

**A comparison of the use of strategies in reading electronic and printed text by Chinese
adult ESL learners**

by

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ABSTRACT

This study investigates whether Chinese adult ESL learners use the same reading strategies online as they do in traditional print.

Three Chinese-speaking graduate students at Iowa State University participated in this study. To best elicit information regarding subjects' thought processes and their use of reading strategies, several methods were used, including think-aloud protocols, Morae software, and a follow-up interview. During the think-aloud process, subjects were assigned two reading tasks. One process involved reading in traditional print, and in the other process, participants read in hypertext. Each text format consisted of three passages. Each subject had the option of choosing two passages in either text. To ensure that the data was interpreted accurately, each oral report was conducted in two forms: concurrent and retrospective. The entire process was recorded using Morae software, which allowed the investigator to review subjects' behaviors easily and thus further clarify questions regarding behaviors observed that were not fully understood during the interview.

The results suggest that there is little variation in the use of strategies between the two contexts. Only the strategy of inferencing was found to be more closely related to hypertext. Moreover, evidence suggests that variation in the use of strategies within this study was influenced more by learner-dependent factors rather than the media of the text.

CHAPTER I: INTRODUCTION

Background

Reading is one of the fundamental skills in language learning. For many ESL learners, reading proficiency is considered to be a key component to achieving success in language learning. Along with the rapid development of technology and the use of the Internet, ESL learners face more challenges than ever before. Many traditional reading materials, for instance, are now presented in a digital format, and some electronic texts, particularly hypertext contain additional multimedia features such as audio, video, and animation. As a result, the reading context in many second language classes has shifted rapidly from traditional print to a non-linear electronic context. Although this shift has been advantageous for many ESL learners, these changes have also created numerous challenges for ESL readers; for instance, electronic texts often do not have the capability that allows readers to take notes while reading.

The infusion of technology plays an increasingly important role in second language learning. Online reading particularly serves as a major source of input for the majority of adult second language readers (Anderson, 2003). The increased use of computers and the Internet, therefore, implies the need to insure that ESL readers will be able to make appropriate adjustments; that is, to make a smooth transition from printed text to electronic text. A critical question, therefore, is raised: Does reading in a digital environment change readers' behaviors, in comparison to their behaviors while reading printed text? More specifically, does reading in a digital environment change an individual's use of reading strategies? Or will ESL readers, therefore, transfer their L1 reading strategies to compensate

their under-developed L2 reading ability when reading in electronic context?

Coiro (2003) indicates that hypertexts provide strong support such as the visual presentation and the nonlinear relationship (readers have the choice of completing the reading task in any order), yet bring new challenges which have a great impact on L2 reading. For instance, strategic reading plays an important role in traditional second language reading. Many research studies have indicated that proficient readers use a wide variety of reading strategies to aid comprehension. Examples in Hosenfeld's study (1997) show that good readers used the following strategies: 1) they read a chunk of information at once rather than a single word or short phrases; 2) they select and read information that is relevant to their reading goals; in other words, they disregard unnecessary information or words during reading; 3) they integrate information read and use prior knowledge to aid comprehension. Black (1986) also compared the use of strategies between good and poor readers. He concluded that good readers process text beyond the author's vision. That is, good readers evaluate and reflect on what they have read and relate the text to their own experiences. In contrast, poor readers draw conclusions based upon the author's ideas and views from the text but engage in minimal amounts of reflection.

In addition to L1 strategy transfer, some researchers (Alderson 1984; Taillefer, 1996) claim that L2 reading is closely related to L1 reading ability. That is, L1 reading strategies can be transferred to L2 reading and can compensate for less developed L2 reading skills to assist reading comprehension. Alderson (1984) compared the reading universals hypothesis (reading is reading) with the notion that L2 readers compensate transferring reading skills from L1. This comparison was used to address the issue of whether "L2 reading is more a reading problem or a language problem" (Taillefer, 1996, p. 461). The results suggest that it

is both, but for lower level readers, it is more a language problem, which is evident in that L2 language proficiency accounts for a larger proportion of the variance in L2 reading ability than does L1 reading ability (Carrell, 1991; Taillefer, 1996).

In the case of reading in English versus in Chinese, the extension with respect to strategy transfer may be limited due to the variation between the two languages. It is clear that these two languages differ in various ways particularly their orthographic differences as well as phonological access (Lepore, 2003). “Chinese characters have been referred to as ideograms, symbols, and icons;” whereas English relies on a phonetic system (Lepore, 2003). This, therefore, leads to processing differences when reading in the two languages. For instance, due to the orthographic differences, Chinese ESL readers tend to process words by their visual ability before applying phonology (Ho and Bryant, 1997).

Regardless of first languages, research reinforces the importance of the use of reading strategies in conventional second language reading. However, little research exists that extends this concept of strategic reading to the electronic context. Instead, many people assume that all strategies used in traditional reading can be simply transferred to reading hypertext without much difficulty. However, it is important to remember that these viewpoints lack data to support them. Moreover, with little doubt, “we cannot assume a simple transfer of L2 reading skills and strategies from the hardcopy environment to the online” (Anderson 2003, p. 5). Rather “the reading community needs to play a central role in the conversation of new literacies which include the skills, strategies and insights necessary to successfully exploit the rapidly changing information and communication technologies that continuously emerge in our world;” however, such “role has yet to be filled adequately” (Leu, 2002, p. 311). Our work now is to concentrate on whether technology is changing ESL

readers' behaviors from traditional reading to online reading, and further provides insights of second language reading in new forms of literacy development.

The Current study

My interest in the use of reading strategies in different contexts stems from my personal struggle with online reading. As a second language reader, I have experienced frustrating moments when shifting reading context from traditional print to electronic text (e.g., not knowing how to take notes while reading electronic text or being unable to highlight or underline key concepts, etc). Strategies used in assisting comprehension in traditional print seem to be inadequate in the electronic context. Therefore, I have become interested in acquiring a deeper understanding of the differences between the use of reading strategies in traditional print and electronic text.

In this study, I set out to investigate the use of strategies elicited from two reading contexts. Specifically, I am interested in whether Chinese adult ESL learners vary in their use of strategies in different reading contexts: electronic text and traditional print (e.g., books, magazines, and newspapers), and under what circumstances, individuals might vary in their use of strategies. Thus, this study focuses on the use of information processing and strategies that the participants used to solve the problems they encountered in different reading environments.

The purpose of this study was to gain a better understanding of individual differences in the use of reading strategies between two contexts through the use of think-aloud protocols. Two reading tasks were used in this study. Each task was used to retrieve individuals' thought processes and their use of strategies in one particular reading context. After completing the

two reading tasks, subjects were asked to complete a written summary. The two tasks differed primarily in their text formats, and the subject's preference and reactions to a particular context were examined. My ultimate goal for this study was to acquire data regarding second language reading practices that will assist other researchers in further exploring second language reading strategies. With this in mind, I set out to identify differences between hypertext and traditional print and to investigate strategies that would continuously promote success in second language reading.

Overview of the remaining chapters

Chapter two

This chapter presents different issues that relate to second language reading, particularly the use of reading strategies.

In the first section, I review literature that explores how technology has changed the way people read (Anderson, 2003). More specifically, the literature emphasizes that the rapid development of technology provides additional supports as well as challenges to second language readers. The new literacy, therefore, expects readers to be familiar with traditional print; for instance, experience from reading academic texts, newspapers, magazine, and so forth to be able to adapt to this new way of reading by compensating the differences found in electronic context; for instance, using resources and techniques, such as reading strategies to aid reading comprehension. The first section also provides a definition of hypertext and a detailed explanation of the differences between hypertext and traditional print.

The second section focuses on reading strategies classification (O'Malley & Chamot, 1985; and O'Malley et al, 1990), particularly in two categories: metacognitive and cognitive

strategies. Research studies of reading strategies used in different contexts are also reviewed and presented later in this section.

The final section provides an overview of the think aloud protocols (Ericsson and Simon, 1993), including the types of think-aloud instruction (i.e., types of oral reports and reminders), the two forms of verbal reports (concurrent and retrospective), and the use of think-aloud protocols in second language reading (Pressley & Afflerbach, 1995).

Chapter three

This chapter provides a detailed description of each method used in this study, including the background questionnaire, think-aloud protocols, Morae software, a written summary task, and a follow-up interview. Moreover, it details the procedure for data collection including the selection of participants, the pilot project, and the instruments used within this study, such as the TOEFL reading test and the two reading tasks. Finally, in the last section, the analysis of the research data from each data collection is presented.

Chapter four

This chapter is divided into two major sections. In the first section, I explore the methodology findings, particularly the effects of each method used in this study and other related issues such as the think-aloud training, topic familiarity, the use of resources, the use of Morae software, and language effects. In the second section, I present all of the research data, the analysis, and research findings. The results suggest that individuals did vary in their use of strategies regardless of the text formats. The difference in the two text formats did not elicit substantial differences on the use of strategies with the exception of inferencing, which

was associated primarily with electronic text. In addition, it was found that subjects spent more time in reading electronic text than printed text. Furthermore, more reported strategies did not relate to higher performance.

Chapter five

In this chapter, I present a summary of this study, key results, the methodological implications (i.e., text selection and time limit), pedagogical applications, and recommendations for future research.

CHATER II: LITERATURE REVIEW

Introduction

The purpose of the study was to investigate differences, using think-aloud protocols, in the use of reading strategies between traditional print and electronic text. In particular, the following three areas are central to understanding the second language reading process: the impact of technology in second language reading, research in second language reading strategies, and the use of think-aloud protocols.

In the first section, I discuss the impact of technology that has been brought into second language reading. Because of the rapid development of new technologies, the traditional definition of literacy becomes incomplete. As a result, the challenges that result from switching from a traditional reading context to a digitalized context suggest that proper transitions should be built along this progression so that second language readers will not be overwhelmed by the new challenges that arise; more specifically, educational pedagogical advancements should strive to build on students' existing knowledge in respect to their use of strategies in traditional reading and develop new techniques or skills based on students' prior reading strategies to assist students' reading comprehension in the digital world. For instance, teachers can provide students with opportunities to read electronic text in order to increase learners' familiarity, thus assist them in adapting strategies that will maximize their degree of success in reading within an electronic context.

In the second section, I review research in reading strategies. There has been a long history of research in second language reading strategies focusing on the strategies used when reading traditional print. However, research on reading strategies used in electronic

contexts is still in its infancy. In this section, a working definition of reading strategies will first be provided, followed by a review of literature on the use of strategies in both a conventional and an electronic reading environment.

In the final section, I discuss research on theoretical and practical aspects of verbal protocol analysis, including a review of the procedure of how to conduct a think-aloud study including the use of introspective and retrospective reports.

Impact of technology on second language reading

Many studies report that the rapid development of new technologies has changed the nature of literacy (Anderson, 2003; Coiro, 2003; diSessa, 2000; Konishi, 2003; Leu 1997; Leu 2002; Leu & Kinzer, 2000). It is suggested that the definition of traditional literacy needs to be updated (The International Reading Association, 2001). According to Leu (1997), we are now experiencing “a historical change in the nature of literacy and learning as digital, multimedia resources enter our world” (p. 162). As a result, new technologies have redefined teachers’ roles and forced us to expand our understanding of literacy by considering new aspects of comprehension that are not merely related to conventional reading but also online reading (Leu, 1997; Corio, 2003). Leu (1997) further points out that the hypertext environment will only expand rather than replace the role of the teacher in improving students’ learning experiences, and focuses on four major changes needing immediate attention in order to maximize students’ literacy development. First, the new literacy implies an impending need for the creation of new strategies, particularly navigating strategies. The Internet stores enormous amounts of information resources, and it contains a variety of communication strategies, which readers are required to learn how to use efficiently. Second,

“being literate [in the digital world] is quickly changing from an end state to a developmental process” (Leu, 1997, p. 65). As a result, educators must devise new ways to assist learners in acquiring strategic knowledge as well as knowledge that readers of conventional reading have not yet completely acquired. Third, new ways of critical thinking and reasoning need to be introduced to readers of electronic text. Information presented on web pages is often created by people who share different political, cultural and religious backgrounds; therefore, readers need to develop the required skills that will enable them to evaluate the information they access on the web. Finally, information resources stored on the web often connect additional features such as video, audio, and animation, which involve a wider range of information that is not currently present in traditional paper-based text.

Because being literate in the digital world implies continuously updating our skills in order to communicate within the electronic world, Researchers (Anderson, 2003; Coiro, 2003; Leu, 1997), therefore, suggest that literacy acquisition is a lifelong endeavor since literacy is applicable to a variety of domains.

One may conclude that electronic text provides great support as well as creates challenges that can have a great impact on an individual’s reading ability. Coiro (2003) suggests that “proficiency in the new literacy of the Internet will become essential to our students’ literacy future” (p. 1). Thus, our response to the change of literacy will be the key to success in second language reading.

2.1. 1. What is electronic text?

Electronic text contains various forms. Hypertext is one of the most commonly used forms for web reading. Behrens et al (2000) defines hypertext as similar to traditional text

which “can be stored, read, searched, or edited, with an important exception: Hypertext contains connections within the text to other documents or links and allows for non-sequential reading and writing of documents by using embedded links to jump from one place in the document to another” (Behrens, Johnson, MacDonald & Mathezer, 2000). In hypertext, readers do not follow “a predefined sequence of text, pictures and graphics” when reading electronic text, but “have the freedom to progress through a text and choose their own order of viewing or reading linked nodes” (Chun, 2001, p. 369). This is supported by Coiro’s (2003), who states that “hypertexts are typically nonlinear, interactive and inclusive of multiple media forms;” and “each of these characteristics affords new opportunities while also presenting a range of challenges that requires new thought processes for making meaning; moreover, it requires different types of comprehension processes and a different set of instructional strategies” (p. 2).

Information stored in hypertext is often sorted into a “semantic net” (Rada, 1989, p. 237). Within this network, readers browse and search information through links embedded within the text (Niederhauser, Reynolds, Salmen, and Skolmoski, 2000). Responsibility given to readers in the electronic environment thus becomes different from traditional paper-based text. That is, readers in an electronic context will have to decide what to read and what sequence of reading they will follow.

Currently, the World Wide Web (WWW) is the most popular and common type of hypertext that is used in a variety of domains, including education and linguistics (Spires, and Estes, 2000). In particular, the Internet provides opportunities for conventional readers to gain new reading experience with respect to the new text format, reading purposes, and ways to interact with enormous online resources (International Reading Association 2001).

2.1.2. Differences between traditional print vs. electronic text

Reading on paper doesn't seem to be the same as reading on a computer screen (Ridder, 2000). According to Spires and Estes (2002), there are four major differences between hypertext and traditional print: "textual boundaries", "mobility, navigation" and linearity (p.116). Unlike printed text, readers can see less text from a computer monitor at once; moreover, hypertext cannot be easily moved from one "physical location to the other," but it allows "multiple [reading] paths through a body of text" (Spire and Estes, 2002, p.116). Hypertext offers opportunities for readers to have multiple navigating options. It also affords readers the authority to construct meanings on their own. Readers of hypertext no longer follow the sequential order predetermined by the authors such as topic selection, logics, etc. Instead, readers of hypertext now can co-construct text and make a variety of decisions while interacting with the text. For instance, they can freely record, delete, supplement, or ignore different parts of the text; thus providing a new prospective for the reader (Spire and Estes, 2002). While hypertext has the power to more actively involve readers in the process of reading, it simultaneously has the ability to take away authority given to the author (Spire and Estes, 2002). However, such power is not without its concerns. Readers who have little experience in reading hypertext can become overwhelmingly challenged or confused.

Numerous factors exist that directly impact hypertext literacy acquisition. The uniqueness of nonlinearity in hypertext has been addressed in many studies (Chou, 2001; Coiro, 2003; Konishi, 2003). Rouet and Levonen (1996) review studies using online resources to aid reading comprehension. The results suggest that most readers of hypertext can benefit from its non-linearity. For instance, readers can access additional information that is embedded within the text while traditional paper-based text can only present limited

information. Moreover, web reading promotes critical thinking skills because readers must evaluate the information they access and determine what material to read and where to locate additional information. Ayersman and von Minden's (1995) further supports that "hypermedia facilitates [cognitive] flexibility because it allows topics to be explored in more than one way, by using numerous concepts and contexts to depict the information; in addition, these multiple paths are one solution to addressing learning style differences" (p. 380). As a result, one of the primary advantages of the non-linearity layout of hypermedia is that it enables users to access data according to their own agendas and purposes.

2.1.3 L2 Web reading

Web reading, however, is not without perils, especially for ESL learners. According to Dillon and Gabbard (1998), "no evidence was found in Web reading for the purpose of increasing learners' comprehension" (p. 334). That is, web reading does not facilitate ESL learners' reading comprehension, even with multimedia features that aim to provide additional resources for web readers. Moreover, recent studies on L2 reading emphasize the interactive model viewed as a combination of both high level (i.e., the use of various strategies and metacognitive knowledge) and low level processes such as word knowledge, decoding at sentence level (Grabe, 1991). This model provides readers with a wide range of reading strategies. Ganderton (1998) claimed that, "higher level processes only apply to a portion of the text located on a particular Web page, as the rest of the site isn't visible without physically linking to it" (pp. 1-2). Moreover, evidence was found from his study that second language readers often have difficulty in locating or evaluating the embedded links which contain additional information such as definitions of unknown words or syntactic knowledge

that learners need in assisting their comprehension. Even if a user clicks on those links, it does not guarantee that the individual knowingly clicked on the link in order to obtain information since the links are often physically emphasized through the means of underlining or highlighting and thus may cause a user to click on the link oblivious to the link's purpose. Thus, it brings up a critical issue that L2 learners often read without direction because they do not have much experience reading hypertext. In addition, prior research supports the claim that higher level thinking requires one to use sequential/linear order thinking processes which are only required when reading traditional print; In contrast, nonlinearity, is mainly supported by computer-based hypertext (Kaplan, 1995; Slatin, 1990; Tuman, 1992). This is to say, choices of embedded links and alternative reading paths "the range of choices, links, starting points, and navigation paths offered by hypertext can very easily make one lost in the new reading environment.

In spite of the technological advancements available in hypertext that may support second language reading, "new is not always better when comparing the Web with older technologies such as print" (Ganderton, 1998, p. 12). In contrast, the effectiveness of reading depends on individual learning styles and the knowledge and experiences they bring to the text (Mayer, 1997).

2.1.4. Summary

The infusion of new technologies has forced us to expand our understanding of new literacy. Such changes produce both advantages as well as challenges to readers of traditional print. The uniqueness of nonlinearity opens up an enormous digital world that stores information of all kinds. A reader familiar only with traditional print may become lost in such

a context since the individual lacks experience navigating informational resources in an electronic environment.

Having a profound impact on literacy acquisition, new technologies have challenged society to modify its thinking regarding the use of critical thinking and other pedagogical practices within educational systems (Sutherland-Smith, 2002). Individuals who cannot keep up with the speed of continuous updated technologies will soon be left behind (Leu, 1997).

Research on second language reading strategies

There has been a long history of second language research in investigating the process of using strategies in second language acquisition (Cohen & Apeh 1981; O'Malley, Chamot, Stewner-Manzanares, Kupper, and Russo 1985; Rubin 1975). With no doubt, strategies are extremely important for ESL learners because they can improve reading comprehension as well as strengthen readers' confidence (Oxford.1990). Research on reading strategies does not merely explore how readers interact with text, but also how they apply strategies to aid reading comprehension (Carrell et al, 1998). That is, interest in second language strategies has focused on a learner's cognitive "process by which learning or acquisition occurs" (Oxford, 1990, p. 5).

2.2.1 Strategy classification

The term, strategy, has been broadly used in second language learning research (Cohen, 1998; O'Malley et al, 1985; O'Malley and Chamot, 1990). Cohen (1996) states that

Second language learning strategies encompass both second language learning and second language use strategies. Taken together, they constitute the steps or actions selected by learners either to improve the learning of a second language, the use of it, or

both. What makes the definition for language learning and language use strategies is that it encompasses those actions that are clearly aimed at language learning, as well as those that may well lead to learning but which do not ostensibly have learning as their primary goal. Whereas language learning strategies have an explicit goal of assisting learners in improving their knowledge in a target language, language use strategies focus primarily on employing the language that learners have in their current interlanguage (p. 2).

While Cohen (1996) provides a broad definition of second language learning strategies, Carrell et al (1998) pays particular attention to second language reading. Carrell et al (1998) defines the term, *strategies*, as requiring readers' engagement in order to improve their reading ability; moreover, she points out that "the relationships between strategies and comprehension are not simple and straightforward; use of certain reading strategies does not always lead to successful reading comprehension, while use of other strategies does not always result in unsuccessful reading comprehension" (p. 99). In other words, success of second language learning is not just choosing the correct strategy to apply, but of knowing how to use it successfully (Anderson 1991).

According to O'Malley et al (1990), reading strategies can be divided into two major categories: metacognitive and cognitive strategies. More specifically, metacognitive strategies (i.e., monitoring, evaluating, selective attention, etc.) can be applied to a variety of learning tasks. They "involve both knowledge about learning (metacognitive knowledge) and control or regulation over learning (metacognitive strategies)" (O'Malley and Chamot, 1990, p. 105). "Students without metacognitive approaches are essentially learners without direction and ability to review their progress, accomplishments, and future learning directions" (O'Malley, Chamot, Stewner-Manzanares, Kupper, and Russo, 1985, p. 24).

On the other hand, cognitive strategies (i.e., repetition, translation, inferencing, note-taking and so on) are often more specific to particular types of tasks. (O'Malley,

Chamot, Stewner-Manzanares, Kupper, and Russo1985). They are “a varied lot, ranging from repeating to analyzing expressions to summarizing” (Oxford, 1990, p. 43). A detailed description including the use of both metacognitive and cognitive strategies as well as examples will be presented later in this study.

2.2.2 Research on learner strategies in Hypermedia environment

Electronic text such as hypertext contains multimedia features such as links, graphics, icons; therefore, additional strategies need to be introduced because web readers do not merely make meanings through the text but also locate the information within the text. (Schmar-Dobler, 2003).

One study comparing twelve students reading in hypermedia and non-hypermedia environment suggests that there is a variation of the use of strategies while working in different reading contexts (Windeatt, 1986).

More evidence on the use of strategies in different contexts is found in Chapelle and Mizuno’s (1989) study. They reported on their observations of the use of reading strategies when students worked on a learner-controlled Computer Assisted Language Learning (CALL) grammar lesson. They claimed that learner-controlled software is often designed with the assumption that students are able to work and interpret requested tasks accurately without much guidance and direction. However, there is little evidence found to approve such assumptions. In this study, they examined the following five strategies that they expected participants to use when working with learner-controlled software: resourcing, practice, self-monitoring, self-management, and self-evaluation. They explained that these strategies were directly related to the elements presented in the software (Chapelle and Mizuno, 1989).

The results showed that the strategies used by the subjects vary, which corresponded to Hosenfeld's (1976) view that students often use strategies different from what educational personnel anticipate. They found, in particular, a notable difference between the uses of two strategies—practice and self-evaluation. Of the 105 subjects who participated, only 34 students practiced with the lessons; moreover, the data shows that self-management only worked for a few students (Chapelle & Mizuno, 1989). This is to say that researchers should not anticipate students to meet their needs by using all of the strategies that are expected. Instead, educators should explore learners' needs and what materials need to be included in the curriculum in order to meet the requirements introduced in new technology (Papert, 1980).

Although studies have suggested that learners vary in their use of reading strategies while working in different reading environment, few conclusions have been formulated with respect to their overall reading performance. In Chou's (1992) study, he focused on the following four types of on-line reading aid in a hypertext environment: plain text and others with vocabulary, sentence structure and strategy support such as skimming and organization, guidelines to each paragraph, and supplementary information. The results show that there is little variation in each text format in terms of readers' performance; however, most of the students agreed that vocabulary help was the most useful tool.

Similar results were found in Son's (2001) study. Strategy use in three text formats were observed in his study, including paper-based format (PF), computer-based non-hypertext format (NHF), and computer-based hypertext format (HF). The study investigated the effects of three different "presentation methods and lexical resources of hypertext-based courseware for learning Korean as a foreign language" (Son, 2001, p. 296). The results indicate that,

second language readers use different reading strategies related to the kind of text they are reading. In particular, learners often read the text first and then figured out the meanings of unknown words or sentences in PF format; while in HF format, they tended to read the passages by moving the cursor along with their eye movement. When encountering unknown words, they often used the Korean-English translation to understand the meaning of the word. In addition, students showed greater preference in the use of the self-management strategy when reading in HF format. The note-taking strategy was used more frequently in PF format. Imaging and transfer, in contrast, were found to be not so popular among all formats. Regardless of the text formats, strategies of resourcing, translation and inferencing were found to be frequently used by all students. Moreover, it was found that students were eager to translate and infer the meanings of the text by using resources such as glossaries for two purposes: to better understand the text, and to prepare for the follow-up tasks (Son, 2001). Self-management, one of the metacognitive strategies, was found to be used more frequently in HF rather than the two other formats due to the unfamiliarity with HF.

In addition, strategies such as the use of prior knowledge, monitoring, repairing comprehension, determining important ideas, synthesizing, drawing inferences, and asking questions were also found to be related to web reading (Schmar-Dabler, 2003)

2.2.3 Individuality

One factor that needs to be considered with respect to the use of learner strategies is individual differences. Cohen (1999) suggests that one should not assume that any strategy is a better or poorer choice for a given task. Readers should be the ones who determine which strategy they apply to a given task, based on the topic and their language knowledge.

Learning style is considered to be a stable, personalized characteristic when processing information (Messick, 1976). Readers, therefore, are expected to benefit from different features afforded by each text format (e.g., non-linearity) based on their individual learning styles. Moreover, it has been suggested that an individual's cognitive style is a factor that has a major impact on the use of hypertext (Chen and Rada, 1996). Research has reported that individual differences may influence readers' performance regardless of the text format (Chun, 1997).

2.2.4. Summary

No doubt, individual reading strategies play an important role in second language reading. Readers use a variety of reading strategies to assist their reading comprehension as well as to improve their problem solving skills. However, along with the changes that have occurred within the reading environment, much research has paid particular attention to observing readers' behavior with respect to their use of strategies in different contexts. It is suggested that there is a variation in the use of reading strategies when working in different contexts. Moreover, individual learning style has an impact on the use of strategies.

Verbal Protocol Analysis

The previous section reviews research on the impact of technology on second language reading and strategies used in different reading environments. This section will further discuss a method used to investigate the subjects' thought processes and explore some of the considerations of using this method such as the instructional procedure and the challenges accompanying the use of verbal protocol.

There has been little doubt that “thinking has been viewed as a temporal sequence of mental events since the time of Aristotle” (Ericsson and Simon, 1993, p. xiii). That is, thought processes can be viewed as “a sequence of states” which contains the final products of individuals’ thought processes. According to Ericsson and Simon (1993), the information is considerably stable so that it can be retrieved by “input to a verbalization process and reported orally” (p. xiii). Moreover, “when readers are mindful information processors, who at least sometimes consciously mediate their understanding, it makes sense to expect self-reports that are veridical with ongoing cognitive processes and strategies, to expect that people can report their cognitive and affective responses to text (Pressley and Afflerbach, 1995, p. 4).

The growing research in cognitive psychology and reader response throughout the 20th century can be viewed as the initiation of the use of Verbal Protocols (Pressley & Afflerbach, 1995). The development of the use of think-aloud protocols can be viewed as the following three stages:

- 1) In 1960-1980s, think alouds were viewed mainly as a research tool to investigate the processes of thinking, problem solving and reading comprehension.
- 2) In 1980s - think alouds were viewed as a technique to model to students the strategies teachers use to comprehend text in order to help students improve thinking and reading comprehension.
- 3) In 1990s, think alouds became accepted as an integral component of the process of constructing meaning within a social interaction -- that is, the notion of thinking aloud is now viewed less as a tool or strategy, and more as an aspect of social interaction, specifically as an aspect of the discourse in social contexts designed to teach reading comprehension (Kucan & Beck, 1997, p. 272).

Ericsson and Simon (1993) interpreted protocol analyses with respect to the information processing theory and “focused on two constructs in that theory of special importance: long-term memory (LTM) and short-term memory (STM)” (p. 6). LTM mainly stores

information/knowledge about how to do things. STM, on the other hand, is known for its limited capacity. Without accessing information stored in STM, subjects tend to lose the information since it is temporarily stored quickly. In contrast, subjects who quickly access the information stored in their STM are able to report on the information they accessed in order to reach their goal or complete a task (Ericsson and Simon, 1993). They further summarized three advantages of the use of verbal reports analysis: 1) it can provide data on cognitive processes and reader responses that could be investigated only indirectly; 2) verbal reports sometimes provide access to the reasoning processes underlying sophisticated cognition, response, and decision making; 3) verbal reports allow for the analysis of affective processes of reading in addition to cognitive processes (Ericsson and Simon, 1993, p. 4).

2.3.1. Verbal report instruction

Instruction in verbal reports can have a major impact on the results. In general, verbal reports are elicited by asking participants to complete a task (e.g. reading a magazine article). To do so, the participants need to comprehend the text and “transform it to retrieval cues that select the relevant information from the vast amount of information in long-term memory” (Ericsson and Simon, 1993, p. xii). In addition, participants have to put the information retrieved in a chronological order, which allow them to produce a “generation of a coherent series of verbalizations” (Ericsson and Simon, 1993, p. xii).

According to Cohen (1998), there are three types of verbal reports: 1) self-report refers to learners’ description of what they do, characterized by generalized statements about learning behavior; 2) self-observation refers to the inspection of specific, not generalized, language behavior, either introspectively or retrospectively, and 3) self-revelation is

'think-aloud,' stream-of-consciousness disclosure of through processes while the information is being attended to (p. 34).

There are also two forms of verbal reports which researchers claim best enable subjects to reflect on their cognitive processes: concurrent and retrospective reports. Concurrent reports are also known as "think-aloud reports" or "talk-aloud reports" in which subjects verbalize their thought processes directly (Ericsson and Simon, 1993, p. 16). Retrospective reports, on the other hand, retrieve information from short-term memory or long-term memory immediately after subjects complete a task (Ericsson and Simon, 1993). It is believed that "remain retrieval cues in short-term memory will allow retrieval of the sequence of thoughts" (Ericsson and Simon, 1993, p. 19)

Ericsson and Simon (1993) state that, "the accuracy of verbal reports depends on the procedures used to elicit them and the relation between the requested information and the actual sequence of heeded information" (p. 27). Therefore, it is necessary to assure that all subjects have reached the same level of understanding with respect to the think-aloud method and its procedure before conducting each experiment. A few suggestions were made to eliminate problems that may occur while conducting think aloud process: 1) researchers should avoid any social contact with subjects during the process; 2) researchers should warn subjects to avoid any explanation or description of the entire process; 3) researchers should provide sufficient time for subjects to be familiar with the tasks in order to reduce any anxiety that may occur during the process (Ericsson and Simon, 1993).

When task-processing requires a lot of STM capacity, subjects tend to stay quiet and refrain from verbalizing. Therefore, researchers (e.g., Duncker, 1945; Johnson, 1964) suggest that a brief reminder will help subjects restart their think-aloud process and verbalize after a

few seconds of pauses. “These reminders may take many forms like such as “please, tell me what you are thinking,” “Please, think aloud,” and “Keep talking” (Ericsson and Simon, 1993, p. 256). However, ‘a reminder like, “what are you thinking about?” is more likely to elicit a self-observation process or produce another –oriented-description as a response’ (Ericsson and Simon, 1993, p. 83).

Verbal report is not without its opposition. There are some challenges researchers need to be aware of while analyzing the data. One of them is individual differences (e.g., Ericsson and Simon, 1993, Claparede, 1934; de Groot, 1965; Johnson, 1964). As Ericsson and Simon (1993) point out, individuals differ in their ways of interacting socially. Such variation may result in differences in verbalization. For instance, some individuals may be self-conscious or anxious about verbalizing; others may make little effort or adapt easily to requests to verbalize about what they are doing.

2.3.2. Research on learner strategies in Hypermedia environment

Methods such as classroom observations often provide some indication with respect to strategies learners use rather than the actual use of strategies. Therefore, researchers, to some extent, need to rely on their intuition to interpret learners’ behaviors observed. It is suggested that verbal protocol is “the most viable- means of obtaining empirical evidence as to strategy use than to other method” (Cohen, 1998, p. 34).

The use of verbal report protocols in L2 learning strategies investigations has benefited greatly from the extensive use of this research methodology in the native language (Cohen, 1998, 35). Pressley and Afflerbach (1995) provide an excellent framework for the use of verbal reports focused on L1 reading, which has been extended to L2 reading research. In

their book, they identify strategies reported from verbal protocols based on the conscious processing. All strategies are categorized based on the reading process: beginning, during, and after reading with the two additional categories of monitoring and evaluating strategies. Their explanation is that all the thinking can be divided into categories because “there is orderliness to the conscious processing that will occur” during reading (Pressley and Afflerbach, 1995, p. 79). Based on 32 research studies reviewed, they concluded that the “think-alouds were extremely revealing about the dynamics of comprehension difficulties and how understandings of text shift in reaction to comprehension difficulties and surprises in text” (Pressley and Afflerbach, 1995, p. 38).

Interests in the use of Verbal Protocols imply a need for verifying the reliability and validity of the method reported by the subjects (Cohen, 1999). Critics of think-aloud protocols claim that cognitive processing may not be accessible due to its unconsciousness; even when subjects are conscious about their thought processes, it may still be too difficult to capture due to its complexity. In addition, such methods may not necessarily reflect subjects’ actual thought processes, especially when “tasks involved are largely automatic” (Cohen, 1998, p. 37). Furthermore, because verbal protocols rely heavily on subjects’ immediate retrospection, this may affect readers’ performance since it may redirect their attention or require additional efforts from the participants when completing the task. As a result, the information reported will no longer reflect the subjects’ actual thought processes that researchers intended to investigate (Cohen, 1998). Cohen (1999) thus suggests that researchers should identify think-aloud procedures in order to unify the use of verbal report and minimize any inadequate manipulation. Ericsson and Simon (1993) also outlined a few suggestions of how self-reports should be collected: 1) subjects should be told to only report

on what is being accessed with no description or explanation; 2) researchers should avoid tasks that are directly accessible; for instance, in reading, “text should be presented sentence by sentence;” 3) any direction given to subjects should remain open-ended because it is assumed that the think-aloud method is a kind of common activity that is not completely alien to all (p. 254).

2.3.3 Summary

There has been a long history of using the think-aloud method in retrieving learners’ cognitive processes, especially in the area of second language reading (Cohen, 1998; Pressley and Afflerbach, 1995). However, variation was found in the use of this method. As research (Cohen, 1998; Ericsson and Simon, 1993; and Pressley and Afflerbach, 1995) suggests the consistency of think-aloud instruction should be maintained in order to assure the accuracy of the oral reports retrieved from the subjects’ thought processes.

CHAPTER III: METHODS

Introduction

This chapter details the methods used in the study. The purpose of the study was to investigate differences in the reported use of strategies by Chinese adult second language learners when reading traditional print and electronic text. Specifically, this study addresses the following two research questions:

- 1) Do Chinese adult ESL learners use the same kinds of reading strategies for printed text as they do for electronic text?
- 2) Under what circumstances, might individuals vary in their reported use of reading strategies?

To best obtain information that addresses the research questions above, several methods were used in this study including a subject's background questionnaire, think-aloud protocols, Morae software, a written summary task, and a follow-up interview. The background questionnaire was first given to all subjects in order to gain an overview of the subjects' familiarity in the use of technology and preference in reading either text format. A think-aloud was used while subjects performed the task to retrieve their thought processes and obtain data regarding the reported use of reading strategies. The think-aloud method was chosen for this study because it unveils the "learners' thought processes while the information is being attended to" (Cohen, 1987, p. 84), and contrary to retrospection, it does not allow time for elaborating on the thought processes afterwards; in addition, 'think-alouds prevent the forgetting that takes place after the information is processed, which makes retrospective reports somehow incomplete' (Saravia, 1995, p. 37). During the think-aloud

processes, all data was recorded and organized by the Morae software which eased the process of data analysis. Subjects were also asked to complete the written summary task after reading each passage, which provided a purpose for subjects to complete the reading tasks. Finally, a follow-up interview was conducted in which subjects were asked to answer a few open-ended questions regarding their behaviors that the interviewer observed during the think-aloud process. The interview provided an opportunity for both the investigator and subjects to clarify questions that were not fully understood from the data retrieved.

The selection of subjects, instruments, and a detailed procedure of the data collection are discussed below.

Participants

The following criteria were followed in selecting subjects. Subjects had to be 1) Chinese adult ESL learners and 2) students at Iowa State University. I selected Chinese adult ESL learners so that all subjects and I would share the same cultural and language background, which would enable me to transcribe the data in Chinese and possibly bring other important cultural information into consideration.

During the preliminary stage, six subjects were recruited for this study. However, three of them dropped out before conducting the experiment due to the semester examination schedule.

The remaining three subjects were used in the study. They were Joe, Kevin and William (pseudonyms). All of them were male native speakers of Mandarin Chinese, ranging in ages from 23 to 28. All subjects had lived in the United States over 24 months, except one who just arrived in the United States three and a half months ago. Their TOEFL scores ranged

from 193 to 223. All subjects had completed their college education in Taiwan and were graduate students at Iowa State University. Two subjects, Joe and William, were both in the department of Biochemistry while Kevin, the third subject, was from the Department of Aerospace Engineering.

Among the subjects, only Kevin had prior experience using the think-aloud method before conducting the experiment. However, to assure that all subjects were comfortable with the think-aloud procedure which involved verbalizing their thoughts while completing the tasks, a think-aloud training was arranged for all subjects two days before the actual task. The purpose of this training was to minimize the anxiety that could possibly occur during the think-aloud processes. Table 1 below presents the information gathered from the background information of all the subjects, including their majors, gender, age, length of stay in the US, their TOEFL scores, and nationality (See Appendix K).

Table 1.

Background information of subjects

| Background | Joe | William | Kevin |
|--------------------------------------|--------------|----------------|-----------------------|
| Major | Biochemistry | Biochemistry | Aerospace Engineering |
| Gender | Male | Male | Male |
| Age | 27 | 28 | 23 |
| Length of stay in the US (in months) | 36 | 24 | 3.5 |
| TOEFL scores | 223 | 193 | 197 |
| Country of origin | Taiwan | Taiwan | Taiwan |

Instruments

To best elicit the individual's reported use of strategies in different contexts, the following instruments were used: the TOEFL reading test and two reading tasks given in different contexts—print and electronic versions. The TOEFL reading test was given to measure the participants' overall reading ability. The two reading tasks were used to elicit the think-aloud data. A detailed description of all tasks including the selection of each task is presented in this section.

The TOEFL reading test

In order to measure the subjects' overall reading abilities, a reading test taken from Reading for TOEFL (LanguEdge™ Courseware Version 1.0) was used (Educational Testing Service, 2002). This test was given to all subjects due to its popularity and incorporation of all subject areas. Moreover, all of the participants had taken a TOEFL test before.

The test contains three reading passages with thirty-eight test items. Each subject had twenty-five minutes to read each passage and answer the reading comprehension questions given in one passage. To complete the reading test, it takes a maximum of 75 minutes. The test consists of two types of test items, multiple-choice questions and inserted text.

All questions are intended to measure the test takers' understanding in terms of the following categories: vocabulary and grammar; major ideas and important information; relative importance of ideas; relationship of ideas to each other; and organization of ideas and concepts (Educational Testing service, 2002). In addition, each test item is especially designed to measure the use of a particular type of reading strategy including identifying facts, inferences, references, vocabulary, summary of the text, rhetorical analysis, and

schematic table (Educational Testing Service, 2002). Each test item is worth one point with the exception that one set in each passage is worth more than one point. A detailed description of each individual's test result including test scores and the effectiveness of the use of a particular strategy was presented upon the subject's request. Such discussion allowed subjects to share their problems and questions regarding certain test items after completing the test (i.e., the content or the comprehension questions in one conversation were easier than the other); moreover, the strategy analysis provided an overview of the use of particular strategies that one subject mastered. All subjects showed a great desire to be informed of their test scores; however, they appeared uninterested in the strategy analysis, except one participant who was curious about what the strategies implied.

The two reading tasks

The two reading tasks varied in their text formats: printed and electronic text. There were a total of six passages selected from *Science News*, a periodical published by Science Service. *Science News* was selected for this experiment because it presents readers with up-to-date and interesting scientific research ranging from Zoology, Biomedicine, and Astronomy. Each set of passages includes three different topics: Zoology, Biomedicine and Astronomy. The variation in topics was used in order to increase the possibility that participants would use various reading strategies in dealing with different but related subject areas. During the experiment, subjects were given a choice of selecting two passages from the three options in each text format in order to increase the likelihood that subjects would be interested in the texts and thus motivated to read. Text in print consisted of the following three passages: 1) *Detecting life on Mars*, 2) *Eight hours of sleep may not be so great*, and 3)

Road range keeps ants moving smoothly (Appendix A-C). Electronic texts included: 1) *Dreaming away pain*, 2) *Maybe what Polly wants is a new toy*, and 3) *Moon story waxes fuller* (Appendix D-F). To control the effects of the reading order, the arrangement was assigned as follows. Joe read 1) *Moon story waxes fuller* in electronic text; 2) *Dreaming away pain* in electronic text; 3) *Eight hours of sleep may not be so great* in print; 4) *Road range keeps ants moving smoothly* in print. William read 1) *Detecting life on Mars* in print; 2) *Eight hours of sleep may not be so great* in print; 3) *Maybe what Polly wants is a new toy* in electronic text; 4) *Dreaming away pain* in electronic text. Finally, Kevin read 1) *Moon story waxes fuller* in electronic text; 2) *Maybe what Polly wants is a new toy* in electronic text; 3) *Eight hours of sleep may not be so great* in print; 4) *Road rage keeps ants moving smoothly* in print.

The passages were selected based on their readability. A readability formula was used for this study as another measure of the appropriateness of the particular texts for the participants in the study. The readability core in this case consisted of a measure of lexical and syntactic difficulty. Readability was determined by the Flesch Reading Ease and Flesch-Kincaid Grade Level. Flesch Reading Ease scores range from 0 to 100 (Web Accessibility Testing and Service, 2005)—the higher the scores, the greater the likelihood that readers can understand the text. Flesch-Kincaid Grade Level, on the other hand, measured the grade level (Web Accessibility Testing and Service, 2005). For instance, the Flesch-Kincaid measurement for the passages used in this study was at 11, which means an average eleventh grade student in the U.S. should understand the text. The average word count of all six reading passages was 228 words. The overall Flesch Reading Ease was 49.55%, and the Flesch-Kincaid Grade Level was at 11th grade. Thus, this would suggest that

subjects would not be overwhelmed by the amount of reading given. That is, the length of each reading passage would help increase the precision of the data obtained from this study. The results from both the Flesch Reading Ease and Flesch-Kincaid Grade Level were used as one method to determine the difficulty of each passage.

Although readability formulas are helpful in determining basic reading levels, one of their major limitations is that they are primarily designed for readers of English as a first language and do not capture readers' background knowledge. Therefore, additional factors such as the background of the readers and content knowledge were taken into consideration before determining the suitability of the texts for this study.

Pilot project

A pilot was conducted a few months before the actual study to allow for certain methods, including the coding system, to be created and revised. The pilot study was conducted in March 2005, with one subject, a female non-native speaker of English, who was asked to report on her thought processes while taking the TOEFL Reading test. The subject was asked to read two passages from a paper-based TOEFL test (Educational Testing Service, 1995) and two others from a computerized TOEFL Reading test (Barron's Educational Series, 2001). In each text format, the subject was asked to report her thought processes in either her native language or in English. After completing the test, a follow-up interview was given to the subject. She commented that it was difficult to think out loud in her native language while she was reading in English. Moreover, she showed much anxiety and discomfort when reporting her thought processes. Although researchers claim that almost everyone has some experience of thinking out loud in their everyday lives (Ericsson and Simon, 1996), this

method did not appear to be successful in its attempt to retrieve information on the reported use of strategies for this particular individual. Furthermore, some strategies were not elicited in the testing situation (e.g., note-taking was not present in this situation.), which limited the range of strategies retrieved from the think-aloud data.

This pilot study is useful since it provides important considerations for researchers interested in learning strategies. More specifically, the pilot result suggests that 1) it is essential to train all subjects before conducting the study; 2) the experiment should not be conducted under a test condition; rather, it should be conducted under conditions suitable for pleasure reading or study.

To increase the accuracy of my results, I made accommodations within my study based on the outcomes of this pilot study. Within my study, subjects were asked to complete a reading task (e.g., summarize a text) rather than take a test. Moreover, the revision based on the pilot study including the think-aloud training and the task purpose (e.g., for study or pleasure) was done in order to ensure that participants were not restricted in their use and choice of strategies. All subjects showed less anxiety after the think-aloud training session in comparison to the one who performed the task without prior training; moreover, they were able to report much more information than simply repeating the content of the passage.

Procedure

To complete the entire experiment, subjects had to complete two think-aloud sessions. One was the think-aloud training, and the other was the actual experiment. The first think-aloud session required subjects to complete the following sub-tasks: 1) take a 75 minute TOEFL reading test, and 2) complete a 30 minute think-aloud training which included

a warm-up session in which the investigator described briefly the entire think-aloud procedure and provided an audio think-aloud demonstration as well as a think-aloud practice after participants completed a background questionnaire. The second session consisted of two major tasks and one follow-up interview. The two tasks in the second session required subjects to verbalize their thought processes which consisted of two forms of reports: concurrent and retrospective followed by a written summary task after reading each passage. Finally, each subject was given a 10-minute follow-up interview immediately after completing all tasks. A detailed description of each task is discussed below.

Think aloud training

The first session began with the 75 minutes TOEFL Reading test, which was immediately followed by the think-aloud training. The latter included a 5-minute warm up session, a 10-minute think-aloud demonstration, and 10-15 minutes of think-aloud practice. Information given in the warm up session included a brief instruction on the think-aloud method and its procedure (Appendix G). The think-aloud demonstration was done by a graduate student from the English Department who had expertise on the think-aloud method. The transcript of the demonstration was given to all subjects (Appendix H), so they could follow what exactly was said in the demonstration. After a few minutes preview, the participants listened to the demonstration. The purpose of giving an audio demonstration was to provide an authentic example of how a think- aloud is conducted. While listening to the demonstration, subjects were encouraged to interrupt and ask questions pertaining to the think- aloud procedure. The passage used in the demonstration was equivalent to the actual task. Subjects all showed a thorough understanding of the procedure after the audio

demonstration. A think-aloud practice, however, was given to reinforce the accuracy of the think-aloud procedure that would be conducted within the study. The passage, "*Little Brain that Could*," taken from *Science News* was selected, and its sentences were randomly mixed (Appendix I). While reading the passages, the participants reported on their thought processes in terms of what strategies they used to rearrange those sentences. A retrospective report was given immediately after the concurrent report, which involved having subjects recall what they had done while verbalizing their thought processes (Appendix J). Subjects were encouraged to report in the order in which their memories occurred. If they could not remember any specific details, they would say, "I do not remember." It was critical that the subjects did not predict or add any irrelevant information to the reports so that the information gathered could be used to interpret the data retrieved from the subjects' oral reports (Ericsson and Simon, 1993). Ideally, the information gathered from the retrospection should correspond to the data retrieved from the concurrent report (Ericsson and Simon, 1993). That is, there should be a correspondence between the behaviors observed in both the concurrent and retrospective reports. However, the results often vary due to individual differences. For instance, one subject reported that he could not recall any details while another subject only repeated the content of the passage. A background questionnaire was given to all subjects to finalize the think-aloud training session (Appendix K).

Think aloud process

The second session, the actual experiment, was conducted two days after the think-aloud training; therefore, a review session was given to all subjects to assure that they acquired a competent familiarity with the think-aloud procedure before conducting the actual

experiment. All subjects were required to review the think-aloud instructions and the transcript of the demonstration before the actual task to recall the information given in the think-aloud training. Subjects were given a choice of reporting in English, Mandarin Chinese, or both. After participants had no remaining questions, the subjects began the actual experiment.

The entire think-aloud process was recorded using a Morae recorder while subjects were working on two reading tasks. A Morae recorder is one of the three major components included in the diagram below.

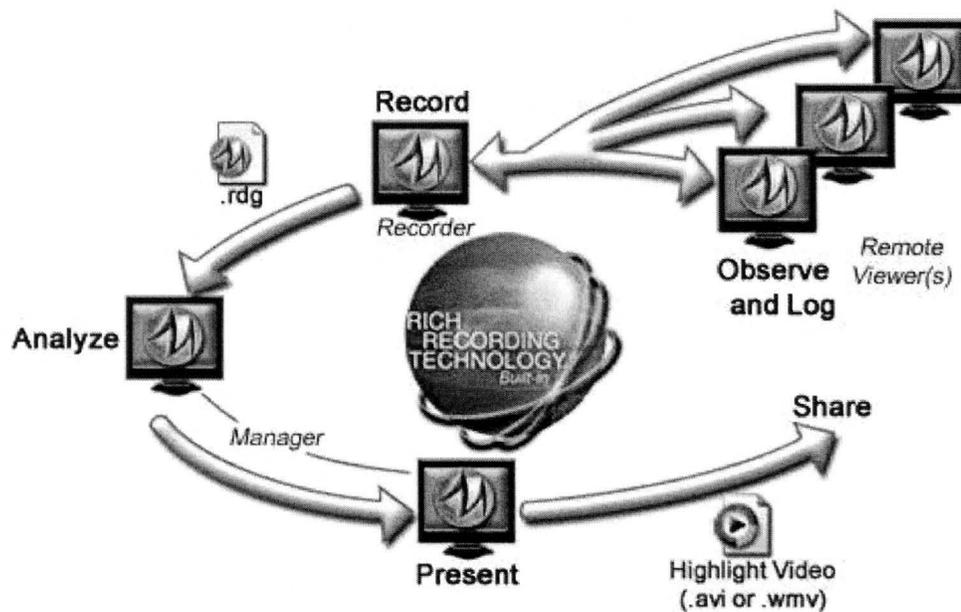


Fig. 1. Overview of the Morae Software (TechSmith Corporation, 2005)

The Morae software consists of three major components, including a Morae Recorder, a Morae Remote Viewer, and a Morae Manager (see Figure 1). The Morae Recorder (See Figure 2) allows investigators to store data “in sync with the video of the user through a web camera or other camera device and an audio that records the user through a microphone.

Because it runs silently in the background, it never disturbs the user” (TechSmith Corporation, 2005). The Morae Remote Viewer, on the other hand, allows one or more computers to work simultaneously through a network to a computer that runs the Morae Recorder. Such a feature provides supports for investigators to observe “the screen, and camera video, and hear the audio of the user, streaming from the Recording source computer” (TechSmith Corporation, 2005). Moreover, “anyone logged into a Remote Viewer computer can add Markers (See Figure 3 and 4) during recording that is equipped with text notes; in addition, it “automatically saves and indexes the Markers with the accompanying video and audio stream” (TechSmith Corporation, 2005). In this study, all markers were set up to indicate the reported use of strategies (e.g., “L” represents “look up dictionary;” “H” represents “highlighting”, and so on). Finally, all data can be viewed in Morae Manager (See Figure 4) including the video and audio recordings. An overview of the Morae features is illustrated above.

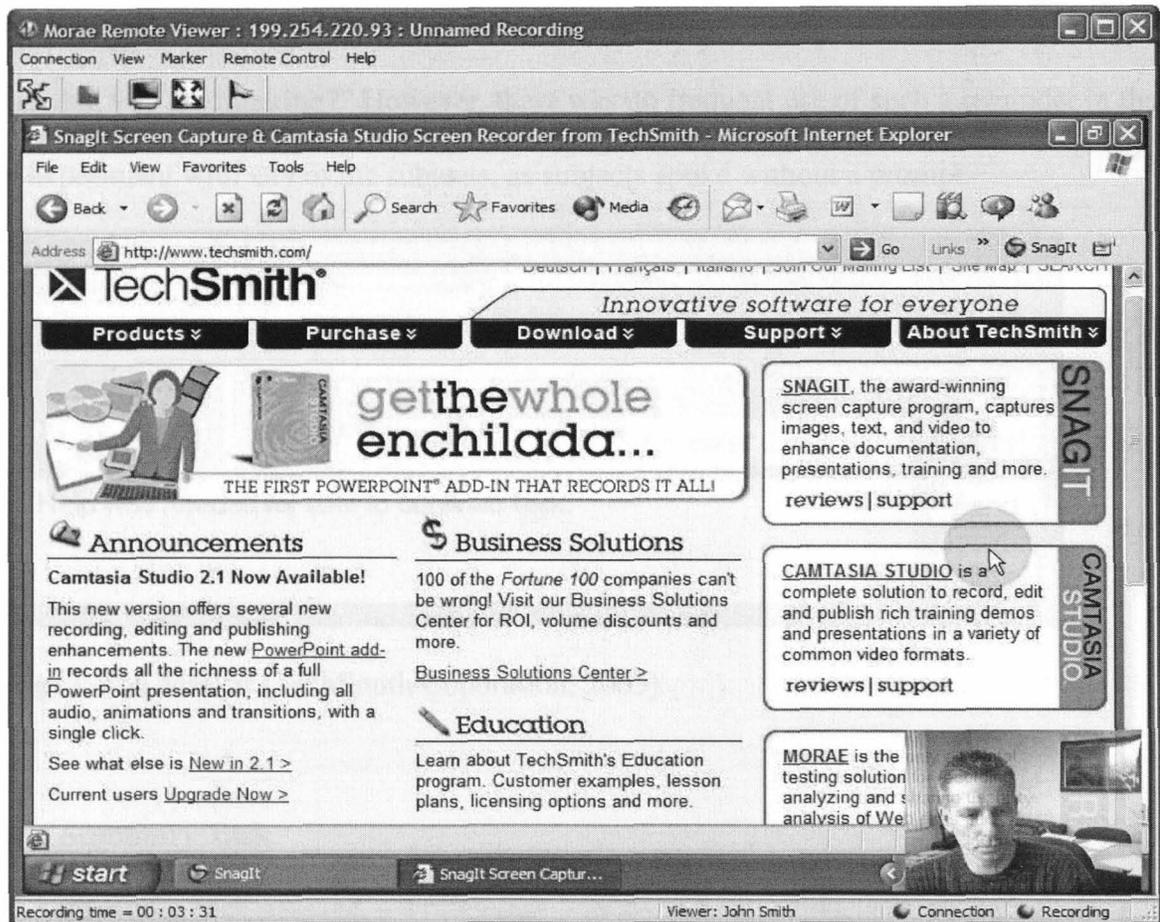


Fig. 2. The Morae Remote Viewer (TechSmith Coporation, 2005)

In short, the investigator was observing the subjects simultaneously from a separate computer using a Morae Remote Viewer. Subjects, on the other hand, were working on a different computer and were recorded by the Morae Recorder to capture their reading behaviors (e.g., cursor movement, use of resources such as online dictionary). During the think-aloud process, subjects thought aloud in two forms: concurrent and retrospective. The concurrent report captured subjects' thoughts during the tasks. Retrospection, on the other hand, relied on memories recalled immediately after reading the passage. In addition, a reminder was given in the actual experiment to encourage subjects to talk again if their

thought processes were interrupted. An example of a reminder used in this study was “Please tell me what you are thinking?” However, there was no frequent use of such a reminder in the actual experiment with any of the subjects, as subjects spoke without a prompt.

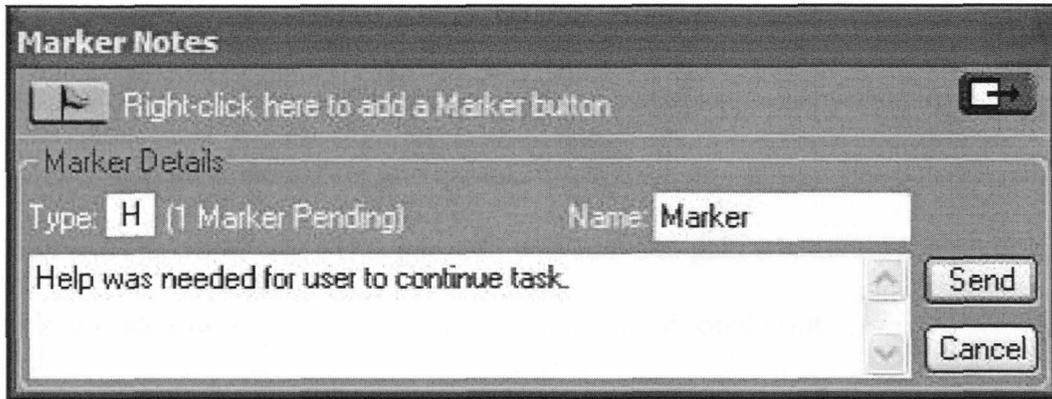


Fig. 3. The Marker (TechSmith Coporation, 2005)

Written Summary Task

After reading each passage, a written task was given to all subjects to measure their comprehension. To complete this task successfully, subjects had to identify the main idea, supporting details, and results. Each passage is worth a total of five points; each section is worth two points except the result is worth only one point. Subjects were not allowed to go back to the text once they started summarizing. Each summary was evaluated by two raters: the primary investigator and a graduate student in TESL. The inter-rater reliability of this task was 95 percent; that is, 95% of the results from both raters matched.

Follow-up interview

The follow-up interview was given immediately after the think-aloud experiment, which included both concurrent and retrospective reports and the completion of the written

summary tasks. The investigator would replay the recording of each individual's think-aloud process using the Morae Manager (See Figure 4) and retrieve markers along with notes while interviewing the subject. Based on the notes, the investigator would ask clarification questions in regard to their reported use of strategies. The interview questions were all open-ended and mainly focused on subjects' behaviors and actions taken during the think-aloud processes, except for one question: Are there any differences between reading print text and electronic text? This question was added to gain a better understanding of the subject's attitude toward reading electronic text and traditional print.



Fig. 4. The Morae Manager (TechSmith Coporation, 2005)

Data Analysis

To address the research questions, the following data were compared and analyzed: the think-aloud transcripts and recordings from each subject, the responses from subjects' background questionnaire, the test scores from the TOEFL Reading sub-test, the written task results, notes taken from the observation of subjects' think-aloud processes, and additional information gathered from the follow-up interview (See Table 2).

Subjects' reported use of strategies retrieved from the think-aloud transcripts in two contexts were compared and analyzed. The data contains 1) evidence of individual strategies used in either text format, which could be divided into two major categories: metacognitive and cognitive strategies; 2) number of time that a particular strategy appeared in the text; 3) number of types of strategies used. Individuals' think-aloud recordings were also timed and compared in order to examine the relation between text formats and individual differences so as the time spent on the computerized TOEFL reading sub-test. Responses gathered from subjects' background questionnaires present information regarding subjects' familiarity with technology and whether they prefer reading one particular text format. The results from the written summary tasks were compared among all subjects. The data presents the variation of subjects' performance in the two text formats. Notes taken during the think-aloud process were mainly formed as questions later to be used in the interview and answered by individual subjects. Finally, responses from individual interviews were gathered in order to clarify any of the subjects' behaviors that were not fully understood from the text.

Overall, two out of the three subjects spoke primarily in English throughout the think-aloud process. All recordings were transcribed. The original Chinese recording was first transcribed in Chinese and then translated into English. To ensure that the data was

accurately transcribed and translated in both the original and translated versions, the original transcripts were reconfirmed with individual subjects; moreover, each translation was examined by another Chinese native speaker. The transcriptions from the individual participants were carefully examined in terms of their reported use of strategies and coded based on the strategy classification adapted from O'Malley et al (1995), and Pressley and Afflerbach's (1995) work. The classification was mainly divided into two categories: metacognitive strategies (e.g., evaluating and monitoring) and cognitive strategies (e.g., note-taking and translation).

All think-aloud data was first coded by the primary investigator and then coded by a second rater, a graduate student of TESL. In order to increase the accuracy the coding process, the investigator went through the entire coding procedure and clarified questions regarding the strategy classification with the second rater before coding. Instances of any disagreement on the strategies coded between two raters were re-examined and were further discussed by reviewing the strategy taxonomy (See Table 4) and evidence from the think-aloud transcripts (See Appendix L)

The inter-reliability rate between the two raters was 92%. That is, the two raters rated 92 percent of the strategies coded the same. Additional information gathered from interviews was added to the transcriptions, which allowed the investigator to further explain the subjects' behaviors and actions taken during the think-aloud processes. A detailed description of the results is discussed in the next chapter.

Table 2.

Research questions and data analyzed

| Research questions | Methods | Data | Analysis |
|---|--|---|--|
| <p>1. Do Chinese adult ESL learners vary in their reported use of strategies in different reading contexts: electronic text and traditional print?</p> | <p>1. Subjects' background questionnaire - Purpose: Background questionnaire was used to gather information regarding subjects' personal information as well as their cultural and academic background.</p> <p>2. Think aloud protocols - Purpose: Individual think-aloud report was conducted in two forms concurrent and retrospective reports. The concurrent report is used to retrieve subjects' thought processes and their reported use of strategies; while the retrospective reports (immediately followed by the concurrent report) is used to recall subjects' memories in terms of what they did during the processes. Both reports allow me to assure the accuracy of individual oral reports.</p> <p>3. The Morae software - Purpose: The Morae software was used to record and organize data retrieved from subjects' thought processes all data was recorded which eased the procedure of data collection and the process of data analysis.</p> | <p>1) Individuals' think-aloud transcripts and recordings. 2) Notes from my observation during the individual think-aloud process. 3) Subjects' responses from the follow-up interview.</p> | <p>1) Subjects' reported use of strategies retrieved from the think-aloud transcripts in two contexts were compared and analyzed. The data includes - <i>evidence of individual strategies used in either text format, which mainly divided into two major categories: metacognitive and cognitive strategies</i> - <i>number of times that a particular strategy appeared</i> - <i>number of types of strategies used</i> 2) Notes taken during the think-aloud process were mainly formed as questions later to be used in the interview and answered by individual subjects. 3) Responses from individual interview were gathered in order to clarify subjects' behaviors that were not fully understood from the text.</p> |
| <p>2. Under what circumstances, might individuals vary in their reported use of strategies?</p> | <p>4. The two reading tasks: printed text and electronic text. - Purpose: The two reading tasks were used to discover subjects' reported use of strategies in different contexts.</p> <p>5. The TOEFL reading test - Purpose: The TOEFL reading test was used to measure subjects' overall reading ability</p> <p>6. The written summary task - Purpose: The written summary task was used to measure subjects' comprehension after reading each passage.</p> <p>7. The follow-up interview - Purpose: The follow-up interview was used to provide an opportunity for both the investigator and subjects to clarify questions that were not fully understood from the data retrieved</p> | <p>1) Responses from the questionnaire; 2) Results from the TOEFL reading test; 3) Individuals' think-aloud recordings 4) The written summary task results;</p> | <p>1) Responses from individual questionnaire were examined. The data particularly addresses the subjects' familiarity with technology and web reading. 2) The time individuals spent on the TOEFL reading test results was calculated when examining the relation between the reading time and subjects' performance. 3) Individuals' think-aloud recordings were timed and compared in order to examine the relation between text formats and individual differences. 4) The results from the written summary task were compared among all subjects. The data presents the variations within the subjects' performances in the two text formats.</p> |

CHAPTER IV: RESULTS AND DISCUSSION

Introduction.

The research discussion in this chapter is mainly divided into two sections that address the two research questions mentioned above: 1) analysis of reading strategies within conventional and electronic environments, 2) findings related to methodology. More specifically, the first section presents a detailed description of the subjects' use of metacognitive strategies and cognitive strategies. The discussion is extended to other related issues, such as the individuals' differences in their use of various reading strategies within the different reading environments. These differences entail the relation between individual performances and their reported use of strategies as well as the individuals' reading time and other related factors, including text formats, the reported use of strategies, and subjects' performances. The second section deals with the methodological effects with respect to the use of reading strategies.

Research findings

This study was set to investigate the following research questions:

- 1) Do Chinese adult second language learners vary in their reported use of strategies in different reading contexts: electronic text and traditional print?
- 2) Under what circumstances might individuals vary in their reported use of learning strategies?

To address these research questions, the data analysis was divided into four sub-sections which dealt with different sets of data with respect to the subjects' reported use of strategies.

The first sub-section focuses on the subjects' approach in completing the reading tasks and the general strategies they applied in completing the task. The second sub-section presents the results found in this study regarding the differences of the reported use of strategies between reading electronic and printed text. All data in the third sub-section was mostly quantified, and the strategy taxonomy used in the coding strategies as well as the rationale for adopting strategy categories chosen for this study are also presented and discussed later in this section. Examples of the use of a particular strategy selected from each subject's verbal report are also illustrated and described in this section. Findings of other related issues regarding individual differences in the reported use of strategies are discussed and analyzed in the remaining section.

The subjects' approach to the tasks

The subjects' approach in completing the reading tasks shared some similarities as well as differences in this study. The discussion was mainly divided into three stages: before reading, during reading and after reading. The purpose was to gain a more precise overview of the subjects' approaches while completing the tasks.

Before reading, subjects had the choice of reading two passages out of three options in both electronic text and traditional print. In choosing each passage, all subjects commented that the selection for reading a particular passage was mainly based on their interests. In other words, if the title sounded interesting to them, they would read the passage; otherwise they would choose from the remaining options.

However, other methods in selecting the reading passage were also observed from the oral reports of all subjects. For instance, Kevin reported that he intended to choose the

shortest passage among the remaining passages when reading the third passage. He explained that he became less motivated due to the extensive time spent reading the text. In addition, other indications were found from Joe's oral report. He reported that the illustration influenced his decision in selecting in selecting the second the second electronic reading passage.

During reading, all subjects except William showed frequent use of the translation strategy. However, their approaches were slightly different from each other. Joe, for example, often scanned a paragraph during the first reading and then translated about 80 to 90% of the entire paragraph when reading the second time. Kevin, on the other hand, translated only the key words and phrases. William, in contrast, showed very little use of the translation strategy and he was the only one who reported in English throughout the entire experiment.

There was a frequent use of the monitoring strategy regardless of the context among all subjects. When subjects encountered any reading problems (i.e., unknown words, or complex sentence structure), they would first identify the problems by saying, for instance, "it's not clear, why he mentioned ... (see Appendix K for the completed transcription)" and then search through the text to figure out the answers. When encountering unclear text, the subjects' reactions varied, and in some instances, they would discontinue their search in responding to the questions or problems they encountered. In addition, all subjects showed great interest when reading the passages. They all pointed out that the passages selected for this study were very interesting. Much research has suggested that motivation is the key in promoting reading ability in addition to content of the text, which plays a major role in determining the reader's level of attention directed at the text (Alderson, 2000).

In comparison to the previous two stages, subjects showed little variation after completing the reading. Both Joe and William's oral reports indicate that they would locate the text portions that were not understood when reading the passage from the first time. They would then try to re-read the passage again to gain a better understanding of a particular part of the text. Kevin, in contrast, often discontinued reading without revisiting passages that were not understood during the first reading and continued the retrospective report immediately after the first reading.

Although some similarities were found from the subjects' approach toward the completion of the tasks, results of the summaries vary for individual readers. William spent the least time but scored the second highest among all subjects. Joe's performance was the most consistent overall. He never rushed through the passage regardless of the time he spent reading and scored the highest while Kevin spent less time reading after the second passage was completed and scored the lowest.

Overall, there is a variation with respect to the subjects' approach toward the completion of tasks, particularly the reading time, methods in approaching problems encountered in the text, and their problem solving strategies. Moreover, all subjects reported that they prefer reading the hardcopy. Kevin further explained that there is no difference when reading for pleasure in both contexts. However, if the reading assigned was parts of a school assignment, he would "print out the text" regardless of the availability in both text formats.

Differences in the reported use of strategies between electronic and printed text

In order to answer the research question: do Chinese adult ESL learners vary in their reported use of strategies in different reading contexts, electronic text and traditional print, I

compared the research results retrieved mainly from the subjects' concurrent reports and found three identical passages in both settings (See Table 3) . Set 1 was selected from Joe's and Kevin's think-aloud data. The passage they both read in print was *Road range keeps ants moving smoothly*, and the electronic text was *Moon story waxes fuller*. Set 2 was selected from Joe and William's data. The passage in print was *Eight hours of sleep may not be so great*, and the electronic text was *Dreaming away pain*. Set 3 was selected from Kevin's and William's data. The passage in print was *Eight hours of sleep may not be so great*, and the electronic text was *Maybe what Polly wants is a new toy*. The purpose of comparing three sets of data was to find out whether there are certain strategies that only appeared in either text. To obtain the information for the reported use of strategies in different text formats, I first examined each strategy used by one subject in both text formats separately and then eliminated any strategies that appeared in both texts. The same procedure was then applied to the other subjects who read the same passage as the first subject. Finally, I compared the remaining strategies used by both subjects (See Appendix L for a detailed data analysis sample). The results suggest that regardless of the text formats, subjects relied heavily on the strategy of monitoring. Moreover, it was found that the inferencing strategy was closely related to electronic text. Such results are supported by an earlier study (Schmar-Dabler, 2003). The author claimed that inferencing is one of the strategies that closely relates to web reading. However, it is not clear at this point why this is the case. Thus, further research is needed to verify this finding.

Table 3.**Three identical passages read by subjects in both settings**

| | Electronic text | Printed text |
|---------------|--|--|
| Set 1. | <i>Moon story waxes fuller</i> | <i>Road range keeps ants moving smoothly</i> |
| Set 2. | <i>Dreaming away pain</i> | <i>Eight hours of sleep may not be so great, and the passage</i> |
| Set 3. | <i>Maybe what Polly wants is a new toy</i> | <i>Eight hours of sleep may not be so great</i> |

Data presented in the following section provides a detailed description of the subjects' use of a single strategy and examines evidence found within the data regarding the individuals' strategies used in either electronic or printed text, number of times that a particular strategy appeared in the text, and the number of types of strategies used.

Taxonomy for strategy analysis

The original taxonomy, developed by O' Malley et al (1995), includes three categories: metacognitive strategies, cognitive strategies and social mediation. This taxonomy was modified based on the results from the pilot study as well as the think-aloud data. Additional information was added from the interviews to help the investigator and the rater code the strategy used in completing the tasks. To be specific, the third category was eliminated due to the restriction from the think-aloud procedure. Social mediation consists of two strategies: question for clarification and cooperation. Research (Ericsson and Simon 199) suggests that interaction may interrupt or cause any interference within the subjects' thought processes. Therefore, subjects were allowed only limited interaction with the investigator so that the investigator's speaking role was primarily restricted to providing a reminder for the subject in

order to encourage them to continue to talk if the subjects stopped talking.

Reading strategies are defined in detail below (See Table 4). Examples of the use of particular strategies retrieved from the think-aloud data are presented later in this chapter (See Table 4 & 5).

Table 4.

Reading strategies definition & examples

| Reading strategies | Description | Examples |
|------------------------------------|--|--|
| I. METACOGNITIVE STRATEGIES | | |
| 1. Directed attention | Deciding in advance to attend in general to a learning task and to ignore irrelevant distracters. | 1... <i>"This is more interesting."</i> (Explanation: He compared two other passages and found one passage to be more interesting, selected from K-03-P-2) |
| 2. Selective attention | Deciding in advance to attend to specific aspects of input, often by scanning for key words, concepts, and/ or linguistic markers. | 1... <i>yet the mice had no immune defects or any other obvious problem</i> (Explanation: He only highlighted the text in from the 1 st paragraph, selected from J-02-E-2] |
| 3. Self-management | Understanding the conditions that help one learn and arranging for the presence of those conditions. | 1... <i>"Pick a short one"...</i> (Explanation: He implies that he picks a short passage from the given options, selected from K-03-P-2) |
| 4. Self-monitoring | Checking one's comprehension during reading or checking the accuracy and/ or appropriateness of one's oral or written production while it is taking place. *Checking whether overall meaning of text is comprehended or reading goal is accomplished, (e.g., "I see"), p. 64 * When text is not understood, p. 64 (e.g., "I don't know;" "I don't understand" * Using dictionary, p. 70 | 1... <i>"What's Martian life?"</i> ...(Explanation: He checks comprehension, selected from W-01-P-1) 2... <i>"As such, it binds to DNA and regulates the activity of genes-make sense"...</i> (Implication: Using overall meaning of the text, selected from, W-04-E-2) 3... <i>"this-enigma...need to look up dictionary"...</i> (Implication: Using dictionary, selected from J-01-E-1) 4... <i>"it wasn't very clear...why it mentioned"...</i> (Implication: When text is not understood, selected from J-01-E-1) |

| Reading strategies | Description | Examples |
|---------------------------------|--|--|
| 5. Self-evaluation | <p>Checking the outcomes of one's own language leaning after it has been completed.</p> <p>* Re-reading parts of the text following reflection in order to reconsider what is in text exactly in light of insights gained during reflection</p> <p>* Overt affective reactions (i.e., laugh), p. 78</p> <p>* Is content interesting? p. 77</p> | <p>1... <i>"I don't like this article"</i>... (selected from W-02-P-2)</p> <p>2... <i>"it's funny-it's funny research"</i> – (selected from W-03-E-1)</p> <p>2... <i>"this topic is quite interesting"</i>... (selected from J-03-P-1)</p> |
| II. COGNITIVE STRATEIGES | | |
| 6. Resourcing | Using target language reference materials such as dictionaries. | 1... <i>"this-enigma...need to look up dictionary"</i> ... (Implication: He uses dictionary, selected from J-01-E-1) |
| 7. Repetition | Imitating a language model, including overt practice and silent rehearsal. | <p>1... <i>"re-united into a single lane leading to an alluring sugar solution...sugar solution and an alluring sugar solution... alluring...leading to...head to... sugar solution"</i> - (selected from K-03-P-2)</p> <p>2... <i>"frequent-change birds approached in about 6 minutes instead of 10 minutes...the frequency change...frequent change... frequent change things"</i> – (selected from K-02-E-1)</p> |
| 8. Deduction | Applying rules to understand or produce the second language or making up rules based on language analysis | <p>1... <i>"She and her colleagues set up a pathway that forked...forked...fork... 叉子"</i>... (Explanation: 叉子 means fork as a noun in Chinese. He basically made up the rule based on his language analysis and misinterpreted it as a noun in Chinese, selected from K-03-P-2)</p> |
| 9. Imagery | Using visual images (either mental or actual)) to understand or remember new information | 1... <i>"from this picture...it should be about the road range"</i> – (selected from J-04-P-2) |
| 10. Auditory representation | Planning back in one's mind the sound of a word, phrase, or longer language sequence. | 1... <i>"a treat that she calls the Ama-zon...A-ma-zon...Amazon... equivalent of chocolate"</i> - (selected from W-03-E-1) |

| Reading strategies | Description | Examples |
|--------------------------------|---|--|
| 11. Elaboration/interpretation | <p>Relating new information to prior knowledge, relating different parts of new information to each other, or making meaningful personal associations with the new information.</p> <p>* pretending to deliberate with other while reading the text, perhaps by talking to themselves, with alternative interpretation entering the dialogue, p. 57</p> | <p>1... <i>"the questionnaires were filled out in 1982...so this was the questionnaire in 1982...but until now-it has been"</i>- (Implication: He looked at the publication date, 2002)... <i>"so it has been twenty years"</i> – (Selected from J-03-P-1)</p> <p>2... <i>"ooh...no...so I misunderstood-it should be reduce dream this thing...so it would... because dream suppress...would suppress formation of dynorphine... so once dream...is mutated dynorphine will increase"</i> –(selected from J-02-E-2)</p> |
| 12. Inferencing | <p>Using available information to guess meanings of new items, predict outcomes, or fill in missing information.</p> <p>* Confirming/disconfirming an inference with information in subsequent text, p. 48</p> <p>* Conscious inferencing making-inferring the referent of a pronoun, p. 46</p> | <p>1... <i>"so may be they can use the...this concept to develop new drug...I also think maybe can use to anesthetize...to do anesthesia"</i>. (Implication: Using available information to predict outcomes, selected from W-04-E-2)</p> <p>2... <i>"In the March Astronomical Journal-someone propose that"</i> (Explanation: He skipped the tile of the person -Edward Belbruno and J. Richard Gott of Princeton University and replaced it by someone) – (Implication: Conscious inferencing making-inferring the referent of a pronoun, selected from K-04-E-2)</p> |
| 13. Note-taking | <p>Writing down key words or concepts in abbreviated verbal, graphic, or numerical form while reading.</p> | <p>失眠</p> <p>1... <i>"insomnia"</i>...(Explanation: He wrote the Chinese translation next to the word) - (selected from K-01-P-1)</p> |
| 14. Summarizing | <p>Making a mental summary of new information gained through reading</p> | <p>1... <i>"if hitting from Earth...should be "size" (code-switching)... should not be this big-next it brought up some viewpoints...then using computer simulations to prove-these...it may possibly happen"</i> – (selected from J-01-E-1)</p> |
| 15. Recombination | <p>Constructing a meaningful sentence or larger language sequence by combining known elements in a new way.</p> | <p>1... <i>"they expected that it should be-in the immune system-problems-caused problems-but the results of the experiment did not"</i> – (Implication: Constructing a sentence in a new way, selected from J-02-E-2)</p> |

| Reading strategies | Description | Examples |
|--------------------|---|---|
| 16. Translation | Using the first language as a base for understanding and/ or producing the second language. | 1...這個東西是從哪裡來的還不是太清楚... Translation: <i>where it came from has remained unclear-</i> (Explanation: He translated directly from the text, selected from J-01-E-1) |

Source: Adapted from O'Malley, Chamot, Stewner-Manzanares, Kupper, and Russo (1990), Pressley and Afflerbach (1995)

Table 5.

Reading passages read in order

| Joe | Kevin | William |
|--|--|--|
| J-01-E-1 Moon story waxes fuller | K-01-P-1 Eight hours of sleep may not be so great | W-01-P-1 Detecting life on Mars |
| J-02-E-2 Dreaming away pain | K-02-E-1 Maybe what Polly wants is a new toy | W-02-P-2 Eight hours of sleep may not be so great |
| J-03-P-1 Eight hours of sleep may not be so great | K-03-P-2 Road rage keeps ants moving smoothly | W-03-E-1 Maybe what Polly wants is a new toy |
| J-04-P-2 Road range keeps ants moving smoothly | K-04-E-2 Moon story waxes fuller | W-04-E-2 Dreaming away pain |

Note: [J-01-E-1] (J=Name of the subject; 01= # of the passage read; E -1 = the first electronic passage read; P= printed text)

Types of strategies

The think-aloud data collected provides an indication of the reported use of strategies. In this study, two major groups of strategies were examined: metacognitive strategies and cognitive strategies. Metacognitive strategies consist of five sub-categories. Cognitive strategies, on the other hand, include ten sub-categories. The data presented in this section

was quantified.

Metacognitive strategies

Metacognitive strategies are strategies that, “involve both knowledge about learning (metacognitive knowledge) and control or regulation over learning (metacognitive strategies)” (O’Malley and Chamot, 1990, p. 105). As research suggests, all subjects showed frequent use of metacognitive strategies when reading either electronic or printed text as shown in Table 6. In particular, William showed relatively high frequency in using the metacognitive strategies in both the electronic and printed text, compared to the other subjects. Joe, however, used metacognitive strategies more frequently when reading electronic text compared to Kevin who used more metacognitive strategies in reading printed text. Moreover, all of the subjects showed some variation by the strategy type and frequency. For instance, both Joe and William primarily focused on two out of five potential metacognitive strategies (evaluating and monitoring) and had relatively high frequency compared to Kevin who used more types of metacognitive strategies but with less frequency in all of the strategies except the monitoring strategy.

Evaluating and monitoring. Among all subjects, William showed a relatively high use of the evaluating strategy regardless of the text formats compared to the other subjects. Noticeably, both Joe and Kevin showed a relatively low frequency of using the evaluating strategy in reading electronic text compared to William. The monitoring strategy, on the other hand, appears to be the most frequently used strategy in the group of metacognitive strategies among all of the subjects regardless of the text formats (See Table 6 below).

Table 6.

Metacognitive strategies reported in printed and electronic text

| Strategy type | Joe | | Kevin | | William | |
|---|--------------|--------------|--------------|--------------|-------------|--------------|
| | Printed | Electronic | Printed | Electronic | Printed | Electronic |
| Metacognitive strategies | | | | | | |
| Evaluating | 5 (18%) | 4 (6%) | 2 (5%) | 0 | 3 (33%) | 5 (26%) |
| Monitoring | 6 (21%) | 15 (24%) | 10 (26%) | 9 (30%) | 3 (33%) | 6 (32%) |
| Selective attention | 0 | 8 (13%) | 3 (8%) | 1 (3%) | 0 | 0 |
| Self-management | 0 | 0 | 4 (11%) | 0 | 0 | 0 |
| Directed attention | 0 | 0 | 1 (3%) | 0 | 0 | 2 (11%) |
| Metacognitive strategies used in total | 11 (39%) | 27 (44%) | 20 (53%) | 10 (33%) | 6 (67%) | 13 (69%) |
| Total # of strategies used | 28 (100%) | 62 (100%) | 38 (100%) | 30 (100%) | 9 (100%) | 19 (100%) |
| Types of strategies used | 2 | 3 | 5 | 2 | 2 | 3 |

Directed attention, selective attention, and self-management. Strategies such as directed attention, selective attention, and self-management only occurred sporadically compared to other strategies in the group of metacognitive strategies (See Table 6 above). Selective attention, in particular, was the most frequently used strategy in comparison to the two other strategies. Examples of the use of selective attention were often found when subjects highlighted a particular part of the text during reading. Moreover, in comparing the frequency of selective attention between the two text formats, selective attention was more frequently used in electronic text than traditional print. Selective attention accounted for only 3 percent of the strategies from Kevin's oral report on paper and 11 percent from William's think aloud data on electronic text. Self-management was only found in Kevin's data on paper since neither Joe nor William showed any indication of the use of self-management.

Research (O'Malley et al, 1985) suggests that metacognitive strategies allow learners to review and monitor their learning progress in order to improve their future learning engagements. This study supports these findings since the results of this study indicate that metacognitive strategies play an important role in second language reading. All subjects showed frequent use of metacognitive strategies, particularly the monitoring strategy, which was the most frequently used strategy present in this study.

Cognitive strategies

Cognitive strategies in this study consist of eleven sub-categories including repetition, deduction, imagery, auditory representation, elaboration/interpretation, inferencing, note-taking, summarizing, recombination, and translation. Participants' use of cognitive strategies within this study is shown in Table 7. Overall, Joe showed the greatest use of cognitive strategies while reading the paper-based passage and Kevin had the highest cognitive strategies frequency when reading electronic text. In contrast, there were only a few instances found from William's think-aloud data in which he used cognitive strategies, compared to the other two subjects.

Table 7.

Percentage of total cognitive strategies reported

| Strategy type | Joe | | Kevin | | William | |
|----------------------|----------|------------|----------|------------|---------|------------|
| | Printed | Electronic | Printed | Electronic | Printed | Electronic |
| Cognitive strategies | 17 (61%) | 56% | 16 (47%) | 67% | 3 (33%) | 6 (31%) |

Translation. Translation was the most frequently used strategy in the group of cognitive strategies from both Joe and Kevin's think-aloud data regardless of the text formats. As research suggests learners are "eager to translate and infer the meanings of the reading passages with the aid of dictionary in order to understand the passage as well as prepare for the follow-up tasks (Son, 2001, p. 302). However, there was no evidence found in the use of translation throughout the entire experiment from William's data because he was the only subject who reported only in English. Joe, in contrast, reported in Chinese throughout the entire experiment. It was found that Joe translated the majority of the text during reading while reading both electronic and printed text. Evidence of the use of translation was only found in parts of Kevin's report. More specifically, he translated only unknown words and text that he did not completely understand.

Resourcing. Interestingly, there was no evidence of the use of resourcing strategy (e.g., using either online or paper dictionary) from William's oral report. Only Joe and Kevin showed a more frequent use of the resourcing strategy regardless of the text format. Moreover, no preference of the use of the resourcing strategy was found in reading either electronic or printed text.

Auditory representation. The use of the auditory representation strategy was only found in subjects who reported in English. There was no indication of the use of auditory representation from Joe who only spoke Chinese throughout the entire experiment. Such evidence provided a great explanation to subjects who merely or partially reported in English because it enabled them to replay the sound of a word or phrases to help them better

understand the text. In addition, more instances of this strategy were found from William since Kevin also partially reported in Chinese.

Inferencing. As the results suggest, the inferencing strategy was used the most frequently when reading electronic text. Instances were found that all subjects showed frequent use of the inferencing strategy in relating the text to their prior knowledge while completing the tasks (See examples in Table 4 above).

Note-taking strategies. Little evidence was found of the use of note-taking. There was no indication of the use of the note-taking strategy from Joe's report. Only a few instances were found in both William's (5 percent in electronic text) and Kevin's (3 percent in printed text) think-aloud data.

Recombination. The use of recombination was only found in reading the electronic text from Joe's and Kevin's reports. Moreover, there was no evidence found in the use of recombination in reading traditional print for any of the subjects.

Imagery. Interestingly, of the two subjects who selected and read the passage with illustrations, only one reported using the images. The subject used this strategy while he was previewing the passage. Because only two passages contained illustrations (one in each text format), it is possible that more passages with illustrations might increase the participants' reported use of this strategy.

Elaborating. Elaborating was one of the most frequently used strategies in the group of cognitive strategies used by all of the participants, except for Kevin. The results from Kevin's report suggest that he often identified the problem and moved on without figuring out the answers to the questions, which explained the results from the think-aloud data. Moreover, the percentage of the use of elaborating from Kevin's report was the lowest among all of the subjects.

Deduction & Repetition. Both deduction and repetition were strategies only found in Kevin's report. Neither Joe nor William's report show any indication of the use of these strategies. Examples of the use of deduction were often found when the subject changed the linguistic elements from the original text and made up his own rules while analyzing the text. For instance, "*Fox also found that some objects provoke* – ('provoked' was in the past tense in the original text)....," an example taken from Kevin's oral report. The original text was supposed to be in past tense, however, it was reported in present tense.

Examples of the use of repetition, on the other hand, often occurred when the participants rehearsed parts of the text in order to aid reading comprehension and obtain a deeper understanding of the text.

Summarizing. Joe was the only one who used the summarizing strategy during the experiment and it accounted for only two percent of his total strategies. No evidence was found in either Kevin's or William's oral reports. This is not surprising since all reading passages are relatively short and the subjects needed to complete a short summary after reading.

Overall, individuals varied in their preferences for certain strategies as much research has suggested (e.g., Chapelle and Mizuno, 1989; Cohen 1992) (See Table 8). Thus, educators should not anticipate learners to use certain strategies to complete tasks. Instead, opportunities to use a variety of strategies should be given to all learners in order to increase the possibility of learners choosing reading strategies that are most conducive of their reading needs and individual learning goals.

Table 8
Cognitive strategies reported in both printed and electronic text

| Strategy type | Joe | | Kevin | | William | |
|---|----------|------------|----------|------------|---------|------------|
| | Printed | Electronic | Printed | Electronic | Printed | Electronic |
| Translation | 7 (25%) | 14 (23%) | 4 (11%) | 5 (17%) | 0 | 0 |
| Resourcing | 2 (7%) | 6 (10%) | 4 (11%) | 5 (17%) | 0 | 0 |
| Auditory representation | 0 | 0 | 2 (5%) | 4 (13%) | 2 (22%) | 1 (5%) |
| Inferencing | 2 (7%) | 9 (15%) | 0 | 2 (7%) | 0 | 1 (5%) |
| Note-taking | 0 | 0 | 1 (3%) | 0 | 0 | 1 (5%) |
| Recombination | 0 | 1 (2%) | 0 | 1 (3%) | 0 | 0 |
| Imagery | 1 (4%) | 0 | 0 | 0 | 0 | 0 |
| Elaborating/interpreting | 5 (18%) | 4 (6%) | 0 | 0 | 1 (11%) | 3 (16%) |
| Deduction | 0 | 0 | 1 (3%) | 1 (3%) | 0 | 0 |
| Repetition | 0 | 0 | 4 (11%) | 2 (7%) | 0 | 0 |
| Summarizing | 0 | 1 (2%) | 0 | 0 | 0 | 0 |
| Cognitive strategies used in total | 17 (61%) | 56% | 16 (47%) | 20 (67%) | 3 (33%) | 6 (31%) |
| Types of strategies used | 5 | 7 | 6 | 7 | 2 | 4 |
| Total # of strategies used | 28 | 62 | 38 | 30 | 9 | 19 |

Individual differences in the participants' reported use of strategies

The following section extends the research discussion to different findings such as the individuals' differences in their use of various reading strategies within the different reading environments. These differences entail the relation between individual performances and their reported use of strategies as well as the individuals' reading time and other related factors, including text formats, the reported use of strategies, and subjects' performance.

Individual performance and the reported use of strategies. As the results suggest, individuals varied in their reported use of strategies. However, it did not seem to have an impact on subjects' reading performance. That is, there was no correlation between readers' performance and the number of strategies used while performing the tasks. The table below shows the written task results which provide information regarding the subjects' level of reading comprehension of each passage they read (See Table 9 and 10). Each summary was scored based on the following three criteria: the main idea, supporting details and the result. Subjects who provided information based on three criteria would receive a full score, 5 points. Those who included the main idea or supporting details would receive 2 points, and those who included the result would receive 1 point.

Interestingly, all subjects received the same scores (35 percent) on the written summary tasks while reading electronic text; however, the number of strategies they used in completing the tasks varied (See Table 9). For instance, Joe used a total of 28 strategies while William only used 9 strategies when reading electronic text. In printed text, on the other hand, Joe scored the highest (40 percent). Kevin received the lowest score (15 percent). Although William scored higher in printed texts than Kevin did on the task, Kevin appeared to use

more strategies than William. Thus, the results suggest that there is no relation associated with subjects' performance and the number of strategies they used on the tasks.

Table 9.
Comparison of individual overall performance

| | | Joe | | Kevin | | William | |
|----------------------------|------------|------------|---------|------------|---------|------------|---------|
| Formats | | Electronic | Printed | Electronic | Printed | Electronic | Printed |
| Written task | Scores | 35% | 40% | 35% | 15% | 35% | 35% |
| | Time (min) | 28: 27 | 17: 01 | 14:11 | 17: 08 | 11: 54 | 09.36 |
| Total # of strategies used | | 28 | 62 | 38 | 30 | 9 | 19 |
| The reading test | Items | 33 | | 38 | | 38 | |
| | Scores | 15.46 | | 27.22 | | 20.29 | |
| | Time | 75 min. | | 65 min. | | 59 min. | |
| TOEFL scores | | 223 | | 197 | | 193 | |

Note: total number of the TOEFL reading test items is 38.

Individual reading time and other related factors

Another important finding is that the participants' reading time related to several factors including the effects on the text formats, the reported use of strategies, and subjects' performance. Each sub-section below details the connections between individual reading time and their reported use of strategies and provides supporting examples.

Individual reading time and text formats. As the results suggest, there was a variation on the reading time subjects spent on the written tasks in the two text formats. For instance, Joe spent more time reading the electronic text than he did the print on the written summary

tasks (See Table 10). This result may be caused by Joe being unfamiliar with the reading context and thus may indicate that Joe should receive proper training in order to obtain the skills and knowledge necessary to improve his reading within the electronic context. Although Joe's increased time spent on completing the task may have resulted in his engagement in a larger number of strategies within this format, this result remains inconclusive.

Individual reading time and the reported use of strategies. Furthermore, while considering the relation to the reading time of each passage and the number of strategies used, the results suggest that the longer the time subjects spent resulted in an increase of the number of strategies used on the tasks. For instance, both Joe and Kevin read an identical passage in the electronic version, *Moon story waxes fuller*. When comparing the reading time of both participants and the number of strategies each participant used, Joe spent three times as long as Kevin to complete the task, and he used five times more strategies than Kevin (See Table 10 below). A similar result was found in the printed passage *Eight hours of sleep may not be so great* that Kevin and William read.

Individual reading time and their performance. The results also suggest that the time subjects spent on the tasks did not assure better performance. For instance, the results show that all subjects read one identical passage, *Eight hours of sleep may not be so great (B)*, in print (See Table 10). Among all, Kevin spent the longest time in reading (09: 53 min.); however, he received the lowest score compared to the others. Other instances are also found in passage F and E (See Table 10). Thus, the results suggest that individual differences in the

reading time and their performance are more learner-dependent than dependent on the type of text media.

Insights on the methodology

This following section focuses on the effects of the methods, including the think-aloud training and the concurrent and retrospective reports. It also explores other related issues including the language effects, topic familiarity, the use of resources, the use of Morae software, and finally, the complexity of the coding process.

Think aloud training

The think-aloud training was very successful. The initial part of the training included a brief introduction of the think-aloud method and was followed by an audio demonstration and a think-aloud practice. All subjects reported that the demonstration was helpful in terms of their understanding of the think-aloud procedure. The transcript was also available while the participants listened to the audio demonstration. All subjects followed the transcript while listening to the demonstration. Both instruments allowed readers to receive different assistance in terms of visual as well as auditory aid to help them acquire a better understanding of the think-aloud procedure.

During the think-aloud practice, Kevin was the only subject who expressed confusion while viewing the procedure used in eliciting the information. Although he was the only one who had prior experience with the think-aloud method before the experiment, this did not seem to place him at an advantage in thinking aloud compared to the two other subjects without any previous experience. Therefore, a follow-up section after the practice was

Table 10.

Individual subject's performance on the written summary tasks

| Names | Joe | | | | | | Kevin | | | | | | William | | | | | |
|----------------------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|--------|---------|--------|--------|--------|--|--|
| | E1 | E2 | P1 | P2 | E1 | E2 | P1 | P2 | E1 | E2 | P1 | P2 | E1 | E2 | P1 | P2 | | |
| Formats | 1 | 2 | 3 | 4 | 2 | 4 | 1 | 3 | 3 | 4 | 1 | 3 | 3 | 4 | 1 | 2 | | |
| Reading order | F | D | B | C | E | F | B | C | E | D | A | C | E | D | A | B | | |
| Passage | 2 | 5 | 3 | 5 | 5 | 2 | 0 | 3 | 5 | 3 | 5 | 3 | 5 | 3 | 5 | 2 | | |
| Scores/pts | 15: 55 | 12: 32 | 07: 20 | 09: 49 | 09: 05 | 05: 06 | 09: 53 | 07: 15 | 05: 51 | 06: 03 | 03: 02 | 06: 16 | 05: 51 | 06: 03 | 03: 02 | 06: 16 | | |
| Time/ min. | | | | | | | | | | | | | | | | | | |
| # of strategies used | 27 | 35 | 12 | 16 | 25 | 5 | 19 | 19 | 5 | 14 | 4 | 5 | 5 | 14 | 4 | 5 | | |

Note: 1) E 1= first electronic passage read; P1= first printed text read; 2) A= Appendix A: Detecting life on Mars; B= Appendix B: Eight hours of sleep may not be so great; C= Appendix C: Road rage keeps ants moving smoothly; D= Appendix D: Dreaming away pain; E=Appendix E: Maybe what Polly wants is a new toy; F= Appendix F: Moon story waxes fuller.

assigned to Kevin in order to provide him with the opportunity to obtain clarifications for any questions that remained after participating in the think-aloud training. Moreover, a review session was given to all subjects before conducting the experiment in order to assure that they were all at the same level of understanding in terms of the think-aloud procedure.

During the actual experiment, there was no indication that the subjects felt anxiety or discomfort as a result of being asked to think aloud. In addition, the subjects did not appear to express any confusion toward the think-aloud procedure. Thus, the think-aloud preparation as researchers suggest (Ericsson and Simon, 1993) is critical even for experienced users.

Effects of concurrent and retrospective report

In addition to research data gathered from the subjects' thought processes, I also attempted to gather information about learning strategies via a retrospective report. The retrospective report involves having subjects recall what they did within the experiment while verbalizing their thought processes. Ideally, the information gathered from retrospection should correspond to the data obtained from the concurrent report. However, little evidence in terms of the reported use of strategies is found in the retrospective report. Subjects often repeated the content of the passage by saying the first paragraph talked about X, the second paragraph discussed Y, and so forth. Although research suggests that the integration of concurrent and retrospective reports allows the investigator to retrieve more reliable data (Ericsson and Simon, 1993), it was not apparent in this study. Therefore, the analysis is focused primarily on the reported use of strategies retrieved from the individuals' concurrent reports.

Language effects

To minimize the language effects, subjects were given the option of reporting in English, Chinese, or in both, and they were instructed that they could switch the language of their choice during the experiment. Among the three subjects, Joe was the only one who reported in Chinese. He occasionally switched codes; that is, replaced a word or a phrase in English; for instance, “*這個是一個 another factor*” (Translation: This is another factor.). Similar to Joe, Kevin reported in both languages, mainly in English and partially in Chinese. In particular, he used English for reading the passage and then spoke in Chinese to report his thoughts. As Son (2001) suggests, learners tend to read the text first and then figure out the meanings of any unknown words or sentences. William, on the other hand, reported only in English throughout the entire experiment. However, instances of mispronunciation occurred within William’s oral report, which had the potential to become problematic since such data could lead to false interpretations without further clarification. Therefore, William was asked to examine the transcript to avoid any misinterpretation or incorrect translations.

The results suggest that reporting in Chinese could ease the process of data analysis; that is, no mispronunciation would occur if participants chose to report in their native language. In addition, there is also a possibility that the data reported in English could not fully explain the subjects’ thoughts and behaviors, especially those referring to reading strategies, since the information retrieved may not necessarily form a meaningful sequence that describes a behavior such as the reported use of strategies in this instance. Therefore, reporting in Chinese eased the process since it minimized the chance that participants would misuse the language when reporting in English.

Effects of topic familiarity

All six passages selected varied in their topics. Each text format contained three different topics: Zoology, Astronomy, and Biomedicine (See Table 11 below).

Table 11.

Topics of the reading passages in each text format

| | Zoology | Astronomy | Biomedicine |
|------------------------|--------------------------------------|-------------------------|---|
| Electronic text | Maybe what Polly wants is a new toy | Moon story waxes fuller | Dreaming away pain |
| Printed text | Road rage keeps ants moving smoothly | Detecting life on Mars | Eight hours of sleep may not be so great in print |

All subjects commented that the passages they read were very interesting. For instance, both Joe and Kevin reported that the passage, *Road rage keeps ants moving smoothly*, was very interesting. William also commented after reading *Eight hours of sleep may not be so great* that the passage was very interesting even though he did not agree with the author's claim that eight hours of sleep per night may not necessarily transfer into a longer life. Such results suggest that all subjects possessed the same level of high motivation while reading the texts and completing the various other tasks.

The participants' level of motivation was perhaps also related to the fact that several different texts were provided, thus enabling participants to choose a text that related to their prior knowledge and experience. Among all the passages, both passages in Biomedicine, particularly *Dreaming away pain* (See Appendix D) seemed to connect best with the participants. Evidence was found that both Joe and William were able to relate the new

information to their prior knowledge/topical knowledge in the area of their field of study when reading the passage related to Biomedicine. The instance below exemplifies the use of prior knowledge.

Instead of controlling an immunity-related gene, as Penninger's team expected, DREAM appears to suppress the production of a natural opioid called dynorphin-immunity-related gene, as Penninger's team expected. 'I think it's similar to dopamine (Selected from William's think aloud report, Dreaming away pain).

Moreover, both Joe and William commented that *The cell* or *Nature* are very well-known periodicals which again related to their field of study. Although topic familiarity may increase the participants' level of motivation, the results suggest that such effects should be avoided in this study in order to retrieve the greater focus on the reported use of strategies by selecting passages that are not centered on a particular subject.

On the other hand, the second passage in Biomedicine, *Eight hours of sleep may not be so great*, seemed to produce the same result as discussed earlier; however, the content of this passage was actually more prevalent to all subjects compared to the first one. Moreover, evidence was found that Kevin was able to overcome the problems he encountered while reading by using his prior knowledge on this topic. That is, he reported that he had read similar articles pertaining to the same topic. However, such experience did not lead to success in his performance. A detailed description of the written summary results is presented later in this chapter.

Although it was found that subjects did vary in their topic familiarity, no evidence was found that subjects chose passages that only related to their field especially for Joe and William; both chose a passage about astronomy.

The use of resources

As research (Chou, 1992) suggests, learners often find resources, especially vocabulary aid, to be helpful as a means to assist them in comprehension. Both an online version of a dictionary and a printed version of a dictionary were available during the experiment. All subjects showed positive feedback on the use of these resources while reading. However, Kevin commented that when reading the fourth passage, he found himself to be less motivated in terms of looking up words he did not understand. Instead, the method he chose to use was to predict meanings of unfamiliar words; that is, use contextual clues to help him understand portions of the text that he was unable to comprehend.

In addition, there was a tendency that subjects only used the online dictionary when reading electronic text and the paper dictionary for the hardcopy. There was only one instance found in the think-aloud data that indicated the use of the online dictionary while reading the hardcopy.

Follow-up interview

All interviews were conducted immediately after the individual subjects completed the concurrent and retrospective reports. It was found that the immediate follow-up interview was very helpful in explaining the subjects' behaviors observed by the investigator. This was particularly beneficial since it elicited information regarding not only the use of specific reading strategies, but also reading behaviors in general, thus providing additional information that allowed the investigator to better understand those instances that could not be fully understood from the think-aloud data. For instance, Kevin pointed out that he thought out loud only when the text or words could not be fully understood, which

corresponds to what earlier research has suggested that think-aloud processes often occur “when you are alone and working on a problem” (Ericsson and Simon, 1993, p. 80).

Moreover, it provides an explanation for the frequent use of the repetition strategy within his oral reports. He later explained that repetition was frequently used to assist his reading comprehension.

Furthermore, the responses collected from Kevin’s interview were compared to the results from the think-aloud data. The think-aloud data shows that Kevin used far fewer strategies when reading the third and fourth passages. He later explained in the interview that he became discouraged due to the amount of time spent reading each passage. There were a total of four passages, two in each text format, and the results indicate that the strategies used and the participants’ level of motivation significantly decreased when completing the last two passages.

The Morae software

The use of the Morae Manager allowed both the subject and the investigator to review the behaviors captured by the think-aloud process. That is, the individual recording was replayed and based on the behavior observed, I asked open-ended questions such as behavior A was observed when reading Paragraph X. Often subjects were able to recall what had happened from watching the recording and proceeded in providing an explanation for their behaviors.

The complexity of the coding process

As results suggest, some instances in terms of the reported use of strategies subjects

reported were coded as more than one strategy. An instance was found in Kevin's think-aloud report shown below:

失眠

Kevin: ... "*insomnia*"...(Explanation: he wrote the Chinese translation above the word)
(selected from K-01-P-1).

The instance shown above illustrated the use of two reading strategies: translation and note-taking. That is, Kevin first translated the word in Chinese, coded as the use of the translation strategy; then he wrote the Chinese translation above the word, coded as the use of the note-taking strategy. Other instances such as the use of dictionary were also coded as the use of two reading strategies: monitoring and resourcing. They were considered as the evidence that subjects detected their problems in terms of the unknown words and used the resource to improve their reading comprehension.

Summary

In this chapter, I first presented the test results and analyzed data, primarily retrieved from the subjects' concurrent reports. Additional information was gathered from the follow-up interview. It was found that the subjects varied in their reported use of strategies while completing the tasks. However, there is little indication of variation in the reported use of strategies between traditional print and electronic text with the exception of the inferencing strategy, which occurred more frequently in the electronic text context. Moreover, subjects spent more time reading in electronic text than printed text, and the more time subjects spent completing a task, the greater the number of strategies they used while completing the task. Thus, this study suggests that individual differences may be a more

important predictor of variation of the reported use of strategies than the media itself. This finding, however, remains tentative since further research is needed in order to formulate more definite conclusions. An overview of the research questions and findings is presented in Table 12 below.

In the second section, I discussed the methodological findings ranging from the think-aloud training and its procedure, to the selection of passages and the use of other methods such as the follow-up interview. The results suggest that the think-aloud is needed to familiarize subjects with the think aloud procedure as well as minimizing the anxiety that may possibly occur during the think-aloud process. Moreover, the use of Morae software was proved to be very useful in terms of organizing and storing data retrieved from the subjects' oral reports. In addition, the information gathered from the interview allowed more detailed explanations to be constructed in regards to any subjects' behaviors that were not fully understood from the reports.

Table 12.

Research questions and findings

| Research questions | Data | Analysis | Findings |
|--|---|--|---|
| <p>1. Do Chinese adult ESL learners vary in their use of strategies in different reading contexts: electronic text and traditional print?</p> | <p>1) Individuals' think-aloud transcripts and recordings. 2) Notes from my observation during the individual think-aloud process. 3) Subjects' responses from the follow-up interview.</p> | <p>1) Subjects' reported use of strategies retrieved from the think-aloud transcripts in two contexts were compared and analyzed. The data includes - <i>evidence of individual strategies used in either text format, which mainly divided into two major categories: metacognitive and cognitive strategies</i> - <i>number of times that a particular strategy appeared</i> - <i>number of types of strategies used</i> 2) Notes taken during the think-aloud process were mainly formed as questions later to be used in the interview and answered by individual subjects. 3) Responses from individual interview were gathered in order to clarify subjects' behaviors that were not fully understood from the text.</p> | <p>1) Individuals varied widely in their reported use of strategies. That is, subjects used a variety of strategies to complete the tasks including monitoring, evaluating, selective attention in the group of metacognitive strategies, and translation, inferencing, and resourcing in the group of cognitive strategies. 2) The difference in the two text formats did not elicit substantial differences on the reported use of strategies with the exception of inferencing, which was associated primarily with electronic text.</p> |
| <p>2. Under what circumstances, might individuals vary in their reported use of strategies?</p> | <p>1) Responses from the questionnaire; 2) Results from the TOEFL reading test; 3) Individuals' think-aloud recordings 4) The written summary task results;</p> | <p>1) Responses from individual questionnaire were examined. The data particularly addresses the subjects' familiarity with technology and web reading. 2) The time individuals spent on the TOEFL reading test results were calculated in examining the relation between the subjects' reading time and their performance. 3) Individuals' think-aloud recordings were timed and compared in order to examine the relation between text formats and individual differences. 4) The results from the written summary task were compared among all subjects. The data presents the variations within the subjects' performance in the two text formats.</p> | <p>1) Subjects spent more time reading electronic text than traditional print 2) A positive relation between reading time and strategies used in reading exists regardless of the text formats. That is, the longer time the subject spent on a reading task, the greater the number of strategies the subject reported using while reading 3) More reported strategies did not relate to higher performance</p> |

CHAPTER V: SUMMARY, AND IMPLICATIONS

In this chapter, I summarize the study and draw methodological implications, applications, and recommendations for future research.

Summary

This study was designed to investigate whether Chinese adult ESL learners use the same reading strategies in electronic text as they do in traditional print. In addition, this study attempts to gain insight into the issue of using the think-aloud process to elicit the reading strategies used while reading electronic and printed text, and to examine under what circumstances individuals might vary in their use of learning strategies.

To best elicit information regarding the subjects' reported use of reading strategies, the following methods were used: the think-aloud method, the use of Morae software, and the follow-up interview. The think-aloud method was mainly used in retrieving the subjects' thought processes and their reported use of reading strategies. The Morae software was used for the purpose of recording and organizing data gathered from the think-aloud processes. The follow-up interview, on the other hand, was used to clarify questions regarding subjects' behaviors that were not fully understood from the individual recordings.

During the think-aloud process, subjects were assigned two reading tasks. The major difference between these tasks was in their context. One was in traditional print, and the other was in electronic text. Each test format consisted of three passages. Each subject had an option of choosing two passages in either text. To best obtain the subjects' reported use of strategies, the oral report was conducted in two forms: concurrent and retrospective. The entire process was recorded by the Morae software, which allowed the investigator to review

the subjects' behaviors easily; moreover, it enabled the investigator to further clarify any questions regarding the behaviors observed during the interview. The research findings are listed and discussed below.

Research findings:

- 1) Individuals varied widely in their reported use of reading strategies. That is, subjects used a variety of strategies to complete the tasks including monitoring, evaluating, selective attention in the group of metacognitive strategies, and translation, inferencing, and resourcing in the group of cognitive strategies.
- 2) The difference in the two text formats did not elicit substantial differences on the reported use of strategies with the exception of inferencing, which was associated primarily with electronic text.
- 3) Subjects spent more time reading hypertext than traditional print.
- 4) A positive relation between reading time and strategies used in reading exists regardless of the text formats. That is, the longer time the subject spent on a reading task, the greater the number of strategies the subject reported using while reading.
- 5) More reported strategies did not relate to higher performance.

As Anderson (2003) suggests, research in the reported use of strategies between traditional print and electronic text is still in its infancy. As a result the results from this study will simply help to bridge the gaps within our current understandings of second language reading.

Methodological implications

Case study. The small number of participants provided advantages. It allowed more control in variation of individual subjects such as age, gender, cultural background, and academic background (see Table 1). It also allowed me to more deeply probe strategies of individuals using a variety of tools. Such depth would not have been possible with a large number of subjects.

Time limit. Although subjects commented that the reading passages were an appropriate length, reading four passages in a row proved burdensome to some subjects. One subject pointed out that he became less motivated when reading the third passage due to the time he spent reading; therefore, he began to guess meanings of unknown words without using any resources. Although he was able to adopt different strategies in solving the problems he encountered within the last two readings, this fatigue factor may have affected the quality of the data gathered from the experiment. For instance, strategies used in the third passages may have been affected by the reading order. However, the results did not seem to influence the subject's performance since no direct evidence exists that shows that the number of strategies used in the last two passages decreased. Therefore, the results suggest that the time subjects spend on tasks should be taken into consideration during the planning stage of the experiment. One solution may be to reduce the number of passages assigned in the tasks. For instance, each subject reads only one passage in each text format so that subjects will be less likely to become exhausted before completing the experiment.

Passages and order effects. All subjects reported that some passages they read were interesting. As research (Alderson, 2000) suggests, it is critical that subjects find passages interesting because it has the ability to increase subjects' motivation as well as encourage them to be more involved in the text and thus more willing to figure out problems that may occur while completing the tasks. In addition, one subject commented on one particular passage, "*Moon waxes fuller:*"

This passage was different from others I have read so far. I did not think of anything while reading because I was not familiar with this topic even though I understood the text or it was print in Chinese. Reading this kind of passage was like reading to learn something which you would not think of anything.

The passage that the subject read was about Astronomy, which he claimed was not familiar to him. This lack of familiarity caused him to believe that there was little to report while reading. Moreover, he explained that even if the text was printed in Chinese, he would still have difficulty understanding its content due to the topic unfamiliarity. Such comment emphasizes the importance of text selection for future researchers who are interested in using the think-aloud method to retrieve a subject's thought process because unfamiliarity may prevent subjects from reporting their thoughts.

In addition, one subject reported that he became less motivated due to his fatigue while reading the last passage, thus resulted in replacing one strategy to another from saving the time spent on the tasks. The research results, therefore, suggest that variation in reading order should also be controlled to minimize the order effects.

Verbal protocols. Verbal protocols proved to be a useful method in retrieving subjects' cognitive processes as well as their reported use of reading strategies. Although Ericsson and

Simon (1993) claim that everyone has some experience of reporting their thoughts, the results of the current study suggest that Chinese subjects benefited from receiving training in verbalizing their thoughts and practice prior to conducting the actual experiment since it helped prevent any discomfort or anxiety that may occur during the experiment. Kevin who had some experience using the think-aloud method still showed little confusion for the think-aloud procedure during the practice. Therefore, the results suggest that preparation in terms of the think-aloud training is essential before conducting the actual experiment.

Related to the issue of think-alouds, research suggests that both concurrent and retrospective reports should be carried out during the experiment (Ericsson and Simon, 1993) to ensure the accuracy of the individuals' think-aloud reports. However, the data gathered from the retrospective reports did not provide much information on the reported use of reading strategies compared to what was gained via the concurrent reports. From Kevin's retrospective report, he only repeated the content of the passage by simply reading directly from the text. This occurrence suggests that additional training may be needed in order to assure accuracy within the retrospective report.

The use of Morae software. The think-aloud method is known for its ability to create the coding system and complete and analyze transcripts. The use of Morae software eases the procedure of data collection and the process of analysis, with better quality compared to earlier studies that all data was recorded by tape recorders.

Applications

As research (Chapelle and Mizuno, 1989) suggests, learners often use a variety of strategies to complete tasks. That is, educators should not anticipate that certain strategies lead to successful reading. In contrast, learners should be frequently exposed to the new reading context so that observations can be done to adapt second language reading instruction to multiple forms of print in order to assist learners in making a smooth transition from traditional print to electronic text.

In addition to the variation in the reported use of strategies, this study also suggests that learners may spend more time reading electronic text. Such results may be caused by the reader's unfamiliarity of the reading context or imply an indication for the need of techniques in improving individual's reading rate within the electronic context. Moreover, for some readers reading electronically may be associated more with reading for pleasure, rather than academic purposes. During the interview, all subjects reported a certain degree of discomfort in reading electronic text due to the lack of features in note-taking. As a result, it would be interesting to investigate if note-taking is available in both contexts, will the reported use of strategies in both contexts vary?

Recommendations

Additional electronic text features. Electronic texts can be presented in a variety of forms. The texts used in this study did not contain all the features hypertext affords. Hypertext is defined as similar to printed text with exception of additional multimedia features such as audio, video, and others including embedded links and non-linearity (Behrens et al, 2000). For further research, one should consider using electronic texts which

include all features mentioned above in order to extend the number of strategies available to participants (e.g., navigating strategy); moreover, to observe how individuals react to the non-linearity when reading hypertext, compared to traditional paper-based text which is only presented in a sequential order.

Extension to other groups of participants. Future researchers may extend the research to other groups in terms of ages, gender, and different language and educational background in order to observe additional examples of readers using strategies on a broader level and explore other factors that may possibly influence the reported use of strategies in different contexts. The results for a group of younger participants, for example, may vary dramatically since younger generations tend to have more experience with web reading, and the computer because they were exposed to technology much earlier than older generations, such as the subjects in this study who were all graduate students.

Consideration of number of required tasks. Little evidence is found in terms of the differences of the reported use of strategies in two text formats. Therefore, future research may either increase the number of participants and reduce the passages assigned (subjects had to complete reading four passages in this study) so that more identical patterns can be found and used for the purpose of examining differences in the reported use of strategies between printed text and electronic text, or increase the tasks so that the variability of participants thus will decrease.

In conclusion, the current study confirms that the study of reading strategies is a

complex endeavor and that strategies used are governed by a multitude of factors, including reading time, reading context, and individual differences. The current study brings additional insights concerning certain methodological tools for studying reading strategies, including the think-aloud procedure and the Morae software. It also suggests that currently there is not reason to believe that reading via electronic text makes a great difference in learners' reported use of reading strategies, with the possible exception of inferencing. In addition, the fact that this was a case study of only 3 Chinese learners leaves room for future studies to conduct research using think-alouds and Morae software on participations of other cultures.

APPENDIX A: DETECTING LIFE ON MARS

Detecting life on Mars (in print) - Week of Feb. 5, 2005; Vol. 167, No. 6, p. 94

Christen Brownlee

Despite ample evidence for liquid water on Mars, scientists remain unsure whether life ever resided there. Results from a 1976 Viking probe to the Red Planet failed to find any chemical sign of life, but many scientists argue that the probe wasn't sensitive enough to do so.

Alison M. Skelley and her colleagues have come up with a new way to search for Martian life. They started with an existing device, the Mars Organic Detector, that would remove trace amino acids—the building blocks of proteins—from Martian soil, if they are there. However, the mere presence of amino acids isn't a definite sign of life, but a key geometric trait of the molecules can be.

So, Skelley's team designed a complementary device, the Mars Organic Analyzer. It would take amino acid residues from the detector and then determine whether the molecules have a left-handed or right-handed configuration. Amino acids can exist in either form in nature. A lifeless setting would have about equal amounts of each, but in living organisms, amino acids invariably assume the left-handed form. Detecting a lopsided abundance of one or the other form of amino acids on Mars, therefore, could be a sign of life, the researchers note in the Jan. 25 Proceedings of the National Academy of Sciences.

APPENDIX B: EIGHT HOURS OF SLEEP MAY NOT BE SO GREAT

Eight hours of sleep may not be so great (in print) -Week of March 16, 2002; Vol. 161, No. 11, p. 173

Nathan Seppa

Doctors may recommend it for good health, but researchers now find that sleeping 8 to 9 hours a night doesn't necessarily translate into a longer life.

Scientists came to that conclusion after analyzing medical and lifestyle data, including sleep reports, of 1.1 million people between ages 30 and 102 who had filled out questionnaires in 1982.

The researchers accounted for 32 factors, such as age, smoking, weight, economic status, exercise, and medications that might influence death rate in the group. When they assessed the volunteers' status 6 years later, the scientists found a surprising trend.

People reporting 7 hours of sleep each night were the least likely to have died in the 6 intervening years, the researchers report in the February Archives of General Psychiatry. People sleeping 8 hours a night were 13 percent more likely to have died than the 7-hour sleepers. Volunteers getting 9 hours a night were 23 percent more likely to die than 7-hour sleepers were. On the other end of the sleep spectrum, people getting just 5 or 6 hours a night were 7 percent more likely than the 7-hours-a-night group to have died.

The study also found that people reporting insomnia were no more likely to have died during the 6 years of the study than those who didn't, unless they were taking sleeping pills, says study coauthor Daniel S. Kripke, a psychiatrist at the University of California, San Diego, in La Jolla.

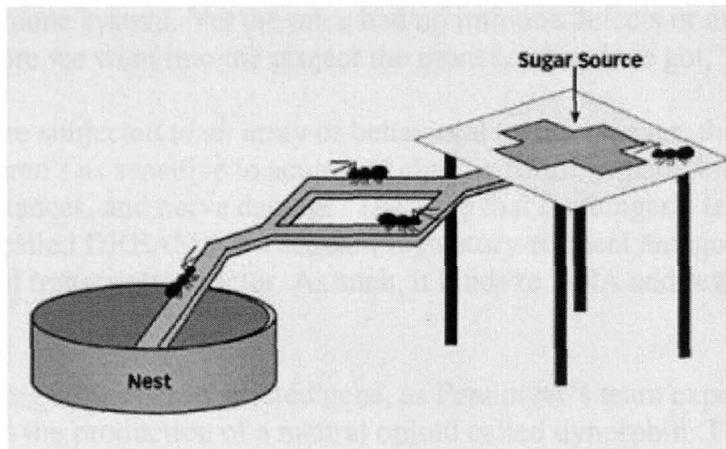
The findings should change the advice physicians give patients, Kripke says. If a person feels rested and alert after 5 or 6 hours of sleep, he says, doctors should tell that person that such a schedule poses little health risk.

The large number of people surveyed lends credibility to the findings, say Daniel J. Buysse and Mary Ganguli of the Western Psychiatric Institute and Clinic in Pittsburgh in the same journal. However, they caution that the numbers don't explain why some people slept more than others. "And they certainly don't tell us that it was the extra hour of sleep that killed them," they say.

APPENDIX C: ROAD RANGE KEEPS ANTS MOVING SMOOTHLY

Road rage keeps ants moving smoothly (in print) - Week of March 20, 2004;
Vol. 165, No. 12, p. 190 by Susan Milius

Traffic scientists, specialists in nonlinear systems, and animal behaviorists have cooperated in a study of one of the natural geniuses of transportation engineering: the black garden ant of Europe.



A BRIDGE TOO NARROW. In a traffic experiment, ants from a nest (left) cross a split-lane bridge to collect a sugar solution.

Nature

Ants don't have police officers or traffic lights, but crowded streams of workers readily redirect themselves into new traffic patterns that ease congestion, according to Audrey Dussutour of Paul Sabatier University in Toulouse, France. "They regulate traffic before it becomes blocked," she says.

She and her colleagues set up a pathway that forked and then reunited into a single lane leading to an alluring sugar solution. When the researchers made each branch of the fork an ample, finger-width freeway, the hundreds of ants in a nest linked to the course tended to do all of their traveling on just one branch of the fork. That's presumably because the first ant to enter the path left behind a trail of scent and the rest followed, all the while reinforcing the scent.

When the researchers narrowed the branches to 6 millimeters or less, traffic got so dense that ants started to collide head-on. Pushing and shoving then nudged some ants at the forks in the road toward the underutilized branch. Both branches soon carried two-way traffic.

This mechanism of congestion control among ants could point to new ways of routing data in networks, Dussutour and her colleagues point out in the March 4 *Nature*.

APPENDIX D: DREAMING AWAY PAIN

Dreaming away pain (in electronic text) - Week of Feb. 9, 2002; Vol. 161, No. 6, p. 93

John Travis

The mutant mice didn't make sense. Josef M. Penninger of the University of Toronto and his colleagues had disabled a rodent gene that they thought controlled another gene, one involved in the immune system. Yet the mice had no immune defects or any other obvious problems. "The more we went into the project the more confused we got," recalls Penninger.

When the mice were subjected to an array of behavioral tests, however, the scientists noticed that the rodents weren't as sensitive to acute and chronic forms of pain, including pain caused by heat, toxic substances, and nerve damage. The gene that Penninger's team had mutated encodes a protein called DREAM (downstream regulatory element antagonistic modulator), which is a so-called transcription factor. As such, it binds to DNA and regulates the activity of genes.

Instead of controlling an immunity-related gene, as Penninger's team expected, DREAM appears to suppress the production of a natural opioid called dynorphin. The mice lacking DREAM overproduce this opioid in spinal cord nerve cells, where it affects pain perception, Penninger's group reports in the Jan. 11 *Cell*.

These results add to a growing puzzle. In contrast to the new work, some experiments have shown that dynorphin actually promotes pain. The new work "is sort of counterintuitive," says Robert M. Caudle of the University of Florida. "Dynorphin is probably more complicated than we realized."

Penninger suggests that dynorphin has either a pain-killing or pain-enhancing action depending on which cell-surface protein it binds. Although drugs that target transcription factors are rare, the team is developing inhibitors of DREAM to test if they are a new class of pain relievers. DREAM is "an intriguing target," he says.—J.T.

APPENDIX E: MAYBE WHAT POLLY WANTS IS A NEW TOY

Maybe what Polly wants is a new toy (in electronic text) -Week of Aug. 2, 2003; Vol. 164, No. 5, p.78

Susan Milius

Changing the toys frequently in a parrot's cage may reduce the bird's tendency to fear new things. Bird keepers grow anxious as their birds fidget, sometimes plucking their own feathers, says Rebecca Fox of the University of California, Davis. The fearfulness, or neophobia, also raises questions about bird development.

Research in rats linked neophobia to early separation from Mom, but experiments found no such link for parrots. Other studies even showed that nestlings fed by people were less afraid of new things until age 6 months than were birds reared by their parents. The effect doesn't last, though, and the hand-reared birds by 1 year of age show the typical neophobia.



SCARY STUFF? Young, hand-raised orange-winged Amazons cope with novelty better initially than parent-raised birds do.

Fox wondered whether hand rearing delayed neophobia because it exposed birds to extra novelty. Fox and James R. Millam of U.C. Davis divided 32 young orange-winged Amazon parrots into two groups. For one group, she replaced two novel objects in their cages five times a week; parrots in the other group kept the same toys. After 11 weeks, she switched treatments.

To measure neophobia, she filled a dish with peanuts and apples, a treat that she calls "the Amazon equivalent of chocolate," then dangled an unfamiliar object above it and timed a bird's delay in approaching. The weeks of frequent toy changing brought a "moderate but significant" easing of neophobia, she reports. The frequent-change birds approached in about 6 minutes instead of 10 minutes.

Fox also found that some objects provoked more reaction than others. Of the 15 doodads she had purchased, three little stuffed pink elephant, a black plastic box, and a mesh shower puff proved too scary to use in the experiments. "Not all novelty is equal," Fox says.

APPENDIX F: MOON STORY WAXES FULLER

Moon story waxes fuller (in electronic text) -Week of April 9, 2005; Vol. 167, No. 15, p. 235

Erica Klarreich

The story of how the moon was born may finally be complete. According to the most widely accepted scenario, a Mars-size rock slammed into the Earth 4.5 billion years ago, spewing material that coalesced into the moon. But where this gigantic impactor came from has remained unclear.

The moon's chemical composition suggests that the impactor formed as close to the sun as Earth did, but another factor made that seem impossible: As Earth was forming, its gravity acted like a vacuum cleaner, gobbling up nearby debris. How the impactor could have grown to the size of Mars has been an enigma.

In the March *Astronomical Journal*, Edward Belbruno and J. Richard Gott of Princeton University propose that the giant impactor could have gradually formed at one of two gravitational sweet spots called L4 and L5, which are situated as far from the sun as is the Earth. At these two points, any object stays put relative to the sun and Earth.

In computer simulations, the researchers found that debris could have collected at either L4 or L5 into a Mars-size protoplanet and then been nudged away from its sweet spot by other gravitational pulls. Were that to happen, the protoplanet would then orbit the sun in a yo-yoing pathway smack in the middle of Earth's trajectory, with a chance of hitting Earth.

APPENDIX G: THINK-ALLOUD TRAINING

Think aloud training

Direction

1) You will first take a 75 minutes TOEFL reading test to evaluate your overall reading ability.

***In this study, I am interested in what you are doing and thinking while reading the text. The research result will be based on the information that you report while reading; therefore, please try to report your thought processes as much as you can. While reading, if you were thinking in Chinese, please report in Chinese; in contrast, if you were thinking in English, please report in English. If you stop reporting more than a few seconds, I will say, “Please tell me what you are thinking,” to remind you to continue reporting.**

2) Now you will LISTEN to an example which demonstrates how to think out loud (basically reporting what you are thinking and doing while completing the task). Please feel free to interrupt to ask any questions you may have.

The task will be exactly the same as the one demonstrated with the exception of different reading passages.

Practice

Now, please take a look the sentences in the envelope, and put them in the right order; in the meantime, **please report on what you are thinking and doing while arranging those sentences.**

APPENDIX H: THINK-ALoud DEMONSTRATION

A drink a day might keep [fuzzy]-fuzzy [laugh] thinking away

One [alco]-alcoholic drink per day—beer, wine, or liquor—can stave off mental decline at least a little bit, a study of elderly women suggests.

So one alcohol drink can – stave off- stave off can be a new word for me-but it could be -ooh -about declining or reducing mental decline at least a little bit, a study of elderly women suggests, okay, supposed.

Researchers conducted phone interviews with thousands of women between the ages of 70 and 81-[that's big older woman-I guess] - who had completed questionnaires about their health and lifestyles a few times during the previous 8 years. Starting in 1995 –[okay-so this is- this is- long-longer-longer vision of study-a long time study - eight years- and started in 1991], the scientists performed a phone test to measure the women's cognitive function. – [ooh] - For each woman, they repeated the test 2 years later. [Ooh- it's like a pretest and post test. It's like they just wanted to see what happened in two year-okay- but the woman's age is not –umm- it's older-it's kind of older-so-I don't know-if they begin in 1995- the woman –one of the woman-could be 79- two years-she is going to be 81-so- how about there other stuff going on-there- related to age-okay-whatever]

Over that time, women who didn't drink were about 25 percent more likely to register a substantial cognitive decline than were those who averaged a drink a day. [Ooh-so-women didn't drink and they didn't show-any-who didn't drink were about 25 percent more likely to register a substantial cognitive decline-they didn't drink and they show cognitive decline -how about other factors-about their ages- Women who averaged two drinks a day fared about as well as the teetotalers-what is this-to-totalers-totalers-this is another new word for me-okay]

The groups had about the same proportions of women who held advanced college degrees,-[okay]- had high blood pressure or heart disease, were overweight, took vitamin E, were on hormone therapy, or smoked, says epidemiologist –[okay-okay-come again-this is a long sentence-oo-one paragraph-good- “The groups had about the same proportions of women who held advanced college degrees”-okay-we held the education level of women -had high blood pressure or heart disease-we had higher status of diseases and they were overweight-we had their weight and “took vitamin E”, were on hormone therapy, or smoked -and this is what epidemiologist says-and she is working “at Harvard Medical School and Brigham and Women's Hospital in Boston”- “excessive drinker-so she is must be one of the researchers then-right- yeah- “Excessive drinkers were excluded from the analysis” –okay-so they were looking for regular drinker like a drink a day-people

The findings, reported in the Jan. 20 *New England Journal of Medicine*, bolster smaller studies suggesting that limited-but-consistent alcohol consumption protects against heart disease, stroke, and Alzheimer's disease -[hmm-okay-but I need some other findings-umm-this is not enough for me-okay-anyway]- “Such alcohol intake might aid blood flow to the brain—as it does in the heart—preventing tiny strokes” –[ooh-so it made

something in the blood and it makes blood flows rapidly as it does in the heart] and thereby preserving brain function-[yeah -the same woman]- Grodstein-Grodstein and her colleagues hypothesize. [So their hypothesis is about the -good effects on alcohol especially heart diseases, stroke and Alzheimer and their baggiest type of thesis is about the flow of blood to the brain-okay]

[Let's go back to the second paragraph then-because I am going to look at the methodology again-it's a long study and a long time study -okay-their health and lifestyles-they are dealing with -their-the woman's health and lifestyle between the ages of 70 and 81- and -over that time- again- this is the third paragraph]-“woman who didn't- who didn't drink were about 25 percent more likely to register a substantial cognitive decline” -[how did they measure this-then were-okay-but this word here -teetotalers- unintelligible -I don't know- what does mean-okay-but-I assume this is a summary of-umm- this study so -because of the space in the journal they just summarize it-umm- very shortly-okay-okay]

APPENDIX I: THINK-ALOUD PRACTICE

Little Brains that could

Bees how big-time working memory

A honeybee's brain may fit on the head of a match, but a research team says that the bee's working memory is almost as effective as that of a pigeon or a monkey.

Working memory is what a person relies on for those few seconds between reading a number from the phone book and punching the number into the phone, explains Shaowu Zhang of the Australian National University in Canberra. He and his colleagues tested honeybee memory by training bees to use exit signs in a chamber to find their way to a treat. To make the correct choice, each bee had to remember a clue it had flown by on its way into chamber.

"The working memory a bee is robust," says Zhang. A short-term memory lasts about the same time in a bee as in a pigeon, he says. And a honeybee's memory is flexible enough to perform a simplified version of a task employed to test memory in rhesus monkeys.

To look at details of the bee's working memory, Zhang and his colleagues used variations of a layout with a wooden tunnel leading into an upright pipe. The two exit holes from the pipe were marked with different patterns. The researchers put a partition in the tunnel with a hole for bees to fly through. The partition carried a pattern, such as stripes slanting left. Bees had to remember the pattern and pick the matching pattern on one of the exit signs to reach the treat. During a bee's training, the researchers regularly switched the patterns.

Once a bee was choosing correctly about three times out of four, the researchers repeatedly lengthened the tunnel beyond the partition. Thus, the flying bees had a longer and longer delay between seeing the pattern and matching it to the exit sign.

The bees' memory of that pattern remains strong for about 5 seconds, the researcher report in an upcoming *Proceedings of the National Academy of Sciences*. In field tests, bees tend to choose flowers that resemble the one they visited some 5 seconds earlier. Birds, short-term memory lasts a similar time.

To test flexibility of memory, Zhang and his colleagues put two partitions with patterns in the tunnels and taught the bees to pay attention to only one partition, such as the first one encountered or the one at a specific distance from the tunnel mouth. The bees still managed to match patterns even when researchers marked the partitions and exits with patterns not seen in training.

The bee test was a two-option version of a memory test in which rhesus monkeys can distinguish more options.

Thomas Collett of the University of Sussex in Brighton, England, says that the cues used by bees in the study aren't clear but their flexibility is interesting. Also he welcomes the memory-duration finding as a "valuable contribution, since measurements haven't been available before." –S. MILIUS

APPENDIX J: THINK-ALLOUD PROCESS

Direction for passages in print

In this study, I am interested in what you are doing and thinking while reading the text. The research result will be based on the information that you report while reading; therefore, please try to report your thought processes as much as you can. While reading, if you were thinking in Chinese, please report in Chinese; in contrast, if you were thinking in English, please report in English. If you stop reporting more than a few seconds, I will say, “Please tell me what you are thinking,” to remind you to continue reporting.

Procedure:

- 1) Please take a few minutes to look at the three given passages and choose two reading passages that you would like to read.
- 2) Concurrent report [同步口述]: While reading, please **report** on what you are thinking in either Chinese or English. If you were thinking in Chinese, please report in Chinese; if you were thinking in English, please report in English.
- 3) Retrospective report[回顧口述]: after you are done with reading, please tell me what you can remember [from the moment you start reading until you are finished reading]. If possible, please tell me **in the order** in which your memories occurred [e.g., first, second, third, and so on]. If you don't remember anything, please say, “I don't remember”. The purpose of the retrospective report is to retrieve [擷取] what you can remember from thinking. Don't worry if you cannot recall something. **Please do not try to guess or predict.**
- 4) If you **stop** reporting more than a few seconds, I will remind you to continue reporting your thought processes.
- 5) **A Dictionary** will be available while reading.

- 6) After reading, you will write a short summary about the passage you just read.
- 7) A short interview will be conducted immediately after completing the task. The researcher will ask you a few questions based on his/her observations during the think aloud session.
- 8) Do you have any other questions before you start?**

Direction for passages in electronic text

In this study, I am interested in what you are doing and thinking while reading the text. The research result will be based on the information that you report while reading; therefore, please try to report your thought processes as much as you can. While reading, if you were thinking in Chinese, please report in Chinese; in contrast, if you were thinking in English, please report in English. If you stop reporting more than a few seconds, I will say, “Please tell me what you are thinking,” to remind you to continue reporting.

Procedure:

- 1) Please take a moment to search the three articles listed below and choose two reading passages that you would like to read.
 - A. Moon story waxes fuller
 - B. Maybe what Polly wants is a new toy
 - C. Dreaming away pain
- 2) Concurrent report [同步口述]: While reading, please **report** on what you are thinking in either Chinese or English. If you were thinking in Chinese, please report in Chinese; if you were thinking in English, please report in English.
- 3) Retrospective report[回顧口述]: after you are done with the reading, please tell me what you can remember [from the moment you start reading until you finished reading]. If possible, please tell me **in the order** in which your memories occurred [e.g., first, second, third and so on]. If you don't remember anything, please say, “I don't remember”. The purpose of retrospective report is to retrieve [擷取] what you can remember from thinking. Don't worry if you cannot recall anything. **Please do not try to guess or predict.**

- 4) If you **stop** reporting more than a few seconds, I will remind you to continue reporting your thought processes.
- 5) **A Dictionary** will be available while reading.
- 6) After reading, you will write a short summary about the passage you just read.
- 7) A short interview will be conducted immediately after completing the task. The researcher will ask you a few questions based on his/her observations during the think aloud session.
- 8) **Do you have any other questions before you start?**

APPENDIX K: BACKGROUND QUESTIONNAIRE

Please answer the following question

Name

Age

Gender

TOEFL score

Email address

Major

Phone number

How long have you been in the U.S.?

Please check the answer(s) that best describe you.

1. How often do you use computer?

Everyday

More than three times a week

Less than three times a week

None

2. For what purpose(s) do you use computers or the Internet?

School work (writing papers, searching materials)

Chatting

On-line Shopping

Online-banking

Others (Please briefly explain.)

3. How often do you read materials unrelated to school purposes (e.g., textbooks, journal articles)?

- Everyday
 More than three times a week
 Less than three times a week
 None

4. How often do you read on-line (e.g., electronic newspapers)?

- Everyday
 More than three times a week
 Less than three times a week
 None

5. If you had the choice of reading on-line text or reading print text (e.g., books, novels, and magazines), which one would you choose? And why?

Example 1: I prefer reading print text because I tend to lose my attention by browsing other websites while reading; moreover, I don't know how to take notes when reading on-line.

Example 2: I prefer reading on-line because it saves a lot of time, and I don't need to carry articles around.

~ You have completed the questionnaire. ~

Thank you!

APPENDIX L: THINK-ALoud TRANSCRIPTION SAMPLE

Direction:

[J-01-HP-1] (J=Name of the subject; 01= # of the passage read; HP -1 = the first Electronic text passage read)

Print in “...” = if reading directly from text or translating directly from text

Print in **[bold]** = the type of strategy used and coded.

Print in *Italics* indicates the transcription or translation

Print in () describes subject's behaviors and its interpretation

Text underlined = code-switching

Title: Moon story waxes fuller

Subject: [J-01-HP-1]

This title is “Moon Story waxes fuller.”

The story of how the moon was born – (unintelligible) – (pause)-okay-

這個文章是在講...是在講月球的形成

this article is about-is about-the formation of the moon -[1. monitoring]-

然後...他一開始...就是講了...

then – It-at the beginning-talked about

“widely accepted scenario, a Mars-size rock slammed into the Earth 4.5 billion years ago, spewing,” (highlighted and read directly from text) - [2. **highlighting: selective attention**]-

一些...一般人認為的...一般人可以接受的理論...然後是...但是作者...提到...

some - people think - some theories that people can accept - then - but the author – mentioned -

這個東西是從哪裡來的還不是太清楚...

where it came from has remained unclear (translated directly from the text) - [3. translating]

接下來他可能就要講不同的理論...或是提出不同的看法...

next - he may talk about different theories - or different opinions - [4. inferencing/predicting: based on what has been read up until this point] - (unintelligible)

他先從他的...化學組成開始講...然後他講到列外一個...另外一個factor...因素...

He began with its - "chemical composition" and then talked about another-another factor (code-switching) - "factor" - [5. translating]-

"seems impossible" (reading directly from text)- (he highlighted the word "enigma" and copied and look up dictionary) - [6. highlighting: selective attention]+ [7. resourcing + 8. monitoring]

告訴我你現在是在想什麼...

Investigator: tell me what you are thinking?

這是地球的形成...就是說...it's gravity...

This is the formation of the Earth - that is - it's gravity (code-switching)-

他說...然後他現在講到 "earth was formed"...

it said - then it now talked about "earth was formed" (original text supposed to be "earth was forming) -

地球形成時的 gravity...

"as Earth was formed, its gravity" (he translated directly from the text) - [9. translating]-

所以他現在講到可能是 地球的形成的時候 它會吸引很多附近的 那個 隕石或是碎屑...

so it now talked about - might be - as Earth was forming - it would grabble up nearby debris - that - or debris -

但是這個為什麼會...上面的...

but why this would - earlier -

"The moon's chemical composition suggests that the impactor formed as close to the sun as Earth did, but another factor made that seem impossible: As Earth" - (he highlighted the text)

這個 "enigma" 查一下單字...所以...

this - "enigma" (code-switching) - need to look up dictionary [10. resourcing] + [11. monitoring] - so-

“How the impactor could have grown to the size of Mars has been an enigma.” (Reading directly from the text) - hard to understand - [12 monitoring]

所以他這邊講的別的因素...都是...為什這個...和...地球的生成有關係...

so here it talked about other factors – all - why this - and the formation of Earth had connections -

因為...因為有可能是地球先生成了很多年以後...

because – because - could be as Earth formed years later - [13. inferencing: conscious inference-making: generating elaborations of specific ideas in the text based on knowledge of the text, p. 47, and 5-C]

恩...才有隕石撞擊所以...我不太清楚...他為什麼會提到...

hmm - then hitting Earth – so - it wasn't very clear - why it mentioned - [14. monitoring: when text is not understood, p. 64, and 9-D]

這個是一個another factor...然後...made that seems impossible...然後...再...他接下來提出一些別人提出觀點....

this is another factor (code-switching) – then - “made that seems impossible” (reading directly from text) – then – next - he brought up a few points by other people - [15. elaborating]

“In the March Astronomical Journal, Edward Belbruno and J. Richard Gott of Princeton University propose that the giant impactor could have gradually formed at one of two gravitational sweet spots called L4 and L5, which are situated as far from the sun as is the Earth. At these two points, any object stays put relative to the sun and Earth,” (he highlighted the entire paragraph) - (unintelligible, seems like he is reading the text) - [16. highlighting: selective attention]

告訴我你現在在想什麼...

Investigator: now tell me what you are thinking?

然後他講到說...這個...兩個人...這個...兩個觀點...

Then it said - this - two people - this - two points - (unintelligible) - [17. interpreting]-

喔...恩...我不太懂這個的意思...

ooh – hmm - I don't quite understand this – (unintelligible) - [18. monitoring: checking comprehension]

“any objects stays put relative to the sun and Earth”... 他為什麼會提到太陽和地球的關係...

“any objects stays put relative to the sun and Earth” (reading directly from the text) - why it mentioned the sun and Earth - [19. monitoring: checking comprehension]

[“could have gradually formed at one of two gravitational sweet spot called,” he highlighted from 3rd paragraph]

他的...他的意思...可能...是講說...這個...

ooh – its - its meaning - could be - it said – this - [20. inferencing: retrieving information thought about earlier for additional consideration when new information relevant to the idea under consideration is encountered, p. 36]

先跳到這邊...

first jumped here -

在電腦模擬的research

in computer simulation “research” (code-switching) - [21. translating]

(he highlighted, copied and pasted the word “Mars” to the On-line dictionary) - [22. resourcing + 23. monitoring] -

接下來是講到...這的...research

next it said – this – research - (unintelligible, seems like reading from the passage)-

他這邊就是 用 電腦模擬的方法

it is here - that is - computer simulation method -

然後它可以想說...它可以作出...這些...這些隕石可以被...collected...可以被...被...在 L4 or L5

then it could - it could make - these-these debris could be collected (code-switching) - could be - could be - in "L4 or L5"

(he highlighted, copied and pasted "nudge" to the online dictionary) - [24. resourcing+ 25 monitoring] -

所以我現在再從第二段開始看一些...

so now I will re-read the second paragraph and look at some - (seems like he was reading from the second paragraph and then jumped to the third paragraph) - [26. evaluating: re-reading parts of the text following reflection in order to reconsider what is in text exactly in light of insights gained during reflection]-

所以他的...我的了解他應該是從...

so its - my understanding is that it should be from-

所以他提出了一個問題...這個問題是為什麼...這個月球可以...長到...

so he brought up a question - but why this question - the Moon could - have grown-

如果是從地球撞擊的話...應該是 size 應該不是這麼大...他接下來這些人提出了一些看法...然後用電腦模擬的...來證實...這些...是有可能發生的

if smack from Earth - size (code-switching) should be - should not be this big - next it brought up some viewpoints - then using computer simulations to prove - these - it may possibly happen - [27. summarizing]

告訴我你在想什麼

Investigator: tell me what are you thinking?

Overall - I know what it is about-don't know its detail

APPENDIX M: A COMPARISON OF THE REPORTED USE OF STRATEGIES IN TWO TEXT FORMATS

| <i>Moon story waxes fuller, in electronic text from Joe</i> | |
|---|----------------------|
| Strategy type | # of strategy X used |
| Selective attention | 3 |
| <i>Translation</i> | 4 |
| Inferencing | 4 |
| <i>Resourcing</i> | 4 |
| <i>Monitoring</i> | 9 |
| <i>Evaluating</i> | 1 |
| <i>Elaborating</i> | 1 |
| Summarizing | 1 |
| Total # of the strategies used | 27 |

Note: print in *Italics* indicates the particular was used in both text formats; print in **bold** indicates strategies used only in electronic text.

| <i>Road rage keeps ants moving smoothly, in print from Joe</i> | |
|--|----------------------|
| Strategy type | # of strategy X used |
| <i>Resourcing</i> | 2 |
| <i>Monitoring</i> | 5 |
| Imagery | 1 |
| <i>Translation</i> | 4 |
| <i>Evaluating</i> | 3 |
| <i>Elaborating</i> | 1 |
| Total | 16 |

Note: print in *Italics* indicates the particular was used in both text formats; print in **bold** indicates strategies used only in electronic text.

| <i>Moon story waxes fuller, in electronic text from Kevin</i> | |
|---|----------------------|
| Strategy type | # of strategy X used |
| Repetition | 1 |
| <i>Resourcing</i> | <i>1</i> |
| <i>Monitoring</i> | 2 |
| Inferencing | 1 |
| Total | 5 |

Note: print in *Italics* indicates the particular was used in both text formats; print in **bold** indicates strategies used only in electronic text.

| <i>Road rage keeps ants moving smoothly, in print from Kevin</i> | |
|--|----------------------|
| Strategy type | # of strategy X used |
| Self-management | 1 |
| Directed attention | 1 |
| Selective attention | 2 |
| Deduction | 1 |
| <i>Resourcing</i> | 3 |
| <i>Monitoring</i> | 5 |
| Auditory representation | 1 |
| Evaluating | 1 |
| Translation | 1 |
| Note-taking | 1 |
| Repetition | 2 |
| Total | 19 |

Note: print in *Italics* indicates the particular was used in both text formats; print in **bold** indicates strategies used only in electronic text.

APPENDIX N: READING STRATEGIES USED IN ELECTRONIC AND PRINTED TEXT

| Strategy type | Joe | | Kevin | | William | |
|--|----------|------------|----------|------------|---------|------------|
| | Printed | Electronic | Printed | Electronic | Printed | Electronic |
| Metacognitive strategies | | | | | | |
| Evaluating | 5 (18%) | 4 (6%) | 2 (5%) | 0 | 3 (33%) | 5 (26%) |
| Monitoring | 6 (21%) | 15 (24%) | 10 (26%) | 9 (30%) | 3 (33%) | 6 (32%) |
| Selective attention | 0 | 8 (13%) | 3 (8%) | 1 (3%) | 0 | 0 |
| Self-management | 0 | 0 | 4 (11%) | 0 | 0 | 0 |
| Directed attention | 0 | 0 | 1 (3%) | 0 | 0 | 2 (11%) |
| Metacognitive strategies used in total | 11 (39%) | 27 (44%) | 20 (53%) | 10 (33%) | 6 (67%) | 13 (69%) |
| Cognitive strategies | | | | | | |
| Translation | 7 (25%) | 14 (23%) | 4 (11%) | 5 (17%) | 0 | 0 |
| Resourcing | 2 (7%) | 6 (10%) | 4 (11%) | 5 (17%) | 0 | 0 |
| Auditory representation | 0 | 0 | 2 (5%) | 4 (13%) | 2 (22%) | 1 (5%) |
| Inferencing | 2 (7%) | 9 (15%) | 0 | 2 (7%) | 0 | 1 (5%) |
| Note-taking | 0 | 0 | 1 (3%) | 0 | 0 | 1 (5%) |
| Recombination | 0 | 1 (2%) | 0 | 1 (3%) | 0 | 0 |
| Imagery | 1 (4%) | 0 | 0 | 0 | 0 | 0 |
| Elaborating/interpreting | 5 (18%) | 4 (6%) | 0 | 0 | 1 (11%) | 3 (16%) |
| Deduction | 0 | 0 | 1 (3%) | 1 (3%) | 0 | 0 |
| Repetition | 0 | 0 | 4 (11%) | 2 (7%) | 0 | 0 |
| Summarizing | 0 | 1 (2%) | 0 | 0 | 0 | 0 |
| Cognitive strategies used in total | 17 (61%) | 56% | 16 (47%) | 20 (67%) | 3 (33%) | 6 (31%) |
| Total # of strategies used (both Metacognitive & Cognitive strategies) | 28 | 62 | 38 | 30 | 9 | 19 |

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