ABSTRACT

There has been little research conducted on e-reader devices and the effect they hold on learning. Also, the literature has demonstrated that there are more negative implications to using e-text in learning than there are positive. Understanding the role of e-reader devices in comprehension and transfer is a crucial component of expanding the literature. The goal of this study was to assess the effects of e-text, specifically on the iPad, on reading comprehension and transfer learning. Sixty nine students enrolled in an Introductory Psychology course read from textbooks and e-text and completed assessment measures in comprehension and transfer learning. Overall, the findings of this study provided support for the notion that there is a positive relationship between learning and reading on an e-text transfer scores when compared to traditional text. Additionally, scores for reading comprehension were similar between both groups.

THE EFFECTS OF MULTIMEDIA TECHNOLOGY ON LEARNING

A Thesis Presented to

The Faculty of the Graduate School

Abilene Christian University

In Partial Fulfillment

of the Requirements for the Degree

Master of Science

by

Ryan T. Gertner

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This thesis, directed and approved by the candidate's committee, has been accepted by the Graduate Counsel of Abilene Christian University in partial fulfillment of the requirements for the degree.

Master of Science in General Psychology

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Dean of the Graduate School

Date

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Thesis Committee

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Chair

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CHAPTER I

LITERATURE REVIEW

Due to the rapid expansiveness of technology and its wide array of uses, the incorporation of technology in learning has become a viable and inexpensive option. As a result, it is becoming increasingly clear that traditional textbooks will be cast aside and the adoption of the e-book will result. Almost three-quarters of Americans, 73% believe that investing in innovation and advanced technology sciences in education is the key to the country's long-term success (Harris Interactive, 2009). The mass array of multimedia learning devices such as the iPad, iPhone, and Kindle hold the potential not only to replicate traditional textbooks but also to provide for a social interface component. Therefore, it is advantageous to utilize these current resources in order to create and to measure appropriate user interfaces that are capable of producing similar if not better learning outcomes from their predecessors, textbooks. The goal of the present study was to examine the effects of both e-reader devices and textbooks on comprehension and transfer learning.

The Advent of Digital Text

Alphabet

The components of written text have not always existed. In fact, the development of the written word rests upon the creation of the alphabet. The institution of the Greek alphabet, with its economy of symbols, its flexibility, and its direct relationship to the sounds of spoken language, made writing far easier to learn and manage (Claiborne,

1974). The alphabet allowed for coherence within the writing system as Fischer (2001) noted "employing an alphabet is statistically more efficient for most languages than Egyptian hieroglyphs, Mesopotamian cuneiform syllables, or Chinese characters" (Fischer, 2001, p. 83). The same alphabet can be shared by many languages. The alphabet helped develop the notion that written language now stood on a par with spoken language, and it was fundamental to all medieval thought (Fischer, 2001). During the 1800s, Western Civilization increased its demand for paper in order to support general education and government records (Fischer, 2001). By the 1900s, paper had become "the most important, efficient and totally irreplaceable medium of modern information storage. Economically and intellectually, our society had become a paper society" (Gaur, 1992, p. 47).

Printing Press

Around the mid 1400's, Johannes Gutenberg developed a complete printing press. Through the mechanization of print, a single Renaissance printing press could produce around 3,600 pages per day compared to 30 to 40 copied by hand (Wolf, 1974). The printed word revolutionized the way people were able to share thoughts and ideas. As early as 1620, the philosopher Francis Bacon wrote that printing has "changed the whole face and state of things throughout the world" (Mann, 1993, p. 445). The printing press was a significant factor in enabling people to easily communicate their ideas and findings through the establishment of easily distributed books and journals. "It can be safely said," historian Albertine Gaur has asserted, "that the two decades Guttenberg spent on the perfection of typography signaled the start of the modern period and that all subsequent scientific, political, ecclesiastical, sociological, economic and philosophical

advances would not have been possible without the use and the influence of the printing press" (Fischer, 2001, p. 272). Printing enabled people to easily broadcast their ideas in a form everyone was able to read.

Textbooks

The ancient Greeks developed the concept of texts intended for education (Bakker, 2010). The modern textbook holds its roots in standardization from Johannes Gutenberg's printing press. Compulsory education and the expansion of school systems in Europe enabled printing of a significant number of standardized textbooks for children. Textbooks have since become one of the main teaching instruments for most individuals since the 19th century (Parker, 2008). However, technological progress has adapted itself even in the interaction with textbooks. Online and multimedia materials are distributed with textbooks making it accessible for students to explore materials other than traditional print textbooks. Due to the development of the alphabet, printing press, and textbooks, digital text has now begun to advance which makes the purpose of the present study even more significant.

A Survey of Digital Text

Computers

Since the innovation of computers, people have been able to acquire information through the internet, online newspapers, online articles, and even online textbooks. Today, everyone with a personal computer has immediate access to the world's scripts and writing systems (Fischer, 2001). The internet has paved a path for the transmission of ideas and information. Eisenstein (1979) proclaims "the home and office desks have become the printer's shop" (as cited in Fischer, 2001, p. 283). Computers are able to

show written language and spread thoughts throughout the globe. An ever-increasing number of people are spending more hours per day using written—that is, keyboard—language rather than spoken language (Fischer, 2001). However, computers remained in a fixed position until the advent of technology such as the iPad or similar multimedia devices that hold e-reader programs.

E-Reader Devices

E-Reader devices like the iPad are in demand in our current society. The ability to gather textual information with a single touch on a screen makes e-reader devices highly valued. The pad has the advantages of the book without its drawbacks—the bulk, the limitations on how much text can be made to fit into a single volume, and the problem that annotating a paper book means, in some ways, ruining it (Ragen, 2008). Print as a primary method of distributing text is slowly disappearing. Electronic book sales tracked by the Association of American Publishers show a 158.1 percent increase over September 2009 ($39.9 million); year-to-date E-book sales are up 188.4 percent (AAP, 2010). Whether e-readers are the next logical step or whether they are an evolutionary rather than revolutionary product is not clear (Griffey, 2010). Not only do e-readers allow for manipulation of a text they are also considerably cheaper compared to traditional texts. E-book pricing is considerably lower than traditional textbooks: Ranging from $6-$10 dollars per book (Raab, 2010). With such a widespread interest in e-readers and their low cost, the question of how digital textbooks affect the learning process becomes extremely relevant.

Multimedia

Multimedia technology is somewhat similar to a traditional textbook in terms of

holding information. However, the ability to manipulate the text itself through an electronic device holds the potential for students to work with the media thereby allowing a more exciting method compared to standard note taking. Multimedia technology has the potential and functionality to hold enjoyment for users compared to that of a standard textbook. Any learning or teaching should be associated with feelings of pleasure and enjoyment instead of boredom or fear (Freeman, 1996). According to Shavinina and Loarer (1999), a common multimedia application consists of at least 3 of these 7 components:

1. Text (including notes, captions, subtitles, and other resources such as tables of contents, indices, dictionaries, and help facilities)
2. Data (such as tables, charts, graphs, spreadsheets, statistics, and raw data of various kinds)
3. Audio (including speech, music, atmospheric background noise, and sound effects)
4. Graphics (often ranging from traditional media such as drawings, prints, maps, and posters to images processed or created entirely within a computer)
5. Photographic images, from negatives, slides, prints, or even digital cameras (which record photographic images directly as computer graphics)
6. Animation (whether recorded on film or video, or created with a computer)

7. Moving pictures (specifically, digital video, either converted from analogue film and video, or created entirely within a computer).

There are varying ways of presenting learning material in a multimedia format to students. For example, Mautone and Mayer (2001) examined the effects of signaling in three different kinds of instructional messages: when the scientific explanation is presented in verbal form as a text passage, when the scientific explanation is presented in verbal form as speech, and when the scientific explanation is presented in verbal and visual form as a narrated animation. Students who received signaled text generated significantly more acceptable answers on the transfer test than did students who received nonsignaled text. It is possible that multimedia technology can help students successfully learn.

However, it is important to realize that failure to present multimedia technology in an appropriate form can lead to negative results. The perception of display on a multimedia application is of significant importance in terms of transfer learning. In fact, too much multimedia stimulation can interfere with the deeper cognitive processing that is critical to learning (Mayer, Griffith, Jurkowitz, & Rothman, 2008). In light of these concerns, it is necessary to see whether learning will be improved or limited by multimedia, which is the focus of the current study. After examining what is composed in an e-text, it is important to understand the concept of learning and how it applies to the present study.

Overview of Learning

Having reviewed the rise of digital text, many are wondering how e-text will

affect our cognitive capabilities. Specifically in educational settings, the questions raised concern issues related to reading, memory, learning, comprehension, and transfer. Do e-texts aid learners or inhibit them with the learning process, particularly compared to traditional paper texts? However, before this question can be answered we must review the psychological literature on learning.

Learning

Learning is defined as "a change in knowledge attributable to experience—(1) learning involves a change in the learner, (2) what is changed is the learner's knowledge, (3) the cause of the change is the learner's experience" (Mayer, 2011, p. 14). Learning is not measured through one operational definition. Rather, learning is a blend of comprehension, transfer of new material, and the retention of material. In fact, most transfer studies focus purely on the similarities and differences between the contexts of initial learning and subsequent transfer (Butler, 2010). Given the current study, learning has been evaluated using a multimedia device.

Cognitive Theory of Multimedia Learning

The present study focuses on a multimedia learning device; therefore, it is important to understand the cognitive functioning of people learning from multimedia. According to the cognitive theory of multimedia learning (CTML), the visual information processing channel may become overloaded when students must process on-screen graphics and on-screen text at the same time (Mayer, 2001). However, when words are presented as narration, words can be processed in the verbal channel, thereby reducing the cognitive load in the visual channel. In several studies testing this theory, both noninteractive multimedia environments and interactive media environments were used.

The results show students who learn from interactive (graphics and narration) learn more deeply and perform better on problem-solving transfer tests than students who learn from noninteractive (graphics and on-screen text) (Moreno & Mayer, 1999; Mousavi, Low, & Sweller, 1995; Sweller, 1999). Austin (2009) explains the bases of CTML:

> (CTML) is based on three *cognitive* science principles *of learning*: the human information processing system includes dual channels for visual/pictorial and auditory/verbal processing (i.e., dual-channels assumption); each channel has limited capacity for processing (i.e., limited capacity assumption); and active *learning* entails carrying out a coordinated set *of cognitive* processes during *learning* (i.e., active processing assumption). The *cognitive theory of multimedia learning* specifies five *cognitive* processes in *multimedia learning:* selecting relevant words from the presented text or narration, selecting relevant images from the presented illustrations, organizing the selected words into a coherent verbal representation, organizing selected images into a coherent pictorial representation, and integrating the pictorial and verbal representations and prior knowledge (Austin, 2009, p. 1340).

Based on these three cognitive principles of learning, the CTML outlines seven factors of multimedia design, multimedia principle (people learn better from words and pictures

than from words alone); spatial contiguity principle (people learn better when related words and pictures are in close proximity); temporal contiguity principle (people learn better when related words and pictures are close together in time); coherence principle (people learn better when irrelevant words, pictures, and sounds are eliminated from the presentation); modality principle (people learn better from narration and animation than from text and animation); redundancy principle (people learn better from narration and animation compared to animation, narration, and text); and individual differences principle (individuals with low prior content knowledge and individuals with high spatial skills benefit most from animation and narration-presented), and evaluated these principles based on transfer (Mayer, 2001). Austin (2009) notes the modality principle (people learn better from narration and animation than from text and animation) and the redundancy principle (people learn better from narration and animation compared to animation, narration, and text) serve as theoretical foundations for the other principles because they describe how information is processed. Researchers found that the modality principle's combination of pictorial and auditory materials yield better test results on transfer performance compared to a combination of written and pictorial (Mayer, 1998; Mayer & Moreno, 2002; Austin, 2009). The modality principle sheds light on how to develop multimedia tools for learning. A combination of visual and hearing aids does not burden students and enables better performance on transfer learning. Moreno and Mayer (2002) discovered that the redundancy principle occurs only when material are presented simultaneously. Austin (2009) replicated the redundancy effects, with students exposed only to narration and text scoring higher on transfer and retention tests. The redundancy principle shows the importance of developing proper multimedia learning tools for

learning. The modality and redundancy principles were not manipulated in the current study but are important to understand because of their affects on learning.

Transfer

The current study focused primarily on transfer learning. Consequently, it is essential to understand what transfer learning is and what specific problem-solving questions formulate transfer learning. Transfer is "the effect of prior learning on new learning or performance" (Mayer, 2011, p. 20). For example in reading, the general concept of vowels and consonants help students comprehend a variety of words; in mathematics, the general concept of a mental number line helps students learn a broad variety of arithmetic procedures; in science, the general concept of variables in scientific experiments helps students learn to assess an array of scientific hypotheses.

Austin (2009) categorizes the types of transfer problem-solving questions as: Redesign, Troubleshooting, Prediction, and Conceptual. Redesign questions revolve around changing the design or function of something. For example, students learning the integral components of an automobile would be able to show how to redesign the motor in order to obtain faster acceleration. Troubleshooting questions are a person's ability to think logically and systematically for the source of a problem. For example, if a person's cell phone is not charging, he would check to see if it was plugged in the outlet because he has learned that electronic devices have to be plugged in. Prediction questions involve the knowledge of what has the potential to cause a reaction for something. Essentially, it is the ability to answer the question of cause and effect or what certain catalysts will bring about the appropriate change that the question might ask. A meteorologist studying the weather would be able to predict how air humidity affects the probability of a tornado

developing. Conceptual questions are a general knowledge of the concept or components of a topic. The ability to understand what causes flowers to bloom is just one example of the conceptual component of transfer learning. Each one of these questions helps define the concept of transfer learning. The focus of the current study was how e-text affected learning as measured by these transfer questions.

Transfer Theory

The Effect Perspective: Positive vs. Negative Transfer

Given that the purpose of the current study focused on transfer, it is important to note how transfer can elicit both positive as well as negative outcomes. Positive transfer is the primary goal of education. What is learned in one context helps enhance learning in a different context. In contrast, negative transfer is a type of error in learning where a previously learned context interferes with the acquisition of an adaptive response to a new context that is similar to the first (Cree & Macaulay, 2000). Negative interpretations prevent relevant skill knowledge from being applied to practiced and unpracticed goals which leads to negative transfer, whereas positive assessments will enable the transfer of relevant skilled knowledge to different goals (Osman, 2008). In the present study, if the experimental group performed better on transfer tasks than the control group, there would be evidence of positive transfer, which is the primary goal in education.

The Situation Perspective: Specific Transfer vs. General Transfer

The current study focused solely on specific transfer as opposed to general transfer; however, it is important to note the dissimilarity between them. One of the major controversies in the learning sciences concerns whether learning is specific or general (Mayer, 2011). The situation-driven perspective on transfer focuses on the

description of the relation between the prior experience and novel situation. Researchers have provided ample evidence for both specific and general transfer (Butterfield & Nelson 1991; Mayer & Wittrock 1996; Austin 2009). For example, Thorndike and Woodworth (1901) showed there was no evidence that learning Latin fostered general transfer. However, more recent research shows that students can learn general strategies, which can be implemented in a variety of tasks (Pressley & Woloshyn, 1995). Mayer (2011) notes this distinction between specific and general transfer and contends "learning appears to be somewhat domain specific but there are general principles or strategies that can apply within a particular domain" (Mayer, 2011, p. 21).

The current study focused on specific transfer by asking students to read from a selection of text from an undergraduate psychology course. Students read a chapter of the text and were asked to answer questions over that specific literature they just read. The transfer questions were over specific components of the psychology course materials in order to measure specific transfer.

Variables That Affect Transfer

The current study not only focused on transfer as a measure of learning but also comprehension. Many variables correlate with transfer learning. However, for the purposes of this study, only three will be noted: working memory capacity, mental model construction, and comprehension. These variables are important to understand due to their particular effects on transfer.

Working Memory Capacity

Working memory capacity is "the ability to maintain task-relevant information in a highly active state" (Meinz & Hambrick, 2010). Human working memory holds a

limited capacity and is capable of becoming overloaded with information (Baddeley, 1999). Working memory tasks focus on the executive and attention control of short-term memory which provide for the processing, disposal, and retrieval of information (Mayer, 2001). Therefore, people who hold a higher working memory capacity perform better on transfer tests. Austin (2009) found "working memory capacity is a relative individual difference that affects transfer learning" (Austin, 2009, p. 1351). Working memory capacity is just one variable that correlates with transfer learning.

Mental Model Construction

Essentially, a mental model is "an internal mental representation of some domain or situation that supports understanding, problem solving, reasoning, and prediction in knowledge-rich domains including the circulatory system" (Azevedo, Guthrie, & Seibert, 2004, p. 95). In fact, several studies have utilized this concept of a mental model (e.g., Azevedo et al., 2002; Chi, 2000; Chi, De Leeuw, Chiu, & LaVancher, 1994; Chi, Siler, Jeong, Yamauchi, & Hausmann, 2001; Narayanan & Hegarty, 1998; Vosniadou & Brewer, 1992; White & Frederiksen, 1998). Azevedo et al. (2004) used mental models specifically in the knowledge and concepts of the circulatory system. The status of mental models refers to a person's correctness and completeness in understanding features of each component they are learning about; the relationships among the features of each component; and the relationships among the local features of different components. The ability to understand the features and relationships between ideas, effects transfer learning.

Mayer, Mathias, and Wetzell (2002) demonstrated the importance of working memory capacity and its effect on transfer learning. Researchers ran two different groups

one of which received pre-training for developing mental models and another group which received no such training. The pre-training group was able to develop more comprehensive mental models and scored 6.67 in comparison to the no pre-training group score of 4.07. When students are first confronted with a narrated animation, their cognitive systems may become overloaded. It is important to construct appropriate mental models before creating near-transfer learning. While working memory and mental model construction affect transfer, the variable that this study focused on in relation to transfer is comprehension.

Comprehension

While working memory capacity and mental model construction do affect transfer, the variable that was examined in this study is comprehension. Comprehension focuses on "those objectives, behaviors, or responses that represent an understanding of the literal messages contained in communication" (Bloom, 1956, p. 89). Text comprehension takes place with a limited working memory. Therefore, activation of prior knowledge and the drawing of inferences in order to build coherence is crucial (Graesser & Britton, 1996). Some researchers have suggested that the ability to scroll through hypertext enables more efficient scanning abilities on visual search tasks (Bernard, Baker, & Fernandez, 2002; Duchnicky & Kolers, 1983; Monk, Walsh, & Dix, 1988; Spool, Scanlon, Schroeder, Snyder, & DeAngelo, 1999).

Measures of Learning: Transfer and Comprehension

The present study focused on measuring learning through the assessment of both transfer and comprehension. Both of these variables help clarify the effects of e-text on

learning. It is imperative to understand how to assess both transfer and comprehension specifically for the current study.

Assessment of Transfer

Austin (2009) used Mayer's (2001) items to elaborate on the measure of problem-solving questions: redesign, troubleshooting, prediction, and conceptual questions for transfer. Several studies have used these question types to measure transfer (Mayer & Chandler 2001; Mayer, Heiser, & Lonn 2001; Mayer, Fennell, Farmer, & Campbell 2004; Austin 2009). All of these question types are integral components in measuring the operational definition of transfer. Problem-Solving Questions consist of creating a list of questions over a subject area and prompting students to apply what they learned to new situations. Participants completed the transfer test with paper and pen and were allotted 10 minutes for completion. Scoring of the answers involves creating a list of appropriate responses (before experimentation) for all problem-solving questions. Typically, there are between two to five acceptable responses per prompt with each response that is correct being worth one point. This same scoring and construction was used for the present study.

Assessment of Comprehension

One way of measuring comprehension is through multiple choice tests. In a chapter on measurement devices, Mayer (2011) explains the importance of not foreshadowing information that will be on a posttest during the pretests phase. Craig, Driscoll, and Gholson (2004) used the multiple choice test to measure differences in student's comprehension after interacting in various conditions with an auto-tutor program. Craig, Sullins, Witherspoon, and Gholson (2006) borrowed the multiple choice

tests designed for their previous experiments to study similar learning conditions. Because the same auto-tutor media was used, it was not necessary to redesign the multiple choice tests. The current study used the same model Craig et al. (2006) used in constructing and assessing comprehension questions. For the current study, participants were given a post measure test consisting of 16 multiple choice questions that assessed their understanding of what they just read during the learning phase.

Current Study

Due to the popularity of e-reader devices, it is beneficial to examine their performance in learning. However, previous studies have focused on learning in multimedia environments specifically on computers as opposed to e-reader devices. The current study focused on the effectiveness of students who use iPads with an e-book application versus students who use textbooks. Specifically, does user interface and e-book layout on the iPad lead to higher performance learning as measured by higher transfer scores? The experiment was conducted in a laboratory setting from students enrolled in an introductory psychology course at Abilene Christian University. Participants were divided in to two separate groups: traditional textbooks and iPad e-text books. Both groups read a chapter from an introductory psychology book and were asked to answer multiple choice comprehension questions as well as transfer questions. For the actual transfer test and comprehension test, the students were allotted a 25 minute time limit to study from the iPad application as well as a separate group using the textbook.

It was predicted that (a) participants in the iPad group would obtain higher scores on transfer and (b) comprehension in comparison to participants in the textbook group.

CHAPTER II

METHODS

Participants

Participants were recruited from an Introductory Psychology course at Abilene Christian University. Students were invited to participate in the study via email after being informed of the study in class. Sixty nine participants (59.4% female and 40.6% male) responded and participated in the study. Participants ranged in age from 17 to 35 with mean age of 19.59 (SD = 2.30). When asked to report ethnicity, 69.6% of participants were Caucasian, 13% were Hispanic, 5.8% were African-American, and 11.6% were Asian or Asian-American.

Materials

For the reading material, King's (2010) *Experience Psychology* textbook was used either in hard copy or e-text copy. The section of the book used was taken from Chapter 11, pages 393-399. The content of the chapter consists of topics focused on social psychology, specifically conformity, obedience, and group influence.

Procedures

Upon arrival, participants were given a consent form (See Appendix A) and a general information questionnaire focusing on demographics (See Appendix B). Participants were then randomly assigned to either a bound paper copy of the text or the electronic version. Prior to administering the reading materials, participants were read the following:

Thank you for participating in the current research interest of the psychology department at Abilene Christian University. The current study is to focus on the effectiveness of students learning and comprehension abilities when reading from specified resources. The aim of this study is to learn how different reading media can affect both learning and comprehension. You will each be given a text from *Experience Psychology*, an introductory psychology textbook. You will have approximately 25 minutes to read this text, please keep reading until you are told to stop. Please read at a regular pace and as if you were studying for a quiz. Do not rush; you will have more than enough time to finish the reading section. After the reading, the text will be gathered, and you will be given a test to measure your comprehension of the reading section you just read. You will have a specified amount of time to complete the test. Once everyone has completed the test, every test will be taken up. You will then be given essay exam questions over your memory of what you have just read. Please write as much as you can until you are told to stop. The first essay exam question will be gathered, and you will begin the second question handed out to you. Once, again please write as much as you can until you are

told to stop. There will be four essay exam questions total. Please remember to include your name on each testing document.

Participants who were assigned to the traditional text copy were given a bound photo colored copy of the text. Participants in the e-text group were handed iPads that already had the appropriate section in the book pulled up. Participants were instructed on how to use the iPad and where to stop. Participants for both sections were allotted 25 minutes to read a section in the text *Experience Psychology* (King, 2010). Once all of the participants had read the section or the time has elapsed, reading materials were gathered, and participants were instructed to complete the following two tests on comprehension (See Appendix C) and transfer learning (See Appendix D). Participants were allowed 10 minutes to complete the comprehension section. Once all participants had finished or time had elapsed, the comprehension section was gathered and the first section of the transfer test was given. Participants were allowed 2.5 minutes for each of the transfer questions for a total of 10 minutes. Participants were instructed to keep working until they were told to stop, at which point participants were given the next transfer question. Once all four questions for the transfer assessment were completed, participants were debriefed and thanked for their participation.

Measures

Comprehension

The same guidelines outlined by Craig et al. (2004) were implemented for the comprehension measurement. Each of the participants in the experimental and control group were given a 16 multiple choice question assessment. Multiple choice questions

for comprehension were selected from the major themes and ideas within the chapter section. Example items include "Which of the following is *not* an example of conformity" and "A risky shift is." Comprehension items can be found in Appendix C.

Transfer Learning

The transfer learning assessment was a 4-item scale adapted from Mayer (2001). The test included four specific questions based on redesign, troubleshooting, prediction, and conceptual prompts. Example items include "What would increase the level of obedience a person has towards a given task?" and "What does social facilitation have to do with performance?" Prompts had two to five acceptable answers per page. Each acceptable answer was worth one point. Each prompt had a question listed at the top, at which point participants wrote their answers on the paper. The transfer learning items can be found in Appendix D.

CHAPTER III

RESULTS

Descriptive Statistics for Transfer and Comprehension

In phase one of the analysis, descriptive statistics were used to calculate the mean and standard deviations for transfer and comprehension scores. These can be found in Table 1. As can be seen in Table 1, participant's scores for both comprehension and transfer learning displayed variability.

Table 1

Descriptive Statistics for Transfer and Comprehension (N = 69)

Measure	M	Mdn	Mode	SD	Range
Transfer	4.18	4.00	4.00	2.03	9.00
Comprehension	9.95	11.00	11.00	2.93	13.00

Traditional Text Vs. E-Text: Effects on Reading Comprehension

It was predicted that participants in the experimental iPad group would obtain higher scores on comprehension in comparison to participants in the textbook group. In phase two of the analysis, a One-way ANOVA was used to examine mean differences on reading comprehension between the traditional text group and e-text group. The ANOVA statistics can be found in Table 2 with the group means presented in Figure 1. As can be seen in Table 2 and Figure 1, participants in the e-text reading group did not score significantly higher on reading comprehension compared to participants in the traditional text reading group. While this finding was not predicted, it does indicate that the e-text device was comparable to the traditional text in a test of learning the

traditional text reading group. While this finding was not predicted, it does indicate that the e-text device was comparable to the traditional text in a test of learning comprehension. As such, this trend in the data is favorable to those who advocate greater e-text usage in educational settings.

Traditional Text Vs. E-Text: Effects on Transfer Learning

In phase three of the analysis, a One-way ANOVA was used to examine mean differences on transfer learning between the traditional text group and e-text group. The ANOVA statistics can be found in Table 3 with the group means presented in Figure 2. As can be seen in Table 3 and Figure 2, the prediction was supported. It was predicted that participants in the e-text group would obtain higher scores in transfer learning in comparison to participants in the textbook group. As expected, the e-text group displayed significantly higher transfer learning tests scores when compared to the traditional text group. These findings can be seen in Table 3, Figure 2. In contrast to the reading comprehension findings, the increased transfer scores for the e-text group suggest that e-text is not merely equivalent to traditional text but may be superior. The effect size for transfer indicates a difference of .85 SD difference in performance on transfer scores.

Table 2

Analysis of Variance for Reading Comprehension

Source	SS	Df	MS	F	P	d
Between Groups	3.15	1	3.15	.36	.55	.15
Within Groups	583.71	67	8.71			
Total	586.87	68				

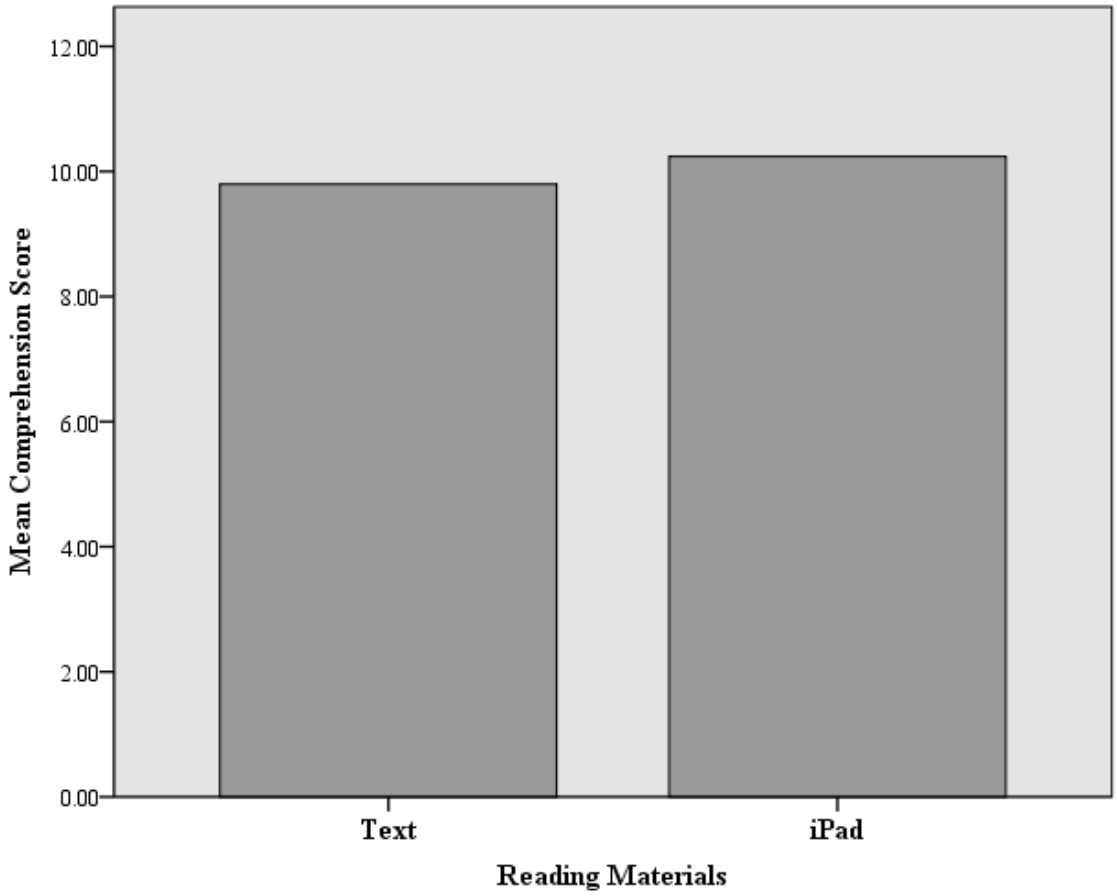

Figure 1. Comparison of Traditional Text and E-text Groups on Reading Comprehension.

Table 3

Analysis of Variance for Transfer

Source	SS	Df	MS	F	P	d
Between Groups	43.35	1	43.53	12.24	.001	.85
Within Groups	327.19	67	3.54			
Total	280.55	68				

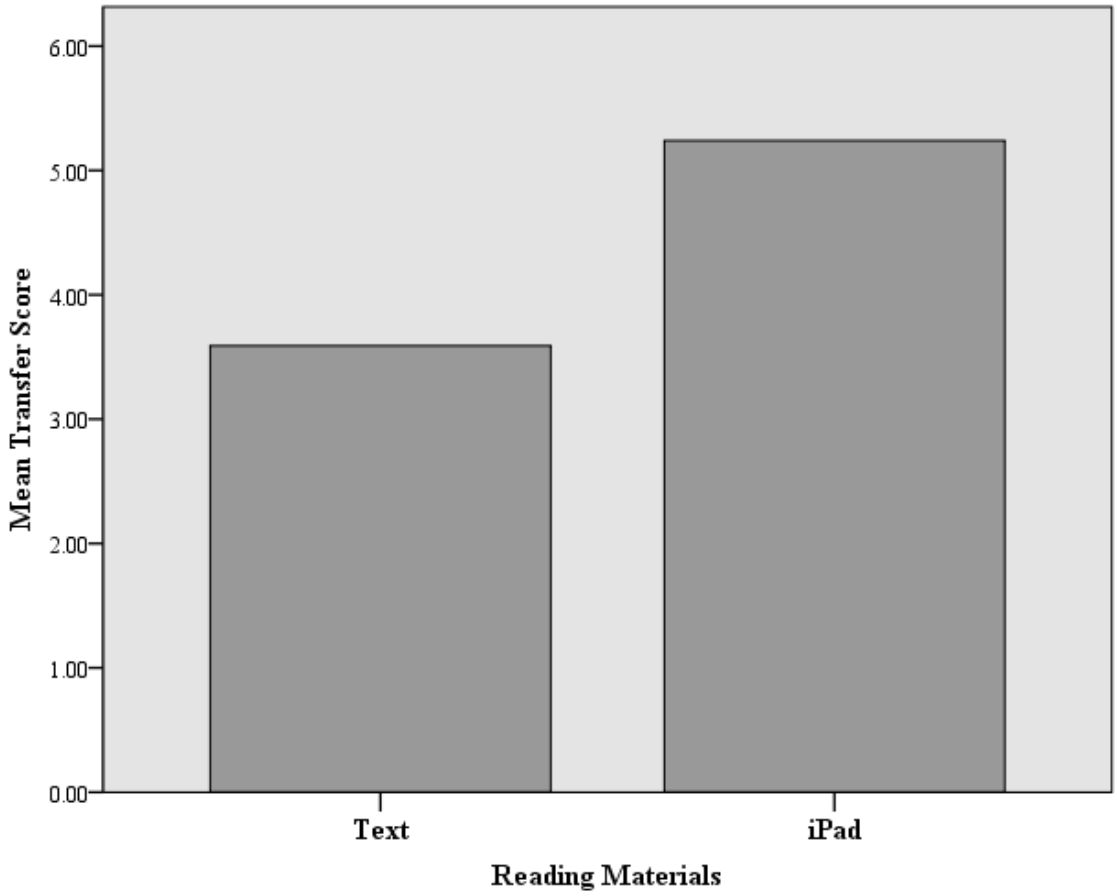

Figure 2. Comparison of Traditional Text and E-text Groups on Transfer Learning.

Summary of Results

In summary, the findings did not support the predictions made for reading comprehension but did for transfer learning. However, reading comprehension scores were equivalent for both the traditional text group and the e-text group, despite the fact that the results were not significant. Traditional text readers scored within the same range as e-text readers. Finally, e-text readers exhibited significantly higher transfer learning scores compared to traditional textbook readers.

CHAPTER IV

DISCUSSION

Summary of Findings

The impact of technology on society is indisputable. It has become increasingly clearer that newer more advanced methods of displaying information through electronic devices is prevalent in today's world. With such advances, the question raised about the effects of technology on learning is a topic in need of further research. No longer are books the sole sources of information to be learned. As mentioned in Chapter One, the sounds of spoken language were once the sole means of advocating newly formed ideas and were the only means of teaching and learning. The spoken word was later transcribed into visual books. A similar adaptation is occurring with textbooks in the present day. E-reader devices have the potential to become the new and improved means of storing information and learning from it. The newest and latest mode of reading and learning is now focused in the form of e-text. Sales are on the rise for e-reader devices; therefore, it has become an important undertaking to evaluate how these devices affect learning capabilities.

As discussed in Chapter One, there are many positive facets to e-reader devices. E-book pricing is relatively cheaper compared to traditional textbooks. E-readers hold a component of annotation and social interaction that traditional texts cannot obtain. E-readers also allow for portable storage of literally hundreds of e-books within one item. However, there is also a negative side to multimedia devices. Interactive texts,

animations, and social components have the potential to be informative but may also hinder learning. E-text users may become overwhelmed when bombarded by a vast array of images, videos, and multimedia applications with e-text, and the potential for learning may be significantly impaired. The question becomes whether or not e-text can effectively display textual information without overloading the reader.

This study examined reading comprehension and transfer learning between readers of both e-text and traditional text. The goal of this study was to assess how iPads and traditional textbooks affect learning, specifically comprehension and transfer learning. As previously mentioned, subjects were recruited from an Introductory Psychology class at Abilene Christian University. Participants were randomly assigned to either the traditional text or e-text groups. After reading a selected text, both groups completed measures of reading comprehension and transfer learning. It was predicted that those readers in the e-text group would have higher scores on both comprehension and transfer learning compared to the readers in the traditional textbook group.

Comprehension was not significantly higher for the e-text group. However, transfer learning was significantly higher among readers in the e-text group compared to readers in the traditional text group. As mentioned previously, little research has been done that emphasizes the effects of e-reader devices on learning. This study indicates that a person's learning when using an e-reader device is equal to or greater than a traditional textbook.

The reason as to why these results occurred is necessary to focus on. The results of this study suggest that how the e-text organizes and illustrates information may lead to higher transfer learning scores. This is interesting as it has been suggested that the

presentation of learning materials on a multimedia device could hinder learning performance, but if the device was appropriately composed it might improve learning. In this study, the e-text presented information identical to traditional textbooks. However, the format permitted scrolling and, thus, displayed less information on the screen. Readers perhaps performed better on the transfer learning assessment due to the way the e-text presented the material as a more manageable reading. E-readers are able to read the text in a less daunting fashion because they are scrolling through bits of each page, instead of being presented with the page as a whole. The e-reader device also allowed access to featured "key words" that the author deemed important. E-readers are able to click on these key words which enabled a small pop out window. This helped minimize time wasted glancing back and forth to see vocabulary definitions which were located in the margins of the traditional textbook. Perhaps the ability not to lose one's place, gave readers on the e-text an inherent advantage by not wasting a user's working memory capacity on scanning the text for key information as presented by the text.

However, this still does not explain why comprehension scores were equivalent for both groups. This could be due to a variety of reasons. There are key differences between transfer learning and comprehension. Comprehension focuses on general information that an individual gathers on a subject matter whereas transfer learning is applied knowledge of the material presented. Based on this study, readers of the e-text group were more easily able to identify with the material as it applied to other situations. As stated before, this may have been due to how the e-text was organized in a more manageable form compared to the traditional text. In order to obtain transfer learning, readers must first be able to comprehend the text. Comprehension of a text includes

every component of the text, meaning any facts, figures, vocabulary words, can be assessed. Thus, there is far more general knowledge that must be acquired whereas transfer learning involves a deeper level of reasoning with a more specific focus. Based on the results of this study, the e-text presented on the iPad was able to elicit a deeper level of reasoning for participants but did not strengthen learning for general knowledge. More research is needed, however, to replicate these findings and to illustrate the contrast found between transfer and comprehension.

Implications

In light of the results of this study, e-text advocates' stance is strengthened. This may pave the path to improved e-reader devices that further enhance learning. E-reader devices can no longer be viewed as just devices for entertainment and light reading. Rather these e-reader devices can be developed to reach even greater heights to improve readers learning.

The way in which learning and reading can occur is changing. The results of this study support the hypotheses that e-text is comparable to traditional text. Carbon copy books are not the only or even preferred way to learn. This study shows that there is not only the potential for e-reader devices to be equal with textbooks. In fact, they are possibly even better when used for learning.

Previous research conducted on the effects of e-text, in any form, on learning has tended to show negative results. The results of this study are significant due to the fact e-text has a more positive effect on transfer learning than did a traditional textbook. The findings of this study are important because researchers who focus on learning need to know the potential positive effects e-text can have when it is appropriately displayed for

readers. Current research is lacking, specifically for the impact of e-text in an e-reader device such as an iPad. Therefore, this study provides a foundation in a new realm of cognitive research.

Educators, too, benefit from being informed of reader's ability to learn the same material in an e-device that differs from traditional textbooks. Educators are responsible for educating students. The fact students may be able to simply purchase one simple device that stores all of their books has the potential to greatly impact how teachers teach. With such information presented, teachers may have to rethink and readapt how their current curricula are taught. Not only would this be easier to manage but the fact that students may even be able to learn better from e-devices is of significant interest for educators.

Not only do educators involved in the learning process need to be informed of this relevant debate but textbook companies may begin to change what they are currently producing. Currently, companies have already begun to produce e-textbooks that are available for download on the iPad, Kindle, and various other e-reader devices. Most textbook companies' primary focus still revolves around mass production of textbooks as opposed to e-text books. However, based on the findings of the current study, companies may begin to switch products in order to minimize costs of productions and to effectively market to an ever growing technologically based society.

Society as a whole may aspire to greater technological heights based on the knowledge that e-text may be beneficial to learning. As previously mentioned, society believes that investing in technology will help with long-term success. Our society is rapidly becoming a paperless world. The implication of this not only enables a greater

breadth of applied knowledge at one's fingertips but also helps benefit the environment itself. Society has persisted in developing and advancing learning from oral stories to textbooks and is currently at a new crossroads: e-reader devices.

Limitations and Future Directions

Despite significant statistical findings in the present study, there were several limitations. The number of participants who responded to this study was small, specifically for the experimental group (N = 25). Not only was the sample size small, but the sample itself consisted of similar demographics. Participants were primarily Caucasian, undergraduate students in an introductory psychology course. Also, this study was conducted in a laboratory setting. Students may perform differently in a real world setting compared to a lab setting.

Furthermore, the assessment measures used were not tested and validated prior to being administered in this study. Despite the fact these measures were modeled after other studies, the development of the measures for the dependent variables: comprehension and transfer learning were not thoroughly tested. It is important to validate these measures. The comprehension assessment was multiple choice, which could account for the results due to the possibility that participants could guess correct answers randomly without knowing the information. Also, for some readers, the allotted 25 minute time limit to read the text may not have been a sufficient amount of time.

Finally, the scoring procedures for the transfer assessment may have scoring bias. The researcher was fully aware of whether or not participants were in either the experimental or control group. Due to the fact the experimenter scoring the assessments was not blind in the study, scoring methods and procedure could possibly be skewed in

favor of one group. Interrater reliability for the transfer assessment must be further assessed in order to assure the prevalence of the results.

The question of how much generalizability the results of this study have needs further evaluation. Further research should assess different age groups and diverse cultures. The measures in this study must also be evaluated and assessed for their validity and reliability.

Not only should the dependent measures be assessed but the content of the subject matter learned should be branched out. Social psychology is one specific subject that focuses on theoretical models. There are a multitude of subjects that possess information that are considered more concrete and directive. Other subjects must be evaluated in order to gain a real understanding of the effects of e-text on learning.

Not only are there a diverse range of subjects that people learn about but there are also a significant amount of differing e-reader devices that vary from the iPad. Other e-reader devices possess different styles and options. Further research should assess whether the actual size of the e-reader's screen and color display of the text affects learning. Not only are e-readers different in terms of construction there are also interactive components such as videos, text editing, annotations, and text pop up. With such additions embedded in the e-text itself, the question of whether or not additional features enhance or hinder learning must be evaluated and assessed.

Finally, current features and applications of some e-text applications allow for social interactions. Users are able to view other's notes and annotations of the e-text. Does such social collaboration help improve learning or does it just overload a person's learning system?

Conclusion

There have been differing views concerning whether e-reader devices are even equivalent for learning compared to traditional textbooks. Consequently, with further innovation and more e-reader devices and e-textbooks being produced, it is important to appropriately assess their influence on learning. This study looked at the effects of e-text on both comprehension and transfer learning in the hopes of increasing further knowledge in this newly developing field. While this study brought to light some of the possible positive effects of e-text on transfer learning, future research is still needed. Due to the increasing prevalence of e-reader devices, researchers, educators, and textbook companies should work with one another to explore their effects on learning.

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APPENDIX A

Informed Consent Form

Dear Participant,

OVERVIEW

The current study is to focus on the effectiveness of students learning and comprehension abilities when reading from specified resources. The aim of this study is to learn how different reading media can affect both learning and comprehension.

PROCEDURES

The experiment will be conducted in a laboratory setting from students enrolled in an introductory psychology course at Abilene Christian University. Participants will be randomly selected to participate in either the experimental or control groups. Both groups will read a chapter from an introductory psychology book and be asked to answer multiple choice comprehension questions as well as transfer questions.

RISKS AND INCOVENIENCES

There are no physical or psychological risks or harms anticipated for this study. Subjects will be asked to stay for up to thirty minutes in order to complete the study.

BENEFITS

Subjects if selected in the experimental group will be able to interact with iPad applications, and learn about e-text.

COSTS AND ECONOMIC CONSIDERATIONS

Subjects will be rewarded with extra credit accredited to their Introductory Psychology Course.

CONFIDENTIALITY

The information gathered is confidential and will be seen only by people who need to do so for scoring and data analysis of the research. The removal of names will be used in order to ensure confidentiality.

VOLUNTARY PARTICIPATION

All subject participation is voluntary. You may leave at any time or say no to answer any questions you do not wish to answer without suffering a penalty of any kind.

QUESTIONS AND FURTHER INFORMATION

Feel free to ask questions at any time and feel free to contact me at any time for further information and what came from the results. Ryan Gertner, rtg06a@acu.edu

Your signature below indicates that you have read and agree to participate in this research and further indicates that:

You have read and understand the information written above.

You understand that participation is voluntary and that refusal to participate will not penalize you in any way; and

You understand that you are free to withdraw from participation at any time without penalty.

I give my consent that my information can be used for research purposes.

Signature:_____ Date:_____

Print Name:_____

APPENDIX B

Demographics Survey

Directions: Please fill out the following survey to best of your abilities by selecting which answer best matches you.

1. What is your age?
   _____

2. What is your sex?
   Male _____ Female _____

3. How do you describe yourself? (Please check the one option that best describes you)
   American Indian or Alaska Native _____
   Hawaiian or Other Pacific Islander _____
   Asian or Asian American _____
   African American _____
   Hispanic or Latino _____
   Non-Hispanic White _____

4. What is your marital status?
   Married _____
   Divorced _____
   Widowed _____
   Separated _____
   Never been married _____
   A member of an unmarried couple _____

5. What is your current grade classification?
   Freshman _____
   Sophomore _____
   Junior _____
   Senior _____

6. What is your religious affiliation? (If other please list below)
   Protestant Christian _____
   Roman Catholic _____
   Jewish _____
   Other _____, _____
7. Please list your major. _____

APPENDIX C

Comprehension Assessment

Directions: You have 10 minutes to complete the following questions. Please indicate your answer choice by circling.

1. The results of the Milgram study are disturbing because
   A. The majority of participants who went all the way to 450 volts did so quite happily.
   B. Milgram violated the ethical principles of his time.
   C. The experimenter had no real power to force the subjects to comply.
   D. The subjects volunteered to be the "teacher" rather than the "learner."

2. Which of the following *is not* an example of conformity
   A. A person comes to college and starts to drink alcohol, even though he has never been a drinker before.
   B. Hitting someone.
   C. Stopping at a stop sign.
   D. Singing a song with a group.

3. Conformity is
   A. A change in a person's behavior to coincide with the group standard.
   B. A behavior that complies with the explicit demands of the individual in authority.
   C. A change in a person's thoughts to coincide with an individual's standard.
   D. A behavior that coincides with the explicit demands of the group standard.

4. A difference between conformity and obedience is that
   A. Conformity has a stronger influence on behavior than obedience.
   B. Conformity does not involve an explicit command from others.
   C. Conformity happens in small groups, whereas obedience happens in large groups.
   D. Conformity is based on wanting to be right; obedience is based on wanting to be liked.

5. Obedience is
   A. The influence others have on us because we want them to like us.
   B. A behavior that complies with the explicit demands of the individual in authority.
   C. The influence other people have on use because we want to be right.
   D. A change in a person's behavior to coincide with the individual in authority.

6. All of the following are contributing factors to conformity *except*
   A. How confident we are of our own independent judgment.
   B. How well informed we perceive the group to be.
   C. The influence other people have on us because we want to be liked.
   D. How regularly of an occurrence we see the group.

7. In Milgram's study disobedience would occur due to
   A. When participants could see others disobey.
   B. When the authority figure was not perceived to be legitimate.
   C. When the victim was made to seem more human.
   D. When at very strong voltage levels, the victim no longer responded.

8. The influence others have on us because we want them to like us is known as
   A. Obedience influence.
   B. Conformity influence.
   C. Informational social influence.
   D. Normative social influence.

9. A defining characteristic of groupthink is
   A. Accurate decision making.
   B. Decisions that are more extreme than normal.
   C. The discouragement of minority viewpoints.
   D. Group discord.

10. All of the following are related to deindividuation *except*
    A. Doing something as part of a large group.
    B. Hearing someone explicitly call your name and express recognition of you.
    C. Losing your sense of personal responsibility while taking part in a group activity.

D. Wearing a disguise while taking part in a group activity.

11. Social contagion is
    A. The tendency of people to perform worse when in the presence of others.
    B. The rapid spread of bad ideas among the members of a group.
    C. Behavior that imitates others' actions, thoughts, or emotions.
    D. The influence of minority groups on the majority group.

12. The improvement in an individual's performance because of the presence of others is known as
    A. Group performance
    B. Social facilitation
    C. Social shift
    D. Group facilitation

13. All of the following is true about social loafing *except*
    A. There is increased accountability for individual effort.
    B. The larger the group, the more likely it is that an individual can loaf.
    C. Individuals within the group who view the task as important are likely to work harder than usual.
    D. Persons tend to exert less effort in a group.

14. Which of the following is not a factor in group decision making?
    A. Risky shift.
    B. Groupthink.
    C. Majority influence.
    D. Social contagion.

15. A risky shift is
    A. The tendency for a group decision to be riskier than the average decision made by the individual group members.
    B. The strengthening of an individual's decision due to a group discussion.
    C. The tendency for an individual's decision to be riskier than the average decision made by the group.
    D. The impaired group decision making that occurs when making the right decision is less important than maintaining group harmony.

16. Symptoms of groupthink include all of the following *except*
    A. Overestimating the power and morality of one's group.
    B. The avoidance of isolation within groups.
    C. Lack of willingness to hear all sides of an argument.

D. Pressure for uniformity.

Scoring Instructions: Each item is worth 1 point. The comprehension assessment consists of 16 items that produce a range of 0 to 16 with higher scores indicating high comprehension.

APPENDIX D

Transfer Learning Assessment

Directions: You have 2.5 minutes to complete each of the following 4 questions (10 minutes total). Please answer these questions as best as you can in essay format. Please keep working until you are told to stop.

1. What would increase the level of obedience a person has towards a given task?

PLEASE KEEP WORKING UNTIL YOU ARE TOLD TO STOP

2. Suppose George desperately wants to quit his job, but his coworkers convince him to stay. How did this happen?

PLEASE KEEP WORKING UNTIL YOU ARE TOLD TO STOP

3. What does social facilitation have to do with performance?

PLEASE KEEP WORKING UNTIL YOU ARE TOLD TO STOP

4. What causes groupthink?

PLEASE KEEP WORKING UNTIL YOU ARE TOLD TO STOP

Scoring Instructions: Each transfer question has a list of acceptable answers, each worth one point. No points are awarded for common sense answers. Table 1 lists the acceptable answers.

Type	Question	Acceptable Answers
Redesign	What would increase the level of obedience a person has towards a given task?	1. An authority figure giving instructions. 2. Observing other people that obey the instructions.
Troubleshooting	Suppose George desperately wants to quit his job, but his coworkers convince him to stay. How did this happen?	1. Group polarization (Solidification and strengthening of first position) 2. Groupthink (Right decision is less important than maintaining group harmony). 3. Social comparison (George's opinion is not as extreme as his coworker's opinions, so he switches).
Prediction	What does social facilitation have to do with performance?	1. Performance improves because of the presence of others. 2. The presence of others arouses performance and energy levels. 3. For new or difficult tasks, social facilitation hinders performance. 4. Social facilitation improves performance on

		well-learned tasks.
Conceptual	What causes groupthink?	1. Groups value conformity over accuracy. 2. Any variation of ideas are met with strong disapproval (Group members are encouraged to get with the program).

Note: Common sense answers not counted as correct; scored for meaning not verbatim from key.