The effects of pre-reading relevance instructions and individual interest on learning outcomes and curiosity

Danielle Ruth Johnson

ABSTRACT

THE EFFECTS OF PRE-READING RELEVANCE INSTRUCTIONS AND INDIVIDUAL INTEREST ON LEARNING OUTCOMES AND CURIOSITY

Danielle R Johnson, Ph.D.
Department of Psychology
Northern Illinois University, 2015
Amanda Durik, Co-Director
Lisa Finkelstein, Co-Director

Epistemic curiosity is a drive that increases arousal and motivates epistemic behavior such as question asking and continued information seeking. According to the knowledge-gap model of curiosity, epistemic curiosity is aroused when a person acknowledges a gap between what they know and what they would like to know. Presenting questions to an individual is theorized to prompt the creation of such knowledge-gaps. In the reading comprehension literature, these questions are called *pre-reading relevance instructions.* Another variable thought to increase continued epistemic behavior is individual interest. This study aimed to replicate past research by exploring how pre-reading relevance instructions, intended to highlight relevant information, affected reading time and recall. Additionally, it extends past research by examining how pre-reading questions affect further question asking and video watching behavior, and by looking at the effects of individual topic interest on these relationships. One hundred and six students from a Midwest university (41 men and 66 women) read passages about walkingstick insects and were then asked to recall specific and general information about each passage. Participants were also asked if they had additional questions on the subject matter and were given the opportunity to view videos related to the topic. Before reading, participants were randomly assigned to one of three conditions. In two of these conditions participants

received pre-reading relevance instructions and in the final condition participants received general reading instructions. Results for recall were only partially consistent with past research on the effects of relevance instructions. Specifically, in one of the relevance instruction conditions, pre-reading instructions facilitated cued recall. In the other relevance instruction condition, pre-reading instructions facilitated free recall. That is, relevance instructions facilitated cued recall for one passage, but not for the other. Pre-reading relevance instructions did not have any other effects on reading time, recall, or continued epistemic behavior. Individual interest in the domain of walkingsticks did not moderate these relationships. However, individual interest was correlated with continued epistemic behavior. Finally, the limitations and implications of the current research are discussed and ideas for future research are proposed.
Keywords: curiosity, individual interest, relevance instructions

NORTHERN ILLINOIS UNIVERSITY
DE KALB, ILLINOIS

MAY 2015

THE EFFECTS OF PRE-READING RELEVANCE INSTRUCTIONS
AND INDIVIDUAL INTEREST ON LEARNING
OUTCOMES AND CURIOSITY

BY
DANIELLE RUTH JOHNSON

A DISSERTATION SUBMITTED TO THE GRADUATE SCHOOL

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS

FOR THE DEGREE

DOCTOR OF PHILOSOPHY

DEPARTMENT OF PSYCHOLOGY

Doctoral Co-Directors:
Amanda Durik
Lisa Finkelstein

ACKNOWLEDGEMENTS

I would like to thank my doctoral co-directors, Dr. Amanda Durik and Dr. Lisa Finkelstein for all of their expertise and support during this process. I learned more than I can say from their patient guidance. I also would like to thank my committee members: Dr. Lacie Barber, Dr. Anne Britt, Dr. Joe Magliano, and Dr. Stephen Tonks for all their feedback and comments on my experiment and manuscript. I would like to thank my colleagues at Northern Illinois University for their encouragement and support. Finally, I would like to thank my friends and family who have always been there for me throughout this long process.

TABLE OF CONTENTS

Chapter Page

LIST OF TABLES

LIST OF FIGURES

Figure Page

LIST OF APPENDICES

CHAPTER 1

LITERATURE REVIEW

Introduction

In both education and training, the desired outcome is learning. One way that learning is traditionally assessed is recall. Recall indicates that information has been remembered. This stored information creates an important foundation of knowledge that can be used to build upon in the future.

Within any educational context, interventions that increase learning are obviously important, but also important are interventions that trigger motivational variables such as curiosity and interest. The latter seem especially critical given the increasing availability to information via technology and the accelerating rate at which information becomes out-of-date. This means the opportunity for continued epistemic behavior is ever present and increasingly necessary. As such, there is a better chance than ever before that as educators, our efforts in the classroom will affect what students learn more about outside of the classroom. In fact, some have made the argument that in this new information-rich, world of technology, curiosity is more important for educational success than intelligence (Friedman, 2007).

Curiosity is tied to learning in both educational and workplace settings as a motivational drive that results in exploration (e.g. Day, 1982; Reio & Wiswell, 2000). The link between curiosity and learning begins early in one's life and is very important to the cognitive development processes of children (Wohlwill, 1987). Piaget linked curiosity and exploratory behavior to the process of incorporating new ideas into existing ones. Additionally, curiosity is often linked with academic achievement in certain educational settings (Kashdan & Yeun, 2007) and is essential for self-directed knowledge seeking.

A construct that is closely related to curiosity is interest. The construct of interest, in relation to learning, has been examined in many different ways over the years. One of the first scholars to discuss interest theoretically in the context of education was John Dewey (1913). Dewey said that while effort played an important role in the learning process, interest promoted a deeper learning and enhanced personal engagement not found with effort alone.

Not surprisingly, given the relationship between curiosity and learning, interest is also related to learning outcomes. Anderson, Mason, and Shirley (1984) had third grade students read a selection of unrelated sentences and then measured attention, recall and interest corresponding to sentences. In this study, children were more likely to recall sentences that they rated as more interesting. Further, interest has been found to lead to deeper levels of processing and a desire for continued learning outside of the classroom (Schiefele, 1996, 1999; Schraw, 1998).

Taken together, the above research suggests that, at the very least, the goal of educational interventions should be to try and strike a balance between learning outcomes important within the classroom for the educational goals/standards and continued self-directed learning via continued epistemic behavior, beyond the classroom.

Past research in the motivational literature has examined the effects of different situational variables on these sought-after educational outcomes. For example, seductive details (Garner, Gillingham, & White, 1989) are entertaining pieces of irrelevant information added to a text in an attempt to increase reader engagement. However, seductive details have been shown to decrease performance on recall tests and continued epistemic behavior (e.g. Garner et al., 1989; Hansen, 2014; Harp & Mayer, 1997).

Pre-reading questions are another type of situational variable that are often used in educational and organizational learning environments. Questions presented to the reader before reading are used by educators to highlight key information within the text that may be important to the goals of the reader (e.g. for curriculum objectives or test preparation). Recently, most of the studies examining the effects of pre-reading questions on educational outcomes have come from the reading comprehension and text processing domain where they are dubbed *relevance instructions* (e.g. McCrudden & Schraw 2007; Rothkpf & Billington, 1979). These studies find that relevance instructions have a positive effect on recall. These positive effects are promising; however, it is less clear how these effects are related to continued epistemic behavior. Theory from the curiosity literature suggests that the presence of relevance instructions may either facilitate or undermine curiosity and subsequent epistemic behavior (Berlyne, 1954; Loewenstein, 1994). In an attempt to shed some light on this problem, the purpose of this study was to examine whether relevance instructions had a positive or negative effect on curiosity and how interest interacts with that relationship.

Theories of Curiosity and Interest

Curiosity has been defined as the universal, intrinsically motivated force that directs information seeking behavior (Berlyne, 1950; Reio, Petrosko, Wiswell, & Thongsukmag, 2006). As such, it is closely linked to the context of education. In the education literature, Dewey

(1910), proposed three dimensions of curiosity including social, physical, and intellectual. Relevant for our purposes, intellectual curiosity is defined as that which occurs when information is lacking and there is interest in both solving the problem and accumulating knowledge.

Within the domain of psychology, and similar to Dewey's notion of intellectual curiosity, is epistemic curiosity (Berlyne, 1954). Epistemic curiosity involves the search for new knowledge which leads to the increase in such knowledge by motivating exploratory behavior aimed at acquiring the information (e.g. Dember, 1960; Keller, Schneider, & Henderson, 1994; Loewenstein, 1994).

Berlyne (1960, p 80) also proposed a dimension within epistemic curiosity based on the scope of exploratory behavior. Specific exploration is associated with exploration aimed at attaining specific pieces of information that the individual wants, such as the answer to a question. Alternatively, diversive exploration is a general desire in human and non-human animals to increase stimulation regardless of what it is or where it comes from.

To recap, epistemic curiosity motivates the search for information and has been described within two separate dimensions. This study will focus on specific epistemic curiosity because of its particular relevance to the context of learning. It will be assumed that for the remainder of the dissertation, when the term curiosity is used, it will refer to the search for knowledge specifically aimed at acquiring new information for the purpose of learning.

Knowledge-Gap Theory of Curiosity

Extending on the work of Berlyne, and related directly to specific epistemic curiosity, Loewenstein (1994) proposed a knowledge-gap theory of curiosity. Loewenstein (1994) hypothesized that in some situations feelings associated with information deprivation occur when individuals lack information and notice a discrepancy between what they know and what they would like to know (Berlyne, 1957; Loewenstein, 1994). This discrepancy in knowledge is referred to as a knowledge-gap and the state of arousal associated with a knowledge-gap is called curiosity. According to Loewenstein, in order to resolve this discrepancy in knowledge, people engage in exploratory behavior in an attempt to seek out information able to close the gap. Based on this aspect of the theory, Loewenstein suggested that the intensity of curiosity should increase for information that can close the gap. He also hypothesized that curiosity should be greater for problems where a single piece of information can close the gap. Finally, he suggested that closing the gap should have a reinforcing effect on the information that is obtained, thereby making it easier to recall in the future. Several studies have examined these predictions.

In one test of the knowledge-gap theory, Litman, Hutchins, and Russon (2005) designed an experiment in which they assessed curiosity by recording the amount of exploratory behavior participants engaged in. Upon arrival each participant received a packet of sealed envelopes. Printed on the outside of each envelope was a general knowledge question, and on the inside was a card with the corresponding answer. Before opening any envelopes, participants were asked to read the questions printed on the envelopes and then to self-report their confidence at being able to answer that question as well as their level of curiosity to find out the answer. At the end of the experiment, participants were given the opportunity to explore (open) as many of the envelopes as they wanted to. The results obtained by Litman et al. (2005) were in line with Loewenstein's knowledge-gap theory. Specifically they found the largest amounts of curiosity and exploratory behavior when individuals rated questions as being "Tip-of-the-Tongue," indicating a small knowledge gap, and the least amount of state curiosity and exploratory behavior when individuals rated the question “I Know,” indicating no knowledge gap.

In order to investigate the knowledge-gap theory within an educational context, Gentry et al (2002) provided middle school and college undergraduate student participants with a list of 20 concepts deemed to be important to a specific class in which they were enrolled. Next, students were asked to provide subjective ratings of how much participants already knew about a topic and how important additional knowledge about the topic would be to them. Participant ratings were then used to calculate a difference score assumed to be an assessment of the knowledge-gap. In accordance with knowledge-gap theory of curiosity and the relationship between curiosity and learning, they found that students with smaller knowledge gaps performed better on both coursework and final course grade.

Another prediction made by knowledge-gap theory, is that curiosity should be positively associated with one’s knowledge in a specific domain because it helps them focus on what is known versus what is unknown. In this case, the shift in focus occurs because the acquisition of knowledge allows an individual to imagine all the things they don’t know about a topic, which then leads to the desire to seek out new information related to that topic. Evidence in support of this prediction comes from Berlyne (1954), where questions about more familiar animals led to a greater level of curiosity than questions about less familiar animals.

In sum, the knowledge-gap theory of curiosity posits that curiosity and subsequent information seeking behaviors are aroused in specific situations in which a gap in knowledge between what one knows and what one wants to know is identified. This curiosity leads to knowledge search that is sustained until the gap is filled or in other words, until the information is acquired.

Curiosity and Interest

According to Schmitt and Lahroodi (2008) the first defining moment of curiosity and the beginning of the learning process is drawing one's attention to a topic of interest. Recall, that interest is closely related to curiosity and has also been shown to play a significant part in determining what we choose to learn and how well we learn it (Alexander & Jetton, 1996; Garner, 1992).

According to Krapp, Hidi, and Renninger (1992), the construct of interest can be further broken down into situational interest and individual interest. Situational interest refers to interest that is environmentally activated. Situational interest tends to be elicited by unusual information and is context specific. Situational interest may be closely associated with the momentary experience of curiosity that is sparked by situational variables (e.g. Berlyne, 1971); however, this interest does not always sustain over time and develop into an enduring interest. In contrast, individual interest resides in the person across time and is carried with the individual across learning contexts.

Some of the characteristics related to individual interest include the relevance of the information to the reader's goals (Schraw & Dennison, 1994), and text engagement (Mitchell, 1993; Schiefele, 1992). A hallmark of individual interest is the tendency to ask questions that sustain curiosity and lead to the continued search for knowledge (Hidi & Renninger, 2006; Renninger, 2000).

Question Asking. One of the most characteristic behaviors associated with curiosity is question asking. According to Ram (1991), question asking is the process of verbally requesting information and using questions to aid in problem solving, reasoning, and understanding.

Question asking occurs when individuals determine what information they want and then asks for it.

Curious people ask more questions (Peters, 1978). In one study, Jirout and Klahr (2011) measured curiosity in children using a behavioral task that assessed the amount of uncertainty the child chose to explore during a computer game. Students were also guided through a question generation task that assessed their ability to generate questions related to a science topic (e.g. bees, clouds, worms, leaves). The results showed that children who were more curious asked significantly more questions than children who were less curious.

One way level of student questioning has been operationalized in the past is with regards to depth of information requested. Chin and Brown (2000), distinguished between surface-level and deep-level questions. When students ask surface-level of questions they are looking for specific data or concept definitions. In contrast, deep-level questions inquire about the relationships between concepts and/or facts, such as cause and effect, and hypothetical situations.

Text Processing

Reading is a pervasive way we communicate information in learning settings. In the text processing literature, one way questions are presented to the reader is through the use of pre-reading relevance instructions. Relevance instructions are task-specific intentions that provide a reader with information for determining what parts of the text are relevant for the current reading situation (McCrudden & Schraw, 2007). Specifically, their purpose is to orient readers to relevant information and steer them away from irrelevant information.

Relevance is the extent to which the information in the text is related to the goals of the reader (Lehman & Schraw, 2002; McCrudden, Schraw, Kambe, 2005). Relevance differs from importance, which is the extent to which information within the text is structurally important when compared to other text segments. Schraw, Wade, and Kashdan (1993) designed a study to test the differences between importance and relevance. In this study, participants were assigned to one of three conditions that instructed the reader to take a particular perspective. As a measure of learning, after reading the passages, participants were asked to recall as much as they could about the passages. The results indicated that readers relied on information that was relevant to the perspective they were asked to take, and relied less on facets of the reading that were important to coherent comprehension of the passage overall. Specifically, they concluded that readers used importance as a default strategy, but switched to relevance to guide processing if they were able to distinguish between relevant and irrelevant information.

In a recent review, McCrudden and Schraw (2007) distinguished between two dimensions of relevance instructions generally identified in the literature, specific and general relevance instructions. Specific relevance instructions guide readers to focus on a specific piece of information or idea. Some examples of prior specific relevance reading instructions include specific questions they must answer after they finish reading, or instructions to ignore certain frivolous details. General relevance instructions prescribe readers to read the text broadly and non-specifically, using their prior knowledge as a guide for strategy selection when reading. Some examples of prior general relevance reading instructions include: to study, for entertainment, for the purpose of discussing or elaborating on the text, reading from a different perspective.

In one important study, Rothkopf and Billington (1979) examined the effects of specific pre-reading instructions on eye movement and general reading times. High school and college students read text about the National Oceanographic Data Center. Before reading the passage, participants were assigned to either a pre-reading question or a control group. In the pre-reading question group, participants were given specific relevance instructions, whereas participants in the control group were told to read in order to learn as much as they could. Results showed that memorizing specific relevance questions prior to reading a text passage lead to more recall of relevant versus irrelevant text. Additionally, participants who received specific relevance questions spent more time processing relevant versus irrelevant information. Eye-gaze data from this study indicated that this was due to participants slowing down and re-reading relevant information while skimming over irrelevant information.

As just described, pre-reading relevance instructions affect reading time and learning, as measured by various recall tasks. This is known as the relevance effect. In one study, McCrudden (2011) tested the relevance effect by examining different types of pre-reading instructions on outcomes after reading text passages. Some participants were presented with questions before reading, (for example, “What is the yearly rainfall in Andora,?” or “Why do tourists visit Andora?”), whereas other participants were simply told to read for understanding. Participants were then told they would be tested on the passages after they had finished reading.

On completion of the reading task, participants were given a free recall test, in which they were “asked to remember everything they could about…be as specific as possible”. Next they were given a cued recall task, in which the questions from the instructions were presented to participants. In this phase of the experiment, all questions were presented to all participants. The results showed that participants given questions before reading were better able to recall relevant versus irrelevant text segments. They also spent more time reading relevant versus irrelevant text segments.

To describe the relevance effect of text processing, McCrudden and Schraw (2007) proposed a goal-focusing model of text comprehension (Figure 1). In this model the designation of relevance is decided by either given or personal intentions, which interact to produce goal focusing, resulting in strategic resource allocation and better learning. Text processing has usually been operationalized as reading time and learning has been operationalized as performance on a recall task.

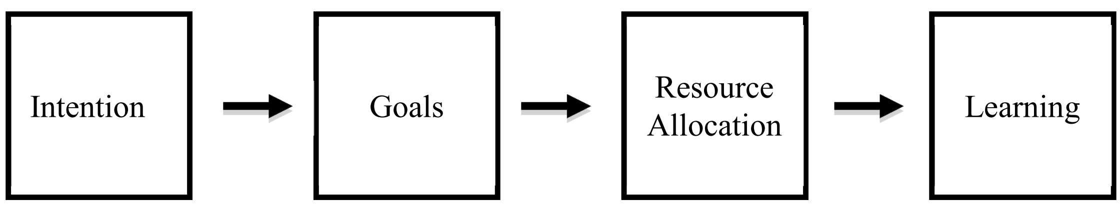

Figure 1. Goal Focusing Model of Text Processing

In a test of the goal-focusing model, McCrudden, Magliano, and Schraw (2010), assigned undergraduate students to one of three relevance instruction conditions. Participants were then asked to read passages based on four remote countries before completing a free recall task. Results showed that participants in the experimental conditions spent more time processing relevant versus irrelevant text passages. No differences between passage reading time or recall ability were found for participants in the control condition. These findings are in support of the relevance effect in text comprehension.

Prior research suggests that relevance instructions can lead to positive learning outcomes such as reading time, recall, and efficient strategy use. However, the relationship between relevance instructions and curiosity and continued epistemic behavior is still unclear.

CHAPTER 2

PRESENT RESEARCH

To recap, epistemic curiosity is the motivation to seek out new knowledge. Curiosity can result from a gap in informational knowledge that one feels necessary to fill, or from an individual interest that emerges from the value of knowledge for its own sake. Relevance instructions provided to the reader before reading have been shown to help focus readers' goals, which leads to more efficient processing strategies and better learning. Consistent with these findings, it seems possible that relevance instructions act as situationally activated knowledge-gaps and thus lead to increased curiosity related to the specific instructions. What is unclear is how they will affect curiosity questions and exploratory behavior, important for well-developed interest, after the answer has been found through reading the text.

The purpose of this study is to test whether relevance instructions, provided during a recall task, will have an effect on curiosity question asking and exploratory behavior, and whether the effect will depend on individual interest.

Participants were given an initial interest measure and then given relevance instructions to either read for the purpose of answering one of two relevance questions or for the purpose of general understanding. They then read two text passages on walkingstick insects. After reading the texts, participants were asked to recall as much information about the passages as they could, and to list any questions they were curious about while reading the passages. Finally, participants were given the chance to explore related concepts further.

Hypotheses

In order to replicate past research from the relevance instructions (RI) literature, the following hypotheses were proposed:

H1a: Participants in the relevance instruction condition will spend more time reading passages with information relevant to the questions versus passages where no relevant information appears; those in the no instructions condition will not show this disparity. (Figure 2).

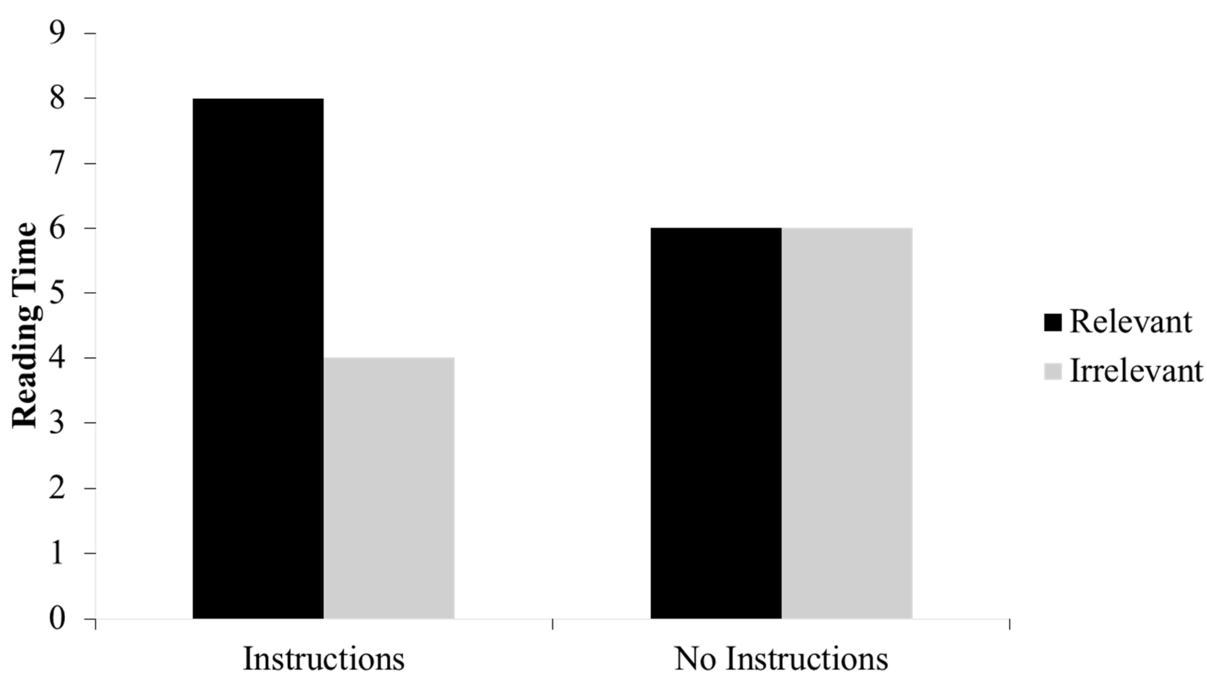

Figure 2. Predicted results for H1.

H2a: Participants in the relevance instruction conditions will remember more on the cued recall test for information relevant to the questions versus passages where no relevant information appears; those in the no instructions condition will not show this disparity. (Figure 3).

H3a: Participants in the relevance instruction condition will recall more relevant idea units versus irrelevant idea units during free recall; those in the no instructions condition will not show this disparity. (Figure 3).

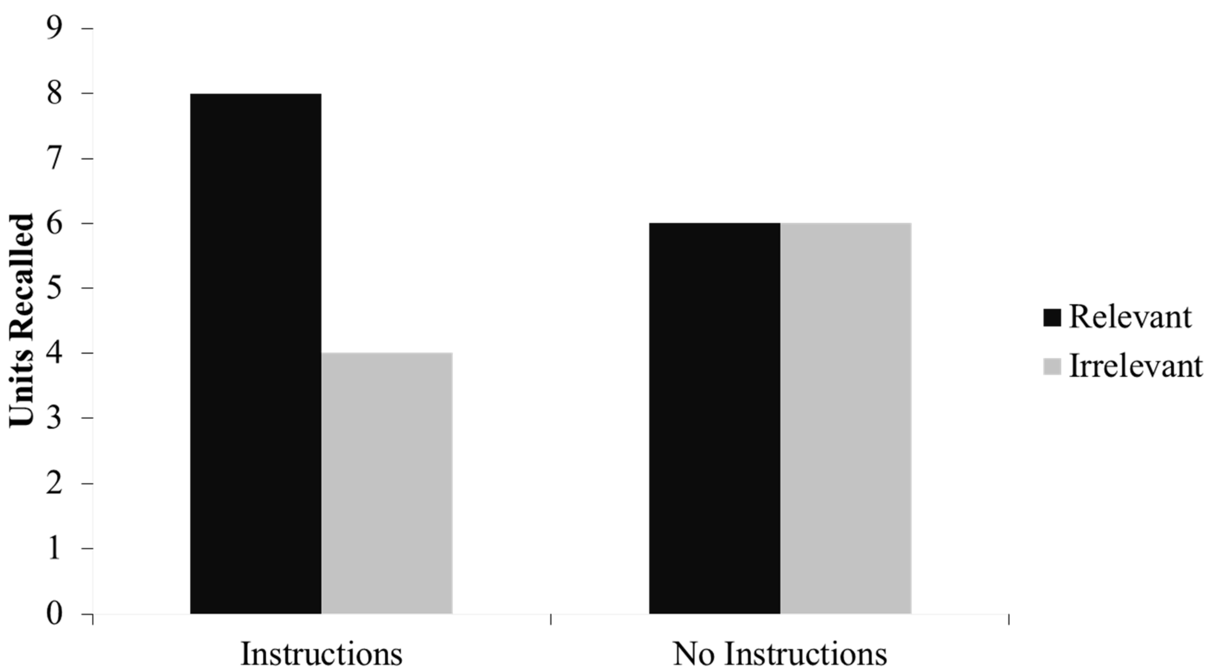

Figure 3. Predicted results for H2 and H3.

In addition to the replication hypotheses above, this study extends past research by examining the effects that relevance instructions have on curiosity and exploratory behavior. In order to assess curiosity, participants were asked to report questions they wondered about while reading the text passages. As a general measure of question asking, a count of total number of questions asked was assessed. In order to assess exploration, participants were given free time to explore two video clips related to walkingsticks. Based on the knowledge-gap theory of curiosity described above, hypotheses regarding how relevance instructions will affect curiosity were tested.

Recall, the knowledge-gap theory of curiosity posits that curiosity and subsequent information seeking behaviors are aroused during specific situations in which a gap in knowledge between what one knows and what one wants to know is identified. This curiosity leads to knowledge search that is sustained until the gap is filled or, in other words, until the information is acquired. Based on this aspect of the knowledge-gap theory, it is possible that relevance instructions will focus the reader's attention specifically on information deemed necessary to fill the knowledge-gap. Once this is accomplished, by reading the text and discovering the answers, it is possible that curiosity will be satisfied and further question asking and exploration will be thwarted. Specifically, the following hypotheses were tested:

H4: Participants in the relevance instruction condition will ask a fewer number of questions in total when compared with participants in the no instructions condition.

H5: Participants in the relevance instruction condition will spend less time openly exploring when compared with participants in the no instructions condition.

While situational variables can affect the development of interest, people also bring varying degrees of individual interest with them to the learning situation. Recall, that individual interest resides in the person across time and is carried with the individual across learning contexts. Further, individual interest is sustained in part by processes internal to the person as a consequence of asking questions that sustain curiosity (Hidi & Renninger, 2006; Renninger, 2000). Extending on these ideas, it is possible that if an initial individual interest in the topic exists, the proposed limiting effects of relevance instructions on curiosity will no longer be significant. In this sense, individual interest may prove to moderate the effects of relevance instructions on curiosity and exploration. Consistent with this idea, McCrudden, Magliano, and Schraw (2010) observed that individuals differed in their reading strategies when presented with pre-reading relevance instructions. Specifically, they found that when reading irrelevant portions of the text, readers employed either a "*narrowing*" or "*broadening*" reading strategy. Both groups spent more time focusing on relevant information (when compared to the control group); however participants in the broadening category also spent more time reading irrelevant information (when compared with the control group). It seems possible that the mechanism driving the increased processing of irrelevant information in the broadening group is related to individual interest. Specifically, people who are low on individual interest might just skim the text for the answers (consistent with the narrowing group); whereas people who are high on individual interest might be inclined to process irrelevant information as well (consistent with the broadening group).

Based on these findings, I propose the following hypothesis:

H6: There will be a significant interaction between initial individual topic interest and relevance instruction condition. Specifically, for participants with low initial individual topic interest, relevance instructions will decrease curiosity and further exploration; for participants *with high initial individual topic interest, relevance instructions will not have an effect on curiosity and further exploration. (Figure 4.)*

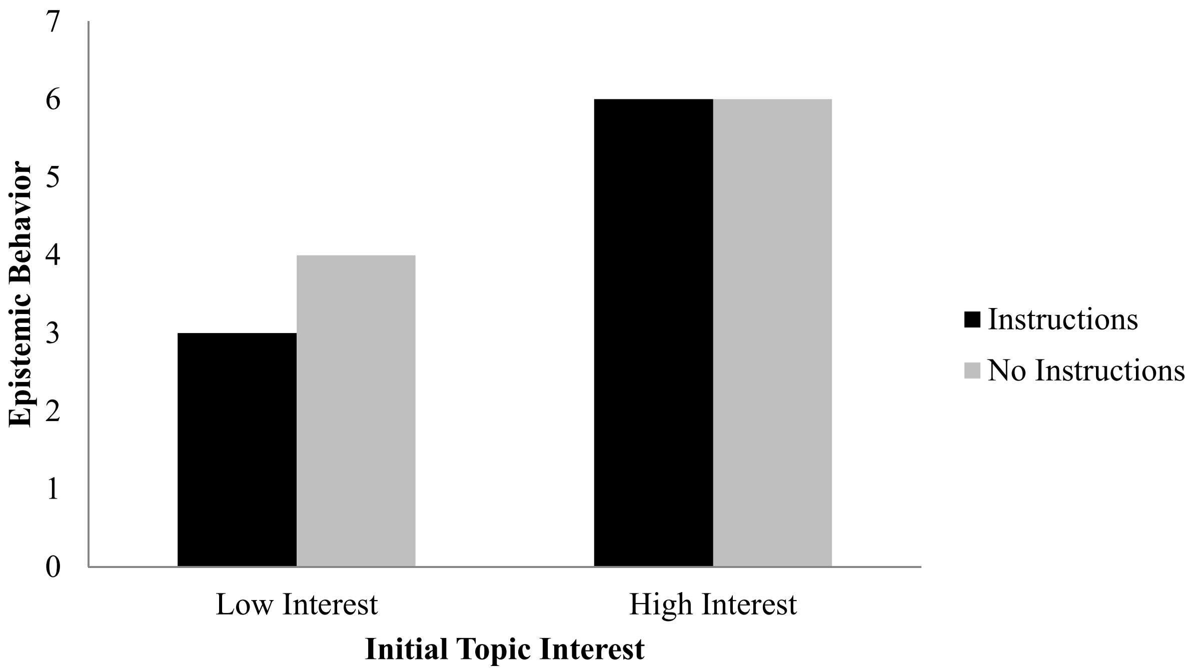

Figure 4: Predicted Results for H6.

Recall that another prediction made by knowledge-gap theory is that curiosity should be positively associated with one's knowledge in a specific domain because it helps to focus an individual's attention on what is known, which can highlight all the possibilities about what is not known. This suggests that people will become more curious about a topic as they acquire more knowledge related to that topic. As an alternative to the above predictions, that relevance instructions will lead to less curiosity and exploration, this aspect of the knowledge-gap theory would suggest that relevance instructions might have the reverse effect. Specifically, relevance instructions could increase attention to the specific knowledge gained through increased processing via successful performance on the cued and free recall tasks. As a result, this increase in specific domain knowledge could trigger the shift in focus from what one knows about the topic to what one does not know, thus increasing awareness of information that is still not clear and thereby increasing curiosity. As such, the following alternative hypotheses are proposed:

H7: Participants in the relevance instruction condition will ask a greater number of questions in total when compared with participants in the no instructions condition.

H8: Participants in the relevance instruction condition will spend more time openly exploring when compared with participants in the no instructions condition.

CHAPTER 3

METHOD

Pilot Testing

Prior to the start of official data collection, a pilot study was conducted to ensure that the study ran smoothly and that the procedures were sound. Eleven undergraduate participants, using the same pool as would be used for data collection in the main study, completed the study and were questioned afterwards about specific aspects of the procedure.

Besides general procedure fluency, there were a couple of specific goals of pilot testing. First, we wanted to make sure that the time limit provided for the free recall portion was adequate. Past research has varied on use of and length of time limits during free recall. Specifically, we found that including a time parameter encouraged participants to spend more time on the free recall section than not including the time parameter. Both five and six minute time intervals were tested. After completing the procedure, participants were specifically asked about the timing in this portion of the experiment. Of the six participants who received the five-minute interval, all stated it was plenty of time to recall necessary information. Of the five participants we received the six-minute interval, two stated that it was too much time and that they ran out of things to write about. Therefore, it was decided that five minutes would be given to each participant during the free recall portion of the experiment.

A second crucial aspect of pilot testing was to determine if we would have variance in the behavioral exploration phase of the experiment. Based on the methods of past research (Hansen, 2014), in this optional part of the experiment, participants were given the chance to watch one, two or no videos related to the life of a walkingstick. Of the 11 participants 3 watched at least one video. Although this number seemed low, upon further questioning, we found that other participants seemed interested in watching the videos but felt they may not have enough time during the experimental session. In order to account for this, an additional step was added to the experimental procedure. Accordingly, after completing the computer portion of the experiment and before the debriefing, participants were offered an informational sheet to take with them which included links to the videos allowing them to access the videos online once they had left the experiment. Additionally, after accepting or denying the informational handout, participants were asked by the experimenter whether or not they were in a hurry to be somewhere after the experiment. This information was recorded and used as a control variable during the final analysis.

Participants

A total of 107 undergraduate students (41 men and 66 women) enrolled in an introductory psychology class at Northern Illinois University participated in this study for partial class credit. One participant was omitted from the analyses due to very fast completion time and nonsensical answers, leaving the final number of participants at 106.

Based on the results of a power analysis, conducted using previous research (d = 0.33), a total of 72 participants were needed to obtain statistical power at the recommended level of 0.80 (Cohen, 1988).

Ages ranged from 18 to 29 (M_{age} = 19.2, *SD* = 1.86); however, nearly all participants (89.7%) were between the ages of 18 and 20. Almost half of the students were Freshmen (47.7 %), 35.5 % were Sophomores, 11.2% were Juniors, and 3.7% were Seniors. Additionally, one participant reported as “Other” and one participant reported they would rather not say what year in school they were. The students were 43.9% Caucasian, 34.6 % African American, 10.3 % Latino/Hispanic, 2.8 % Asian, 3.7 % reported “Other” and 1.9% indicated they would rather not say.

Overview of Design

Participants were instructed to read two different ecology text passages related to the living conditions of walkingsticks. Participants were randomly assigned to one of three conditions, two relevance instruction conditions (Hurricane and Predator) and one no relevance instruction condition. These conditions were based on the types of pre-reading relevance instructions received by the participant. In the relevance instruction conditions participants received a target question based on the main ideas of one of the readings. In the control condition, participants were instructed to read the passages for understanding. Thirty-five of the participants were in the Hurricane condition, 35 participants were in the Predator condition, and 36 participants were in the no relevance instruction condition.

Materials

Relevance Instructions

All participants received the following instructions on the computer screen:

> "You will read a collection of short passages on walkingsticks. Please read each passage carefully, in order to better understand the topic content. Later you will be given a test on how well you understood what you read."

Participants assigned to one of the Relevance Instruction conditions also received additional pre-reading instructions, which read: "Before you read the passages, please read the question below. We want you to focus on this question as you read the story." Next they were presented with a different relevance question. The Hurricane group read the following question: "What are four reasons that hurricanes are bad for walkingsticks?" The answer to this question can be found in Passage 1 but not Passage 2. This makes Passage 1 the relevant passage for this group. The Predator group read: "What are the four reasons walking sticks don't get eaten by predators who eat other insects? " The answer to this question can be found in Passage 2 but not in Passage 1. This makes Passage 2 relevant for this group.

Text Passages

The two text passages (Appendix A) were created by a professional writer and were 507 and 524 words in length. Passages were normed using the Flesch-Kincaid readability tests and were found to have a fifth grade reading level. Each passage described a different aspect of the life of a walkingstick. Specifically, the two texts presented in the learning section of the experiment were on hurricanes and predators as they relate to the life of the walkingstick. The two passages were presented in counterbalanced order between participants.

Measures

Dependent Variables

Free-Recall Test. The free recall phase of the experiment asked participants to write down as much as possible about the text passages they just read. Specifically, participants read, "Please write down as much as possible from the passages you just read. Try to remember as much as you can. It is extremely important that you write down every piece of information you can remember."

Cued-Recall Test. In this portion of the experiment, participants were presented with the same relevance questions presented in the pre-reading relevance question manipulation phase of the experiment. However, in this cued recall phase, all participants, regardless of condition, were presented with both of the questions. First each participant read: "Please answer each of the following questions. Try your best even if you are unsure about the answer." Next each of the relevance questions were presented one at a time in counterbalanced order between participants.

Covariates

Initial Knowledge Questions. In order to control for the amount of initial knowledge participants possessed about walkingsticks when coming into the experiment. This is important because prior knowledge has been shown to influence curiosity (Day, Langevin, Maynes, & Spring, 1972; Loewenstein, 1994). Specifically, the topic of walkingsticks was chosen based partially on our anticipation that initial knowledge would be relatively low. Before beginning the task, participants were presented with 4 items designed to assess knowledge in both ecology in general and more specifically in walkingsticks. Two open-ended were used to assess actual knowledge. Participants were asked: "What do you know about the study of ecology?", and "What do you know about the insects commonly known as walkingsticks? Specific items were: "Please rate how much knowledge you have about ecology.", "Please rate how much knowledge you have about walkingsticks." Participants were asked to rate each item on a 5-point scale (1 = *very little* to 5 = *very much*).

Ease of Comprehension Test. *(McCrudden, Schraw, & Hartley, 2011)* (α = .86). In order to control for differences in perceived ease of comprehension on relevant outcomes, a 10-item ease of comprehension test (Appendix B) was given to participants after completing the reading phase of the experiment. Participants were asked to rate each item on a 5-point Likert scale (1 = *strongly disagree* to 5 = *strongly agree*). This test was used as a subjective rating of how easy it was to understand the text. The purpose of including this was to control for differing levels of ease of comprehension between participants.

Individual Difference Measures

Initial Individual Interest. This questionnaire was adapted from Harackiewicz, Durik, Baron, Linnenbrink-Garcia, and Tauer (2008) (α = .90). It was included in order to test for the effects related to the amount of initial individual interest participants possess about ecology and walkingsticks when coming into the experiment (Appendix C). Before beginning the task, participants were presented with six items designed to assess interest for each of two topics: ecology in general and more specifically, walkingsticks. Participants were asked to rate each item on a 7-point Likert-type scale (1 = *strongly disagree* to 7 = *strongly agree*). Specific items included: “I’m really interested in the topic of ecology.”, and “I’m really interested in the topic of walkingsticks.”

Demographics. Participants were asked to self-report gender ethnicity, major, year in school, and age. Additionally, participants were asked to self-report ACT or SAT scores. This variable was used to control for cognitive ability between participants.

General Procedure

Students were greeted by the experimenter and led into a small private room containing a desk, chair, and a computer. Participants were introduced to the study and asked to give their informed consent before continuing with the rest of the study. Participants were then familiarized with the computer procedures and left alone to complete the task.

The experiment was conducted using the computer program MediaLab. First, participants were presented with a brief definition of ecology and walkingsticks. Specifically, they read: “Ecology is the branch of biology that deals with the relations of organisms to one another and to their physical surroundings.” and “Walkingsticks are a species of insects that look like sticks.”

Next, participants were asked to report their level of initial knowledge about ecology and walking sticks by typing everything they knew about ecology and walkingsticks besides the definitions they just read. They were then instructed to complete the initial knowledge and initial interest questionnaires. Once completed, participants were randomly assigned by the computer program to one of the three conditions. Participants assigned to the relevance instruction conditions were presented with only the relevance instructions that corresponded specifically to that condition, such that one relevance instruction asks a question that can be answered only by reading Passage 1 and the other asks a question that can be answered only by reading Passage 2. On the screen after reading their relevance instruction question, participants were asked to type the question they were asked to read for. They were also permitted to return to the instruction screen at this time, to review the question again if they wished. This was used as a manipulation check during data analysis.

After reading and recording the relevance instructions, participants were provided with the two passages of the text. The participants were instructed to read each passage, using the spacebar to advance to the next passage once they were finished. They were instructed to read at a pace that was comfortable to them and that once they advanced, they would not be able to go back to completed text passages.

Text-passage presentation order was assigned by the computer and was counter-balanced between conditions. Relevance instructions were only provided to participants before the text passages were presented and were not available while they were reading. After participants completed reading, they completed an ease of comprehension questionnaire specific to the texts they just read. They were then asked to complete a two-minute distractor task which asked them to “Describe what you do during a typical day.” Next, they completed the cued and free recall portions of the experiment.

During the curiosity assessment phase of the experiment, participants were asked what questions they had regarding the text. Specifically, on the computer screen they read, “During your reading did you have questions or wonder about anything related to this topic, regardless of how small or inconsequential you think it may be?” At this point participants were prompted to provide a yes or no answer. If they responded “No” they were taken to the demographics portion of the experiment. If they responded “Yes,” they were asked to: “Please type the questions you wondered about. (If nothing in particular, please type “Nothing in particular”).” Next participants completed the demographics questionnaire. As an optional part of the experiment, participants were given the chance to watch video clips about the life of a walkingstick. Two video clips were presented and participants were told they could watch zero, one or both of them. When they were satisfied, they were instructed to alert the experimenter of their completion. At this point the experimenter re-entered the room. Participants were provided with the option to take a slip of paper with the links to the videos if they were interested in viewing them at a later time (Appendix D). The experimenter also asked participants if there was any reason they were in a hurry to complete the session. Next, participants were debriefed and given an explanation of the study. Finally, they were asked not to discuss the study with other students, thanked, and given a credit slip for their participation. The entire procedure took less than one hour.

CHAPTER 4

RESULTS

Data Scoring

Before data analysis began, reading time for each passage was converted into a second per word ratio. Additionally, free and cued recall answers were scored for relevant and irrelevant text. Finally, curiosity question responses were scored and totaled.

Initial individual interest. Initial individual interest was scored for each participant using six items rated on a Likert-type scale ranging from 1-7. Separate scores were calculated for initial individual interest in ecology (general) and more specifically, walkingsticks for each individual. For these items a higher score indicated greater individual interest in the respective topics. Composite scores were calculated using all seven items with possible scores ranging from 0-42 ($\alpha = .92$).

Ease of comprehension

Ease of text comprehension was scored for each participant using ten items rated on a Likert scale from 1-5. For eight of the items, a higher score indicated greater self-reported ease of comprehension of the specific passages. Two of the items were reverse coded such that a lower score indicated lower self-reported ease of comprehension of the passages; these scores were transformed prior to analysis. A composite score was calculated using all ten items with possible scores ranging from 0-50 ($\alpha = .85$).

Reading time

Reading times for each of the two passages viewed by participants in the reading phase of the experiment were recorded to the nearest millisecond. This was done using the computer program running the experiment. Consistent with previous research, a second/word ratio was calculated for each passage (McCrudden, Schraw, & Kambe 2005). Ratios closer to zero indicated a faster reading time.

Cued recall

Idea units reported in the cued recall portion of the experiment were matched to answers for relevance instruction condition pre-reading questions. Each idea unit was scored dichotomously as either 0 = *not correct answer* or 1 = *correct answer* (Appendix E). Each pre-reading question and thus each passage had four correct idea units associated with it. A composite score as well as a percentage of correct to incorrect answers was calculated for each passage. Composite scores ranged from 0 to 4 for each passage.

Note that for participants in the relevance conditions, their cued recall may have been relevant or not. Cued recall scores were also coded for relevance, either 0 = *question-not-relevant recall* or 1 = *question-relevant recall.* For the Hurricane group, answers for the question “What are four reasons that hurricanes are bad for walkingsticks?” were considered relevant. For the Predator group answers for the question: “What are the four reasons walking sticks don’t get eaten by predators that eat other insects?" were considered to be relevant. There were no relevant cued recall answers for the no-instruction condition. Following the protocol from past research regarding relevance instructions (McCrudden, Magliano, & Schraw, 2010), all cued recall responses were scored by the author, who was blind to condition. Additionally, a randomly selected subset of 15 responses were scored by a trained research assistant who was blind to the experiment. All disagreements were resolved through discussion. Interrater agreement was high for cued recall responses for the Predator passage (93%). Interrater agreement was moderate (84%) for cued recall responses for the Hurricane passage and so an additional 15 randomly selected responses from this passage were scored by the second rater. Interrater agreement for additional 15 responses was (91%). All remaining responses were rated by the author.

Free Recall

Idea units reported in the free recall portion of the experiment were scored based on their inclusion in either Passage 1 or Passage 2 (Appendix F). An idea unit was scored if it matched the text verbatim or if it captured the gist of the meaning portrayed by the text. Incomplete and extraneous idea units were excluded. An idea unit was considered to be extraneous if it did not pertain to either text (e.g. "That is pretty amazing if I say so myself" and "Pretty rad. Evolved especially for this purpose-Darwinism at its finest. Walkingsticks, yeah."). Idea units that were found in both passages were also omitted from the analysis. Remaining idea units were scored as either Hurricane or Predator. If a participant duplicated an idea unit within their response, it was only scored once. Responses were scored by the author, who was blind to experimental condition. Additionally, a randomly selected subset of 30 responses were scored by one independent rater who was blind to the experiment. All disagreements were resolved through discussion. Interrater agreement was high (96%.). Participants received one score for each passage and scores ranged from 0-11.

Curiosity Questions

Total number of curiosity questions posed was the criterion used to assess the differences between participants' level of curiosity question production after reading. Idea units were scored as 0 = *non-question* and 1= *question*. Questions were only considered curiosity questions if they pertained to information discussed in the text. Some participants chose to ask questions regarding the nature of the experiment, (e.g. "Why am I reading these articles?" or "This made me wonder about being able to remember things"). These questions were not counted as curiosity questions. A complete list of the responses can be found in Appendix G. A composite score was calculated for each individual, indicating the total number of curiosity questions posed. Scores on this measure ranged from 0-4.

As an additional follow-up analysis, not related to any specific hypotheses, an exploratory analysis was conducted. A total of 49 (46.2%) participants indicated that, while reading the passages they had questions or wondered about something related to the topic of walkingsticks. Those participants were then asked to type in what they wondered about. Of the 49 participants who said they had questions during the readings, 12 responded "Nothing in Particular" when probed for specific questions. Questions were listed individually and grouped into three categories: questions about walkingsticks, questions about ecology, and questions about the experiment (Appendix G). Of the 37 participants who actually wrote specific questions they wondered about, seven participants asked a total of 14 questions related to experimental measures of procedures (e.g. Why is this important? How am I able to remember things?). These questions were not counted as curiosity questions during analysis. The remaining 30 participants (28.3%) each asked between one and four questions (Table 1). A total of 52 distinct questions were asked by participants. Thirty-eight of those questions were about walkingsticks specifically and 14 of those questions related to the broader domain of ecology.

Table 1

Frequency Data for Indication of Further Curiosity Questions and Total Number of Curiosity Questions Asked

"Did you wonder anything"	Frequency	Percent
Yes	49	46.2
No	57	53.8

Number of Curiosity Questions Asked	Frequency	Percent
0	76	71.7
1	14	13.2
2	11	10.4
3	4	3.8
4	1	0.9

Originally, additional analysis of the curiosity questions using the 16-category taxonomy suggested by Graesser and Person (1994) was proposed. This analysis was exploratory, so no specific predictions were made. However, upon further inspection of the actual questions posed, there were not enough questions in each of the 16 different categories for meaningful analysis (i.e. most questions were fairly shallow). Therefore, no further qualitative analysis was conducted using the curiosity questions posed by participants.

Continued Exploration

Continued exploration was scored in two different ways. First, during the session, participants were given the chance to watch up to two videos on the life of a walking stick. For each of the two videos a score of 0 = *did not watch the video* or 1 = *did watch the video* was assigned. These scores were added for a composite score of video watching. Scores on this measure ranged from 0-2. In addition participants were scored 0 = *did not take video slip* or 1 = *did take video slip*. This score was added to the composite video watching score to create an overall continued exploration score. Scores on this measure ranged from 0-3 (Table 2).

Assumption Checks

Before testing the hypotheses, all data were screened for errors and statistical assumptions were tested. All statistical tests were considered significant at $p = .05$.

Preliminary Analysis

Several analyses were conducted to compare the three conditions on initial variables. These tests were completed in order to verify, as would be expected, that the conditions did not vary prior to the independent variable. Additionally analysis was conducted in order to ensure

Table 2

Frequency Data for Additional Exploration (Number of Videos Watched, Video Slip Taken, Total Exploration) and If Participant Was in a Rush

Videos Watched	Frequency	Percent
0	75	70.8
1	26	23.6
2	6	5.7
Video Slip Taken		
Yes	68	64.2
No	38	35.8
Total Exploration Participation		
0	22	20.8
1	66	67.3
2	15	14.2
3	3	2.8
Participant in a Rush		
Yes	17	16
No	89	84

that participants in the experimental conditions understood their instructions. Of the participants who received relevance instructions 67 of them correctly reported the question they were asked to focus on. Although the remaining three participants did not correctly report the question they were asked, further investigation showed they attempted instead to produce a correct answer to the question they were asked (e.g. Their relevance question was: What are the four reasons hurricanes are bad for walking sticks? and they responded: 1. Get sucked into air 2. destroys habitat 3. increase in air pressure 4. Flooding). Therefore it was assumed that all participants in the relevance instruction conditions understood and remembered their pre-reading relevance question. Correlations between all continuous variables were calculated and examined. As expected, scores on measures of prior knowledge were significantly and positively correlated with scores of initial topic interest. Also to be expected, scores on cued and free recall tests were also significantly and positively correlated. As expected, recall scores were significantly and positively correlated with self-reported ACT scores and with scores on the ease of text comprehension measure. These variables were considered as covariates in further analysis on recall. Finally, scores of initial topic interest were significantly and positively correlated with both types of recall for the Hurricane passage, combined passage recall, and both types of continued epistemic behavior. All correlations for continuous variables are presented in a correlation matrix (Appendix H).

Initial Topic Knowledge

In order to test for differences in initial topic knowledge between experimental conditions, two one-way ANOVAs, with experimental condition as the independent variable and initial perceived topic knowledge ratings (ecology and walkingstick) as the dependent variable were conducted. Due to randomization procedures, we found no significant differences in initial perceived topic knowledge about ecology between the three conditions, $F(2, 103) = 2.32$, $p = .103$. We did, however, find a significant difference in initial perceived topic knowledge about walkingsticks among the three conditions $F(2, 103) = 4.16$, $p = .018$. Specifically, participants in the Hurricane condition ($M = 1.63$, $SD = 1.00$) self-reported significantly more prior-knowledge about walkingsticks than participants in the Predator ($M = 1.29$, $SD = 0.57$) and No Instruction conditions ($M = 1.17$, $SD = 0.38$). Although differences did occur between groups for self-reported initial knowledge for walking sticks, scores in general for this item were very low. Specifically, on a 5-point scale, 91.5% of participants reported having "very little" or "little" prior knowledge about walking sticks. Visual inspection of the open-ended measure of initial knowledge about walkingsticks confirmed that overall participants had very little or no prior knowledge about the insects known as walkingsticks. Based on these results, initial topic knowledge was not included in subsequent analysis unless otherwise specified.

Initial Topic Interest

In order to test for any differences in initial topic interest among the three conditions, two one-way ANOVAs, with relevance instructions as the independent variable and scores on the initial topic interest questionnaires as the dependent variable were conducted. As would be expected given random assignment, we found no significant differences in initial topic interest about walkingsticks between the three conditions $F(2, 103) = 1.61$, $p = .21$.

Cognitive Ability Factors

Ease of Text Comprehension. In order to test for any differences in the perceived ease of text comprehension among the three conditions, a one-way ANOVA, with relevance instructions as the independent variable and scores on the perceived ease of text comprehension questionnaire as the dependent variable was conducted. As expected, we found no significant differences in perceived ease of text comprehension between the three conditions, $F(2, 103) = 1.01$, $p = .37$.

ACT/SAT score. In order to test for any differences in general cognitive ability among the three conditions, a one-way ANOVA, with relevance instructions as the independent variable and self-reported ACT/SAT scores as the dependent variable was conducted. Only two participants reported SAT scores and their scores were converted to equivalent ACT scores based on recommendations from the ACT website (ACT, 2014). As expected, we found no significant differences in ACT scores between the three conditions, $F(2, 98) = 0.37$, $p = .69$.

Replication Hypotheses Tests

The means and standard deviations for all dependent variables based on condition are reported in Table 3.

Table 3

Means and Standard Deviations for Dependent Measures Based on Condition

Instruction Type	Hurricane (n=35) Mean (SD)	Predator (n=35) Mean (SD)	No Instruction (n=36) Mean (SD)
Reading Time			
Hurricane Passage	0.353 (0.154)	0.315 (0.125)	0.386 (0.154)
Predator Passage	0.319 (0.153)	0.281 (0.173)	0.318 (0.118)
Cued Recall			
Hurricane Question	3.20 (0.80)	2.34 (1.08)	2.47 (0.94)
Predator Question	2.17 (0.82)	2.54 (0.95)	2.36 (0.87)
Free Recall			
Hurricane Passage	5.14 (2.02)	4.31 (2.59)	4.44 (2.57)
Predator Passage	4.66 (2.92)	5.80 (2.30)	4.56 (2.25)
Curiosity Questions Asked	0.40 (0.78)	0.60 (0.88)	0.47 (1.03)
Videos Watched	0.91 (0.61)	1.03 (0.62)	1.03 (0.81)

Reading Time Hypotheses

Hypothesis 1 predicted that participants in the relevance instruction conditions would spend more time reading passages with information relevant to their pre-reading relevance questions compared to passages where no relevant information appears; and that no differences would appear in the no instruction condition. In order to test for differences in reading time between relevant and irrelevant text passages, a 2 (passage type: Hurricane or Predator) x 3 (relevance instruction condition: Hurricane, Predator, No Relevance Instruction) mixed model repeated measures ANOVA was conducted. In this analysis passage type was the within-subjects variable and relevance instruction condition was the between subjects variable. The main effect for passage type was significant, $F(1, 104) = 10.22$, $p = .002$, $\eta^2 = .03$. Participants spent significantly more time reading the Hurricane passage ($M = 0.352$, $SD = 0.147$) compared to the Predator passage ($M = 0.306$, $SD = 0.149$). The main effect for relevance instructions, $F(2, 103) = 1.70$, $p = .19$, $\eta^2 = .03$, was non-significant. The interaction of passage type and relevance instruction was also non-significant, $F(2,103) = 0.63$, $p = .54$, $\eta^2 = .003$. These data are presented in Table 4.

Table 4

Results for 2x3 ANOVA of Reading Time for Relevant and Irrelevant Text Segments by Relevance Instruction Condition

Source	df	SS	MS	F	p
Condition	2	0.11	0.06	1.70	.19
Reading Time	1	0.11	0.11	10.22	.002
Interaction	2	0.01	0.007	0.63	.54
Error	103	1.12	0.01		
Total	103	3.36	0.03		

Note. N = 106

Cued-Recall Hypotheses

Hypothesis 2 predicted that participants in the relevance instruction conditions would do better on cued recall than participants in the no instruction condition. In order to test for differences in cued recall between relevant and irrelevant text passages, a 2 (passage type: Hurricane or Predator) by 3 (relevance instruction condition: Hurricane, Predator, No Relevance Instruction) mixed model repeated measures ANOVA was conducted. In this analysis passage type was the within-subjects variable and relevance instruction condition was the between subjects variable. The main effect for passage type was significant, $F(1,104) = 8.63$, $p = .004$, $\eta^2 = .077$. Specifically, participants did better at answering the Hurricane question ($M = 2.67$, $SD = 1.01$) than they did at answering the Predator question ($M = 2.36$, $SD = 0.89$). The main effect of relevance instructions was non-significant, $F(1,104) = 1.45$, $p = .24$, $\eta^2 = .027$. The interaction of passage type and relevance instruction was significant, $F(2,103) = 11.87$, $p = .00$, $\eta^2 = .187$. In order to explore the significant interaction, three dependent-sample t-tests were conducted using Bonferroni adjusted alpha levels of .0167 per test (.05/3). Participants in the Hurricane condition, did better on the Hurricane cued-recall question than they did on the Predator cued-recall question, $t(34) = 5.54$, $p < .01$. There were no significant differences between scores on the Hurricane cued-recall question and the Predator cued-recall question for either the Predator condition, $t(34) = -.96$, $p = .34$; or the No Relevance Instruction condition, $t(35) = .70$, $p = .49$ (Figure 5). These data are presented in Table 5.

Free Recall Hypotheses

Hypothesis 3 predicted that participants in the relevance instruction condition will be better at recalling idea units from the relevant than irrelevant passages during free recall; those in the no instructions condition will not show this disparity. In order to test for differences in free recall between relevant and irrelevant text passages, a 2 (passage type: Hurricane or Predator) x 3 (relevance instruction condition: Hurricane, Predator, No Relevance Instruction) mixed model repeated measures ANOVA was conducted. In this analysis passage type was the within-subjects variable and relevance instruction condition was the between subjects variable. Contrary to predictions, the main effects for passage type $F(1, 104) = 1.18$, $p = .28$, $\eta^2 = .011$ and relevance instructions were non-significant, $F(2, 103) = 0.996$, $p = .37$, $\eta^2 = .019$. The interaction of passage type and relevance instruction was also non-significant, $F(2, 103) = 2.90$, $p = .06$, $\eta^2 = .053$. These data are presented in Table 6.

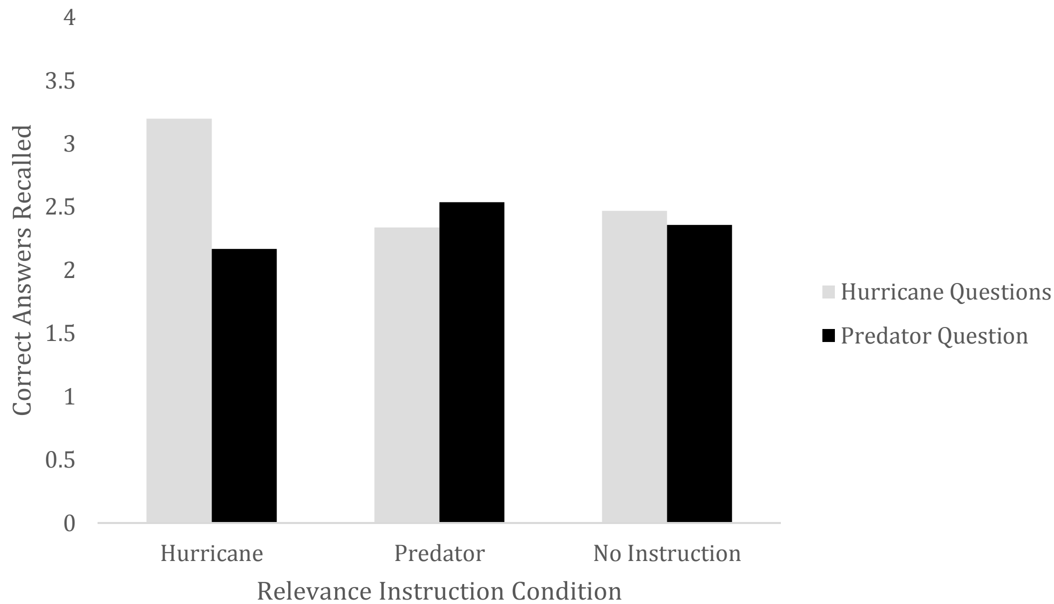

Figure 5. Number of idea units identified for cued recall question broken down by relevance instruction condition.

Table 5

Results for 2x3 ANOVA of Cued Recall for Relevant and Irrelevant Text Segments by Relevance Instruction Condition

Source	df	SS	MS	F	p
Condition	2	3.1	1.55	1.45	.24
Cued Recall	1	5.2	5.19	8.63	.004
Interaction	2	14.3	7.15	11.87	.000
Error	103	62.06	0.60		
Total	103	110.36	1.07		

Note. N = 106

Table 6

Results for 2x3 ANOVA of Free Recall for Relevant and Irrelevant Text Segments by Relevance Instruction Condition

Source	df	SS	MS	F	p
Condition	2	11.75	5.88	0.99	.37
Free Recall	1	7.27	7.27	1.18	.28
Interaction	2	35.81	17.90	2.90	.06
Error	103	635.52	6.17		
Total	103	607.57	5.90		

Note. N = 106

Additional Analyses of Relevance Effect Hypotheses

The original analyses of reading time and recall were conducted to explore both the within subject and between subject effects of relevance instructions. However, during the discussion portion of my committee meeting, the alternative approach of using a priori planned comparisons was suggested as a more precise and powerful way to answer the question of whether or not participants in the relevance instruction conditions differed from participants in the no instruction condition on reading time or recall. These analyses were considered a priori because they were based on predictions made before data collection as opposed to being driven by significant results that emerged from the collected data. It was decided that only the relevance instruction condition that corresponded to the passage being analyzed would be used.

As such, we chose to use a priori planned contrasts, which allow specific comparisons between any two means, as opposed to Dunnett's test, in which all groups are compared with the control and equal sample sizes are required (Holm, 1979). Thus, six a priori between-subjects planned contrasts were conducted to compare the relevant relevance instruction condition with the no instruction (control) condition for each specific passage on each of the three outcomes (reading time, cued recall, and free recall). For each comparison, participants in the control condition were coded as "+1", participants in the relevance instruction condition relevant to the passage being analyzed were coded as "-1", and participants in the condition who received the relevance instructions not related to the passage being analyzed were coded as "0". Specifically, the first three comparisons contrasted the no relevance instruction group with the Hurricane relevance instruction group on reading time, cued recall and free recall of the Hurricane passage.

No significant effect was found between the Hurricane relevance instruction group and the control group on Hurricane passage reading time, $t(103) = 0.96$, $p = .34$, $d = -0.22$. A significant effect was found between the Hurricane relevance instruction group and the control group on Hurricane passage cued recall, $t(103) = -3.24$, $p = .002$, $d = 0.84$. Specifically, when asked to recall the answers to the Hurricane question during cued recall, participants who were in the Hurricane relevance instruction condition ($M = 3.20$, $SD = 0.80$) did better than participants in the no instruction condition ($M = 2.47$, $SD = 0.94$). No significant effect was found between the Hurricane relevance instruction group and the control group on Hurricane passage free recall, $t(103) = -1.22$, $p = .22$, $d = 0.30$.

The final three comparisons contrasted the no relevance instruction group with the Predator relevance instruction group on reading time, cued recall and free recall of the Predator passage. No significant effect was found between the Predator relevance instruction group and the control group on Predator passage reading time, *t*(103) = 1.07, *p* = .29, *d* = -0.25. No significant effect was found between the Predator relevance instruction group and the control group on Predator passage cued recall, *t*(103) = -0.87, *p* = .39, *d* = 0.20. Finally, for the last comparison, a significant effect was found between the Predator relevance instruction group and the control group on Predator passage free recall, *t*(103) = -2.09, *p* = .04, *d* = 0.55. Specifically participants who were in the Predator relevance instruction condition (*M* = 5.8, *SD* = 2.30) remembered more information from the Predator passage than participants in the no instruction condition (*M* = 4.56, *SD* = 2.25).

Hypotheses Tests: Competing Hypotheses

Curiosity Questions Hypotheses

Hypothesis 4 predicted that participants in the relevance instruction condition would ask fewer total questions when compared with participants in the no instruction condition. As an alternative prediction, Hypothesis 7 predicted that participants in the relevance instruction condition would ask more total questions when compared with participants in the no instruction condition. In order to test whether relevance instructions affected curiosity question generation, a one-way ANOVA was conducted, using relevance instruction condition as the independent variable and the total number of questions asked as the dependent variable. Given that curiosity questions were not specific to the particular passage, the two relevance conditions were combined into one condition in this analysis. Contrary to both of the original hypotheses, there was no difference in the number of questions asked between groups who received relevance instructions and those who did not F (1, 104) = 0.14, p = .71, η^2 = .001. These data are presented in Table 7.

Table 7

Results for One-way ANOVA of Number of Questions Asked by Relevance Instruction Condition

Source	df	SS	MS	F	p
Between Subjects	1	0.13	0.13	0.14	.71
Within Subjects	104	93.23	0.90		
Total	105	93.36			

Note. N = 106.

In order to further test the relationship between relevance instruction condition and indication of further curiosity questions, a chi square test for independence was conducted. Contrary to predictions, there was no significant difference between the relevance instruction conditions in terms of whether or not they indicated they had additional curiosity questions related to walkingsticks $x^2(1, N = 106) = 5.08$, $p = .08$.

Free Exploration Hypotheses

Hypothesis 5 predicted that participants in the relevance instruction condition would openly explore less when compared with participants in the no instruction condition. As an alternative prediction, Hypothesis 8 predicted that participants in the relevance instruction condition would openly explore more when compared with participants in the no instruction condition. In order to test whether relevance instructions affected the desire to explore the topic further, an ANOVA was conducted, using relevance instruction condition as the independent variable and the total number of exploration choices as the dependent variable. Contrary to both of the original hypotheses, there was no difference in the number of exploration choices between groups who received relevance instructions and those who did not F (1, 104) = 0.16, p = .69, η^2 = .002. These data are presented in Table 8.

Table 8

Results for One-way ANOVA of Number of Exploration Choices Made by Relevance Instruction Condition

Source	df	SS	MS	F	p
Between Subjects	1	0.08	0.08	0.16	.69
Within Subjects	104	48.92	0.47		
Total	105	48.99			

Note. N = 106.

Moderation Hypothesis

Hypothesis 6 predicted that there would be a significant interaction between initial individual topic interest and relevance instruction condition. Specifically, I predicted that for participants with low initial individual topic interest relevance instructions would decrease curiosity and further exploration; for participants with high initial individual topic interest relevance instructions would not have an effect on curiosity and further exploration. In order to test the hypothesis that initial individual interest would moderate the effects of relevance instructions on curiosity, a logistic regression analysis was conducted. Z-scores were created for initial interest about walkingsticks before being entered into the regression equation. Two orthogonal contrast codes were created in order to test the effects of relevance instruction condition. Contrast 1 compared the no relevance instruction condition (-2) to either experimental condition (+1). Contrast 2 compared the relevance instruction conditions for either the Hurricane passage (+1) or the Predator passage (-1). A test of the full model against a constant only model was not statistically significant, indicating that the predictors did not reliably distinguish between whether a participant asked curiosity questions or did not (x^2 (5, 100) = 9.94, p = .07). The model correctly classified only 56.6 % of the cases. Wald statistics indicated no significant predictors of curiosity question asking. These data are presented in Table 9.

Table 9

Logistic Regression for Hypothesis 6 Examining the Effects of Relevance Instructions and Initial Interest in Walkingsticks on Further Question Asking

Predictor	ΔR^2	B	SE	Wald	Sig. (p)	Odds Ratio
Step 1	.09					
Hurry		0.09	0.57	0.02	.88	1.09
Contrast 1		-0.23	0.15	2.47	.11	1.43
Contrast 2		0.34	0.25	1.86	.17	0.51
Initial Interest in walkingsticks		-0.19	0.21	0.81	.37	0.83
Initial Interest x Contrast 1		0.21	0.15	1.81	.18	1.23
Initial Interest x Contrast 2		-0.37	0.26	1.94	.16	0.69
Constant		0.12	0.23	0.28	.60	1.23

Note: DV = Asked curiosity questions or didn't. Contrast 1 = Control condition vs. Relevance instruction conditions. Contrast 2 = Relevance instruction type.

In order to further test the hypothesis that initial individual interest would moderate the effects of relevance instructions on curiosity, another logistic regression analysis was conducted. This time the broader domain of individual interest in ecology was used to test this prediction. Z-scores were created for initial interest about ecology before being entered into the regression equation. A test of the full model against a constant only model was statistically significant, indicating that the predictors reliably distinguished between whether a participant asked curiosity questions or did not (x^2 (5, 100) = 13.15, p = .04). The model correctly classified 62.3 % of the cases. Wald statistics indicated that individual interest in ecology significantly predicted curiosity question asking. These data are presented in Table 10.

Table 10

Logistic Regression for Hypothesis 6 Examining the Effects of Relevance Instructions and Initial Interest in Ecology on Further Question Asking

Predictor	ΔR^2	B	SE	Wald	Sig. (p)	Odds Ratio
Step 1	.12					
Hurry		0.13	0.57	0.06	.81	1.14
Contrast 1		-0.15	0.15	0.97	.32	0.86
Contrast 2		0.46	0.27	2.96	.09	1.59
Initial Interest in Ecology		-0.60	0.24	6.55	.01*	0.55
Initial Interest x Contrast 1		0.01	0.16	0.01	.94	1.01
Initial Interest x Contrast 2		-0.34	0.30	1.24	.27	0.71
Constant		0.19	0.23	0.67	.41	1.21

Note: DV = Asked curiosity questions or didn't. Contrast 1 = Control condition vs. Relevance instruction conditions. Contrast 2 = Relevance instruction type. $p < .05$*.

CHAPTER 5

DISCUSSION

The purpose of the above research was to replicate past research related to the effects of pre-reading relevance instructions on learning outcomes. It also attempted to extend past research by examining the effects of pre-reading relevance instructions on continued epistemic behavior. Additionally, it looked at how initial topic interest affected these relationships. Specifically, this study had three main research objectives: to replicate the relevance effect, to determine the effect of relevance instructions on continued epistemic behavior (i.e. question asking, video watching, and video slip taking), and to examine the effects of a more developed, individual interest on these relationships.

First, this study attempted to replicate the *relevance effect*. Recall that the *relevance effect* predicts that when a reader is provided with pre-reading relevance instructions they spend more time reading relevant (vs. irrelevant) text and they recall relevant (vs irrelevant) text better. (McCrudden & Schraw, 2007).

The relevance effect also predicts differences in recall ability between groups who receive relevance instructions and groups who do not. In the relevance instruction literature, recall ability has typically been measured in two ways: the cued recall and free recall paradigms. Our study measured both; however, support for the relevance effect was mixed with regards to recall.

Cued recall test showed that people who received the Hurricane relevance instruction ahead of time did better at answering the Hurricane question as opposed to the Predator question when the questions were presented again after reading. Additionally, participants who received the Hurricane relevance instruction did better at answering the Hurricane question then people who were told to read for general understanding. Cued recall was not enhanced for participants who received the Predator question

Contrary to what the relevance effect would predict, we found no significant mean differences in free recall scores based on passage or in total free recall scores between conditions. Additionally, we did not find a significant interaction between total free recall scores and differences in total reading time across conditions; however it was trending in the right direction. Further analysis showed that participants who received the Predator question ahead of time, recalled more information about the Predator passage than participants who received only general reading instructions. When combined with the results of the cued recall test, these findings suggest that the Hurricane question successfully produced the relevance effect but the Predator question did not. Furthermore, it seems to be the case that participants who were given the Predator question before reading were alerted to the relevance of the Predator passage, but that the specific responses required to correctly answer the predator question were more difficult to ascertain.

It is likely that at least part of the failure in our attempt to replicate the relevance effect was due to the stimuli selected for this experiment. The passages were selected from the motivational domain as opposed to the relevance instruction domain. Each passage was composed by an expert and normed for classroom reading; however, the pre-reading questions were designed by the experimenter based on the existing passages. The implication here is that the passages were not designed specifically to correspond with the provided relevance instructions. The lack of alignment between the cued recall questions and answers was not identified in initial pretesting; however during coding some trouble areas were identified. Specifically, the answers to the Predator question seemed not to be as easily identified within the passage as the answers for the Hurricane question. For example, regarding the Predator passage, one "correct" answer to the question about why walkingsticks are not eaten by predators is that they grow to be very big however this was never directly stated in the passage. In this instance the passage read, "Walkingsticks also have their size working for them. An adult walkingstick can grow up to thirty centimeters, or one foot, long. That is pretty big for a predator like a tiny coqui frog." This suggests that in order to identify all of the correct answers to the Predator question, a reader had to engage in a certain degree of inference as opposed to simple encoding and recalling process. This might account for the minimal results we found with regards to cued recall for this passage.

Methodological differences may also account for why we were unsuccessful in replicating a strong relevance effect for free recall in this experiment. First, past research using a free recall paradigm has varied on the amount of time given to participants to engage in free recall. Specifically, studies in the relevance instruction literature have given participants longer amounts of time (McCrudden. Magliano, & Schraw, 2011) and in some studies where the relevance effect is found for free recall participants are given unlimited time (McCrudden, 2011). In this study, based off of free recall research measures in the education literature (Harp & Mayer, 1997) and pilot data, we gave participants 5 minutes to recall as much as they could. It seems possible that providing a shorter amount of time created a ceiling effect for the free recall measure.

Another aspect of the study design that might have affected the free recall findings is the way relevant and irrelevant text segments were presented and coded in this experiment.

Typically, the relevance instruction literature presents passages to participants sentence by sentence. This is important because it allows relevance to be determined at the sentence level. Other sentences that are in the passage but that are not specifically related to the relevance instruction are coded as base text and not included in analysis. In the current study, relevance was determined at the passage level and therefore any sentence that was recalled from anywhere within the relevant passage was coded as relevant.

Another prediction related to the relevance effect is that relevance instructions increase reading time. Contrary to the predictions of the relevance effect, our study found no differences in reading times between relevance instruction conditions, and no differences in time spent reading relevant vs irrelevant information between relevance instruction conditions. A significant difference was found between reading times on the Hurricane passage versus the Predator passage. But overall, no significant differences in reading time were found by condition. Additional analysis found no evidence of differences between reading times of the first and second part of each passage.

There are a few possible reasons why we failed to replicate the relevance effect for reading time in our study. First, although reading time is generally included in the definition of relevance effect, other past research has failed to replicate this part of the effect. Early relevance instruction research found that pre-reading relevance instructions increased reading time and recall of relevant text segments compared to irrelevant text segments (Goetz, Schallert, Reynolds, & Radin, 1983). Kaakinen, Hyoenae, and Keenan (2002) replicated these findings and proposed the *encoding time hypothesis*. According to this hypothesis, pre-reading relevance instructions increase recall of relevant information because participants spend more time processing relevant information. More recently, McCrudden, Schraw, and Kambe (2005), tested these original findings, which they deemed the *increased effort hypothesis*, against the competing *no increased effort hypothesis*. Contrary to early research and consistent with the no increase effort hypothesis, McCrudden, Schraw, and Kambe (2005) found no differences in participants' reading times of relevant versus irrelevant text segments. One difference between studies in which reading time results support the *increased effort hypothesis* (Goetz, Schallert, Reynolds, & Radin, 1983; Kaakinen, Hyoenae, & Keenan, 2002) and those in which findings support the *no increased effort hypothesis* is in the type of pre-reading relevance instruction provided to participants. Both Goetz, Schallert, Reynolds, and Radin, (1983) and Kaakinen, Hyoenae, and Keenan (2002) used general perspective pre-reading relevance instructions. Goetz, Schallert, Reynolds, and Radin, (1983) had participants read descriptions of houses from either a house buyer perspective or a burglar perspective. Kaakinen, Hyoenae, and Keenan (2002) had participants read passages about different countries from the perspective of deciding where they would want to live. More recent research using general perspective relevance instructions also found evidence for the increased effort hypothesis (McCrudden, Magliano, & Schraw, 2011). In contrast to these general perspective relevance instructions, McCrudden, Schraw, and Kambe (2005) and this study used very specific pre-reading relevance instructions. In one experiment McCrudden, Schraw, and Kambe (2005) asked questions like: "Why does the heart shrink in space?" and in the other, "How would you describe the climate of Morinthia?" and found no differences in reading time. Taken together this suggests that more specific relevance instructions affect processing differently than more general perspective instructions. It is possible that this is because specific relevance instructions provide a more targeted scope for information seeking which allows the reader to skim the text for specific answers more efficiently and thereby leads to a decrease in reading time. Future research should utilize both specific and general relevance instructions in order to test these ideas further.

Overall, specific findings show only mixed support for the relevance effect in this sample, however it is likely that the methodological concerns described above are enough to account for this discrepancy.

In order to extend past research and make a unique contribution to the literature, the second goal of this study was to examine the effects of pre-reading questions on continued epistemic behavior. We measured post-reading, topic relevant question asking and continued exploratory behavior operationalized as actual or expressed interest to watch videos related to walkingsticks. We proposed competing hypotheses with regards to the effect that relevance instructions would have on continued epistemic behavior based on the work of Berlyne (e.g. 1954, 1960) and the knowledge-gap model of curiosity (Lowenstein, 1994). Based on the prediction that once a knowledge-gap has been successfully filled subsequent information seeking behavior will be thwarted, we hypothesized that participants who received relevance instructions would ask fewer questions and engage in less continued exploration than participants in the no relevance instruction condition. Alternately, aligned with the prediction that a greater knowledge base increases epistemic behavior (Loewenstein, 1994) and findings in the curiosity literature examining pre-reading questions (Berlyne, 1954a, 1954b), we also speculated that participants who received pre-reading relevance instructions would ask a greater number of questions and engage in more continued exploration when compared to participants in the no instruction group.

The second goal of this study was to examine the effects of relevance instructions on continued epistemic behavior, namely question asking and video watching. No such effects were found. Specifically, participants who received relevance instructions were no more or less likely to ask questions or watch videos related to walkingsticks than participants who received general reading instructions. These non-findings held even when controlling for whether or not the participant was in a rush.

It could be argued, given our inability to completely replicate the relevance effect, that our manipulation of relevance instructions was not strong enough to create an effect and as such these results could not be interpreted. However, if this were the case, we would have expected to see effects on continued epistemic behavior for participants in the Hurricane instruction group considering the manipulation did work in that condition.

Another possible reason for not finding these predicted effects would be if our measures of continued epistemic behavior were not valid. While this is possible, the finding that scores for the continued epistemic behavior measures are correlated with each other and with scores of individual interest is evidence that they are good indicators of curiosity (i.e. convergent validity). This implies it was the theoretical basis for the study that was not supported.

Even so, future research should test continued epistemic behavior in other ways. For example, in the original design of our study we intended to use photo gallery, instead of videos, as a way to operationalize continued epistemic behavior. Based on the suggestions of a colleague (Hansen, 2014), the decision was made to switch to videos. The thought process behind the switch was that videos would be more engaging and familiar to members of the subject pool than a photo gallery would be. However, it is also possible that watching a video is more of a commitment than looking at a picture would be, and that we would have had more people who explored materials further had we provided that option. While this is just speculation, it is interesting to note that five different participants who posed curiosity questions similar to "I wondered what a walkingstick looks like." did not opt to watch either of the videos, even though it would have answered their question. Future research should make multiple types of media available to participants in order to account for a variety of preferences.

Also, 46% of participants indicated they wondered about things while reading the passages; however when prompted further only 13% actually identified specific curiosity questions. This could be an indication that participants were unable to reproduce the questions they had while reading the passages when asked about them at a later time. Future research could explore this by allowing students to identify questions as they read. Additionally, while this study focused only on topic specific curiosity questions, future research could examine how relevance instructions affect curiosity related to other topics (e.g. asking questions about the experimental procedures or about other unrelated topics).

The final goal of this research was to examine the effect that initial individual topic interest had on the relationship between pre-reading relevance instructions and further epistemic behavior. Overall, individual interest was positively associated with questions asking and video watching. However, contrary to our predictions, individual interest did not affect the relationship between relevance instructions and continued epistemic behavior. Most importantly, we found that individual topic interest in the domain of ecology, predicted whether or not individuals indicated they had curiosity questions related to the passages they read about walkingsticks. These results are consistent with the four-phase model of interest development, which predicts that people with an initial individual topic interest ask questions and continue searching for more information about the topic of interest. Past research has shown evidence to suggest that the development of interest is a continual and cyclic process (Harackiewicz, Durik, Barron, & Linnenbrink, 2008). If this is the case, it could be the case that some individuals need more time to process information they read before curiosity develops. Future research should use longitudinal designs in order to examine the effects that relevance instructions have on continued interest in a topic over time.

General Limitations and Potential Future Research Directions

Before drawing any serious conclusions from our results, the methodological limitations discussed above suggest it would be warranted to refine our materials and try our study again. This would allow for a more definitive interpretation of our current findings. Also, in addition to the limitations and future directions already mentioned, there are other ways in which this study could be improved and these lines of research could be extended.

One concern is regarding the generalizability of our sample to the general population. Specifically, the average age of a participant in our study was 19 and 90% of our participants were between the ages of 18-20. Additionally, all participants were currently enrolled in college. Given that the age range of learning spans the entire lifespan of a human being, and that it applies to people of almost all levels of cognitive complexity, our sample was a very restricted representation of the available population. In order to better understand the key variables in this study, future research should explore their effects on learners of different ages and capabilities.

Another limitation of our sample was that it consisted of college-aged students, enrolled in a general education class, participating for class credit. In this type of sample there is always the risk that commitment to the task will be low, especially given the nature of our specific task (i.e. reading expository text). Future research should further explore the relationships tested in this study within an applied setting.

Theoretical and Applied Implications

Something that would be important to field, but that was beyond the scope of this study, would be to identify the specific mechanisms at work between the time that individuals received the relevance instructions and the time they read the passages. Two different theoretical accounts of these mechanisms have been highlighted throughout this study. The goal-focusing model of text processing (McCrudden & Schraw, 2007) says that relevance instructions provide the reader with information that aids them in setting goals for reading. According to the knowledge-gap theory of curiosity, specific relevance instructions are hypothesized to create a feeling of deprivation that triggers the goal to close the gap through continued epistemic behavior (e.g. information seeking). While this hypothesis is grounded in theory and is supported by the results from both literatures, this study provides no direct test of or evidence for what actual meta-cognitive, motivational, or emotional processes occurred once participants had read the relevance instruction and before they read the passages. Future research should examine these processes, perhaps through the use of think-out-loud protocols, in order to better test the theoretical basis of the knowledge-gap theory of curiosity and the goal-focusing model of text processing.

The findings related to the effects of pre-reading questions and individual interest on subsequent information seeking and information processing behavior, suggest these factors may be critical to educators within a variety of contexts. If pre-reading relevance instructions can consistently aid in learning, it is important to test their effects within a more realistic and high stakes environment, such as a real classroom. Also, fully understanding the role that individual interest plays both within and beyond the prescribed learning environment seems especially beneficial for instructional design. Given the increasing availability of information and the recent advancements in technology, it seems possible that future classrooms could ground basic skill development within each student's specific passion. This could in turn maximize learning and increases enjoyment for both the student and the educator.

Individual interest is also becoming an area of focus within organizational contexts. Strong (as cited in Savickas, 1999) provides a definition of vocational interest very similar to the definition of individual interest. Specifically, he describes interest as a dispositional preference for activity that: increases feelings of liking for, focus attention on, directs behavior toward, and promotes action upon, a specific object. More empirical evidence is needed to fully understand the scope of individual interest in the workplace. Additionally, the prevalence of computer guided training modules and the importance of self-directed learning are increasing within organizations. This is due to the previously mentioned trends toward automization and globalization (Friedman, 2007). Therefore, it seems crucial to understand how instructional features, such as relevance instructions, and motivational factors, such as curiosity, can increase our ability to adapt to the changing nature of the organizational landscape.

Conclusions

Overall, this study attempted to shed some light on the complex interactions between motivational variables and desired outcomes within the learning environment. Specifically, it did not provide evidence that providing students with pre-reading relevance instructions can increase reading time and performance on all recall based learning tasks. It supports past findings related to the positive relationship between individual topic interest and epistemic behavior. What remains unclear is how pre-reading relevance instructions affect continued epistemic behavior. Given recent advances in technology that increase both the ease and speed of information seeking capabilities, it seems as likely that continued epistemic behavior is going to be an important variable for educational success in both the classroom and the workplace. This research has potential implications for educators, who often strive to create a balance between learning demands and student interest. In addition, this information could be important for organizations that are always in need of ways to make training both educational and interesting. More research is needed to identify the complex nature of these relationships, but this study does suggest that giving students pre-reading relevance instructions does not hinder continued epistemic behavior.

REFERENCES

ACT (2014). Compare ACT and SAT scores. ACT. Retrieved 2014. From web address www.act.org.

Alexander, P. A., & Jetton, T. L. (1996). The role of importance and interest in the processing of text. *Educational Psychology Review, 8*(1), 89-121.

Alexander, P. A., Jetton, T. L., & Kulikowich, J. M. (1995). Interrelationship of knowledge, interest, and recall: Assessing a model of domain learning. *Journal of Educational Psychology, 87*(4), 559.

Anderson, R. C., Mason, J., & Shirey, L. (1984). The reading group: An experimental investigation of a labyrinth. *Reading Research Quarterly, 20* (1), 6-38.

BBC (Producer). (2010). The Stick Insect [video file]. Retrieved from https://www.youtube.com/watch?v=Cs1Xs3Eheag.

Berlyne, D. (1950). Novelty and curiosity as determinants of exploratory behavior. *British Journal of Psychology, 41*, 68-80.

Berlyne, D. (1954). An experimental study of human curiosity. *British Journal of Psychology, 45*, 256-265.

Berlyne, D. E. (1954). A theory of human curiosity. *British Journal of Psychology, 45*, 180-191.

Berlyne, D. E. (1957). Uncertainty and conflict: A point of contact between information-theory and behavior-theory concepts. *Psychological Review*, *64*, 329-339.

Berlyne, D. E. (1960). *Conflict, arousal and curiosity*. New York, NY: McGraw-Hill.

Berlyne, D. E. (1962). Uncertainty and epistemic curiosity. *British Journal of Psychology, 53*, 27-34.

Berlyne, D. E. (1963). Complexity and incongruity variables as determinants of exploratory choice and evaluative ratings. *Canadian Journal of Psychology, 17*, 274-290.

Berlyne, D. E. (1971). *Aesthetics and psychobiology*. East Norwalk, CT: Appleton-Century-Crofts.

Berlyne, D. E. (1974). Novelty, complexity, and interestingness. In D. E. Berlyne (Ed.), *Studies in the new experimental aesthetics* (pp. 175-180). Washington, DC: Hemisphere.

Berlyne, D. E. (1978). Curiosity and learning. *Motivation and Emotion, 2*, 97-175.

Boyer, K. E., Lahti, W., Phillips, R., Wallis, M. D., Vouk, M. A., & Lester, J. C. (2010). *Principles of asking effective questions during student problem solving*. In Proceedings of the 41st ACM technical symposium on Computer science education (pp. 460-464). ACM.

Chin, C., & Brown, D. E. (2000). Learning in science: A comparison of deep and surface approaches. *Journal of research in science teaching*, *37*(2), 109-138.

Day, H. (1982). Curiosity and the interested explorer. *Performance & Instruction 21(4), 19-22*.

Deci, E. L., Eghrari, H., Patrick, B. C., & Leone, D. R. (1994). Facilitating internalization: The self-determination theory perspective. *Journal of Personality, 62*(1), 119-142.

Deci, E. L., & Ryan, R. M. (1985). *Intrinsic motivation and self-determination in human behavior*. New York, NY: Plenum.

Dember. (1960). *The psychology of perception*. New York, NY: Henry Holt & Co.

Dewey, J. (1910). *How we think*. Boston, MA: Heath.

Dewey, J. (1913). *Interest and effort in education*. Boston, MA: Riverside.

Dillon, J. T. (1988). *Questioning and teaching: A manual of practice*. New York, NY: Teacher's College.

Friedman, T. L. (2007). *The world is flat 3.0: A brief history of the twenty-first century*. New York, NY: Macmillan.

Garner, R. (1992). Learning from school texts. *Educational Psychologist*, *27*(1), 53-63.

Garner, R., Gillingham, M. G., & White, C. S. (1989). Effects of 'seductive details' on macroprocessing and microprocessing in adults and children. *Cognition and Instruction*, *6*(1), 41-57.

Gentry, J. W., Burns, A. C., Dickinson, J. R., Turevu, S., Chun, S., & Hongyan, Y. (2002). Managing the curiosity gap does matter what do we need to do about it. *Developments in Business Simulation and Experiential Learning, 29*, 67-73.

Goetz, E. T., Schallert, D. L., Reynolds, R. E., & Radin, D. I. (1983). Reading in perspective: What real cops and pretend burglars look for in a story. *Journal of Educational Psychology, 75*, 500-510.

Görlitz, D., & Wohlwill, J. F. (Eds.). (1987). Curiosity, imagination, and play. Hillsdale, NJ: Lawrence Erlbaum Associates.

Graesser, A. C. (1992). *Questioning mechanisms during complex learning*. No. TR-92-1-ONR. Memphis State University. Memphis, TN.

Graesser, A. C., & McMahen, C. L. (1993). Anomalous information triggers questions when adults solve quantitative problems and comprehend stories. *Journal of Educational Psychology*, *85*(1), 136-151.

Graesser, A. C., & Person, N. K. (1994). Question asking during tutoring. *American Educational Research Journal, 31*, 104-137.

Graesser, A. C., Singer, M., & Trabasso, T. (1994). Constructing inferences during narrative text comprehension. *Psychological Review, 101*, 371-395.

Hansen, E. (2014). *How are curious people affected by seductive details in written texts? Exploring the various relationships between curiosity, the seductive details effect, and learning outcomes.* (Unpublished doctoral dissertation). Northern Illinois University, Dekalb, IL.

Harackiewicz, J.M., Durik, A.M., Baron, K.E., Linnenbrink-Garcia, L., and Taue, J.M. (2008). The role of achievement goals in the development of interest: Reciprocal relations between achievement goals, interest, and performance. *Journal of Educational Psychology, 100*(1), 105-122.

Harp, S. F., & Mayer, R. E. (1997). The role of interest in learning from scientific text and illustrations: On the distinction between emotional interest and cognitive interest. *Journal of Educational Psychology*, *89*(1), 92.

Harp, S. F., & Mayer, R. E. (1998). How seductive details do their damage: A theory of cognitive interest in science learning. *Journal of Educational Psychology*, *90*(3), 414-434.

Hidi, S. (1990). Interest and its contribution as a mental resource for learning. *Review of Educational Research, 60*, 549-571.

Hidi, S. (2000). An interest researcher's perspective: The effects of extrinsic and intrinsic factors on motivation. In C. Sansone & J. M. Harackiewicz (Eds.), *Intrinsic and Extrinsic Motivation* (pp. 309-339). San Diego, CA: Academic Press.

Hidi, S. (2001). Interest, reading, and learning: Theoretical and practical considerations. *Educational Psychology Review, 13*, 191-209.

Hidi, S., & Berndorff, D. (1998). Situational interest and learning. In L. Hoffman, A. Krapp, K. A. Renninger & J. Baumert (Eds.), *Interest and learning* (pp. 74-90). Kiel, Germany: IPN.

Hidi, S., & Renninger, K. A. (2006). The four-phase model of interest development. *Educational Psychologist, 41*(2), 111-127.

Hofstein, A., Navon, O., Kipnis, M., & Mamlok-Naaman, R. (2005). Developing students' ability to ask more and better questions resulting from inquiry-type chemistry laboratories. *Journal of Research in Science Teaching, 42*(7), 791-806.

Holm, S. (1979). A simple sequentially rejective multiple test procedure. *Scandinavian Journal of Statistics, 6,* 65-70.

Iran-Nejad, A. (1987). Cognitive and affective causes of interest and liking. *Journal of Educational Psychology, 79*, 120-130.

Iran-Nejad, A., & Cecil, C. (1992). Interest and learning. In K. A. Renninger, S. Hidi & A. Krapp (Eds.), *The role of interest in learning and development* (pp. 327-332.). Hillsdale, NJ: Lawrence Erlbaum.

James, W. (1980/1950). *The principles of psychology*. New York, NY: Dover Publications.

Jirout, J., & Klahr, D. (2011). *Children's question asking and curiosity: A training study*. Paper presented at the Society for Research on Educational Effectiveness.

Kaakinen, J. K., Hyoenae, J., & Keenan, J. M. (2002). Perspective effects on online text processing. *Discourse Processes, 33*, 159-173.

Kashdan, T. B., & Yuen, M. (2007). Whether highly curious students thrive academically depends on perceptions about the school learning environment: A study of Hong Kong adolescents. *Motivation and Emotion, 31*(4), 260-270.

Keller, H., Schneider, K., & Henderson, B. (1994). Preface: The study of exploration. In *Curiosity and exploration* (pp. 1-14). New York, NY: Springer.

Kendeou, P., Bohn-Goettler, C., & Fulton, S. (2011). What we have been missing: The role of goals in reading comprehension. In M. T. McCrudden, J. P. Magliano & G. Schraw (Eds.), *Text relevance and learning from text* (pp. 375-394). Charlotte, NC: Information Age Publishing.

Kintsch, W. (1998). *Comprehension: A paradigm for cognition*. Cambridge, UK: Cambridge University Press.

Krapp, A., Hidi, S., & Renninger, K. A. (1992). Interest, learning, and development. In K. A. Renninger, S. Hidi & A. Krapp (Eds.), *The role of interest in learning and development* (pp. 3-25). Hillsdale, NJ: Lawrence Erlbaum.

Kulikowich, J. M., & Alexander, P. A. Intentionality to Learn, in an Academic Domain. *Early Education and Development, 21*(5), 724-743.

Lehman, S., & Schraw, G. (2002). Effects of coherence and relevance on shallow and deep text processing. *Journal of Educational Psychology, 94*, 738-750.

Litman, J. A. (2005). Curiosity and the pleasure of learning: Wanting and liking new information. *Cognition and Emotion, 19*, 793-814.

Litman, J. A., Collins, R. P., & Spielberger, C. D. (2005). The nature and measurement of sensory curiosity. *Personality and Individual Differences, 39*(6), 1123-1133.

Litman, J. A., Hutchins, T. L., & Russon, R. K. (2005). Epistemic curiosity, feeling-of-knowing, and exploratory behaviour. *Cognition & Emotion, 19*(4), 559-582.

Litman, J. A., & Jimerson, T. L. (2004). The measurement of curiosity as a feeling of deprivation. *Journal of Personality Assessment, 82*, 147-157.

Litman, J. A., & Silvia, P. J. (2006). The latent structure of trait curiosity: Evidence for interest and deprivation curiosity dimensions. *Journal of Personality Assessment, 86*(3), 318-328.

Litman, J. A., & Spielberger, C. D. (2003). Measuring epistemic curiosity and its diversive and specific components. *Journal of Personality Assessment, 80*, 75-86.

Loewenstein, G. (1994). The psychology of curiosity: A review and reinterpretation. *Psychological Bulletin, 116*, 75-98.

Loewenstein, G., Adler, D., Behrens, D., & Gillis, J. (1992). Why Pandora opened the box: Curiosity as a desire for missing information. *Unpublished manuscript, Department of Social and Decision Sciences, Carnegie Mellon University, Pittsburgh, PA*.

McCrudden, M.T. (2011). Do specific relevance instructions promote transfer appropriate processing? *Instructional Science, 39,* 865-879.

McCrudden, M. T., Magliano, J. P., & Schraw, G. (2010). Exploring how relevance instructions affect personal reading intentions, reading goals, and text processing: A mixed methods study. *Contemporary Educational Psychology, 35*, 229-241.

McCrudden, M. T., Magliano, J. P., & Schraw, G. (2011). *Text relevance and learning from text.* Charlotte, NC: Information Age Publishing, Inc.

McCrudden, M. T., & Schraw, G. (2007). Relevance and goal-focusing in text processing. *Educational Psychology Review, 19*(2), 113-139.

McCrudden, M. T., Schraw, G., & Hartley, K. (2006). The effects of general relevance instructions on shallow and deeper learing and reading time. *The Journal of Experimental Education, 74*(4), 293-310.

McCrudden, M. T., Schraw, G., & Kambe, G. (2005). The Effect of Relevance Instructions on Reading Time and Learning. *Journal of Educational Psychology*, *97*(1), 88.

Mitchell, M. (1993). Situational interest: Its multifaceted structure in the secondary school mathematics classroom. *Journal of Educational Psychology, 85*(3), 424.

Moje, E. B., Stockdill, D., Kim, K., & Kim, H.-J. (2011). The role of text in disciplinary learning. In M. L. Kamil, P. D. Pearson, E. B. Moje & P. P. Afflerbach (Eds.), *Handbooks of reading research* (Vol. IV, pp. 453-486). New York, NY: Routledge.

National Heritage Collection (Producer). (2008). Giant Walkingstick Insect [video file]. Retrieved from https://www.youtube.com/watch?v=W6UmLxv-AMs.

Peters, R. A. (1978). Effects of anxiety, curiosity, and perceived instructor threat on student verbal behavior in the college classroom. *Journal of Educational Psychology, 70*(3), 388.

Piaget, J. (1951). *Judgment and reasoning in the child*. London, England: Routledge & K. Paul.

Pluck, G., & Johnson, H. (2011). Stimulating curiosity to enhance learning. *GESJ: Education Science and Psychology, 2*(19), 24-31.

Ram, A. (1991). Theory of questions and question asking. *Journal of Learning Sciences, 1*(3 & 4), 273-318.

Reio, T. G., & Wiswell, A. (2000). Field investigation of the relationship among adult curiosity, workplace learning, and job performance. *Human Resource Development Quarterly*, *11*(1), 5-30.

Reio Jr, T. G., Petrosko, J. M., Wiswell, A. K., & Thongsukmag, J. (2006). The measurement and conceptualization of curiosity. *The Journal of Genetic Psychology, 167*(2), 117-135.

Renninger, K. A. (2000). Individual interest and its implications for understanding intrinsic motivation. In C. Sansone & J. M. Harackiewicz (Eds.), *Intrinsic and extrinsic motivation* (pp. 373-404). San Diego, CA: Academic Press.

Reynolds, R. E., & Anderson, R. C. (1982). Influence of questions on the allocation of attention during reading. *Journal of Educational Psychology, 74*(5), 623-632.

Rothkopf, E. Z., & Billington, M. J. (1974). Indirect review and priming through questions. *Journal of Educational Psychology*, *66*(5), 669-679.

Rothkopf, E. Z., & Billington, M. J. (1979). Goal-guided learning from text: inferring a descriptive processing model from inspection times and eye movements. *Journal of Educational Psychology*, *71*(3), 310-327.

Rouet, J. F., & Britt, M. A. (2011). Relevance processes in multiple document comprehension. In M. T. McCrudden, J. P. Magliano & G. Schraw (Eds.), *Text relevance and learning from text* (pp. 19-52). Greenwich, CT: Information Age Publishing.

Rouet, J. F., & Vidal-Abarca, E. (2002). "Mining for meaning": A cognitive examination of inserted questions in learning from scientific text. In J. Otero, J. A. Leon & A. C. Graesser (Eds.), *The Psychology of Science Text Comprehension* (pp. 417-436). Mahwah, NJ: Lawrence Erlbaum Associates.

Rouet, J. F., Vidal-Abarca, E., Bert-Erboul, A., & Millogo, V. (2001). Effects of information search tasks on the comprehension of instructional text. *Discourse Processes, 31*(2), 163-186.

Savickas, M.L., & Spokane, A.R. (Eds.). (1999). *Vocational Interests.* Palo Alto, CA: Davies-Black.

Schiefele, U. (1992). Topic interest and levels of text comprehension. In K. A. Renninger, S. Hidi & A. Krapp (Eds.), *The role of interest in learning and development* (pp. 151-182). Hillsdale, NJ: Lawrence Erlbaum.

Schiefele, U. (1996). Topic interest, text representation, and quality of experience. *Contemporary Educational Psychology, 21*, 3-18.

Schiefele, U. (1999). Interest and learning from text. *Scientific Studies of Reading, 3*, 257-279.

Schiefele, U. (2001). The role of interest in motivation and learning. In J. M. Collis & S. Messick (Eds.), *Intelligence and personality: Bridging the gap in theory and measurement* (pp. 163-194). Mahwah, NJ: Lawrence Erlbaum.

Schiefele, U., & Krapp, A. (1996). Topic interest and free recall of expository text. *Learning and Individual Differences, 8*, 141-160.

Schiefele, U., Krapp, A., & Winteler, A. (1992). Interest as a predictor of academic achievement: A meta-analysis of research. In K. A. Renninger, S. Hidi & A. Krapp (Eds.), *The role of interest in learning and development* (pp. 183-212). Hillsdale, NJ: Erlbaum.

Schmitt, F. F., & Lahroodi, R. (2008). The epistemic value of curiosity. *Educational Theory, 8*, 125-148.

Schraw, G. (1998). Processing and recall differences among selective details. *Journal of Educational Psychology*, *90*(1), 3-12.

Schraw, G., Bruning, R., & Svoboda, C. (1995). Sources of situational interest. *Journal of Reading Behavior, 27*, 1-17.

Schraw, G., & Dennison, R. S. (1994). The effect of reader purpose on interest and recall. *Journal of Literacy Research, 26*(1), 1-18.

Schraw, G., & Lehman, S. (2001). Situational interest: A review of the literature and directions for future research. *Educational Psychology Review, 13*, 23-52.

Schraw, G., Wade, S. E., & Kardash, C. A. (1993). Interactive effects of text-based and task-based importance on learning from text. *Journal of Educational Psychology*, *85*(4), 652.

Silvia, P. J. (2008). Interest--The curious emotion. *Current Directions in Psychological Science, 17*(1), 57-60.

Snow, C. (2002). *Reading for understanding: Toward an R&D program in reading comprehension*. Santa Monica, CA: Rand Corporation.

Sperber, D., & Wilson, D. (2002). Pragmatics, modularity, and mind-reading. *Mind & Language, Special Issue: Pragmatics and Cognitive Science, 17,* 3-23.

Sullins, J., Tran, K., Ewing, S., Velaga, N., & Graesser, A. *The effects of cognitive disequilibrium on question generation while interacting with AutoTutor.* Paper presented at the Proceedings of the Third Workshop on Question Generation.

Vygotsky, L. S. (1978). *Mind in society: the development of higher psychological processes*. Cambridge, MA: Harvard University Press.

Wade, S. E., & Adams, B. (1990). Effects of importance and interest on recall of biographical text. *JRB: A Journal of Literacy, 22*, 331-353.

Wilson, D., & Sperber, D. (2004). Relevance theory. In L.Horn & G.Ward (Eds.), *Handbook of pragmatics* (607-632). Oxford, England: Blackwell.

Wohlwill, J.F. (1987). Preface. In D. Gorlitz & J.F. Wohlwill (Eds.), *Curiosity, imagination, and play: On the development of spontaneous motivational processes* (1-18). Hillsdale, NJ: Lawrence Erlbaum Associates.

Zimmerman, B. J., & Pike, E. O. (1972). Effects of modeling and reinforcement on the acquisition and generalization of question asking behavior. *Child Development, 43*, 892-907.

APPENDIX A

TEXT PASSAGES

Appendix A

Text Passages

Relevant information is underlined in passages below. Underlining was removed when passages are presented to participants.

Passage 1

Every once in a while, a hurricane comes to El Yunque. Depending on what type of organism you are, a hurricane might not be that big of a problem. It might even be good for you if things get shaken up a bit. But not if you are a walkingstick. In that case, a hurricane is bad news for you.

Hurricanes are known for their very strong winds and their heavy rains. Walkingsticks are twig shaped. In other words, they are thin and lightweight. The wind can knock walkingsticks right off the branches that they call home. Branches falling from trees might destroy the shrub they're on. That is just the start of their troubles. All that heavy rain can cause flooding .The walkingsticks may be carried off in sudden streams of water. They will quickly drown.

It is not just the adult walkingsticks that have a tough time during a hurricane. The young walkingsticks also have problems. They live on or near the forest floor. They are in danger when the rains start, too. They hatch from walkingstick eggs. These, too, often fall or are laid on the ground. Eggs don't even have the chance to move to higher ground. They too will drown if any flooding occurs. So you can see how entire generations of walkingsticks can be wiped out in a single day or two of a hurricane.

Then the hurricane will be over. Many of the rainforest organisms can rebound quickly. Some species will even do better than ever. The changed conditions of their environment will be good for them. Not for walkingsticks that survived the storm. Their troubles are just beginning.

Many branches and leaves have fallen from the trees above. That creates holes in the canopy. Normally the canopy provides shade and keeps temperatures cooler for the understory below. With the gaps in the canopy, sunlight pours in. The additional light is great for the understory plants. They will grow taller, leafier, and bushier. That means more food for the walkingsticks. But they won't be able to take advantage of all the food if there is not enough shade for them. Walkingsticks do not do well in direct sunlight. They also do not like the warm temperatures as the sunlight pours in.

Too make bad matters worse, after a hurricane there is often a drought. A drought is simply a long time span without rainfall. Humidity is low. Adults are less likely to reproduce when conditions are poor for them. Young walkingsticks are especially affected by the drought. They molt and have thinner skin than adults. They are less likely to survive the hot temperatures, direct light, and low humidity. Walkingstick eggs absorb water when the humidity is high. During a drought, the eggs, will shrivel up and die. Normally, walkingsticks can be one of the most common insects in the rainforest. After a big storm, they are one of the species most affected. It can take up to fifteen years or more for walkingstick populations to recover after a hurricane.

Passage 2

There are a lot of animals in El Yunque rainforest that will eat an insect. There are no animals that will eat a twig. That is good news for walkingsticks, which are insects that look like twigs. Spiders, lizards, birds, frogs, rats, and young snakes all include insects in their diets. Yet not many eat walkingsticks regularly. Walkingsticks have evolved special adaptations that keep it that way.

Their most obvious adaptation is described by their name. Walkingsticks look like a stick that can walk. Some species even have nodes spaced just like that of the plants they live and eat on. A node is the part of a stem where a leaf or branch will grow. They can look like ridges on the stem. Walkingstick bodies can have the same ridges simply for camouflage. They are green, brown, or gray. Some walkingsticks can turn from light green during the day to dark green at night. They even act like sticks. When walkingsticks are holding still on a branch, their legs will make random movements. It causes them to sway or quiver like a twig in a breeze. Holding completely still would be as noticeable as moving quickly.

Walkingsticks wait until the cover of darkness to find leaves to eat. Even then, they move very slowly. Predators like coqui frogs have brains wired to notice quick movement. They capture their quick-moving prey faster than you or I can blink an eye. A walkingstick only averages about 0.5 meters a day. That is less than one normal step for human adults. If an animal still tried to taste a walkingstick, despite all these tricks, the walkingstick might just hold rigid. It is its last effort to pretend to be a stick. If the predator loses interest and the insect is dropped, the walkingstick might not move the rest of the day – just to be safe.

Walkingsticks also have their size working for them. An adult walkingstick can grow up to thirty centimeters, or one foot, long. That is pretty big for a predator like a tiny coqui frog. The frog might get away with only a leg. That is one more way walkingsticks are like actual branches. They can grow back body parts like legs and antennae. Lastly, some walkingsticks can secrete a bad smelling liquid from a gland in their bodies. Who would want to eat something that could do that?

Young walkingsticks do not have many of the adaptations of the adults. They are especially at risk of being eaten because they molt their skin a few times before they are adults.

Without even the protection of their skin, they are easy to snap up. Also, they spend time on the forest floor and they are small. All these factors make them easier to prey on than adults. Walkingstick eggs are also preyed on. Some female walkingsticks will let their eggs drop from wherever on a plant they happen to be. Others carefully hide their eggs under a leaf. Parasitoid wasps that find the eggs will lay their own eggs in the walkingstick eggs. Their larvae will kill the developing walkingsticks as they grow.

APPENDIX B

EASE OF COMPREHENSION QUESTIONNAIRE

Appendix B

Ease of Comprehension Questionnaire

1=strongly disagree 3=neutral 5=strongly agree

1. The information in the text was well organized
2. The text was easy to understand
3. The text had a clear chronological order.
4. The examples were easy to understand.
5. The text was easy to read.
6. The text moved forward in a logical fashion.
7. The text always gave all the information the reader needed to understand the text.
8. The text seemed awkward in certain places.
9. The text was easy to remember.
10. The text required a lot of effort on the reader's part.

APPENDIX C

INDIVIDUAL INTEREST QUESTIONNAIRE

Appendix C

Individual Interest Questionnaire

1=strongly disagree 7=strongly agree

1. I’ve always been fascinated by ecology/walkingsticks.
2. I’m really interested in the topic of ecology/walkingsticks.
3. I’m really excited about reading more about ecology/walkingsticks.
4. I’m really looking forward to learning more about ecology/walkingsticks.
5. I think the field of ecology/topic of walking sticks is important.
6. I think information about ecology/walking sticks will be worthwhile to know.

APPENDIX D

ADDITIONAL HANDOUTS FOR ACCESSING VIDEOS

Appendix D

Additional Handouts for Accessing Videos

If you are interested in learning more about watching sticks, here are the links to the videos in the study:

The Stick Insect (3:22)-BBC Life in the Undergrowth Documentary

https://www.youtube.com/watch?v=Cs1Xs3Eheag

Giant Walking Stick Insect (3:13)-National Heritage Collection

https://www.youtube.com/watch?v=W6UmLxv-AMs

APPENDIX E

CODING RUBRIC FOR CUED RECALL SCORING

Appendix E

Coding Rubric for Cued Recall Scoring

Correct responses for the two pre-reading relevance instruction questions are listed below. For each question, 1 point was given for answer included in the participants cued recall responses. Each possible answer was only coded once, even if the participants mentioned it more once. Italicized text indicates additional wording scored as correct for each answer.

Question Hurricane: What are the four reasons hurricanes are bad for walkingsticks?

1. High winds can knock walkingsticks off their branches

   Destroy the branch they are on so they fall off, ruin branches they call their homes/live in coded here and not in ruins canopy

2. Flooding drowns walkingstick eggs

   Entire generations can be wiped out

3. Holes in the canopy are created which increases sunlight

   Damage to tree branches; includes high temperatures related to sunlight

4. Hurricanes are followed by a drought, which is bad for walkingsticks

   Humidity, high temperatures-but only when not related to sunlight

Question Predator: What are the four reasons walking sticks do not get eaten by predators who eat insects?

1. They are evolved to look like a stick

They have nodes, ridges, colors, they move like a twig

2. They move very slowly

   They wait until dark to eat, their speed

3. They grow very large in size

   Size,

4. They secrete a bad smelling liquid

APPENDIX F

CODING RUBRIC FOR FREE RECALL SCORING

Appendix F

Coding Rubric for Free Recall Scoring

Rate each idea unit as Passage 1, Passage 2, Excluded

- If the same idea unit is reported by the same participant twice, score it as yes once and excluded for all other times
- Mark incomplete or unrelated idea units as excluded

Words in boldface must be present to count as that idea unit

Italicized idea units are excluded

Idea Units for Passage 1

Every once in a while, a hurricane comes to El Yunque.

-If just say El Yunque generally the idea unit is excluded

Depending on what type of organism you are, a hurricane might not be that big of a problem.

It might even be good for you if things get shaken up a bit.

But not if you are a walkingstick.

In that case, a hurricane is bad news for you.

Hurricanes are known for their very strong winds and their heavy rains.

Walkingsticks are twig shaped.

In other words, they are thin and lightweight.

The wind can knock walkingsticks right off the branches that they call home.

Branches falling from trees might destroy the shrub they're on.

That is just the start of their troubles.

All that heavy rain can cause flooding .

The walkingsticks may be carried off in sudden streams of water.

They will quickly drown.

It is not just the adult walkingsticks that have a tough time during a hurricane.

The young walkingsticks also have problems.

They live on or near the forest floor.

They are in danger when the rains start, too.

They hatch from walkingstick eggs.

These, too, often fall or are laid on the ground.

Eggs don't even have the chance to move to higher ground.

They too will drown if any flooding occurs.

So you can see how entire generations of walkingsticks can be wiped out in a single day or two of a hurricane.

Then the hurricane will be over.

Many of the rainforest organisms can rebound quickly.

Some species will even do better than ever.

The changed conditions of their environment will be good for them.

Not for walkingsticks that survived the storm.

Their troubles are just beginning.

Many branches and leaves have fallen from the trees above.

That creates holes in the canopy.

Normally the canopy provides shade and keeps temperatures cooler for the understory below.

With the gaps in the canopy, sunlight pours in.

The additional light is great for the understory plants.

They will grow taller, leafier, and bushier.

-Any idea unit that mentions growth of plants

That means more food for the walkingsticks.

But they won't be able to take advantage of all the food if there is not enough shade for them.

Walkingsticks do not do well in direct sunlight.

They also do not like the warm temperatures as the sunlight pours in.

Too make bad matters worse, after a hurricane there is often a drought.

A drought is simply a long time span without rainfall.

Humidity is low.

Adults are less likely to reproduce when conditions are poor for them.

Young walkingsticks are especially affected by the drought.

They molt and have thinner skin than adults.

They are less likely to survive the hot temperatures, direct light, and low humidity.

Walkingstick eggs absorb water when the humidity is high.

During a drought, the eggs, will shrivel up and die.

Normally, walkingsticks can be one of the most common insects in the rainforest.

After a big storm, they are one of the species most affected.

It can take up to fifteen years or more for walkingstick populations to recover after a hurricane.

Idea Units Passage 2

There are a lot of animals in El Yunque rainforest that will eat an insect.

There are no animals that will eat a twig.

That is good news for walkingsticks, which are insects that look like twigs.

Spiders, lizards, birds, frogs, rats, and young snakes all include insects in their diets.

-Mention at least two of the animals

Yet not many eat walkingsticks regularly.

Walkingsticks have evolved special adaptations that keep it that way.

Their most obvious adaptation is described by their name.

Walkingsticks look like a stick that can walk.

Some species even have nodes spaced just like that of the plants they live and eat on.

A node is the part of a stem where a leaf or branch will grow.

They can look like ridges on the stem.

Walkingstick bodies can have the same ridges simply for camouflage.

They are green, brown, or gray.

Some walkingsticks can turn from light green during the day to dark green at night.

They even act like sticks.

When walkingsticks are holding still on a branch, their legs will make random movements.

It causes them to sway or quiver like a twig in a breeze.

Holding completely still would be as noticeable as moving quickly.

Walkingsticks wait until the cover of darkness to find leaves to eat.

Even then, they move very slowly.

Predators like coqui frogs have brains wired to notice quick movement.

They capture their quick-moving prey faster than you or I can blink an eye.

A walkingstick only averages about 0.5 meters a day.

-Score as idea unit if they have the metric wrong

That is less than one normal step for human adults.

If an animal still tried to taste a walkingstick, despite all these tricks,

the walkingstick might just hold rigid.

It is its last effort to pretend to be a stick.

If the predator loses interest and the insect is dropped,

the walkingstick might not move the rest of the day – just to be safe.

Walkingsticks also have their size working for them.

An adult walkingstick can grow up to thirty centimeters,

or one foot, long.

That is pretty big for a predator like a tiny coqui frog.

The frog might get away with only a leg.

That is one more way walkingsticks are like actual branches.

They can grow back body parts

like legs and antennae.

-Score as yes even if they just have one body part listed

Lastly, some walkingsticks can secrete a bad smelling liquid from a gland in their bodies.

Who would want to eat something that could do that?

Young walkingsticks do not have many of the adaptations of the adults.

They are especially at risk of being eaten because they molt their skin a few times before they are adults.

Without even the protection of their skin, they are easy to snap up.

Also, they spend time on the forest floor

and they are small.

All these factors make them easier to prey on than adults.

Walkingstick eggs are also preyed on.

Some female walkingsticks will let their eggs drop from wherever on a plant they happen to be.

Others carefully hide their eggs under a leaf.

Parasitoid wasps that find the eggs will lay their own eggs in the walkingstick eggs.

Their larvae will kill the developing walkingsticks as they grow.

APPENDIX G

MASTERLIST OF CURIOSITY QUESTION RESPONSES ARRANGED BY TOPIC

Appendix G

Masterlist of Curiosity Question Responses Arranged By Topic

Participants were asked to write down what additional questions they had or what they wondered about. Numbers after responses indicate the number of different participants who included that response. Responses with no numbers were mentioned by only one participant.

<u>Questions About Walkingsticks</u>

What do they look like? (4)

What is their lifespan? (4)

What part of the world/which rainforest are they from? (4)

I just wondered more about walkingsticks (4)

I wanted to see a picture (2)

What do they eat? (2)

Why don't they make it safer for their eggs/lay their eggs in trees so they won't get flooded? (2)

What is their relationship/are they beneficial to humans? (2)

What types of animals hunt/do dogs try to eat walking sticks? (2)

How long have they been a part of history?

What is its anatomy?

What is its habitat?

How many babies do they reproduce?

How do they survive?

How do they grow back limbs? How long does it take them to grow back their limbs? Are they left defenseless until then?

Are they endangered?

What do walkingsticks do?

What color are they?

Are they actual sticks?

<u>Questions About Ecology</u>

How do other animals survive the weather and predators? (3)

What are the animals that enjoy/need the hurricane? (2)

I wondered about the lives of organisms in different environments

If it takes walkingsticks 15 years, how long does it take other species to recover?

What other insects live in the rainforest?

I wondered about the environment as a whole

Where is El Yunque located?

Is there other damage done to the rainforest during hurricanes?

I wondered about rainforests

If walkingsticks became extinct, what insects would take over?

A Bugs Life the Movie

<u>Questions About the Experiment (Not Scored as Questions for Analysis)</u>

Why is this important?/ Why do I need to learn about walkingsticks?/Is it really that big of a deal? (3)

I wondered about how I am able to remember things/recall back passages (2)

Why did they choose this topic? (2)

Why did they put the information I was asked about hurricanes just at the beginning of the reading?

I found it odd how the second part of the reading seemed unimportant to the question and then there was some random question about it

Why did they pick walkingsticks and not something more interesting?

Why did they want to know what I do in the morning on a typical day?

Why am I reading these articles?

Are these even real?

Is this an actual insect that had the name changed to confuse me?

APPENDIX H

CORRELATION MATRIX FOR ALL CONTINUOUS VARIABLES

Variables	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.
1. Prior Knowledge Total	-																	
2. Prior Knowledge Eco	**.90**	-																
3. Prior Knowledge WS	**.89**	**.61**	-															
4. Initial Interest Total	**.42**	**.38**	**.37**	-														
5. Initial Interest Eco	**.44**	**.44**	**.34**	**.90**	-													
6. Initial Interest WS	**.29**	**.21**	**.31**	**.85**	**.54**	-												
7. Reading Time Total	-.14	-.11	-.14	.004	-.05	.07	-											
8. Reading Time Hurricane	-.09	-.04	-.12	.05	-.01	.11	**.87**	-										
9. Reading Time Predator	-.15	-.15	-.12	-.04	-.08	.02	**.87**	**.51**	-									
10. Cued Recall Total	.002	.01	-.01	**.31**	**.28**	**.26**	.11	.01	.18	-								
11. Cued Recall Hurricane	.08	.08	.07	**.28**	**.26**	**.22**	.06	-.01	.12	**.81**	-							
12. Cued Recall Predator	-.09	-.07	-.10	**.19**	.16	.18	.11	.03	.16	**.74**	**.20**	-						
13. Free Recall Total	-.03	-.03	-.03	**.32**	**.31**	**.24**	-.17	**-.20**	-.10	**.50**	**.33**	**.46**	-					
14. Free Recall Hurricane	.02	.001	.03	**.30**	**.23**	**.29**	-.08	-.19	.05	**.48**	**.45**	**.28**	**.67**	-				
15. Free Recall Predator	-.06	-.04	-.06	.15	.10	.15	-.16	-.09	-.18	**.23**	.02	**.35**	**.71**	-.04	-			
16. Total Curiosity Questions	-.02	-.01	-.02	**.26**	**.28**	.16	.18	.04	**.26**	.13	.03	.18	**.19**	.14	.13	-		
17. Total Exploration	-.02	-.01	-.03	**.29**	**.20**	**.33**	.16	.13	.15	.07	.01	.10	.06	.08	.01	**.33**	-	
18. Ease of Comprehension	-.09	-.12	-.05	.16	**.21**	.07	.17	.09	**.20**	**.39**	**.26**	**.34**	**.25**	**.26**	.08	.05	.01	-
19. Self-reported ACT	.11	.12	.07	.17	**.25**	.04	-.27	**-.27**	-.19	**.27**	**.24**	.17	**.44**	**.41**	.20	**.29**	.05	.10

Note: N = 106. Correlations in bold are significant $p < .05$