading patterns can be identified by examining the most frequently used strategy used at each defined interval by all participants, three modal analyses were further conducted on each of the three clusters to seek possible sequential patterns of these particular groups of readers.

Figure 4.6 presents the most frequently used strategy at 10-second intervals by each type of reader throughout the reading process. The graphs indicate that the reading patterns of each group varied distinctively. For the uncertain readers, the meaning-making strategy still dominated without any other reading patterns shown in the graph, which was consistent with the characteristics of this group of readers. While for the exploratory readers, even though meaning-making still dominated, it was interspersed with episodes of self-monitoring and text location. As shown on the graph with the use of

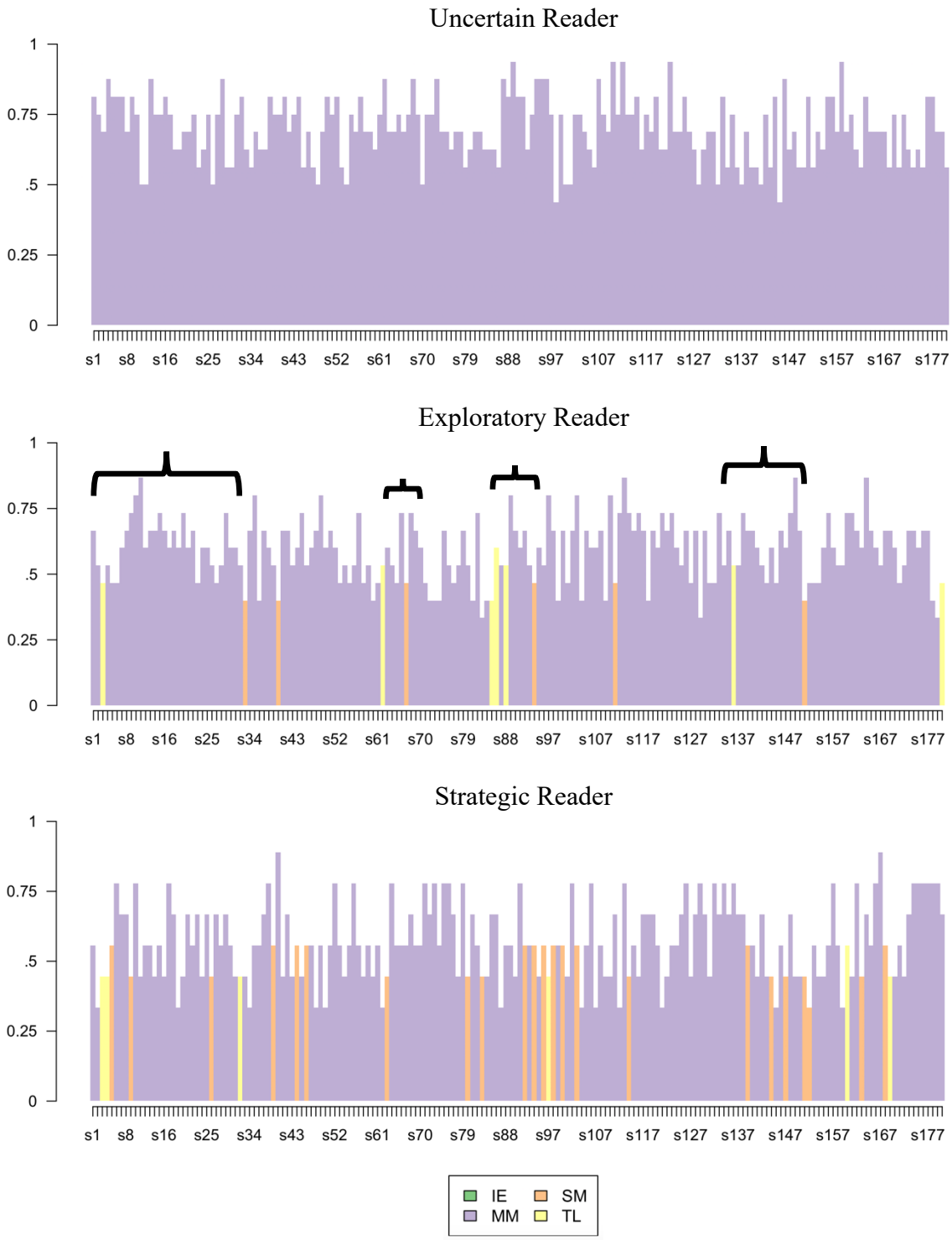

Figure 4.6. The Most Frequently Used Strategy by the 3 Readers Types across the Reading Process.

brackets, several similar reading cycles were identified for this group of readers, where their reading strategy use followed an order of text location to meaning-making, and then to self-monitoring. As self-monitoring is a more internally focused perspective and text location is very external, the reading cycles of readers from this group tended to revolve from external to internal. Furthermore, for the strategic readers, one notable distinction is that there were fewer episodes of text location and more episodes of self-monitoring. This suggests that readers from this group often monitored their reading in a consistent way; they tended to adopt a more structured approach. This result reflects the characteristics of the strategic readers who were more internally-aware and focused. Their approach was more reader-directed as opposed to the other groups that were more text-oriented.

Research Question Four

The fourth research question explores what relationships exist between the comprehension outcome measure, the types of readers, and their four types of online reading strategy use. Two specific sub-questions were posed as follows: 4.1) Is the comprehension outcome measure influenced by the distribution of the four types of online reading strategies? and 4.2) Is the comprehension outcome measure influenced by the types of readers? First, linear regression analyses were conducted to answer the first sub-question. Then, a one-way analysis of variance (one-way ANOVA) was used to answer the second sub-question.

Linear regression analyses. A step-wise multiple linear regression analysis was initially proposed to pursue the connection between participants' reading comprehension and their use of online reading strategies. Before the multiple regression analysis, a preliminary analysis was conducted to test the assumption of multicollinearity.

As reported in Table 4.5, inspection of the correlation coefficients of the four independent variables showed a strong negative correlation between the meaning-making and self-monitoring strategies. The Pearson correlation coefficients between these two variables was almost .7. According to Cohen et al. (2003), this high correlation suggests that the meaning-making and self-monitoring strategies are multicollinear variables.

Although the original design incorporated only a step-wise multiple linear regression analysis, the preliminary analysis discussed above indicated a potential violation of the assumptions to the step-wise multiple regression model. Therefore, to pursue the best-fitting model for the multiple regression analysis, four simple linear regressions were conducted to understand the effect of each of the four types of strategy use on the comprehension outcome.

Testing assumptions. Preliminary statistical analyses were conducted to first test the following assumptions before any simple regression analyses.

Table 4.5 Correlation Coefficient among the Four Types of Strategies

Variables	IE	MM	SM	TL
Information evaluation (IE)	--	-.423**	.249	-.004
Meaning-making (MM)	--	--	-.670**	-.574**
Self-monitoring (SM)	--	--	--	.274
Text location (TL)	--	--	--	--

** Correlation is significant at the .01 level (2-tailed)

Normality. First, inspection of the normal P-P plot showed that, although the points were not aligned perfectly along the diagonal line, the residuals were close enough to normal for the analysis to proceed. Also, the skewness value (s = -.087) was computed. According to Lomax and Hahs-Vaughn (2012), a skewness value within the range of ±2.0 suggests a relatively normal distribution. Therefore, the assumption of normality was not violated.

Independence of error terms. The Durbin-Watson statistic was computed to test the assumption of independence of error terms. There was independence of residuals, as assessed by a Durbin-Watson statistic of 2.152, 1.708, 1.476, and 2.410 for information evaluation, meaning-making, self-monitoring, and text location as predictors, respectively. All test statistic values were in the range of 1.5 to 2.5.

Linearity. Inspection of the scatterplot of standardized residuals versus standardized predicted values suggested that the residuals formed a horizontal band. This roughly rectangular distribution indicated that the assumption of linearity was assumed.

Homoscedasticity. As assessed by the visual inspection of the scatterplot of standardized residuals versus standardized predicted values, the residuals were almost constantly spread. The spread of the residuals did not increase or decrease across the predicted values. Therefore, the assumption of homoscedasticity was met.

Outliers. A casewise diagnostics was conducted to check for outliers. This analysis found no case where the standardized residual was greater than 3 standard deviations. This indicated that no outliers were found.

Simple linear regression results. Table 4.6 presents the descriptive statistics for the comprehension outcomes of all participants in the following order: number of

participants (*N*), mean, standard deviation (*SD*), minimum score (*Min*), and maximum score (*Max*).

Table 4.6 Descriptive Statistics of the Comprehension Outcome for All Participants

N	*Mean*	*SD*	*Min*	*Max*
40	14.1	3.13	9	19

Table 4.7 presents the results of the four simple linear regressions in the following order: R square (R^2), significance level (p), unstandardized coefficients (β), and standardized coefficients (β).

The results suggest that three individual strategies—information evaluation, meaning-making, and self-monitoring—significantly predicted the comprehension outcome. The R square statistics indicate that approximately 80% of the variation in the comprehension outcome was predicted by the meaning-making strategy, 65% was predicted by the self-monitoring strategy, and 14% was predicted by the information evaluation strategy. According to Cohen et al. (2003), such results suggest a strong effect size for both the meaning-making and self-monitoring strategies as a predictor and a week effect for the information evaluation strategy.

Additionally, the examination of the standardized and unstandardized coefficients indicate the following: 1) on average, for the information evaluation model, every additional use of the information evaluation strategy led to an increase of .333 points in

Table 4.7 Simple Linear Regression Results

Predictors	R^2	*p*	*Unstd. Coefficients (β)*	*Std. Coefficients (β)*
Information evaluation (IE)	.138	.018	.333*	.372*
Meaning-making (MM)	.790	.000	-.193**	-.889**
Self-monitoring (SM)	.645	.000	.237**	.803**
Text location (TL)	.087	.064	.091	.295

** Correlation coefficients is significant at the .01 level (2-tailed)
* Correlation coefficients is significant at the .05 level (2-tailed)

the comprehension outcome; 2) for the meaning-making model, every additional use of the meaning-making strategy use decreased the comprehension outcome by .193 points; and 3) for the self-monitoring model, every additional use of the self-monitoring strategy increased the comprehension outcome by .237 points.

However, examination of the standardized coefficients between the four types of strategies and comprehension also indicates that the meaning-making strategy was substantially correlated with the comprehension outcome. This high correlation suggests that there was an extensive overlap between these two variables. Therefore, once the meaning-making strategy was taken into account, there was no comprehension overlapping with the other strategy variables on their own.

To sum up, the above-mentioned analyses revealed two findings: 1) The multicollinearity of the meaning-making and self-monitoring strategies suggested that only one be included in the multiple regression model, and 2) the overlap between the

meaning-making strategy and the comprehension outcome left insufficient relationships for the other independent variables to explain. Thus, the meaning-making strategy was excluded from the multiple regression analysis. The best-fitting multiple regression model contained only the following three independent strategy variables: self-monitoring, information evaluation, and text location.

Multiple linear regression results. As the best-fitting multiple regression model had been built, a standard multiple linear regression was conducted to test the effect of the self-monitoring, information evaluation, text location model on the comprehension outcome. Instead of using the proposed step-wise multiple linear regression, this examination explored whether there were changes to the effect of the three strategies on the comprehension outcome after controlling for the use of the other two strategies. First, five tests of assumptions were conducted, including tests of normality, of independence of error terms, of linearity, of homoscedasticity, and of outliers. As reported in the simple linear regression section, the results indicated that all the above-mentioned assumptions were satisfied. Additionally, in addressing multicollinearity, three particular measures were conducted, including the correlation coefficients of the independent variables, the tolerance values, and the VIF values. The inspection of correlation coefficients of the three independent variables showed that none of them had a correlation greater than .7. Also, the tolerance values for the information evaluation, self-monitoring, and text location strategies were .937, .907, and .967, respectively. The VIF values for the information evaluation, self-monitoring, and text location strategies were 1.068, 1.102, and 1.034, respectively. The tolerance values of the three independent variables were all larger than .1, and the VIF values were all less than 10. Therefore, it is concluded that the assumption of multicollinearity was met.

The result of the multiple linear regression shows that approximately 87% of the variation in comprehension outcome was predicted by the self-monitoring, information evaluation, and text location strategies together ($R^2 = .868$, $F(3, 36) = 79.125$, $p < .01$). Table 4.8 further presents the change in the effect of each strategy on the comprehension outcome after controlling for the other two strategies in the following order: standardized coefficients (β) from the simple linear regression analyses, unstandardized coefficients (β) and standardized coefficients (β) from the multiple linear regression analysis, and percentage of β change.

As illustrated in Table 4.8, the change of the standard coefficients indicates that these strategies interact. Comparing the results from both the four simple linear regressions and the standard multiple linear regression, three findings are noted.

1. The initial positive effect of the self-monitoring strategy on the comprehension outcome was slightly increased by 5% when controlling for the other two strategy uses. Every additional use of the self-monitoring strategy was expected to increase the comprehension outcome by .249 points when the use of the other two strategies held constant.
2. Although the initial positive effect of the information evaluation strategy was largely reduced when controlling for the other two strategies, its effect was still statistically significant. This decrease indicates that at least part of the overall relationship between the information evaluation strategy and the comprehension outcome was accounted for by the impact of the other two strategies.
3. The initial insignificant effect of the text location strategy on the comprehension outcome was largely increased by 51% when taking the other two strategy uses into account. Every additional use of the text location strategy was expected to increase

Table 4.8 Change in Effect of Strategy after Controlling for Other Two Strategies

Strategy	Simple Linear Regression	Multiple Linear Regression		% of β change
	Std. Coefficients (β)	*Unstd. Coefficients (β)*	*Std. Coefficients (β)*	
Self-monitoring (SM)	.803**	.249**	.841**	+5%
Information evaluation (IE)	.372*	.147*	.165*	-56%
Text location (TL)	.295	.137**	.445**	+51%

** Correlation coefficients is significant at the .01 level (2-tailed)
* Correlation coefficients is significant at the .05 level (2-tailed)

the comprehension outcome by .137 points when the use of the self-monitoring and information evaluation strategies held constant.

To conclude, the above-mentioned results support the findings of the simple linear regressions, which revealed that self-monitoring strategy use retained a stable and substantial impact on the comprehension outcome. Another informative finding was that the addition of both the self-monitoring and information evaluation strategies to the prediction of comprehension led to a statistically significant increase in the effect of text location strategy use on the compression outcome. This indicates that the impact of the text location strategy became prominent when used with the self-monitoring and information evaluation strategies. Since the text location strategy is a unique strategy adopted by readers only in the online reading environment, this result confirms its significant and supportive role in effective online reading.

One-way ANOVA. A one-way ANOVA was conducted to determine whether there is a mean difference in comprehension outcome among the three types of readers. In this analysis, the dependent variable is participants' comprehension outcomes, and the independent variable is the three types of readers, which were categorized by the sequential analyses mentioned in the earlier section. The null hypothesis is that there is no significant difference in comprehension outcome among the three types of readers.

Testing of assumptions. Preliminary statistical analyses were conducted to test three assumptions before conducting the one-way ANOVA.

Normality. The Shapiro-Wilk statistic (Shapiro et al., 1968) was calculated to test normality because the sample size (N=40) was smaller than 50. Table 4.9 reports the computed Shapiro-Wilk statistics, degrees of freedom (*df*), and significance values (p) of the comprehension outcomes for the three reader types, respectively. Since the p values were all greater than .05, the normality for all three groups were assumed.

Table 4.9. Test of Normality of Comprehension Outcome for the Three Reader Types

Reader Types	*Shapiro-Wilk Statistics*	*df*	*p*
Uncertain reader	.926	16	.213
Exploratory reader	.952	15	.560
Strategic reader	.889	9	.194

Homogeneity of variance. Levene's test was conducted to test the assumption of homogeneity of variance. The Levene statistics (F=.716, p=.495, $p > .05$) showed that the assumption of homogeneity of variance was not violated.

Outliers. There were no outliers for all three groups' data, as assessed by boxplot.

One-way ANOVA results. Table 4.10 presents the descriptive statistics of the comprehension outcome for the three types of readers in the following order: number of participants (*N*), mean, standard deviation (*SD*), minimum score (*Min*), and maximum score (*Max*).

In addition, the results from the one-way ANOVA indicate that the comprehension outcome was significantly different among the three types of readers, $F(2, 37) = 76.609$, $p < .001$. Because the F-test identified significant differences overall, I further examined the individual contrasts between groups in a post-hoc comparison using the Fisher Least Square Distance (LSD) test. Table 4.11 presents the LSD post hoc test results with the mean difference and significance values (*p*) among two reader groups.

Table 4.10 Descriptive Statistics of the Comprehension Outcome for the Three Reader Types

Reader Types	*N*	*Mean*	*SD*	*Min*	*Max*
Uncertain reader	16	10.94	1.53	9	14
Exploratory reader	15	15.20	1.47	13	18
Strategic reader	9	17.89	1.05	16	19

Table 4.11 The LSD Post Hoc Test Results

Reader Type A	Reader Type B	Mean Difference (A-B)	*p*
Uncertain reader	Exploratory reader	-4.26	.000
	Strategic reader	-6.95	.000
Exploratory reader	Strategic reader	-2.69	.000

As shown in Table 4.11, the LSD post-hoc comparison test further reveals that the comprehension outcome of the three types of readers were all significantly different from each other. The highest performing group was the strategic readers, followed by the exploratory readers. The lowest group was the uncertain readers (see Table 4.10).

Summary

This chapter has presented the results of the data analyses. First, the Rao-Scott chi-square analysis revealed a statistically significant difference in the four types of strategy use between my data and Cho's (2014) data. The meaning-making strategy was used more frequently by participants from the present study, while the information evaluation strategy was applied less often. Second, another Rao-Scott chi-square analysis showed that the strategy most frequently associated with clicking was the text location strategy. Third, three sequential analyses were conducted to seek the patterns of strategy use throughout the reading process. Both transversal and modal analysis confirmed the dominant role of the meaning-making strategy as used by all participants across the whole reading episode. Cluster analysis identified three different groups of readers:

uncertain readers, exploratory readers, and strategic readers. Further modal analyses on each reader type identified specific reading patterns, which reflect the characteristics of each population group. In addition, the results of a series of regression analyses suggest that both the meaning-making and the self-monitoring strategies are good predictors of the comprehension outcome. Specifically, self-monitoring strategy use positively predicted comprehension, while meaning-making strategy use was inversely correlated with comprehension. Both strategies had a fairly strong effect on the comprehension outcome. The findings also reveal that when the text location strategy was used with the self-monitoring and information evaluation strategies, its impact on the comprehension outcome became obvious. Lastly, a one-way ANOVA was conducted to examine whether there is a mean difference in reading comprehension among the three types of readers. The results suggest that the comprehension outcome was significantly different among all three types of readers. The comprehension outcomes of the strategic readers ranked highest, followed by the exploratory readers and the uncertain readers.

CHAPTER FIVE

DISCUSSION AND CONCLUSION

Guided by the model of Constructively Responsive Reading on the Internet (CRRI model) (Afflerbach & Cho, 2009; Cho & Afflerbach, 2017), the current study was conducted to explore how 40 proficient, college-level Chinese EFL leaners use reading strategies while completing an online reading task. Specifically, the statistical results revealed the participants' strategy use patterns, the categorization of reader types, and the relationships among the strategy use and the comprehension outcome.

This chapter begins with a discussion of the findings for each research question. It then addresses the implications of this study for both practice and research. Third, it presents the limitations for research and provides recommendations for future research. Lastly, the conclusion section briefly summarizes the significant points of the study.

Discussion of Research Findings

This section discusses the significance of the findings for each research question. It first relates the findings to prior work by comparing the strategy use among readers from different backgrounds. It then describes the relationship between the clicking behavior and the reading strategies. Third, it reviews the patterns of strategy use and the reader types identified in this study. Lastly, it addresses the relationship between strategy use and the comprehension outcome based on the findings of the strategy use patterns.

Strategy Use among Readers from Different Backgrounds

The first research question aimed to explore whether the proportions of usage among the four types of online reading strategies measured in the present study differ from those reported by Cho (2014). Since Cho's 2014 study was the first study that

provided empirical evidence to Afflerbach and Cho's (2009) CRRI model, which served as the theoretical framework of the present study, a comparison of the strategy use between participants from these two data sets not only enriches, but also expands our understanding of the model. The distributions of the strategies that were identified from the current study were compared with those reported by Cho (2014). The results of the Rao-scott chi-square analysis revealed that participants from the two data sets applied the four types of strategies differently. The Chinese EFL learners' application of the meaning-making strategy was more than that of the adolescent readers in Cho's (2014) study, yet their use of the information evaluation strategy was less.

This finding follows the argument made by many researchers that "reading is a situated literacy practice" (Cho, 2011, p.35). That is, a reader's reaction to different texts varies as different reading materials and contexts evoke different reading responses. Consequently, the reader's use of reading strategies to construct meaning of the texts also differs according to the reading goals and reading context (Afflerbach, Pearson, & Paris, 2008; Cho, 2014; Graesser, 2007; Pressley & Harris, 2006). In the present study, the reading materials and the reading goals were to some extent different from Cho's (2014) study, and this led to readers' distinctive use of strategies. In Cho's (2014) study, readers were required to generate a critical question regarding a particular topic based on their reading from the Internet, while the present study required readers only to read from a preselected website to strengthen and further their understanding of a particular topic. It is possible that these two different reading tasks led to readers' variations in strategy use, especially in the information evaluation strategy use. As the reading task in Cho's (2014) study encouraged more critical thinking, it is reasonable that the readers spent more time on assessing and applying judgment to the text source.

Moreover, the primary difference among the readers from the two data sets is that the readers in Cho's (2014) study were all native English language learners; while the readers in the present study were all EFL learners. This variation may also have resulted in their dissimilarities in strategy use, particularly in meaning-making strategy use. One possible explanation for the different use of the meaning-making strategy by the two population groups is that English proficiency level might be the key reason for this variation (Amer et al., 2010; Chen, 2015; Taki, 2016; Lin, & Yu, 2015). Since the readers from the current study were all learning English as a foreign language, their language proficiency necessitated more effort and focus on constructing meaning than the native speakers from Cho's (2014) study did. This interpretation is also consistent with the findings of Kang's (2014) study, which examined first language and second language learners' online reading patterns. Kang's (2014) investigation revealed that first language learners read twice as fast as second language learners, which explains why the EFL learners in this study spent more time on meaning construction while reading online.

To sum up, the results from the first research question have made connections between the empirical data and the theories that guide the design of the study. The findings are consistent with the theoretical framework proposed in Chapter Two that both reading goals and reading contexts impact a reader's decision of strategy use. Therefore, it is concluded that the complex online reading environment requires readers' adjustment of their strategy use, as the reading materials and the online context vary (Afflerbach & Cho, 2009; Cho, 2014; Park & Kim, 2011, 2017).

Clicks and Reading Strategies

The second research question aimed to explore whether certain strategies are more likely to be associated with the clicking action. Since clicking to select links to read

is an important event in online reading, this cross-categorical analysis of the relationships between clicks and the recently applied strategy helps researchers better understand a reader's attempt to look for further or additional information. In this study, two types of clicks were identified. They are the hover type of clicks, which provides the readers with a preview of the content, and the hyperlinks type of clicks, which requires readers' actual clicking to load a new page. The descriptive statistics indicate that the two types of clicks were used almost equally across the reading process. The fact that the participants spent almost the same amount of time on these two types of clicks shows that readers' navigation of the online text involves both overviewing to choose the potential text and clicking to locate the text. As Cho (2014) indicated, readers usually begin their online reading by exploring, and "their initial focus [is] on identifying potentially helpful links, rather than directly retrieving a particular webpage" (p. 269).

Also, as the clicking behaviors identified in this study comprised 18% of the total occurrences across the reading process, the amount of time that the participants spent on clicking suggested a substantial focus on links. This finding reveals that the readers in this study were actively involved in the exploration and navigation of potential texts to read in order to accomplish their reading goals. The readers not only followed the traditional reading strategies, but also actively selected the links to facilitate their achievement of the objective.

In addition, the results of the Rao-scott chi-square analysis indicate that although meaning-making is the dominant strategy used across the reading process, text location becomes the strategy most frequently associated with clicks. This aligns with the definition and the purpose of using the text location strategy, which is to overview in order to choose relevant websites and information or to search for and locate potential

texts to read. However, since this study did not examine the strategies that precede the action of clicks, it is premature to draw any conclusions regarding the strategies that may prompt reader's action of clicks.

Patterns of Strategy Use and Reader Types

The third research question aimed to examine the readers' general patterns of strategy use and then to categorize the reader types based on their sequential patterns of strategy use. To answer this research question, three sequential analyses were conducted. The results of the first two sequential analyses, transversal and modal analyses, indicate that meaning-making was the dominant strategy used by all participants in this reading task. Both the self-monitoring and text location strategies were consistently applied throughout the reading process and played a significant role. Yet the information evaluation strategy accounted for the smallest portion.

First, the finding of the meaning-making strategy being the backbone of this online reading behavior indicates that the participants' reading was to a large extent focused on meaning. The participants spent much time using strategies, such as paraphrasing, translating, clarifying, etc., to make meaning of the words and texts. As noted earlier, one possible reason might be their English proficiency level. As foreign English language learners, the readers' proficiency level demands more time investment on making meaning of the text, which is also shown in previous studies (Kang, 2014; Lin, & Yu, 2015). Second, the finding of the self-monitoring and text location strategies being used almost the same reveals that, unlike traditional print reading, online readers not only monitor their reading, but also spend time on locating and navigating potential text to read. Nevertheless, these two strategies served more as a supporting role to the meaning-making strategy even though they were used consistently. This indicates that the

meaning-making strategy is still essential to online reading (Cho, 2014; Cho, Woodward, Li, & Barlow, 2017), particularly among the ESL and EFL population (Mudra, 2018; Tien, & Talley, 2014). Lastly, readers' rare use of the information evaluation strategy indicates that their analytic and reflective thinking is limited. That is, the participants seldom paid attention to the features of the online text, such as the authorship or publication, to assist their evaluation of the information credibility. This may have resulted from the reading task, which did not encourage much critical thinking. Another possible reason is that readers are lacking in knowledge and practice of how to conduct an effective evaluation of online sources, which is indicated in previous research (Coiro et al., 2015; Barzilai & Zohar, 2012; Brand-Gruwel & Stadtler, 2011). Therefore, instructions and guidance of how to assess online sources are greatly needed to facilitate readers' use of the information evaluation strategies (Coiro et al., 2015; Goldman et al., 2012).

In addition, the third sequential analysis, cluster analysis, was conducted to explore the reader types. Being different from the transversal and modal analyses which are based on frequencies by intervals and descriptive in nature, cluster analysis is a higher order analysis that makes inferences about how participants seem to cluster together. The results of the cluster analysis identified three types of readers based on the similarities of participants' strategy use. The three types were named as the uncertain readers, the exploratory readers, and the strategic readers.

The uncertain group presents readers who seldom shift focus from one strategy to another, while the strategic group presents readers who implement a variety of strategies in a deliberate way and thereby are more strategy inclined. The strategic readers in this study also showed a greater tendency to rely on the information evaluation strategy,

which is consistent with the idea that they are strategy conscious. Compared with the uncertain readers, proportionally, the exploratory readers showed less use of the meaning-making strategy, yet a willingness to apply more text location strategy. The self-monitoring and information evaluation strategy use remained almost the same in both groups. This finding reflects the results of Cho's (2014) study, in which two distinct sequential patterns of readers were observed: reading driven by the use of meaning-making strategy and reading driven by the use of text location strategy. Similar to the readers driven by the meaning-making strategy identified in Cho's (2014) study, the uncertain readers in this study paid more attention to making sense of the existing texts they have. However, the exploratory readers, which can be related to Cho's text-location-driven readers, dedicated more emphasis on seeking out further potential text to read. This finding provides evidence to Cho's (2014) claims that these two groups of readers use the self-monitoring and information evaluation strategies consistently. However, their focuses on the meaning-making strategy and the text location strategy are apparently distinctive. The distinction between the meaning-making and text location strategy use in these two groups characterizes the different factors that drive readers' reading.

Furthermore, although meaning-making strategy use dominated the whole reading process, the further examinations of the modal state of the clusters helped distinguish differences in strategy use among the three groups of readers. The results of the modal analysis on each reader type recognized particular reading patterns for both the strategic and exploratory groups. For the exploratory readers, their reading strategy use followed a sequence of text location to meaning-making, and then to self-monitoring. This identified reading cycle shows a tendency of reading from externally to internally focused perspective. The identifications of the reading cycles reflected the ways that reading

works. Ultimately, the self-regulated readers also decide whether they are getting close to their goals (Balcytiene, 1999; Cho & Afflerbach, 2017). Similarly, for the strategic readers, their regular and consistent use of the self-monitoring strategy reflects their internally-aware nature. Overall, the distinctions drawn from the different reading patterns show that the strategic readers are more internally-driven while the other two groups are more text-oriented. The identification of the strategic readers mirrors the findings in McEneaney et al.'s (2016) study.

To sum up, the purpose of the third research question was to generate results that can be related to Cho's 2014 study and then to use higher-order quantitative analysis to support and expand Cho's findings. The graphic representations generated from the sequential analyses depict the overall patterns of the strategy use. They provide a better basis for understanding the arguments in Cho's (2014) study of these patterns. By visualizing the sequential patterns, the data supporting the judgments is made clear.

Reading Strategy Use and Comprehension

The last research question first sought out the relationship between comprehension outcome and reading strategy use. The regression analyses were conducted to examine whether the participants' reading comprehension could be predicted by their use of online reading strategies. The results indicate that both the meaning-making and self-monitoring strategies have a strong effect on the comprehension outcome. Specifically, self-monitoring strategy use positively predicted comprehension, while meaning-making strategy use was negatively correlated with comprehension. The positive relation between the self-monitoring strategy and comprehension outcome identified in this study is consistent with the claims of previous studies (Balcytiene, 1999; Coiro & Dobler, 2007; Huang et al., 2009). However, the

negative relation between meaning-making strategy use and comprehension contradicts the findings of prior research in that an effective use of the meaning-making strategy is vital to a successful online reading (Coiro and Dobler, 2007; Goldman et al., 2012; Hoffman et al., 2003). One possible explanation for this negative correlation might be that most readers in this study applied the meaning-making strategy ineffectively. The dominant use of the meaning-making strategy identified in this study reveals that readers may spend too much time on making sense of the words rather than comprehending the text as a whole. This may be caused by the characteristics of ESL and EFL learners, who often struggle to find a balance between word meanings and comprehension (Huang et al., 2009; Tien, & Talley, 2014). Although meaning-making is essential because readers must make sense of the text, it is not sufficient. Once the readers start to construct meaning of the text, they need to adopt other strategies to better regulate their reading. Meaning-making remains the foundation. Yet, good readers deliberately apply the meaning-making strategy with other strategies, whereas poor readers overuse it (Goldman et al., 2012). Therefore, instructions on how to effectively use the meaning-making strategy are necessary, particularly for the ESL and EFL population.

Also, another result of the study suggests that the impact of the text location strategy on the comprehension outcome becomes apparent when used with the self-monitoring and information evaluation strategies. This finding supports Cho's (2014) argument that "effective text location requires equally effective strategy uses in making meaning, monitoring reading process, and evaluating information qualities (p. 281). Although the online reading context demands readers to navigate, search for, and locate texts to read, the ability to detect reading or navigation problems and apply solutions and the ability to evaluate the online sources are also crucial and supportive to successful

online reading (Anmarkrud et al., 2014). The influence of the text location strategy is limited when used alone (Cho et al., 2017).

To sum up, the findings of the relationship between strategy use and the comprehension outcome identified in this study add empirical evidence to Goldman et al.'s (2012) claim that online reading "involves interplay among sense-making, monitoring, and evaluating processes, all of which promote strategic reading" (p. 356). That is, effective online reading demands a strategic and coordinated implementation of the four types of strategies (Cho, Afflerbach, & Han, 2018; Cho, Han, & Kucan, 2018).

Reader Types and Comprehension

The last research question also investigated the relationship between the comprehension outcome and the reader types identified earlier in the cluster analysis. A one-way ANOVA was conducted to determine whether there is a mean difference in comprehension outcome among the three types of readers. The results indicate that strategic readers had the highest comprehension scores, followed by the exploratory readers, while the uncertain readers' comprehension outcome ranked last. Since the strategic readers frequently shift from one strategy to another in a deliberate way, their willingness to use a wider range of strategies and to regularly monitor and adapt their strategy uses brings a better comprehension outcome. This corresponds with the claim made in previous research that effective readers are strategic (Cheng, 2016; Huang et al., 2009; Park & Kim, 2011).

In addition, Cho's 2014 study suggested that a continuous use of the text location strategy may cause by a disorientation in the online reading environment. Also, readers who consistently use the meaning-making strategy demonstrate a focus on the meaning after identifying potential text to read, which indicates the critical role of the meaning-

making strategy to successful reading. However, the findings of this study reveal that the exploratory readers tend to have a higher comprehension outcome than the uncertain readers. One possible explanation is that, although the exploratory readers identified in this study showed a tendency to more frequently use the text location strategy, the use of this strategy still represented a small proportion among the four types of strategies. Therefore, it is assumed that the text location strategy applied by this group of readers is not caused by disorientation or uncertainty. However, they adopted the text location strategy as a supporting strategy to facilitate their reading. Their intentional use of this strategy is based on a rigorous plan rather than aimless wandering, which was denoted in the external to internal reading cycle identified in the modal analysis. They use the text location strategy to identify potential texts to begin their reading; then, they devote to an extensive meaning-making process. At the same time, they occasionally monitor their reading. Their reading follows this cycle until the end. Thus, this finding is consistent with the argument made in prior research that an ill-structured plan results in the failure of effective use of the text location strategy (Fidel et al., 1999; Schacter et al., 1998), thereby causing disorientation and frustration (Coiro & Dobler, 2007).

Implications

This section addresses the implications of this study. It consists of two parts: implications for practice and implications for research. First, this study provides empirical support of strategy use that can better facilitate students' online reading. Based on the main findings, several tentative implications were drawn for instructors and practitioners.

Implications for Practice

The use of appropriate reading strategies can be an important component in achieving more effective and proficient online reading. Therefore, this study's exploration of strategies which might better facilitate students' online reading comprehension has important implications for teachers.

The first implication that can be drawn from this study is that, although the findings of this study reveal the impact of each strategy on comprehension, as discussed above, successful online reading demands a deliberatively interactive use of the four types of strategies (Cho, 2014; Coiro & Dobler, 2007) and an adjustment of the strategy use patterns according to the reading goals (Zhang & Duke, 2008). Aligned with previous research's finding that strategic readers tend to use a variety of strategies, an emphasis on only one single strategy will not produce successful online reading. Therefore, it is important for teachers to help students develop the awareness of strategy use to facilitate more effective online reading (Endley, 2015; Liaw, 2017). Similarly, the findings of the study also indicate that the self-monitoring strategy plays a crucial role in effective online reading. Consequently, it is suggested that teachers' nurturing of readers' ability to regulate while reading would not only empower their online reading, but also help them develop as more independent readers (Hsieh & Dwyer, 2009).

Additionally, this study revealed that one challenge EFL learners face is to evaluate the online sources. As the Internet presents unbounded information, it is vital that readers develop the ability to assess the relevance, the usefulness, and the credibility of different sources, therefore locating valuable and reliable information to read (Braasch, Rouet, Vibert, & Britt, 2012). However, due to the lack of the knowledge of applying strategies to evaluate, readers rarely consider judging both internal and external features

of texts (Walraven, Brand-Gruwel, & Boshuizen, 2009). Therefore, detailed instructions of how to evaluate the features of the online sources will facilitate readers' acquisition of this ability. A step-by-step guidance and an explicit modeling will not only help develop the readers' source awareness, but also help them better learn applications of this strategy in an online reading context.

Implications for Research

This study adopted the think-aloud method to collect data about Chinese EFL learners' online reading. Verbal reports and protocol analysis have been considered as an effective way to observe people's cognitive process and they have been largely applied to investigate native language learners' reading behavior. However, this method has rarely been used in studies among ESL and EFL populations. Most studies on online reading among these populations rely on a survey method or descriptive qualitative data. The lack of a research foundation on the think-aloud method among the ESL and EFL populations leaves researchers without sufficient guidance. Therefore, one of the significant implications of this study for research is that it informs future research about how to effectively employ the think-aloud method to second or foreign language contexts. This study's practical suggestions to ensure the validity of conducting this method include the means to conduct an effective think-aloud training and the choices of languages used in verbalization.

First, an effective pre-experiment think-aloud training is not only necessary, but also the key point for successful use of this method. In this study, a pre-research questionnaire was administered to gather information on participants' reading experiences. In this questionnaire, two questions were asked regarding participant's comfort with and aptitude for the think-aloud method. The review of the answers showed

that many of the participants had never verbalized their thoughts as they read before. They expressed tremendous concerns regarding this method. Based on the practices in both the pilot study and the present study, two implications are generated regarding the think-aloud training session: 1) It is suggested to use a pre-made video to instruct the participants and model how to verbalize their thinking processes. This method would not only ensure the consistency of the modeling for different participants, but also demonstrate computer screen movement while reading online, thereby providing the participants a holistic view of what they will do in the subsequent data collection process; 2) It is important to choose a different genre of text while modeling, as it prevents the researcher from manipulating participants' actual strategy use. In addition, offering students opportunities to practice this technique after modeling and providing feedback to them makes a valuable addition to a successful think-aloud training.

Second, it is important to provide participants with options to incorporate either the foreign language, or their native language, or both languages during the verbalization process. As discussed in Chapter Two, the pilot study preceding the present study showed that requiring participants to verbalize in only the foreign language greatly increased their cognitive load and ultimately resulted in unproductive verbal reports. Participants were largely distracted by the language barriers they encountered while using a foreign language to express their thoughts as they read. However, giving participants the opportunities to choose the languages they prefer to use largely reduced their struggles, thereby producing effective verbal responses. To sum up, conducting a structured think-aloud training and allowing for flexibility in the language use in verbalization are significant to a successful application of the think-aloud method among the ESL and EFL populations.

Another important implication that this study can contribute to research is the sequential analysis conducted to visualize the strategy use by readers across the whole reading episode. As previous studies are mostly limited to more descriptive qualitative data, the present study addresses this research gap. It introduces another means of higher-order quantitative analysis that focuses on the sequence of the categorical data and visually presents the sequential data. The three sequential analyses conducted in this study provide a holistic view of the whole sequence of the strategy patterns rather than just one element in the sequence. The first two sequential analyses, the modal and transversal analysis, examined two types of sequences of the strategy use patterns. The modal analysis presents the state sequences of the strategy pattern, while the transversal analysis captures the sequences of transversal characteristics. Additionally, another sequential analysis, the cluster analysis, builds the typology of sequences based on the similarity of the patterns. The graphical representations not only directly display how strategy use evolves along the time frame, but also identify the typical sequential patterns. To sum up, the sequential analysis offers another perspective for researchers to seek the successive patterns of online reading strategy use as well as the transitions between certain states and the preceding events that provoke these transitions.

Limitations of the Study

While the unique target population and quantitative approach of this study facilitate a new perspective on the topic of online reading strategies among EFL learners, the study's contributions should be analyzed carefully with consideration for its potential limitations. The first two limitations apply to the accuracy and validity of the data collection and measurement tools employed by the study, and the latter two limitations apply to factors that affect the generalizability of the results.

Verbal Reports

This study applies the think-aloud method, which, while recognized as a comprehensive and reliable way to reveal readers' thinking process and strategy use, demands a high cognitive load. The think-aloud data relies on the participants' ability to be aware of and to accurately express their thoughts. As Chinese EFL learners are generally not familiar with this method, it is possible that the cognitive load of verbalizing while performing a reading task causes exhaustion and inaccurate or incomplete expressions of thoughts. Although a thorough training session was conducted, the think-aloud method may still be overwhelming for some of the participants. In this way, the whole reading process may be disrupted and the data skewed. Also, since the think-aloud process is a metacognitive process, it may increase the mindfulness of the participants during their reading process, thereby leading to artificially better outcomes, different than those that would occur in natural reading settings. Even if the method itself is very sound and accurately reflects the participants' verbalized communication, there is still the potential for results to be skewed due to the social desirability bias. Specifically, readers may be more likely to focus on aspects of the text that they easily comprehend instead of addressing components that confuse or challenge them. Conversely, other readers may exert more effort than they typically would on parts of the text that offer the potential to showcase their use of strategies. Ultimately, while these limiting considerations should be taken into account in evaluating the validity of the measures, it is important to note that such issues are inherent in most if not all similar methods and that the think-aloud method remains that most trusted and holistic option.

Comprehension Measure

Because of the wide range of actions that can be taken from any given starting point online, and the exponentially increasing options that exist at each subsequent step, it is inevitable (and desirable) that different readers will read different texts, despite some limitations in terms of their search options. This complicates the alignment of a comprehension assessment with the varied texts read by all the participants (Coiro, 2009). Although this study used an objective measurement format, and all 20 multiple-choice questions were designed to cover as much as possible of the relevant and significant information, it is still unavoidable that some of the information will be excluded. In addition, even though the influence of prior knowledge on the comprehension measure has been considered during the development of the assessment, the variety of the readers will increase the likelihood that each reader's prior knowledge will to some degree inform his/her answers to certain questions. Thus, as mentioned previously, the infinite nature of the Internet has complicated students' reading attempts, and it has similarly complicated creation of a valid measure, though appropriate steps (discussed in Chapter Three) have been taken to increase the accuracy of the tool.

Reading Materials

Although this study aimed to examine the EFL learners' online reading strategy use, it explored their online reading process only in a relatively closed reading environment. The participants were asked to read in a pre-selected website instead of being allowed to access a completely open online reading environment, which would be more representative of the actual Internet context. Although they were encouraged to use hyperlinks and search functions within this pre-selected website, they were not allowed to use any other search engines to identify more resources. This decision was based on the

limited access to English websites in mainland China as well as the chosen site's appropriate reading level, which matched the proficiency level of the participants. Finally, it was necessary to impose some limitations on the participant's range of access in order to create measures individualized to the available content. Also, since the reading materials were limited to informational text and the goal of the reading task was somewhat specific, the strategies exhibited during this study may not be applied to various other Internet reading contexts with different types of purposes and tasks. Even though this reading environment and task were deemed ideal for this research, the patterns identified in the student may not represent those that would be found in the unbounded context of the Internet and for this reason may not provide a holistic view of the online reading process.

Sampling

The present study used a convenience sample. Although a purposeful sampling method was applied during the sample selection process to restrict the participants to Chinese proficient EFL learners, all the participants were selected from only one university. This limits the generalizability of this study. In addition, this study included 40 participants. Because of the insufficient prior work to support a power analysis, this sample size is considered appropriate and practical to fulfill the purpose of the study. However, as sample size is an important element for a reliable and informative quantitative study, a larger sample size would broaden the range of data, therefore making the data more representative of the particular population.

Recommendations for Future Research

This quantitative study both provides the empirical evidence for the CRRI model (Afflerbach & Cho, 2009; Cho & Afflerbach, 2017) and offers a quantitative validation

of Cho's 2014 work. By targeting an under-studied population, Chinese EFL learners, this study expands our understanding of online strategy use. To better contribute to our knowledge of online reading for this unique population as a whole, this section presents four recommendations for future research.

First, as discussed above in the limitation section, the online reading materials used in this study were limited to a pre-selected website. Although the reading task was designed to encourage the use of hyperlinks and search functions within this website, the strategies demonstrated in this study may not be representative of other unbounded online reading contexts. Thus, future studies could assign readers with different tasks and online reading materials, thereby providing a comprehensive picture of online reading.

Second, this study only investigated the online reading strategies used by proficient college EFL learners. It reveals little about the online reading behavior of non-proficient EFL readers, or EFL learners from a different age group. Therefore, further investigations could target learners from a different age group or proficiency level, then demonstrate the differences of strategy use among these populations.

Third, this study recorded the participant's clicking action and investigated its association with the strategy applied when clicking happened. However, since the clicking action reveals a reader's attempt to look for additional information, identifying the most recently applied strategy preceding the action of clicks would help reflect and determine the reasons of a reader's clicking attempts. Investigating what strategy prompts readers' action of clicking would provide informative evidence of how readers navigate in an online reading environment. Therefore, future studies could identify strategies used before clicks to see whether a specific kind of strategy tends to more likely precede the action of clicks. Future studies could use the Rao-scott chi-square analysis to compare the

strategies adopted at an interval before the clicking action with the overall frequencies of the strategy use across the reading task as a whole.

Lastly, the present study only examines readers' actions based on the four main strategy types proposed in the CRRI model (Afflerbach & Cho, 2009; Cho & Afflerbach, 2017). Although the CRRI model has provided a list of sub-categories to detail the four types of reading strategies, it is the purpose of the present study to adopt a simpler framework that only includes the four main categories. However, a more thorough examination of sub-categories of the four main strategy types would be meaningful in future studies, as the coding of the current data has revealed that readers apply each main strategy type in various ways. For instance, while making meaning of the text, some readers prefer to translate the English text to Chinese to help them better understand the text, while others tend to use different words to paraphrase what they read. Therefore, further investigations could first identify and code the sub-categories of each strategy type—for instance, MM-translation, MM-paraphrasing, etc.—and then examine the relationship among each sub-category to comprehension. This exploration will not only provide empirical evidence of strategies that may not be identified in the CRRI model (Afflerbach & Cho, 2009; Cho & Afflerbach, 2017), but also expand the existing definitions of the strategy categories, especially the ones that are unique to the particular populations of ESL and EFL learners.

Conclusion

Based on the CRRI model (Afflerbach & Cho, 2009; Cho & Afflerbach, 2017), the present study explores the patterns of online reading strategies that proficient, college-level, Chinese EFL learners use while reading online. It also seeks to identify the relations of these patterns to reading comprehension.

In order to fulfill the purposes of the study, multiple approaches were used to collect data. The primary data consist of participants' verbal reports of their thinking processes that occur during online reading and their computer screen moves. Throughout the reading process, participants' online actions and verbalizations of their thinking processes were video-recorded using Camtasia. In addition, participants' comprehension outcomes were collected through completing an objective assessment after the online reading. Protocol analysis was conducted to examine the primary data.

Quantitative analyses were then conducted to answer four research questions. First, the Rao-Scott chi-square analysis showed that there is a significant difference in the four types of strategy use between the Chinese EFL population of the present study and the American adolescents from Cho's (2014) study. Second, another Rao-Scott chi-square analysis suggested that the most frequently used strategy when clicking was text location. Third, the results of the modal and transversal analyses revealed the dominant role of the meaning-making strategy and the supporting role of the self-monitoring and text location strategies. In addition, cluster analysis identified three different groups of readers, which can be related to Cho's (2014) findings. Lastly, the results of a series of regression analyses indicated that the meaning-making and self-monitoring strategies each has a strong effect on the comprehension outcome. Also, the result of the one-way ANOVA suggested that the comprehension outcome was significantly different among all three types of readers.

The discussion of the results presented in this chapter showed that the findings of this study are aligned with the prior work. Furthermore, although there are several limitations due to the exploratory nature of the study, this research has provided implications for both research and practice. The findings of the present study will add to

the digital literacy research base by examining an under-studied population in its unique learning environment, thereby extending our understanding of the online reading process to a different cultural context. Additionally, use of appropriate reading strategies can be an important component in encouraging more effective and proficient online reading. Therefore, this study's exploration of strategies that might better facilitate students' online reading comprehension will have important implications for both teachers and researchers.

APPENDIX A

IRB APPROVAL LETTERS

Appendix A-1 IRB Approval Letter

Institutional Review Board for the Protection of Human Subjects

DATE:	July 27, 2017
TO:	Wen Wu
FROM:	Oakland University IRB
PROJECT TITLE:	Chinese EFL Learners' Use of Online Reading Strategies
REFERENCE #:	1093945-1
SUBMISSION TYPE:	New Project
ACTION:	APPROVED
APPROVAL DATE:	July 26, 2017
EXPIRATION DATE:	July 25, 2018
REVIEW TYPE:	Expedited Review
REVIEW CATEGORY:	Expedited review category # 6 and 7
IRB MEETING DATE:	August 31, 2017

Thank you for your submission of New Project materials for this project. The Oakland University IRB has APPROVED your submission. This approval is based on an appropriate risk/benefit ratio and a project design wherein the risks have been minimized. All research must be conducted in accordance with this approved submission. The submission includes the following approved documents:

- IRB Application
- Consent Form (found under "Board Documents" and stamped with a version date of 7/26/2017. **Please download a copy for your files and use the IRB-approved, date-stamped version in the recruitment and consent of all research participants**.)
- Recruitment Email
- Script for Think Aloud Instruction
- Comprehensive Assessment
- Reading Experience Questionnaire

This submission has received Expedited Review based on the applicable federal regulation.

Please remember that informed consent is a process beginning with a description of the project and assurance of participant understanding followed by a signed consent form. Informed consent must continue throughout the project via a dialogue between the researcher and research participant. Federal regulations require each participant receive a copy of the signed consent document.

Please note that any revision to previously approved materials must be approved by this office prior to initiation. Please use the appropriate revision forms for this procedure. Do not collect data while the revised application is being reviewed. Data collected during this time cannot be used.

All UNANTICIPATED PROBLEMS involving risks to subjects or others (UPIRSOs) and SERIOUS and UNEXPECTED adverse events must be reported promptly to this committee. Please use the appropriate reporting forms for this procedure. All FDA and sponsor reporting requirements should also be followed.

All NON-COMPLIANCE issues or COMPLAINTS regarding this project must be reported promptly to this office.

This project has been determined to be a Minimal Risk project. Based on the risks, this project requires continuing review by this committee on an annual basis. Please use the appropriate forms for this procedure. Your documentation for continuing review must be received with sufficient time for review and continued approval before the expiration date of July 26, 2018.

Please note that all research records must be retained for a minimum of three years after the completion of the project.

Please retain a copy of this correspondence for your record.

If you have any questions, please contact Stephanie Edwards, J.D. at (248) 370-4329 or sedwards@oakland.edu. Please include your project title and reference number in all correspondence with this committee.

This letter has been electronically signed in accordance with all applicable regulations, and a copy is retained within Oakland University IRB's records.

Appendix A-2 IRB Continuing Review Approval Letter

OAKLAND UNIVERSITY

Institutional Review Board for the Protection of Human Subjects

DATE:	June 28, 2018
TO:	Wen Wu
FROM:	Oakland University IRB
PROJECT TITLE:	Chinese EFL Learners' Use of Online Reading Strategies
REFERENCE #:	1093945-2
SUBMISSION TYPE:	Continuing Review/Progress Report
ACTION:	APPROVED
APPROVAL DATE:	June 28, 2018
EXPIRATION DATE:	July 25, 2019
REVIEW TYPE:	Expedited Review
REVIEW CATEGORY:	Expedited review category # 6 and 7
IRB MEETING DATE:	July 26, 2018

Thank you for your submission of Continuing Review/Progress Report materials for this project. The Oakland University IRB has APPROVED your submission. This approval is based on an appropriate risk/ benefit ratio and a project design wherein the risks have been minimized. All research must be conducted in accordance with this approved submission.

The project is closed to recruitment. All participants have completed all research interventions/ interactions and the project remains open for data analysis only.

The continuing review approval begins on the day following the expiration of the current approval period. The new approval period is 7/26/2018 - 7/25/2019.

This submission package includes the following approved document:

- Continuing Review Application

This submission has received Expedited Review based on the applicable federal regulations.

Please note that any revision to previously approved materials must be approved by this committee prior to initiation. Please use the appropriate form(s) for this procedure. Do not collect data while the revisions are being reviewed. Data collected during this time cannot be used.

All UNANTICIPATED PROBLEMS involving risks to subjects or others and SERIOUS and UNEXPECTED adverse events must be reported promptly to this office. Please use the appropriate reporting forms for this procedure. All FDA and sponsor reporting requirements should also be followed.

All NON-COMPLIANCE issues or COMPLAINTS regarding this project must be reported promptly to this office.

This project has been determined to be a Minimal Risk project. Based on the risks, this project requires continuing review by this committee on an annual basis. Please use the appropriate forms for this procedure. Your documentation for continuing review must be received with sufficient time for review and continued approval before the expiration date of July 25, 2019.

Please note that all research records including signed consent forms if applicable must be retained for a minimum of three years after the completion of the project.

Please retain a copy of this correspondence for your records.

If you have any questions, please contact Stephanie Edwards at (248) 370-4329 or sedwards@oakland.edu. Please include your project title and reference number in all correspondence with this committee.

This letter has been electronically signed in accordance with all applicable regulations, and a copy is retained within Oakland University IRB's records.

APPENDIX B

PRE-RESEARCH QUESTIONNAIRE

Pre-research Questionnaire to Gather Information on Participants' Reading Experiences

Code number: _____ Age: _____
Gender:_____ Major:_____

This questionnaire is primarily designed to learn about your reading experiences in both print and Internet contexts. Please circle the most accurate response and fill in information as needed.

Print reading experience: (5 items)

1. Do you like to read print texts in English?
a. Yes b. Sort of c. No
2. On average, how much time do you spend reading English print texts in a week?
a. Less than 1 hour b. Between 1 and 3 hours
c. Between 3 and 5 hours d. More than 5 hours
3. How well do you understand the English texts that you read?
a. Quite well b. Adequately c. Not so well d. Not well at all
4. How well can you evaluate the English texts that you read?
a. Quite well b. Adequately c. Not so well d. Not well at all
5. How often do you use strategies when you read print texts in English?
a. Always b. Sometimes c. Seldom d. Never

Internet reading experience: (5 items)

1. Do you like to read in English on the Internet?
a. Yes b. Sort of c. No
2. On average, how much time do you spend reading in English on the Internet in a week?
a. Less than 1 hour b. Between 1 and 3 hours
c. Between 3 and 5 hours d. More than 5 hours:
3. How well do you understand the English texts that you read on the Internet?
a. Quite well b. Adequately c. Not so well d. Not well at all
4. How well can you evaluate the English texts that you read on the Internet?
a. Quite well b. Adequately c. Not so well d. Not well at all
5. How often do you use strategies when you read in English online?
a. Always b. Sometimes c. Seldom d. Never

Study-related inquiry: (2 items)

1. Do you ever verbalize your thoughts as you read?
a. Yes b. No
2. How comfortable would you be verbalizing your thoughts as you read text online?
a. Very comfortable b. Mostly comfortable
c. Not comfortable d. Very uncomfortable

Modified after Coiro & Dobler (2007) and Cho (2011).

APPENDIX C

PRE-RESEARCH QUESTIONNAIRE SCORING SYSTEM

Pre-research Questionnaire Scoring System

Print reading experience: (5 items)

1. Do you like to read print texts in English?

a. Yes (**3 points)** b. Sort of (**2 points)** c. No (**1 point)**

2. On average, how much time do you spend reading English print texts in a week?

a. Less than 1 hour (**1 point)** b. Between 1 and 3 hours (**2 points)**

c. Between 3 and 5 hours (**3 points)** d. More than 5 hours (**4 points)**

3. How well do you understand the English texts that you read?

a. Quite well (**4 points)** b. Adequately (**3 points)**

c. Not so well (**2 points)** d. Not well at all (**1 point)**

4. How well can you evaluate the English texts that you read?

a. Quite well (**4 points)** b. Adequately (**3 points)**

c. Not so well (**2 points)** d. Not well at all (**1 point)**

5. How often do you use strategies when you read print texts in English?

a. Always (**4 points)** b. Sometimes (**3 points)**

c. Seldom (**2 points)** d. Never (**1 point)**

Internet reading experience: (5 items)

1. Do you like to read in English on the Internet?

a. Yes (**3 points)** b. Sort of (**2 points)** c. No (**1 point)**

2. On average, how much time do you spend reading in English on the Internet in a week?

a. Less than 1 hour (**1 point)** b. Between 1 and 3 hours (**2 points)**

c. Between 3 and 5 hours (**3 points)** d. More than 5 hours (**4 points)**

3. How well do you understand the English texts that you read on the Internet?

a. Quite well (**4 points)** b. Adequately (**3 points)**

c. Not so well (**2 points)** d. Not well at all (**1 point)**

4. How well can you evaluate the English texts that you read on the Internet?

a. Quite well (**4 points)** b. Adequately (**3 points)**

c. Not so well (**2 points)** d. Not well at all (**1 point)**

5. How often do you use strategies when you read in English online?

a. Always (**4 points)** b. Sometimes (**3 points)**

c. Seldom (**2 points)** d. Never (**1 point)**

Study-related inquiry: (2 items)

1. Do you ever verbalize your thoughts as you read?

a. Yes **(2 points)** b. No **(1 point)**

2. How comfortable would you be verbalizing your thoughts as you read text online?

a. Very comfortable (**4 points)** b. Mostly comfortable(**3 points)**

c. Not comfortable (**2 points)** d. Very uncomfortable (**1 point)**

APPENDIX D

THINK-ALOUD INSTRUCTION

Thank you for participating in this study. The purpose of this study is for me to better understand how you read online text. In order to know what you are thinking while reading, we are going to use a method called “think-aloud.” Basically, it means that you describe, in spoken words, the things you are doing and thinking as you read through the text. Your verbalization can be anything that comes to mind as you read the information.

Here is an example of think-aloud.

[OK, I am at the opening page of the story.] 10veOne by Judy Malley [I am looking at the title of this story. 10veOne. I don’t understand what it means right now. Oh, it should be LOVE. I know sometimes authors like to play with the letters to convey extra meaning. I am guessing this would be a story about love, but I think I need to read on to see if my guess is right. It seems there are lots of different kinds of links available. And I am gonna choose something. Um, I guess this image kind of captured my eyes. I guess this is probably a photo of the author. Let me read the text below.] The pagescreens of Gweneth's diary are like thin cathode ray tubes. [I have no idea what the words “cathode ray tubes” mean because I never see this word “cathode,” but the comparison of a diary to ray tubes makes me wonder about the connection between them.] The book grows warm in your hands. Text flickers on the pagescreen, and you read these words. [Well, this link looks like a logical starting place, so I am gonna click it to see what I can find.] It doesn't seem so long ago/that I was walking the streets of Washington, DC wearing white gloves/those strange cotton hand coverings/were what the natives were wearing/even though it was August, /and sweat soaked the armpits/of my short black linen dress as I stood at the bus stop/clutching an envelope of laboriously hand typed resumes. [Well, it sounds like a memory from the past. The description is vivid and helps me visualize a picture of a person wearing a pair of white gloves on a hot summer day and waiting for a bus. Since the author mentioned hand typed resumes, this makes me think of old-fashioned typewriters. Well, it seems there are a couple of different links here. Let me see where these links would bring me to.] It doesn't seem so long ago/that I was riding a three-speed bicycle/from Furth to Nurnberg [Well, the first red line seems to bring readers to the next section of the story. Let me read the whole section.] It doesn't seem so long ago/that I was riding a three-speed bicycle/from Furth to Nurnberg/on that road that is riddled with slippery trolley tracks/when it began to rain. /I was wearing a wool suit/ that my grandmother had bought me at Peck and Peck in Boston. /It was the only appropriate thing/ that I could think of to wear to a job interview/although at the time when I tried it on/ (while my grandmother waited outside the dressing booth/exuding French perfume), /I had no intention of ever wearing it. [Well, now the author introduces another character, the grandma. And obviously, the main character is looking for jobs. I am just wondering why she wore winter clothes in summer. This doesn’t make much sense to me. Also, there are a couple of new words to me, such as trolley, but I guess it’s a kind of transportation that needs tracks to make it go. Maybe something like train? Oh, it seems there is no way for me to go back to the section I just read. Oh, probably I can use the back button. Yeah, it works. Now let me go back to the section I just read. Let me see where the second red line would bring me to.] It doesn't seem so very long ago that I was sitting on the grass/that surrounded the Washington

Monument. On a warm humid Fourth of July night, /I was wearing a sleeveless white dress/waiting in a crowd of indistinguishable faces/for the fireworks to begin. /A man whose face was vaguely familiar sat down beside me. [Oh, that's a different section. This reminds me of the fourth of July night in 2009 when I was in Washington DC, watching the fireworks at Washington Monument. Till now I thought what I read about were all different memories from the past, but I couldn't find the strong logic among these sections. I am a little confused now and I don't understand how these sections are connected with the title. I didn't find much about loving someone. Let me click the home button. Yes, this takes me back to the main page, so I know I can always back here through the home button. Now I think I am gonna read the whole story without using the links, to see whether it makes sense to me. I hope I can find the logic of the whole story here.]

Well, after watching the short video demo of think-aloud. Do you have any questions about how to complete your own think-aloud process?

OK, now its' your turn to try it out. Please read each sentence aloud and then try to verbalize what you are thinking after each sentence.

Well, you did a great job on thinking your thoughts aloud. Now, do you still have any questions about using this method?

APPENDIX E

MATERIALS FOR THINK-ALOUD PRACTICE

Fast Food and Health

How is fast food marketed to youth?

Nadine Burke: Fast food has a tremendous effect on our youth in ways that many of us don't realize. High-sugar, high-fat food is marketed to kids on the go, and much of it is advertised to them on their way home from school. It's tragic that the industry is able to market these foods to our kids, when you consider their long-term health effects, such as high blood pressure, heart disease, and diabetes.

Nowadays, kids are becoming smarter, but it seems like a lot of companies take advantage of the fact that kids don't always think through what they're eating. The fast food industry makes money on foods that have little nutritional benefit, and our kids often end up with a lifetime of disease.

How does fast food affect the growth and development of children?

Nadine Burke: A lot of fast food is high in sugar and fat. These types of foods stimulate the reward center of the brain, the same part of the brain that's stimulated by cocaine, heroin, and other addictive drugs. Foods that are high in sugar and fat are, in many ways, addictive. When kids become accustomed to eating these foods, they want more. We see kids developing problems like diabetes, high blood pressure, and high cholesterol. You think that a 32-ounce soda is not that big of a big deal, but it can lead to serious long-term health problems.

What makes me nervous is, you have all these kids who developed diabetes when they were fifteen, and now they're forty and they can't work anymore. Not only does this have huge health implications, it has huge economic implications, in terms of our ability to be competitive as a nation in the future.

Taken from *Fast food and health*. (n.d.). Retrieved from http://www.nourishlife.org/2011/03/fast -food-and-health/

APPENDIX F

READING TASK

Reading Task

Now you are going to read from the *Simple English Wikipedia* website to strengthen and further your understanding of the topics of global warming and climate change. You are encouraged to use the links to clarify any points of confusion and should also use them to expand your reading to related subjects. You may stay on any given page for as much or as little time as you decide based on how relevant and useful you find the text to be.

While you are reading, please tell me what you are thinking and doing as you look for information and make meaning from the text. You should make comments whenever you wish, but try to comment on each sentence or diagram that you see. To help you think aloud, I will regularly ask you, "What are you thinking?" or encourage you to "Please try to keep talking."

At the end of the reading, you will be asked to answer 20 multiple-choice comprehension questions which evaluate your foundational knowledge on the topics, your ability to make connections and inferences and see patterns, and your understanding of key terms and concepts.

APPENDIX G

COMPREHENSION ASSESSMENT

Code number: _____ Age: _____
Gender:_____ Major:_____

Since you have now finished reading the texts, I want to know what you have learned about the topics. Please read the following 20 multiple-choice questions carefully and choose the ONE best answer for each. I appreciate your time and effort.

1. Which of the following statements is true regarding the Kyoto Protocol?
   A. The Kyoto Protocol was created by Japanese Government.
   B. One of the goals of the Kyoto Protocol is to create jobs.
   C. So far, not many governments have agreed to the Kyoto Protocol.
   D. One of the Kyoto Protocol's regulations is to reduce carbon dioxide emissions.

2. Ice ages resulted from _____.
   A. the greenhouse effect
   B. global warming
   C. climate change
   D. None of the above

3. What is the length of the sunspot cycle?
   A. One day
   B. 11 years
   C. 100 years
   D. 1,000 years

4. Which of the following is a purpose of Earth Hour?
   A. To significantly reduce the earth temperature
   B. To help people learn about behaviors that will reduce global warming
   C. To save money on the electricity
   D. To influence other countries' pricing of electric energy

5. What is a natural source of dust?
   A. Volcanos
   B. Erosion
   C. Meteoric dust
   D. All of the above

6. Which of the following statements is NOT true about measurement of Earth's temperature?
   A. People use proxy measurements to estimate temperatures during time periods before thermometers existed
   B. Major changes in Earth's temperature have been common over the past 2000 years.
   C. Measurements have indicated both minor increases and minor decreases in temperature during certain periods

D. The Earth's temperature can be measured using satellites

7. What are the three most important fossil fuels?
   A. Coal, petroleum, carbon
   B. Coal, petroleum, natural gas
   C. Petroleum, natural gas, charcoal
   D. Coal, natural gas, metal

8. What is the relationship between climate change and global warming?
   A. Global warming refers to human-caused changes while climate change refers to only natural changes.
   B. Climate change is a type of global warming.
   C. Global warming is a type of climate change.
   D. Both climate change and global warming began recently.

9. Which of the following is a cause of climate change?
   A. Variations in sunlight intensity
   B. Extreme weather
   C. Shortage of fossil fuels
   D. Increased earthquake activities

10. The term "climate change" refers to _____.
   A. short-term differences in the Earth's climate
   B. significant changes in typical weather over a long period of time
   C. global differences in the Earth's climate
   D. regional differences in the Earth's climate

11. Which of the following statements is true regarding fossil fuels?
   A. Fossil fuels are produced in factories.
   B. Fossil fuels are important to transportation.
   C. There are no current replacements for fossil fuels.
   D. Fossil fuels are renewable resources.

12. Greenhouse gases make the atmosphere warmer because they _____.
   A. produce heat
   B. keep heat close to Earth
   C. evaporate heat
   D. destroy heat

13. Which is an effect of global warming?
   A. Deforestation
   B. Flooding in coastal cities
   C. Expanding glaciers
   D. Greenhouse gases

14. What is the relationship between deforestation and global warming?
   A. Global warming causes deforestation.

B. Deforestation causes global warming.
C. They are not related.
D. Both deforestation and global warming are caused by climate change.

15. Which of the following is a function of forests?
A. Allow for soil erosion
B. Absorb oxygen
C. Produce soil
D. Generate carbon dioxide

16. Which of the following gases are mainly responsible for the greenhouse effect?
A. Nitrogen and hydrogen
B. Water vapor and carbon dioxide
C. Ozone and oxygen
D. Oxygen and nitrogen

17. Which are causes of global warming?
A. Greenhouse gases, fossil fuels, deforestation
B. Deforestation, extreme weather patterns
C. Greenhouse gasses, fossil fuels, earth's rotation around the sun
D. Loss of animal habitats, flooding

18. Which is a source of greenhouse gases?
A. Farmed animals
B. Deforestation
C. Trees
D. Solar power

19. The term "global warming" refers to _____.
A. an unpredictable and short-term increase in the Earth's temperature
B. the opposite of the greenhouse effect
C. the gradual rise in temperature due to the greenhouse effect
D. a cause of climate change

20. If the Earth had no greenhouse effect, it would be _____.
A. completely covered with water
B. colder
C. hotter
D. the same as it is now

APPENDIX H

PARTICIPANTS' MAJORS

Participants' Majors

Major	Number of participants	Percentage
Accounting	1	2.5
Agriculture	1	2.5
Biotechnology	1	2.5
Chinese	3	7.5
Computer science	1	2.5
Economics	1	2.5
Electrical engineering	8	20
Environmental engineering	1	2.5
Finance	2	5
Financial management	2	5
Food science	3	7.5
History	1	2.5
Industrial design	2	5.0
Law	2	5
Materials engineering	1	2.5
New energy	1	2.5
Pharmacy	2	5
Environmental protection	1	2.5
Political science	3	7.5
Public administration	3	7.5
Total	40	100.0

APPENDIX I

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Dear Wen Wu on Behalf of Oakland University,

Material requested: Adaptation of Table in
Byeong-Young Cho (2014)
Competent Adolescent Readers' Use of Internet Reading Strategies: A Think-Aloud Study
***Cognition and Instruction*, 32 (3): 253-289.**
DOI: 10.1080/07370008.2014.918133

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