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# Native and Emergent Bilingual University-level English Speakers Reading Online: The Influence of Hypertext on Comprehension

## **Cover Page Footnote**

This paper is adapted and updated drawing on McDonell (2006), unpublished dissertation.

# Native and Emergent Bilingual University-level English Speakers Reading Online: The Influence of Hypertext on Comprehension

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Our study contributes to our understanding of Internet reading by Emergent Bilinguals (EB) and Native English speakers (NS) by investigating their recall of two Internet reading passages containing additional information available through either hypertext links or footnotes. Participants included 25 EB and 25 NS college students. Answers to cued recall questions were scored on the basis of the number of correctly recalled propositions (Kintsch, 1998). Additional interpretive data came from semi-structured interviews with four NS and four EB participants. Quantitative results showed that both groups of students recalled significantly more propositions with linear text than with hypertext. However, although descriptive statistics indicated that NS recalled more than EB, this difference did not reach significance. Interview and survey data confirmed that both NS and EB found the footnoted text easier to recall than the version containing hypertext. Interview themes included the impact of unfamiliar vocabulary and contrasting motives for accessing the links.

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**Keywords:** Emergent bilinguals, Native English speakers, hypertext reading comprehension

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Among the technological innovations that have excited and challenged readers is the change from reading print on paper to reading on the Internet. This often entails shifting enriching or explanatory information from footnotes into hypertext links. Like their native English speaking (NS) counterparts, Bilinguals (EB) do a substantial amount of reading on the Internet (Parker, 2008). Emergent bilinguals, however, must retrieve information through a second language (L2), and this adds a complicating dimension.

In their 2010 report, Warschauer and Liaw review contemporary uses of the Internet to support literacy development for EBs. Meskill (2008) reflects on the transformative potential of technology for EBs and their teachers. However, the need persists for research that investigates the range of specific possibilities offered by the Internet (Grabe, 2009) for natives and non-natives alike. As hypertext use continues to expand (Welch, 2013), the need for understanding its impact becomes more crucial.

Our study contributes to the conversation by investigating how linear text and hypertext affect EB and NS readers' recall. For the study we selected two parallel articles; one had additional information in footnote form; the other had additional information retrievable through clicking on hypertext links. Through a cued recall task, we compared how well NS and EBs could reconstruct the information in each reading and we gleaned additional insights from interviews.

We begin this article by reviewing the scholarly background on this issue. We then describe our research methodology and present quantitative and qualitative findings. Our discussion considers the degree to which results echo or contrast with previous studies and explores possible explanations to account for the data. Finally, we consider implications for teaching and future research.

### **Literature Review**

Reading comprehension is affected by the readability or accessibility of the text to the reader (Sharp, 2003). Interactive reading theories (Bernhardt, 1991; Goodman, 1996) emphasize linguistic competence, background knowledge, reading strategies, and metacognitive strategies. Furthermore, in contrast to L1 reading, successful L2 reading can be achieved only if the reader has reached a threshold level of L2 proficiency (Clark, 1988; Hunt & Belgar, 2005; Rodríguez, 2010), transfers good reading skills from L1 (Devine, 1988), and activates background knowledge of the topic (Alexander, 2005). The degree to which these general principles pertain in Internet reading for native and non-native English speaking college students continues to be an active area of research. Since Internet readings commonly include hyperlinks but may also contain endnotes or footnotes for additional information, it is important to determine how retrieval of this information may affect online reading comprehension and retention (De Ridder, 1999, 2000).

The following discussion highlights the nature of hypertext and the complexities it presents to native and non-native EB readers. While some research supports an enriching and helpful role for hypertext, other studies suggest that it can be a burden and a distraction for readers, particularly when hypertext must be accessed and processed through a second language. Additional variables shown to be relevant to hypertext use include degree of familiarity with content, as well as the age, language proficiency, and working memory of the reader.

### **Contrasting Text Types**

Hypertext is defined by Fotos and Browne (2004) as "a medium for representing information as a network of linked informational 'chunks' that exists online and can be accessed in any order" (p. 83). As indicated by the investigations discussed below, researchers have considered the benefits and challenges of reading online using hypertext as compared with linear text, read either on the computer or in traditional paper format. Schmar-Dobler (2003) underscored the dual potential of hypertext to enhance reading by providing additional information yet distract the reader from the text itself.

It is evident that some of the same activities are required in reading hypertext and traditional text; for example, character decoding and word recognition are

important to reading in both formats (Niederhauser & Shapiro, 2003). However, these two text types differ significantly in that hypertext challenges our presumption of linearity, using a series of nodes connected by links to create potentially non-sequential organization of material (Parker, 2008; Sasson-Henry, 2007).

Links also allow hypertext to be interactive. When reading hypertext, students must make choices about whether or not to click on a link and also what they will read next, thus shaping their own reading experience (Slatin, 1990). Similarly, Chorney (2005) emphasized that aspects of hypertext's organization allow the reader to play a more active role. However, she has acknowledged that readers of paper-based texts also have the option of taking an active role, for example through referring to more than one source at a time. Nevertheless, Kamil and Lane (1998) have maintained that a problem in reading on the Internet is that there is no way for the reader to predict in advance whether a link will be valuable or not. Indeed, Plass, Chun, Mayer, and Leutner (2003) have commented that reading may be affected not only by the presence or absence of a link, but also by the nature of information it contains.

### **Hypertext Impacts Reading Comprehension**

Several studies have proposed that the choice-making opportunity provided by links encourages the reader to be active (Ercetin, 2003; Kasper, 2000; Martínez-Lage, 1997). Shapiro and Niederhauser (2004) listed flexibility and learner control among the positive aspects of hypertext. Lee and Tedder (2004) added that hypertext allows us to tailor information to the needs of different learners. Finally, students have reported that they enjoy using hypertext. Landow (2006) has suggested that hypertext is more active than traditional text on the computer as it provides a more interactive environment. A web page designer chooses which Internet pages may be connected to each other. While we may, as readers of linear text, decide which page to read or which index to look up, we rarely reorganize the author's text to the degree that the Internet allows.

Thus, the interaction with the reader and the non-linearity of hypertext have the potential to help create complex schemata that will support readers in thinking flexibly about content. In a review of empirical studies on electronic text tools, Navas de Rentas (2011) concluded that English language learners successfully used hypertext-enabled texts to improve their reading comprehension. Zumbach (2006) found that students comprehended more information from native language reading passages with hypertext than with linear text. Comprehension was measured with concept maps, completed while students read and with pre- and post-tests on the material covered in the texts. Akbulut (2008) provided further evidence that hypertext links can positively impact reader comprehension, perhaps due to hypertext's potential to promote deep cognitive engagement with text (Enslin, 2006; Niederhauser & Shapiro, 2003). Interestingly, Chen and Rada (1996) reported that in 8 out of 13 studies reviewed, hypertext positively affected learning. Hypertext use may also promote flexible thinking (Chen & Rada, 1996; Strambi & Bouvet, 2003). Shapiro (1998) compared NS student learning with two kinds of hypertext (with and without clues about the links' information) versus non-linked text. On a post-reading activity, students who read hypertext remembered significantly more of the additional information offered. Student responses on a post-reading essay task also showed a relative advantage of reading

unstructured hypertext (in which the level of specificity of information had to be inferred) as compared with a structured condition (which distinguished between general information on the first level from more specific subtopics on deeper hypertext levels). In addition, Cobb (2009) has listed hypertext resources among the ways computers can assist EBs to enhance their L2 lexicons as their L2 reading develops.

### **Hypertext Challenges**

Despite the optimistic views of hypertext on supporting online reading, Chun and Plass (2000) have cautioned that the way Internet tools are applied in foreign language reading is crucial to determining their usefulness. For example, Brandl (2002), echoing Schmar-Dobler above, warned that “the hyper-linked structure and presentation of information on the Internet may easily cause students to get lost...” (p. 88). Some research does indicate that in addition to offering flexibility, non-linearity can make hypertext difficult to read. Each link encountered requires readers to make a choice as to whether or not they will click on it. Proponents of “Cognitive Load Theory” suggest that this decision-making option introduces increased cognitive load for the reader (DeStefano & LeFevre, 2007). Kamil and Lane (1998) add that readers must make this choice, often with little ability to predict the potential usefulness of the information accessed by the link. Connecting increased cognitive load to slowed performance, DeStefano and LeFevre (2007) found that more links, and thus more options for decision-making, represented a greater cognitive load for the reader. Also, splitting attention among multiple sources, i.e., different frames or nodes, can increase cognitive load and strain short-term memory (Chandler & Sweller, 1991). Niederhauser, Reynolds, Salmen, & Skolmoski (2000) reported that very frequent hyperlink usage inhibited learning. However, Madrid, Oostendorp, and Melguizo (2009) stated that in comparing NS reading documents with three versus eight hyperlinks per page, learning outcomes were not affected. In this study they also found that using link suggestions, such as double arrows or highlighting, improved learning outcomes. Perhaps these aids guided learners and therefore reduced the cognitive load brought on by the decision-making process.

The effectiveness of hypermedia annotations used in L2 reading was studied by Sakar and Ecertin (2005). While their interview data showed that many learners liked hypermedia reading, results on a reading test showed that those who used links more frequently scored lower on the reading test. Additional hypertext challenges included a negative effect on student ability to construct a mental model of the whole text and the presence of distracting textual features. Thus, the non-linear nature of hypertext has been criticized for negatively affecting students’ abilities to build text coherence. “Flexible sequencing in hypertext may interrupt the development of situation models because readers will encounter propositions that are unrelated to those held in working memory more frequently than in linear text” (DeStefano & LeFevre, 2007, p. 1627). Shapiro and Niederhauser (2004) have identified other possible distractive aspects of hypertext including color, contrast, and fonts. Finally, Walz (2001) has pointed out that the drop-down boxes associated with some types of hypertext might even cover part of the text itself, thus adding to the reader’s burden.

The effect of hypertext on students with higher and lower working memory has also been explored. Findings have suggested that hypertext taxes the reader's working memory (Shapiro & Niederhauser, 2004). Students with low working memory retained less information when reading paged hypertext than they do when reading linear text (Lee & Tedder, 2004).

### **Hypertext and Diverse Users**

In research with school children, Anderson-Inman and Horney (1998) reported that these students found it easy to read on the Internet. However, Gillingham's (1993) research with a similar population showed that when hypertext was present, it slowed reading down while students searched for an answer. MacDonald (2005) investigated reading comprehension strategy use and indicated that middle school children found reading hypertext more difficult than linear text. Similarly, Niederhauser, Reynolds, Salmen, and Skolmoski (2000) maintained that students who used links to compare and contrast material were less successful in their reading.

A project by Son (2003) compared L2 learners of Korean from English and Japanese L1 backgrounds reading the same passage in a paper-based format versus two computer-based alternatives: a non-hypertext format that involved clicking on an icon for additional information and a more traditional hypertext format. Students expressed a preference for traditional hypertext but liked the paper-based alternative even better than the non-hypertext format on the computer.

EB students in a community college setting participated in a study by Kasper (2000); they worked in focus groups on particular content areas. Kasper found that hypertext use by EB had the potential to be more active and interactive than linear text, but cautioned that without instruction hypertext could overwhelm learners and have negative consequences. The effect of hypertext with and without highlighting on EB college students' language vocabulary learning and general comprehension of text in French was studied by De Ridder (2002, 2003). Participants were native speakers of Dutch and had studied French as a foreign language for nine years. While the highlighted condition resulted in more clicking on the hypertext links, there was no significant difference in short or long-term vocabulary acquisition or in general comprehension of the text. However, De Ridder postulated that the effectiveness of the particular kind of hypertext offered might be associated with the learning style of the reader in terms of self-regulation and processing approach. Thus, additional research was suggested.

### **Hypertext and Prior Knowledge**

It is well established that the reader's degree of familiarity with the content of a text can have an important positive influence on comprehension while lack of content knowledge adds an additional barrier (Fisher & Frey, 2009). Interestingly, Calisir and Gurel (2003) found that mixed hypertext produced better post-reading recall than traditional linear text for readers with low subject area knowledge. Higgins and Boone (1990) suggested that hypertext can provide useful supplemental information to support comprehension. However, Salmerón, Canas, Kintsch, and Fajarado (2005) reported contrasting results: readers with low subject area knowledge retained more information when reading linear texts while readers with high subject area knowledge

benefited most from nonlinear texts. Amadiou, Tricot, and Marine (2008) compared learners with relatively less or more prior knowledge. Readers with low prior knowledge benefited more from linear text than from text that had been arranged hierarchically. Zumbach (2006) offered an additional interpretation for the differences in hypertext comprehension between experts and novices. Experts have prior knowledge and schema around which they can organize new information from the hypertext. Novices who do not already have schema benefit from text with a linear format. The researcher further argued that much traditional reading by subject area experts is in fact, non-linear. Consider, for example, the graduate student switching between articles and textbook pages while investigating a given topic. In some ways this kind of linear reading activity shares aspects of hypertext. Thus, Zumbach cautions against making broad generalizations about cognitive processing differences in traditional versus hypertext reading.

Salmerón, Kintsch & Cañas (2006) found an interaction effect between readers' prior knowledge and strategies for selecting hypertext reading interesting sections first, *interest strategy*, versus selecting links with perceived semantic relationship to the main text, *coherence strategy*. The coherence strategy was more useful for those with low prior knowledge. Additional research highlights the importance of interest in the topic, irrespective of prior knowledge (Akbulut, 2008).

We have seen that despite substantial research on NS and EB readers' response to hypermedia, conflicting data are reported. Even when readers display positive feelings, hypermedia can sometimes interfere with processing, understanding, and memory of text. Thus, taken together, studies reported in the literature are inconclusive, indicating that NS and EB learners may be helped and/or hindered by reading hypertext links on the Internet. Given the lack of consensus in the research to date, our study seeks to add to the conversation by addressing these conflicting results as they may apply to NS and EB readers on the university level.

## Methodology

### Research Questions

The current study compares recall of linear reading of a single footnoted passage on the computer to reading with the footnote information offered via hypertext. We were interested in investigating:

- (1) Is there a significant difference between the level of recall of computer-based linear footnoted text versus computer-based reading with hypertext for Native Speakers in a university?
- (2) Is there a significant difference between the level of recall of computer-based linear footnoted text versus computer-based reading with hypertext for Emergent Bilinguals in a university?
- (3) Do university-level Native Speakers and Emergent Bilinguals differ significantly in their recall of computer-based linear footnoted text versus computer-based reading with hypertext?



- (4) What insights into processes and challenges for footnoted vs. hypertext reading emerge from interviews with Native and Emergent Bilingual readers?

### **Participants**

Fifty students, 25 NS and 25 EB participated, a number sufficient to allow for quantitative analysis but limited by practical considerations such as the time-consuming nature of response coding (described below) and the availability of volunteers to participate in the study. Criteria for participation included studying English on the college level and at least 3 years of experience reading in English. Ten students were male and 40 were female. The mean age was 27.1 (SD= 8.1). Of the participants, eight students (four NS and four EB) agreed to be interviewed.

Participants consisted of a non-random sample, recruited on a voluntary basis. Flyers briefly describing the study were distributed across two college campuses. Interested students were directed to contact the second author. Additional information about the study including e-mail and phone numbers of both authors were provided. Individuals who chose to volunteer signed a consent form and were guaranteed anonymity. Participants were then emailed the background questionnaire and were sent a link to the online reading and response activities.

Participants were recruited from two colleges in Northeastern US, their major areas of study included: Communications, Dance, Theater, Psychology, and Language Education. Level of study ranged from undergraduate to doctoral, with participants distributed as follows: BA: 18, MA: 24, Post-MA Advanced Certificate: two, and Doctoral: six. In addition to the 25 native English speakers, Emergent Bilinguals spoke a range of languages: Mandarin: six, Spanish: five, Korean: five, Haitian Creole: three; Japanese, two; and one each of Bengali, Hebrew, Portuguese, and Taiwanese. Based on the data available from written comments and oral interviews and discussions, most participants were judged by the second author to range from the low to high intermediate range of English proficiency as defined by the ACTFL Proficiency Guidelines (ACTFL, 2012).

### **Design**

A mixed design (Cresswell, 2008) was used to explore the research questions. The quantitative part of the study was quasi-experimental as all participants were recruited on a voluntary basis from classes at two private universities in Northeastern US. Participants were randomly assigned to one of two possible reading orders and their responses were recorded and quantified as described below. The inclusion of interviews to help interpret the quantitative data and provide insights into the reading process of participants was considered potentially illuminating for this exploratory study. As noted qualitative interview data from participants was elicited to aid in the interpretation of the quantitative data and help to understand readers' experiences and perceptions. Our goal was that readers' voices would uncover why they believed that hypertext use was helpful, problematic, or both.

## Pilot

Ten volunteers for the pilot (five NS and five EB) came from students at the same colleges from which study participants were drawn. While most aspects of the procedure including the background questionnaire, readings, and cued recall prompts, worked well, the number of prompts for recall of each text was reduced from 12 to 8 as the pilot volunteers found the original number of prompts tiring.

### Instruments and Materials

**Background questionnaire.** A background questionnaire elicited demographics and reading background, exploring the students' experiences and views regarding reading in alternative formats and general familiarity with computers. Open-ended questions were also included to provide a more thorough exploration of student backgrounds and experiences (McDonell, 2006).

**Readings.** Reading materials used were adapted from *Encarta* (<http://www.encarta.com>) which offers authentic text (Nunan, 1991) designed to be viewed on a computer using software for recording actions of the participant. Two texts were chosen, one on the printing press and another on the cell phone. These readings were parallel in topic and explored the backgrounds of communication media that were part of the students' lives. The selection was intended to balance the likelihood that students would have some background knowledge of the topics but that substantial new information would be presented to them in the readings.

Advertisements on *Encarta* were removed because they were considered distracting, would not be typical of many academic texts, and eliminated an additional extraneous variable that might affect the results of the study. No other adjustments were made to shorten either text nor were there any changes made to the vocabulary in the texts.

The printing press article contained 2,419 words in 16 paragraphs and 108 sentences. The cell phone article contained 2,628 words, in 12 paragraphs and 122 sentences. The original texts were kept intact. Both articles had a reading level of 12.0 (Readability scores, 2010). *The Printing Press* was presented on the computer in linear format. For this reading, the supplemental information was copied and placed in footnote format on the frame. In the hypertext condition represented by the *Cell Phone* article, the links took students completely out of the frame of text they were reading to supplemental information.

**Prior knowledge scale.** Prior knowledge of topic (Ariew & Ercetin, 2004; Niederhauser et al., 2000) regarding the printing press and cell phone was evaluated through participants' responses to a five-point scale ranging from "not at all" to "expert" and supplemented with participant comments from post-reading comments and interviews. Data showed that much of the information in both readings was actually not known before to the volunteers and their reported prior knowledge was in the low to intermediate range.

**Tracking process.** The computer pages and program were designed by Elizabeth McAlpin in Flash software. This software measured the time it took for each

participant to do the readings. It also tracked each step of the student's progress including the hypertext links that the student chose to click on, the responses to the cued recall questions for both readings, as well as any additional comments they wished to add.

As the second reading had hyperlinks, an electronic log was created which showed the identification number of the participants, whether or not they had visited the links, as well as their recall of passages read.

**Interviews.** Eight participants (four NS and four EB) volunteered to be interviewed. The questions were designed to give the participants a chance to discuss how they felt during and after the readings and explore their views of other relevant issues that might arise pertinent to reading on the Internet as part of their overall reading experiences. Interviews were semi-structured, allowing participants' perspectives to emerge as the conversation evolved (Ely, 1991; Seidman, 1998). Appendix A includes the open-ended questions asked.

### **Quantitative Data Collection and Analysis**

The order of the texts presented to participants was randomized. After each reading, the computer program posed cued recall questions for participants to answer (Kintsch, 1998; Plass et al., 2003). Their answers could potentially result in eliciting all of the propositions in the text that had just been read. The operational definition of a proposition used in this study is based on Kintsch (1998), who defines a proposition as "a relational term, the predicate and one or more arguments" (Kintch, 1998, p. 37). *Cued recall questions* were chosen to help students remember the information in the readings and maximize the potential of the task to measure comprehension of the passages read. As a number of studies have debated how long it takes to read online (Muter, 1996; Potter, 1999), no time limit on reading was imposed. Each response was scored on the basis of the number of correctly recalled propositions.

Students were given a series of boxes in which there was a cue and they typed their responses to each. First they read the comment:

No one can remember everything in any article. In the following questions there are cues to help you remember. Just write down what you remember to the best of your ability. If you cannot remember something, just write I don't remember or leave the space blank and move on.

Here are two sample prompts:

"Please tell what you remember about printing as a name used for several purposes."

"Please tell about other names for cell phones."

A box was below each prompt in which students could write what they remembered. (See Appendix B for screen capture of a reading.)

Each answer was scored on the basis of the number of correctly recalled propositions. We computed scores by giving one point for each proposition correctly recalled (Kintsch, 1998; Plass et al., 2003). Also, four literacy experts (who had each had graduate degrees in applied linguistics or reading and had taught university-level

courses for over five years) validated the number of propositions contained in - participants' recalled texts.

Effect size and Cohen's *d* were determined. Proportions of propositions answered correctly were transformed into Arcsine Square Root values, as explained below. Within-group variables were compared using *t*-tests; between-group variables were compared with a Repeated Measures ANOVA using the transformed percentage of propositions recalled from the linear text and the transformed percentage of hypertext answers correct as the dependent variable.

### **Qualitative Data Collection and Analysis**

Eight participants agreed to participate in a short interview after they had completed the computer-based reading task. All interviews were audio-taped and transcribed. Themes were identified and coded through a recursive process (Savin-Baden & Major, 2013) and interpretations were triangulated by consensus of four educational professionals (professors who were language educators).

All interviews were conducted by the second author in English after the readings, at the convenience of the volunteers. (See Appendix A.)

### **Limitations**

Participants were a non-random sample of college students studying in English with significant experience reading in English based on self reports of their academic backgrounds. Therefore, we may not extrapolate from this sample to other native and non-native populations who have not reached the level of academic English required for entry into colleges in the United States. In addition, since the interviews were conducted at the convenience of the participants some did not take place immediately after their experience and their memories of the reading process may not have been completely accurate.

## **Results**

### **Participants' Reading and Computer Attitudes**

Based on the initial background questionnaire, all but five of the 50 students reported that they liked to read. Those who did not were EB. Twenty-eight percent of students reported reading textbooks or news, 14% reported reading about history, and 10% reported reading romantic novels. While native speakers said they were always reading something, emergent bilinguals often reported that they found L2 reading a slow process and had little time to do so for leisure. Questionnaire data also demonstrated that the majority of the students considered themselves to be comfortable with the Internet. Twenty-two percent considered themselves to be better than average and 8% considered themselves to be experts.

## Speaker Status, Text Type, and Propositions Recalled

Independent variables are NS vs. EB and text type: plain text or hypertext. The dependent variable is the number of propositions recalled in response to the questions regarding the two text types. The univariate distribution of the values of each variable was studied to confirm that the data did not exhibit anomalies.

The main response variable in the analysis was the proportion of correct responses. As noted by Winer (1971) it is inappropriate to use proportions directly as the response variable in a *t*-test or analysis of variance because the proportions do not satisfy the underlying assumptions of these procedures. However, the analysis can proceed if the original proportions are transformed by the arcsine square root transformation and then the transformed values are used in the analysis (Dendane, 2012; Freeman & Tukey, 1950). Thus, all analyses of the proportions were done using the appropriate arcsine square root values.

## Comprehension Data

**Research question 1.** The first research question queried whether there is a significant difference between the level of recall of computer-based linear footnoted text versus computer-based reading with hypertext for NS in a university. Native speakers had higher mean recall scores with the linear text article (35.6% correct, SD 21.2) than with the hypertext (20.6% correct, SD 17.0). (See Tables 1 and 2.)

Table 1.

*Descriptive Statistics for Raw and Percentage Scores- Research Question 1 (NS)*

Article Type	N	Raw Number Correct			Percent Correct		
		Mean	SD	SEM	Mean	SD	SEM
Linear	25	7.5	4.4	.89	35.6	21.2	4.2
Hyper-text	25	5.6	4.6	.92	20.6	17.0	3.4

Table 2.

*Descriptive Statistics for Arcsine Square Root Values-Research Question 1 (NS)*

Statistics	Mean	N	Std. Deviation	Std. Error Mean
Arcsine of Square Root of Proportion Print Correct	.623	25	.241	.048
Arcsine of Square Root of Proportion Cell Phone Correct	.414	25	.261	.052

For native speaker data, the effect size=.384, Cohen's  $d=.743$ . A paired-samples t-test was performed using the native speakers and comparing the transformed percentage correct on the linear text article with the transformed percentage correct on the hypertext article. Table 3 summarizes the results of the analysis. Thus, NS were able to recall significantly more propositions from the linear text/footnoted article than the one with hypertext.

Table 3.

*Paired t-test- Research Question 2 (NS)*

Statistics	Paired Differences								
	Mean		Std. Error Mean	95% Confidence Interval of the Difference		<i>t</i>	df	<i>p</i>	
	Mean	Std. Deviation		Lower	Upper				
Arcsine of Square Root of Proportion Print Correct vs. Arcsine of Square Root of Proportion Cell Phone Correct	.208	.284	.057	.091	.325	3.67	24	.001	

**Research question 2.** The second research question asked whether there is a difference between the level of recall in computer reading of linear text with footnotes versus hypertext for the EBs. Table 4 shows the descriptive statistics for this question. It indicates that EBs, like their native peers, had higher mean scores on the article with linear text (28.0% correct, SD 19.6) than the article with hypertext (15.4% correct, SD 11.3). For EBs data, effect size =.348; Cohen's  $d=.743$ .

Table 4.

*Descriptive Statistics for Raw and Percentage Scores-Research Question 2 (EBs)*

Article Type	Raw Number Correct				Percent Correct		
	N	Mean	SD	SEM	Mean	SD	SEM
Linear	25	5.9	4.1	.82	28.0	19.6	3.9
Hypertext	25	4.2	3.1	.61	15.4	11.3	2.3

Table 5 shows descriptive statistics for the arcsine square root values for Research Question 2.

Table 5.

*Descriptive Statistics for Arcsine Square Root Values- Research Question 2 (EBs)*

Statistic	Mean	N	Std. Deviation	Std. Error Mean
Arcsine of Square Root of Proportion Print Correct	.527	25	.247	.049
Arcsine of Square Root of Proportion Cell Phone Correct	.360	25	.200	.040

A paired-sample t-test then compared EB reading in both conditions. Results show that emergent bilinguals recalled significantly more propositions from the linear text versus the hypertext readings. (See Table 6.)

Table 6

*Summary of Paired t-test for Research Question 2 (EBs)*

Statistics	Paired Differences							
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference		<i>t</i>	df	<i>p</i>
Arcsine of Square Root of Proportion Print Correct vs. Arcsine of Square Root of Proportion Cell Phone Correct	.166	.289	.058	.047	.286	2.88	24	.008

**Research question 3.** The third research question asked if NS and EB differed in relative recall of computer-based linear footnoted text versus computer-based text with hypertext. A Repeated Measures ANOVA was performed using the transformed percentage of linear text answers correct and the transformed percentage of hypertext answers correct as the dependent variable. Text type (linear text or hypertext) and speaker status (native or EB) were the two predictor variables. Table 7 summarizes the results of the analysis.

Table 7.

*Repeated Measures ANOVA for Research Question 3*

Source	<i>df</i>	<i>F</i>	n2p	<i>p</i>
Status (native or EB)	1	1.93	.20	.17
Error	48	(.073)		
Text Type (linear text or hypertext)	1	21.39	.55	<.0005
Status × Text Type	1	.27	.08	.61
Error	48	(.041)		

*Note:* Mean Squared Errors are shown in parentheses.

Table 7 reveals a substantial difference in readers' ability to recall the two text types ( $p < .0005$ ), but participants' native or EB status was not associated with a significant difference ( $p = .17$ ). There was no evidence of an interaction effect ( $p = .61$ ).



**Summary of quantitative results.** The analysis revealed that both NS and EB English speakers recalled significantly more of the passage in the linear text than the hypertext condition. Further, although descriptive statistics suggested that natives recalled more than emergent bilinguals, this difference did not reach statistical significance.

### **Qualitative Data**

All interviews were conducted by the second author in English after the readings, at the convenience of the volunteers. Additional qualitative data came from open-ended questions on the questionnaire. The experiences and perceptions participants had towards the readings and recall prompts in the study and towards reading in general and on the Internet helped us to interpret the quantitative data and gave us deeper insights into participants' perspectives. While not all comments were specifically tied to issues of hypertext vs. footnoted text, they helped provide insights into the participants' perceived reading experiences and are responsive to research question four.

Four native and four emergent bilingual speakers volunteered to be interviewed. The following are some of the themes that emerged from the qualitative data. Interview and survey data are combined here for efficiency of presentation. After the reading and recall tasks, both NS and EB reported that they found the readings somewhat difficult. However, relatively speaking, they commented that the linear text was easier to recall than hypertext. This was consistent with the quantitative data.

The fourth research question explored the insights into processes and challenges for footnoted vs. hypertext reading that emerge from interviews with native and EB readers.

**Reading footnotes and links.** In interviews participants were asked whether they actually read the links and the footnotes. While some interviewees from both groups reported that they found it harder to read with hypertext, it turned out that not all students accurately remembered whether they accessed the links or read the footnotes. While this does not affect the results reported in the quantitative part of the study (the computer program tracked what actually happened), it would appear that students' memories of the readings were more based on the meanings they got from texts than the specific process through which they retrieved information.

Students from both groups said they read the links but did so for different purposes. Native speakers said they read the hypertext if they thought a link would present more information, or if they were looking for something specific. Emergent bilinguals said they followed links thinking that perhaps hypertext would provide an explanation to help understand the text better. With regard to the footnote issue, several students said they would like to think they read the footnotes but not all were sure they had. They mentioned that they knew they were supposed to read them. An exception was an EB, who said he did not read footnotes because he believed that in general, the writing in footnotes was often more difficult to comprehend than language in the regular text.

**Difficulty with prompts.** While both groups of speakers had difficulty with the prompts, the qualitative analysis suggests that these problems were different in nature. Native speakers, for the most part, said they would have liked to know prior to the readings about the type of questions they would be asked and believed this would have improved their recall. Many EBs, on the other hand, would have preferred multiple choice questions to cued recall because they believed that having to respond productively in English reduced their abilities to remember the information.

**Interest and motivation for study readings.** Several students raised the issue of topic interest on their questionnaires and this was pursued further in the interviews. Most of those who commented said that they found at least one of the articles to be interesting but not the same one. Some discussed the historical nature of the printing press or the fact that they liked to know how things worked with the cell phone.

**Encountering new vocabulary.** Both NS and EBs admitted that vocabulary was a problem in reading. Content based and abstract lexicon was problematic for both groups in L1 or L2. Several EBs commented that they believed that to fully understand technical reading, they needed to know the meaning of every word in a passage. However, interviewees who commented on this admitted that they often did not take the time to look up the meaning of a word. This issue may have impacted the results of the study.

## Discussion

Since much of the research students do in college is done on the Internet (Jones, 2002; Malaney, 2004-2005), the findings of our study are provocative in that the hypertext condition proved more difficult for both groups of students. Although Strambi and Bouvet (2003) are among those who tout hypertext use as productive because “large amounts of information (in hypertext) can be made available without becoming distracting or intimidating for the learner” (p. 86), our study contradicts this view.

Our data confirm the concerns expressed in the literature regarding the cognitive burden of hypertext usage for native and emergent bilingual readers as both participant groups recalled less under the hypertext condition. As early as 1996, Cob and Stevens noted that “interactive text” presented a challenge to second language readers. They specifically mentioned greater cognitive requirements for emergent bilinguals who might lack a range of *automatized* processes for L2 reading, including word recognition and familiarity with L2 discourse structure. Grabe (2009) also stressed the importance of achieving automaticity in reading fluency and the barriers for EBs. As noted above, Chun and Plass (2000) and Brandl (2002), in their research regarding the use of online materials in foreign language reading caution that there are drawbacks associated with non-linear or “hypermedia” information structure. These can disrupt students’ processing causing confusion and disorientation. In our study, a few participants could not recall whether they had actually clicked on links indicating an issue associated with how the mere presence of the links can affect readers’ perceptions.

The qualitative data also indicate that although the difference between NS and EB readers did not reach significance, EB readers did report encountering difficulty with reading vocabulary in English and also noted that the cued recall approach we used was more difficult than a multiple choice approach because of the burden caused by needing to process information through a second language.

Additional struggles were mentioned in our interviews. Participants raised the issue of how unfamiliar vocabulary impacts reading. There is a large literature on vocabulary for both native and emergent bilingual readers (Durán, 2008; Laufer & Hulstijn, 2001; Nation & Coady, 1998). While the passages chosen for the current study were rated as equivalent to grade 12, and thus, should not have posed major vocabulary challenges for natives, they did contain some technical vocabulary, so it is not surprising that emergent bilinguals encountered unfamiliar lexicon in the readings.

Our interviews also revealed that students' perceptions of their reading experiences were not always consistent with the objective data. This seems to indicate that while reading on the Internet, some students may be more focused on the content itself than on how it is presented. In addition, all participants in this study had easy access to and experience with reading on the Internet. However, Warschauer et al. (2010) cautioned that *the digital divide* means that we cannot draw conclusions from such learners whose access to computers is limited.

### **Implications and Future Research**

Fotos and Browne (2004) note that the use of computer-based forms like hypertext is "changing our practices of literacy and expression" (p. 70). While such development may be inevitable and even beneficial, we can conclude from our study that reading hypertext can be problematic. Our findings regarding less successful recall of Internet passages with hypertext show an area in need of more extensive research and the development of targeted pedagogical interventions regarding hypertext use.

Another important consideration for future research highlighted by our results is the role of proficiency for second language learners in processing both hypertext and footnotes. Lower recall scores for EBs as compared to NS in recalling passages containing hypertext, while they did not reach significance, are supported by comments of EB interviewees regarding language-based difficulties. Studies which systematically control for specific levels of L2 proficiency, particular for relatively advanced learners such as those in our study, may uncover a more robust role for L2 levels in processing hypertext.

Since the Internet explosion is likely to result in greater online reading requirements for NS and EB students, we need more detailed investigations of hypertext-based reading for both populations. The authors agree with Richards (2000) who argues for a revised rhetorical representation of electronic texts that reflect the multidimensionality and complexity of hypermedia and hypertext. The point is well taken. Indeed, different types of hypertext need to be considered and researched. Furthermore, strategies for reading hypertext effectively are clearly needed. Such strategies might include learning to evaluate the likelihood that information contained in hypertext may be crucial for comprehension or potentially enriching. Readers will need to be aware that a new or additional link could add to their cognitive load and

possibly disrupt the processing of text and information. Grabe (2009) highlights the need for teachers to help EBs identify specific reading goals.

Pre-service and in-service teachers need to be prepared to integrate strategies regarding Internet use, in general, and hypertext use, specifically, into their classrooms. Many classes now use some form of technology, but unfortunately, teachers are sometimes given little preparation in using this technology effectively (Ebsworth, Kim, & Klein, 2010). We concur with Atchison (2004) who urges teachers to offer students training and guidance in order to use hypertext advantageously. "Researchers and educators must respond to the unique nature of hypertext and train students how to use this mode of learning effectively" (p. 5).

Grabe (2009) stresses that an awareness of textual discourse structure can provide scaffolding for reading comprehension. Consistent with Anderson's (2002) view, the use of metacognitive skills to monitor the reading process adds a potentially helpful dimension. Thus, including the structural aspects of hypertext information and its discourse functions in online text can be helpful to native and emergent bilingual readers in making good decisions regarding hypertext use. Indeed, Han and Anderson (2009) stress the relationship between reading, comprehension and second language acquisition. They call for an integration of alternative views so that pedagogical issues can be successfully addressed.

There are also potentially relevant variables that may impact reading including the density of hypertext additions as well as alternative modes of hypertext presentation. These support systems might be effective for learners with lower prior knowledge of the material (such as EBs) who need help making connections between sections of the text to build a coherent whole. Ideally, more guidance would increase the likelihood that students would progress through hypertext material in a more meaningful and coherent way. Finally, in order to help learners read on the Internet more successfully and use hypertext options optimally, it is crucial that teachers have the necessary background in language and technology to support learners' development.

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### **Notes**

This paper is adapted and updated drawing on McDonell (2006), unpublished dissertation.

## Appendix A: Interview Questions

Initial questions were general, in order to make respondents feel comfortable. The following questions were asked, but as is typical of semi-structured interviews, participants were encouraged to expand on their answers and follow new directions according to their inclinations. Questions already answered earlier in the interview were omitted.

Warmup: This part of the discussion focused on reading issues in general.

Do you like to read? Why or why not?

What do you usually read on a daily basis? Do you read in your first and second language? What do you read in each (that language)?

Targeted interview questions: What do you think about reading on the computer? (Why? Tell me more.)

Do you read articles online? Do you read articles in print? Say more about that.

What did you think about the readings in the study? (Did you like them? Why or why not?)

Was either reading easier than the other? Tell me why you think so.

When you read on the computer do you usually read the footnotes? Why? Why not?

Do you click on the links? Why? Why not?

In the study, did you read links? Why? Why not? Tell me more about it.

Did you read footnotes? Why? Why not? Tell me more about that.


How do you feel about the prompts at the end of each reading?

Is there anything else about the study you'd like to tell me?

## Appendix B. Sample of Reading Materials

### Cellular Radio Telephone

I Introduction



**Cellular Radio Telephone**, also called cellular telephone or cell phone, low-powered, lightweight radio transceiver (combination transmitter-receiver) that provides voice telephone and other services to mobile users. Cellular telephones primarily operate like portable or cordless telephones. However, unlike conventional wire-based cordless phones, cellular telephones are completely portable and do not require proximity to a jack to access the wire-based networks operated by local telephone companies. A new generation of services for cell phones includes videoconferencing and Internet access with the ability to send e-mail.

Cellular telephones have become very popular with professionals and consumers as a way to communicate while away from their regular, wire-based phones - for example, while traveling or when in remote locations lacking regular phone service. As cellular radio service proliferates and achieves greater market penetration, some users have begun to consider it an alternative to conventional wire-based services.

Cellular telephones work by transmitting radio signals to cellular towers. These towers vary in their capability to receive cellular telephone signals. Some towers can receive signals from distances of only 1.5 to 2.4 km (1.0 to 1.5 mi), while others can receive signals from distances as far as 48 to 56 km (30 to 35 mi). The area a tower can cover is referred to as a *cell*. However, more than one tower may exist in a given cell area. The cells overlap so that the system can handle increased telephone traffic volume. The towers within these cells are networked to a central switching station, usually by wire, fiber-optic cable, or microwave. The central switching station handling cellular calls in a given area is directly connected to the wire-based telephone system. Cellular calls are picked up by the towers and relayed to another cell telephone user or to a user of the conventional wire-based telephone network. Since the cells overlap, as a mobile caller moves from one cell into another, the towers "hand off" the call so communication is uninterrupted.

Cellular phone networks exist in nearly every metropolitan area throughout the world, and cellular coverage is expanding in rural areas. Due to the convenience and mobility of cellular telephones, users typically pay a higher fee than they would for normal telephone

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