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The Impact of Cultural Dimensions and the Coherence Principle of Multimedia Instruction on the Achievement of Educational Objectives within an Online Learning Environment

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THE IMPACT OF CULTURAL DIMENSIONS AND THE COHERENCE PRINCIPLE OF MULTIMEDIA INSTRUCTION ON THE ACHIEVEMENT OF EDUCATIONAL OBJECTIVES WITHIN AN ONLINE LEARNING ENVIRONMENT

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Title: The Impact of Cultural Dimensions and the Coherence Principle of Multimedia Instruction on the Achievement of Educational Objectives within an Online Learning Environment

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Abstract

The purpose of this study was to gather information about how individuals from two different cultural dimensions (Hofstede, 2001) score on three differently designed e-learning modules. Specifically, this investigation sought to understand whether individualist undergraduate and graduate students learn differently from instructional content designed according to the coherence principle than collectivist undergraduate and graduate students. Each of the three e-learning modules shared the same instructional content: time travel. A post-test measured retained knowledge in subjects from both cultural dimensions on each of the three differently designed e-learning modules. The coherence principle of multimedia instruction stipulates that the addition of extraneous audio, images, or text impairs learning. The interpretation of results presented in this dissertation contextualize the interaction of the coherence principle and the cultural background of the subjects as they relate to post-test scores as well as to applied multimedia design.

Key contributions included the following findings:

1. The cultural and linguistic composition of the multimedia designer is perhaps just as important to consider as the intended learner audience;

2. The choice to present abstract information (such as a timeline) may be predicated by one's cultural background. This in turn may have contributed to lower achievement among collectivists than individualists for a sub-section of the post-test;

3. Consistency (in terms of volume, tonality, and genre) in the arrangement of non-essential audio adjuncts coupled with interesting instructional content may have neutralized the potential for decreased learning in both cultural groups;

4. The results for both collectivists and individualists for each respective control and experimental groups suggest modifications to the traditional coherence principle albeit given the limited scope of this investigation.

One normative standard of multimedia design does not apply to a group of culturally and linguistically diverse learners. A flexible coherence principle requires the multimedia designer to do more work than design and develop instructional content; attention must be given to the cultural and linguistic composition of the intended audience. If such knowledge is unknown, however, it is advisable to adhere to the traditional coherence principle given the results from the controls for both cultural groups.

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"Some rise, some fall, some climb, to get to Terrapin."
– from *Terrapin Station*
Words by Robert Hunter; music by Jerry Garcia

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CHAPTER ONE: INTRODUCTION TO THE STUDY

The principal hypothesis driving this study speculated that the coherence principle may *not* apply to the diversity of cultures and languages present in our world. Specifically, this study sought to understand whether individualist undergraduate and graduate students learn differently from instructional content designed according to the coherence principle than collectivist undergraduate and graduate students. The coherence principle of multimedia instruction (Clark & Mayer, 2003; Mayer, 2008; Moreno & Mayer, 1999) implies applicability to all potential learners regardless of linguistic or cultural diversity. This study contributes new knowledge as to whether students from one culture learn differently from instructional content designed according to the coherence principle compared to students from another culture. Key contributions included the following findings:

1. The cultural and linguistic composition of the multimedia designer is perhaps just as important to consider as the intended learner audience;
2. The choice to present abstract information (such as a timeline) may be predicated by one's cultural background. This in turn may have contributed to lower achievement among collectivists than individualists for a sub-section of the post-test;
3. Consistency (in terms of volume, tonality, and genre) in the arrangement of non-essential audio adjuncts coupled with interesting instructional content may have neutralized the potential for decreased learning in both cultural groups;
4. The results for both collectivists and individualists for each respective control and experimental groups suggest modifications to the traditional coherence principle albeit given the limited scope of this investigation.

Language is the medium by which individuals acquire, organize, integrate, and disseminate knowledge. By knowledge is meant the collection of information, skills, beliefs, and awareness gained through exposure to experience, facts, and situations. Knowledge can be gained a posteriori (through experience), and it can also be gained a priori. A prior knowledge refers to those assumptions about reality that human beings often presuppose, such as gravity, three-dimensional space, or mortality.

The effectiveness of instructional content depends on the nature of its design given that human beings acquire knowledge through language. Instructional materials based on poor design make reaching the stated objectives difficult or impossible. However, it is likely that achievement of learning objectives may depend on the language of the learner. Further, the design of instructional content may need to be adapted to different learner cultural backgrounds. It was the purpose of this study to find answers for both of these suppositions.

Statement of the Problem

The results indicated that students from an individualist culture achieved similar scores as with students from a collectivist culture when instructional content had been designed according to the coherence principle. Conversely, the results showed that students from a collectivist culture scored similarly in some instances and differently in others than students from an individualist culture when instructional content was not designed according to the coherence principle.

The coherence principle is based on research that lacks discussion of the cultural backgrounds of the subjects used in the studies that tested multimedia principles of design. Research is therefore needed to determine the effect of the interaction of cultural dimensions and the coherence principle on the achievement of different educational objectives.

Rationale for the Study

The justification for this inquiry bases itself in the knowledge that little or nothing is known about this *specific* topic. The researchers behind the coherence principle, indeed the cognitive theory of multimedia instruction, took little or no consideration of culture or language as variables in the interaction between learner and content. Research conducted on multimedia principles lacks consideration of linguistic and cultural diversity in the human subjects used in the studies. If managers are expected to take cultural diversity into account when promoting successful business operations within the global community (Jandt, 2007; Triandis, 1995; Trompenaars & Hampden-Turner, 1998), multimedia instructional designers and educators should also take linguistic and cultural diversity into account.

Need for the Study

No prior studies have examined culture and the cognitive theory of multimedia learning in this matter. Accordingly, the use of the individualist-collectivist (I-C) construct in this study is based on prior research that identified the presence of different student learning strategies depending on culture of origin (Brown et al, 2007; Ho & Chiu, 1994; Marsella, DeVos, & Hsu, 1985; Triandis, Bontempo, Villareal, Asai, & Lucca, 1988; Weisz, Rothbaum, & Blackburn, 1984). For the purposes of this research, the I-C construct was appropriate in separating subjects into two groups per cultural dimension given that specific countries and national cultures were *not* under specific investigation. This is especially the case given that this is the first investigation of its kind.

Background

The coherence principle of multimedia learning asserts that the addition of interesting material can hurt or impede learning. Interesting material is understood as extraneous information. Extraneous information includes (1) entertaining stories that are related but not essential to the instructional objective, (2) background music and environmental sounds, and (3) images or detailed textual descriptions. While numerous studies have provided foundation for the multimedia principles (Harp & Maslich, 2005; Harp & Mayer, 1998; Mayer, 1998; Mayer, 2001; Moreno & Mayer, 2000; Mayer & Anderson, 1991; Mayer, Heiser, & Lonn, 2001; Renninger, Hidi, & Krapp, 1992; Robinson, 2002), there is little if any discussion on the cultural backgrounds of the subjects in studies testing the principles. Thus, there is a dearth of investigation as to whether culture plays a role in learning from instructional content that has been designed either with or without the coherence principle.

Purpose of the Study

The purpose of this study was to gather information about how individuals from two different cultural dimensions score on three differently designed e-learning modules. Each of these three e-learning modules shares the same instructional content: time travel. A post-test measured retained knowledge in subjects from both cultural dimensions on differently designed e-learning modules. It was impossible for the subjects to possess prior knowledge in the subject matter given that it was entirely fictional. The researcher created the time travel instructional content. No amount of prior exposure to science fiction content could prepare someone to do well on the post-test without having taken one of the modules. The coherence principle of multimedia instruction stipulates that the addition of extraneous audio, images, or text hurts

learning. The results from this study described the interaction of this e-learning design principle and the cultural background of the subjects on the post-test scores.

Theoretical Framework

This investigation sought to understand whether cultural dimensions interacted with the coherence principle on the achievement of educational objectives in an e-learning environment given no such previous study. This study was guided by knowledge from research on and discussion of linguistic relativity and cultural dimensions.

Role of Linguistic Relativity

Linguistic relativity suggests that language shapes thought (Boroditsky, 2001; Humboldt, 1836; Slobin, 1996; Whorf, 1956). While other versions of linguistic relativity exist, this is the fundamental core. If language shapes thought, then perhaps language impacts the process of learning in terms of what items of instructional content a student acquires and what items are ignored. Perhaps students do not acquire knowledge uniformly. It is possible that students who speak a certain language and represent a particular culture learn in ways that differ when compared to students of another culture or language.

Role of Individualist and Collectivist Dimensions

It is for these reasons that this investigation employs the cultural dimensions as articulated by Hofstede (2001) and Triandis (1995). Perhaps differences exist between cultures in terms of what a particular culture views as extraneous. If one culture views certain items as extraneous to instructional content or as potential distractions, another culture may not share the same view. Further differences may exist between and among members of a particular cultural dimension. This process may determine what items if any a speaker of a given language perceives as extraneous.

Research Question

This investigation was primarily concerned with the following question: What is the impact of cultural dimensions and the coherence principle of multimedia instruction on undergraduate and graduate students [at the Indiana University of Pennsylvania (IUP)] within an online learning environment on the achievement of educational objectives? To answer this question, a series of hypotheses were formulated and subsequent statistical tests calculated. Experimental groups received a module not designed according to the coherence principle. Control groups got an identical module, in terms of instructional content, designed according to the coherence principle. It is important to note that modules differed only in terms of their design; the non-coherence adjuncts (audio and images, respectively) were merely added on after the coherence principle version of the module was created. Each module was identical in terms of instructional content. It was therefore appropriate to use an experimental design to test the research hypotheses, but also to maintain parity with previous investigations of multimedia elements principles (Clark & Mayer, 2003; 2008).

Variables

The independent variables in this study are as follows: collectivist and individualist cultural dimensions (Hofstede, 1984; Pedersen & Hofstede, 1999) and the coherence principle of multimedia instruction (Mayer, 2001; Clark & Mayer, 2003; 2008). The dependent variables (DV) are the two educational objectives presented in the module as (1) identify correct symbol sequences associated with the time travel instructional content and (2) demonstrate understanding of time travel laws. These objectives were measured separately in the post-test. Any detected significant differences are presented for both dependent variables separately and together. This is because the post-test has two sections; each pertains to one of the educational

objectives. Significant differences in the overall post-test and each section, when analyzed separately, were included in the data analysis and interpretation of results.

Assumptions

It was the assumption of this study that given cultural and linguistic variety, the coherence principle may not be appropriate for everyone. This assumption proposes that cultural diversity may show an inclination toward the inclusion of perceived extraneous material deemed inadvisable by previous research. This assumption is based on three points.

Individual perception of reality is nuanced by linguistic and cultural variety. First, the research on the multimedia principles includes little or no discussion of cultural and linguistic diversity. A gap in knowledge exists as to whether culture impacts learning from instructional content designed either with or without the coherence principle. Second, given the review of the literature on linguistics, language has some impact on thought, perhaps if only in a modular way. Accordingly, if language impacts thoughts, we may need to take linguistic and cultural diversity into consideration when designing instructional content.

The design of instructional content may be received differently by culturally and linguistically diverse peoples. Third and finally, research on cultural differences in terms of what Hofstede (2001) classifies as cultural dimensions suggests that individuals from a given cultural dimension communicate and interpret the world in ways unique to their dimension but dissimilar to another.

Limitations

There were several limitations in this study. The reliability testing of the post-test and control module for this study was conducted using doctoral level students from the researcher's

home university department. Advice against this was based on the logic that doctoral-level students may score higher than undergraduates on a given test. However, the content of the module(s) precluded the need for a pretest; this limitation is duly noted yet not acknowledged as severe.

The size of the overall sample is a limitation. While inferential statistics were used to analyze data and to detect significant differences between and among group means, it is not advisable for the researcher to use the results from this study to generalize to larger populations of entire cultural groups.

The proficiency level of English among the collectivist participants is a possible limitation, but one that deserves acknowledgement. While graduate students with high grade point averages comprised the majority of the collectivists, there was no opportunity to access each student's level of English proficiency. However, the researcher has experience in assessment, materials development, and teaching English as a Second Language (ESL) and would rate the level of English necessary to understand any of the modules as novice high or intermediate low.

The experiments were conducted over the course of two consecutive days, Sunday February 20, and Monday February 21, 2011. It would have been ideal to run the entire experiment on one day to ensure little to no threats to internal validity. This is not a major limitation since students did not all come from the same segment of the university. The researcher recruited students from varied departments and programs.

The version of the post-test administered to subjects after taking the assigned module was in hard-copy form. It was initially proposed to use Qualtrics™ online software to create the post-test and present it in each of the module types as a hyperlink to the online post-test. However,

given the non-traditional symbols (see *Figure 10*) used in the e-learning module, the researcher was unable to include these symbols in the Qualtrics™ online software. Hard copies of the post-test were distributed to subjects, collected, and their data entered into SPSS 19.0 software for data analysis.

Definition of Terms

The *Coherence Principle of Multimedia Learning* suggests that an individual is likely to learn more deeply when multimedia instructional content is designed without extraneous audio, images, or text (Clark & Mayer, 2003; Mayer, 2008; Moreno & Mayer, 1999).

E-Learning (or e-learning) refers to learning and teaching environments whose structure is enabled by some form or combination of computerized or simply electronic technology and whose purpose is to build "job-transferable knowledge and skills linked to individual learning goals or organizational performance" (Clark & Mayer, 2003, p. 311; Tavangarian, Leypold, Nölting, & Röser, 2004).

Collectivism is not a political concept but represents a dimension of national or real cultures and pertains to those societies which emphasize harmony, group interests, and "cohesive-in-groups [that] continue to protect [individuals] in exchange for unquestioning loyalty" (Hofstede & Hofstede, 2005). It is a concept forming a part of the individualist collectivist (I/C) construct (Triandis, 1995).

Individualism is the conceptual opposite of collectivism and implies societies that have loose ties between individuals in the sense that the individual is expected to see to oneself or to one's immediate family (Hofstede & Hofstede, 2005; Triandis, 1995).

Universal Grammar is a linguistic theory and is most often associated with Noam Chomsky, but earlier versions of it asserted that common or universal concepts are shared by all

human beings. Chomsky (1965; 1986) and Chomsky and Peck (1987) explain that cognitive structures form a faculty of language acquisition whereby language learners inherently know incorrect from correct expressions. Further, UG posits that logical propositions can be made from one language or family of languages to another. For example, let us assume that the sentence word order for one language X_Y of a particular family of languages XY is subject-object-verb (SOV). Universal Grammar suggests that language Y_X of the same language family should either prefer the SOV word order or allow for its formulation. A similar case can be made for color. If language X_Y of a particular family of languages XY has a word for the color purple, language Y_X of the same language family will likely have a word for same color. In fact, the phonemic and phonetic structures may also share similarities.

Generative Grammar is a narrowed approach to the study of syntax. A generative grammar of a language attempts to give a set of rules that will correctly predict which combinations of words will form grammatical sentences (Chomksy, 1965).

Linguistic Relativity suggests, however controversially, that language shapes thought. This theory emerged around the time of Humboldt (1836). He supposed that differentiation of language systems is not a *diversity* of signs and sounds, but rather of world view (Hill & Mannheim, 1992). This perspective implies that language impacts the reality one inhabits and implies creation of world view. Later, Whorf (1956), Sapir (1949), Slobin (1996), and Lakoff (1987) carried this line of inquiry further by positing that while empirically untenable in the eyes of critics of linguistic relativity, mental concepts are nuanced by the language one speaks. Boroditsky (2001; 2010) has recently provided the first empirical support for linguistic relativity.

Cognitive Load Theory assumes that individuals possess a limited working memory. Individual ability differs in terms of storage and operation (Paas & van Merriënboer, 1994; Paas,

Renkl, & Sweller, 2004; Sweller, 1994; van Merriënboer & Sweller, 2005). At its core, this theory seeks to explain the interaction between the organization and structure of the information presented in instructional content and the process whereby the isomorphic cognitive structure of the human brain acquires this information as knowledge. It posits the existence of schemas; these are cognitive combinations of constitutive informational elements that are or can be associated with specific functions (Paas, Renkl, & Sweller, 2003). Of interest to designers of multimedia instructional content, Mayer and Moreno (2003) argue that complex text and image presentations in multimedia content lead to cognitive overload.

Significance to the Field of Communications

Specific to the variables under investigation in this study, the results showed that students from an individualist culture achieved similar scores as students from a collectivist culture in an online learning environment when instructional content had been designed according to the coherence principle. Conversely, considering the two experimental modules students from a collectivist culture achieved different scores than students from an individualist culture when instructional content was *not* designed according to the coherence principle but had non-essential images added. For comparison, the students from similar cultural backgrounds scored similarly on the experimental module with non-essential music added. This served as the primary contribution of new knowledge to the fields of communications, educational psychology, and linguistics.

Organization of the Remainder of the Study

The remainder of this manuscript is divided as follows. Chapter Two presents a critical evaluation of the literature associated with the coherence principle, the I/C cultural construct,

language acquisition and linguistic relativity, the genre of time travel in film and literature, and cultural differences expressed in advertising and architecture. There will also be critical reviews of the time travel genre for film and literature to provide the justification for the content of the instructional module.

Chapter Three delineates and discusses the research design used to carry out the study. It presents the chosen research methodology to conduct the study, the population and sampling, the instrumentation used to conduct the study, content and design of the instructional module (screenshots of control module are located in *Appendix F*), the analysis of data collected, and ethical considerations. Chapter Four contains a presentation and analysis of the research findings. First, demographic data are presented as frequencies and descriptive statistics. Second, the results from statistical tests of difference are shown in the context of the research hypotheses. Chapter Five presents the interpretation of results, discussion and conclusions, limitations of the study, and recommendations for further research.

The estimated timeline (available in *Appendix A*) for the project was 12 months from the date of approval for the dissertation proposal and topic (November 15, 2010) and the Human Subjects Review Protocol submitted to the Institutional Review Board (IRB) at IUP (approved November 10, 2010).

CHAPTER TWO: EVALUATION OF THEORETICAL AND PRACTICAL CONTRIBUTIONS

Introduction

The purpose of this review is to provide a critical evaluation of the literature associated with (1) the coherence principle of multimedia instruction, (2) cultural dimensions, cultural awareness training, and correlative calls for more research on e-learning design, (3) language acquisition and linguistic relativity, (4) the genre of time travel in film and literature, and (5) cultural differences expressed in advertising and architecture.

Organization and Content of the Literature Review

There are three major sections of this review, with two additional subdivisions. Following the order of presentation a critical discussion and historical overview of universal grammar, linguistic relativity, cultural dimensions, and the cognitive theory of multimedia instruction form the core of this review. The first subdivision examines the theories and applications surrounding the visual communications of advertising and architecture. These additional perspectives are helpful to understand inherent differences in the way communication is expressed across cultures. The second subdivision, which presents a critical review of the time travel genre for film and literature, provides the justification for the content of the instructional module.

Linguistics. In order to explore prior work on language it is appropriate to review extant literature from linguistics. Accordingly, a review and critical discussion of universal grammar and linguistic relativity attempt to explain how human beings learn with special attention to the role language plays as the medium of knowledge acquisition. The section on linguistics is described in further detail below and suggests a common language faculty which is based bio-

genetically in the human species. However, while this faculty leads to differences in expression in the form of varied languages and cultures, the language spoken by an individual may impact, shape, and constrain thought. If language shapes thought and yet all individuals possess some common language faculty that is independently capable of producing diverse expression, then the coherence principle may not apply to this linguistic and cultural diversity since it does not take this diversity into account.

Cultural dimensions. A second major section of the literature review analyzes the literature on the previously discussed cultural dimensions. This investigation aims to understand whether culture and instructional content designed according to the coherence principle impact learning in an online environment. It is important for this study to use the cultural dimensions as articulated by Hofstede (2001) and Triandis (1995) given their use as cultural constructs in research. It is convenient and appropriate for this study to incorporate the cultural dimensions, individualism and collectivism, given their use in prior research. Individualism is defined as the subordination of group or community goals to individual goals or interests; collectivism subordinates individual goals or interests to the community or group (Hui & Triandis, 1986; Jandt, 2007). Since nations are not compared and contrasted in this study, it is logical to use the cultural dimensions. The purpose of this research is to explore whether culture has any impact on transfer knowledge from instructional content that has been designed according to the coherence principle given that there is no research that currently addresses this line of inquiry.

Coherence principle. A third major section of the literature review is expectedly a critical evaluation of research pertaining to the coherence principle of multimedia instruction. Accordingly, a review and critical discussion presents theories that led to the development of and serve to support this principle. Specifically, these theories pertain (1) to the design of the

instructional content, (2) to the objective to teach a given learner as efficiently as possible, and (3) to the amount of information that can be transferred to knowledge given assumptions based on cognitive load (Paas, Renkl, & Sweller, 2003; Paivio, 1986; 2006; Sweller, 1994).

This investigation emphasizes the coherence principle of multimedia instruction for the purposes of exploring its interaction with cultural dimensions of individuals. The coherence principle states that the less presented in instructional content, the more students tend to learn. This proposes that students are actively building a coherent mental depiction of the presented instructional content (Clark & Mayer, 2003, p. 121; Mayer, 2001, p. 132). Since students are engaged in this process of active learning by means of creating mental structures which connect the new instructional content with a familiar concept part of the student's prior knowledge, researchers Clark and Mayer advise against the inclusion of extraneous sounds, images, and text.

Relevance of linguistic relativity and cultural dimensions to coherence principle assumptions. Given the supposition that language shapes thought and given relevant research on the differences in individuals around the globe in terms of individualist and collectivist cultural dimensions, the coherence principle may not apply to all people.

If language does shape thought, whether directly, modularly, or incrementally, then the way an individual thinks and learns is associated in some way with the arrangement of linguistic items enabled by the language faculty that Chomsky (1986) presumed common to all human beings. Based on that assumption, it appears unwise to advise against adding *extraneous* words, pictures, or sounds to instructional content since that research did not investigate cultural or linguistic diversity as variables.

Additional subdivision of literature review. This study required the creation of an online e-learning module. This subdivision pertains to the subject matter chosen for the module.

It is important to note that common to the three e-learning modules designed for this study is their instructional content: time travel. Extraneous information (images and audio) added to make the two separate experimental modules is discussed in greater depth in Chapter Three.

Instructional content of module. The topic of the module will be time travel. Specifically, this topic has been chosen to check for the transfer and retention of knowledge about a topic unfamiliar to the learner. In Mayer's (2001) experiments that led to the development of a cognitive theory of multimedia instruction, it was not obvious whether the subjects in his experiments had prior knowledge of the instructional content of the modules. In this investigation it is important that the instructional content be a topic that is unfamiliar to the learner. The logic behind this rests in the elimination of a serious threat to the module's internal validity (Buddenbaum & Novak, 2001).

Cognitive Theory of Multimedia Learning

Clark and Mayer (2003) propose a cognitive theory of multimedia learning that defines learning as an active process of *sense-making*. It defines teaching as an attempt to encourage adequate cognitive processing in the learner. This is an updated version of cognitive load theory as proposed by Chandler and Sweller (1991) and Sweller (1988; 1994).

Coherence Principle

The cognitive theory includes several multimedia principles that serve as guidelines for instructional designers of multimedia with an educational objective (Clark & Mayer, 2003, p. 273; 2007, p. 3-4). Tested in laboratory experiments (Mayer, 2001; Harp & Mayer, 1998; Sanchez & Wiley, 2006), the coherence principle asserts that the addition of interesting material can hurt or impede learning. *Interesting* material is understood as extraneous information. Extraneous or adjunct information includes (1) entertaining stories that are related but not

essential to the instructional objective, (2) background music and environmental sounds added for motivation, and (3) images or detailed textual descriptions. According to Clark and Mayer (2003, p. 111-112), these adjuncts may harm learning through distraction, disruption, and seduction. Numerous studies support the multimedia elements principles as outlined in Clark and Mayer (2003), several of these studies include: Harp and Maslich (2005), Harp and Mayer (1998); Mayer, (1998); Mayer, (2001); Moreno and Mayer, (2000); Mayer and Anderson, (1991); Mayer, Heiser, and Lonn, (2001); Renninger, Hidi, and Krapp, (1992); Robinson, (2002).

Seductive details and arousal theory. The argument against including extraneous information in a multimedia instructional lesson refutes the fundamental thesis of arousal theory. At its core, arousal theory (Weiner, 1990), also referred to as emotional interest theory (Mayer, Heiser, & Lonn, 2001) argues *for* the inclusion of entertaining image, text, or auditory adjuncts to increase the interest level a learner may have in the instructional content. Further, if the learner is interested in the content, arousal theory states that the learner's overall level of *arousal* will increase thus implying that the learner has an enhanced or greater level of attention in the content. Proponents of arousal theory argue that the inclusion of extraneous information to spice up a lecture leads to better retention and transfer. For example, Kozma (1991) finds that as long as people view television with a purpose, seductive details add to the learning process in that people are more attentive to and construct elaborate schemas of the televised information. This is in direct opposition to the coherence principle (Burke, 2007; Moreno & Mayer, 2000; Sanchez & Wiley, 2006) which stipulates that extraneous information be excluded from multimedia instructional content.

Garner, Gillingham, and White (1989) performed two experiments with adults and children to examine micro and macroprocessing of information. They found that seductive

details, specifically the inclusion of interesting but non-essential information about a particular subject led to lower recall levels of the main idea.

Sanchez and Wiley (2006) performed two separate experiments using undergraduates in a lecture format. Their findings state that students whose working memory capacity was low were more susceptible to the seductive details effect. They argue for a re-articulation of the effect to allow for the interaction of low working memory capacity but also for varying levels of reading comprehension ability. In other words, students may be able to overcome the *seductiveness* of extraneous but interesting details given an excellent reading ability charged with critical thinking to permit the learner to discriminate between essential and non-essential information.

However, Mayer, Heiser, and Lonn (2001) found in three experiments that the addition of seductive details to instructional content led to poor transfer in post-test results. Harp and Maslich (2005) found similar results in a lecture format. Together, these results echo Dewey's (1913) avowal against adding extra material to a lesson for the sake of increasing the level of interest students may have in the subject. However, the research in favor of arousal theory suggests that designing instructional multimedia with or without seductive details is ultimately the choice of the designer. None of these studies examined transfer knowledge from instructional content with or without seductive details among linguistically and culturally diverse subjects.

Claims that music style may benefit learning. For the e-learning module this study necessitated, the researcher has chosen to add music to one of the two experimental modules, making its design inconsistent with the coherence principle. It is important to note that in Mayer's articulation of the six multimedia principles (the coherence principle is one of these six) there is no discussion of the potential *benefit* that certain music may have on learning (Mayer, 2001). The argument that listening to classical music leads to enhanced spatial-logical cognitive

processing is often referred to as the *Mozart effect* (Hisama, 2000; Nantais & Schellenberg, 1999; Rauscher & Shaw, 1993; Steele, Bass, & Crook, 1999). According to Rauscher and Shaw (1993; 1995) college students who listened to ten minutes of Mozart achieved better scores on standardized tests of spatial abilities compared to groups of college students who either listened to narrative instructions aimed at relaxing the test-takers or to nothing at all (Thompson, Schellenberg, & Husain, 2001). However, failure to replicate these results has led to doubts in their reliability.

Steele, Bass, and Crook (1999) followed Rauscher and Shaw's design but concluded that the results provided no evidence for the Mozart effect. A later study by Thompson, Schellenberg, and Husain (2001) posited that the Mozart effect is merely an *artifact* of a stimulated or aroused mood. In a comprehensive analysis of newspaper coverage of the Mozart effect in the United States, Bangerter and Heath (2004) correlated interest in the Mozart effect with those states that had been experiencing problems in childhood education. Manthei and Kelly (n.d.) subjected undergraduate students (n = 72) to three different musical varieties, tested their mathematic acumen for placement, and used a regression analysis to show that music had no significant impact on the test scores. Their subjects were neither music nor math majors. LaBach (1960) discovered that background music had no impact on reading comprehension scores and also found that among the subjects listening to music while studying had no significant outcome when used as a covariate.

These studies collectively indicate that the Mozart or similar effect does not exist. More important to this discussion, however, is the sense that individuals learn differently; this is the central logic behind this researcher's hypothesis. To assume that one musical style has a universal influence on learners (regardless of cultural origin) is a fallacious argument that

excludes individual differences and preferences. Finally, it fails to consider the *type* of task during which a person listens to a musical style.

Foundational Support for the Cognitive Theory of Multimedia Learning

There are three assumptions that serve as the foundation of the cognitive theory of multimedia learning. These are based further on the assertion that instructional content should be designed according to the way people process information (Mayer, 2001). It is important to note that none of the three assumptions include any literature, perspective, or theory on cultural and linguistic diversity as pertinent to the discussion of how people process information. Indeed, this theory fails to consider that learning is not nuanced by the dynamics of language and culture, discussed in greater depth in the second section of this review.

The coherence principle is one of six such principles that are prescriptions as to the design of instructional content per the cognitive theory of multimedia learning. The theory is based on three assumptions, (1) dual channels, (2) limited capacity, and (3) active processing.

Dual channels. Human beings possess within their cognitive structure separate processing channels for visual and verbal information. This is the core of the dual channels assumption. It is rooted in research and perspectives articulated by Mayer and Moreno (2003) drawing on Paivio's (1986) dual-coding theory and Baddeley's (1992; 1998; 2000; Baddeley & Hitch, 1974) theory of working memory.

Dual-coding theory. In order to support his dual-coding theory, Paivio recalls Giordano Bruno's mnemonic tradition, itself drawing on variants of the method of loci, or memory palace, and he discusses Comenius' instructional approach in presenting images of objects alongside words in *Orbis Sensualium Pictus*, or 'The world explained in pictures' (Paivio, 2006; Yates, 1966). Paivio insists that there are internal cognitive systems that are structurally composed of

logogens and *imagens*, or word and image units, respectively. He assumes that learning is accomplished through independent visual and verbal channels that serve to code objects as words given that physical objects carry a visual meaning and a linguistically ascribed meaning (Paivio, 1969; 1971; 1986). On the basis of his assertions, Mayer (2001) proposed that efficient learning and instruction is accompanied by taking into consideration the separateness of the verbal and nonverbal channels. Mayer modified the term *visual* to *nonverbal* to allow for sound and motion. For Mayer, there is a presentation-mode approach implied in Paivio's contribution that distinguishes between verbal and nonverbal learning. Thus, pictures or music are processed by one channel, whereas verbal words and sounds (spoken language) are processed by a separate channel.

The problem with this logic is the implicit assumption that language does not have any influence on thought. In particular, there is no discussion as to whether a language or a culture *could* influence the way in which associations are made within the individual about verbal and nonverbal information. There is no disagreement here as to whether processing verbal and related nonverbal elements in an instructional context proceeds along separate channels. It is unlikely, however, that each person would associate a given image, object, or sound to a given word or concept similarly and uniformly. It is likely that language and culture impact expressed and internalized meaning differently depending on the particular case.

Clark and Mayer (2003) and Mayer (2001) assume through an interpretation of Paivio's dual-coding theory that during instruction, narration (verbal information) may initially proceed along the verbal channel but may also be processed as if it were nonverbal information in the same way that words can conjure up images. However, if language influences thought,

generalizations should not be made as to the presumed impact which verbal and nonverbal cues may have on linguistically and culturally diverse learners.

Theory of working memory. As indicated by Miller's (1956) and Baddeley's (1992) research, working memory (WM) is limited to approximately seven items of information that an individual can remember at a given point. This theory posits a limitation within WM and an unlimited capacity in long-term memory (LTM) (Bower, 1975; Sweller, 1994). Instruction of information leads to a cognitive load in the learner given the limits in WM and its place in transmitting learned or remembered information for permanent storage in the LTM. While WM can only process a finite amount of informational items at a time, the construction of schemas alleviates the risk of overloading WM. Schemas are new knowledge that have been processed by the WM and are stored in the LTM (Sweller, 2002). Schemas constitute a structure that enables linkage between understanding and remembering information. They organize information according to the manner in which it will be accessed later (Chi, Glaser, & Rees, 1982).

Assuming that language shapes thought, it is possible that what is processed in working memory during instruction may differ in terms of associative meaning and schematic construction depending on culture and language. Mayer (2001) assigns working memory the role ascribed to it by Baddeley (1992) and others, namely, that its primary function is to process actively consumed input, potentially both verbal and nonverbal, along separate channels. One channel deals with sounds and verbal or spoken information, and the other channel handles nonverbal and image or pictorial representations (Mayer, 2001, p. 45). Mayer extends this assumption to suggest that the verbal or spoken word may prime the nonverbal pictorial representation.

He implies that when one hears the word *cat* one necessarily visualizes a *cat*. However, one person's interpretation of the sound (signifier) may differ from another person's conceptualization (signified) especially upon consideration of linguistic and cultural diversity (Saussure, 1983). As an applied example, Boroditsky (2001) found that speakers of German assign notions of rigidity or vigor to the masculine-gendered word *key* [German: *der Schlüssel*] as contrasted by French speakers assigning elegance and finesse to the feminine-gendered word *key* [French: *la clé*]. Thus, while visual and auditory items are processed along separate channels, it should not be assumed that each person associates the mental representation of an idea or thing with the verbal or spoken word used to signify the concept.

Limited Capacity

A limited amount of processing capacity exists in visual and verbal channels. This is rooted in the work of Miller (1956), Baddeley (1992), as well as Chandler and Sweller's (1991; Sweller, 1999) cognitive load theory. The theory posits that a person is able to remember a limited amount of presented material, and while this amount may vary from person to person (Mayer, 2001), it is still *limited*. Types of cognitive load include intrinsic and extraneous (Sweller & Chandler, 1994). Difficult subject matter in terms of the amount of instructional items presented and the interconnectedness between items refer to intrinsic load. Design and delivery of instructional content fall in the realm of extraneous load. Germane cognitive load is a third kind of cognitive load and is defined as the resultant construction of schemas provided learner attention is directed toward cognitive processes during learning. Germane cognitive load is to be promoted because it benefits retention.

Active Processing

The act of learning requires substantial cognitive processing in the verbal and visual channels. The active processing assumption implies that we tend to pay attention to and select from presented instructional content, organize it, and integrate it into a coherent cognitive structure that is connected to older knowledge (Mayer, 2001). Central to Wittrock's (1989) generative-learning theory is the assumption that learning is neurological meaning-making as contrasted with memorization. Generative learning relates to the cognitive processes involved with crafting relationships between concepts and experience. Wittrock's (1992) research tracks cognitive processing and retention of information at the relational, not rote, level. Mayer (2001) adds to this the selection-organization-integration theory of active learning (Mayer & Moreno, 2003).

Recent Discoveries

Recently, researchers Muller, Lee, and Sharma (2008) identified limits to the generalizability of the coherence principle. They carried out an experiment in an authentic online learning environment and found that the addition of around 50% of interesting but non-essential information did *not* lead to lower post-test scores as predicted by the coherence principle. While the researchers admit that the difference in test scores may have been situational because students were more attentive to the module with extra material (Muller, Lee, & Sharma, 2008, p. 218; Mitchell, 1993), the study provided no evidence for the coherence principle in a real learning setting.

The Muller, Lee, and Sharma (2008) study, however, failed to discuss cultural backgrounds, at least generally, of the subjects in the sample. Student learning strategies have been identified as dissimilar based on cultural dimensions. Brown, Aoshima, Bolen, Chia, and

Kohayama (2007) assert that culture is a mediating factor which instructors, and by extension designers of multimedia instructional content are urged to consider. These researchers advocate awareness of cultural differences, but they also admonish making generalities about a given culture.

Cross-Cultural Learning

Learning styles, schooling, student strategies, and cognitive variations permeate the discourse on differences that exist between presumably dichotomous cultural structures. The literature on the individualist-collectivist cultural dimension touches on business, education, psychology, sociology, anthropology, and government. Common throughout the discourse is the reality of difference. While this difference between the individualist and collectivist exists, it does not suggest immutability. Training, such as intercultural simulation games, can assist in helping individuals from one cultural dimension adapt to and become aware of the fundamental characteristics that comprise the particular dimension (Lambertini & ten Thije, 2004; Koskinen, Abdelhamid, & Likitalo, 2008; Wiggins, 2011).

It is also important to realize that uniformity is not implied when a particular culture has been identified as individualist or collectivist. There are elements of collectivism in an individualist culture and vice versa.

This construct is incredibly useful in understanding that there are indeed differences in the ways individuals both perceive and communicate about the world they inhabit. Harmony, avarice, impoliteness, nepotism, and formality are all potential personal attributes that may appear to be real to a person as a result from interacting with another from a different culture. The same interaction may lead to a completely different conclusion depending on whether one is from a culture that is more or less individualist or collectivist. Before delving into depth on the

individualist-collectivist construct as it pertains to this research, a summative review of literature is presented on the applied cross-cultural learning differences that pervade schooling and students around the world.

Schooling and Student Learning Strategies

Acknowledging the dynamism of culture, Drake (2004) characterizes the introduction of international baccalaureate programs into the non-Eurocentric world as a source of potential dissonance. This argument rests on the reality of complex cultural differences which exist among various nations around the world. Indeed, among the Eurocentric nations, differences exist; however, these are differences in terms of being more or less of a particular cultural dimension, such as individualism, power-distance, or uncertainty avoidance. The introduction of a Western-styled schooling system into a collectivist society may not be successful given the larger potential differences such as world view and interpersonal relationships.

Studies of students from Western and non-Western cultures propose that while some learners rely more on rote memorization (surface strategy), other learners enact a deep learning strategy (Ballard & Clanchy, 1984; Samuelowicz, 1987; Volet, Renshaw, & Tietzel, 1994). Three learning strategies relate to this discussion: surface, achieving, and deep.

A student maintaining a surface strategy meets minimal requirements stated by institutional curricular objectives and utilizes rote memory (Biggs, 1987; Hunt, 2003; King 1996). Conversely, an achieving strategy envisions a situation in which a student strives to get high grades and is generally as good a student as possible, even if the subject is of no interest to the student. A deep learning strategy is one focused both on competence and the process of relating new knowledge to previous knowledge. Research that has defined Western and non-Western cultures in terms of Hofstede's cultural dimensions (Hofstede, 1980; 2001; Hofstede &

Pedersen, 1999), i.e. defining Western as individualist and non-Western as collectivist, has provided consistent distinctions in "learning, motivation for learning, learning strategies and goals or purposes of learning" (Brown et al, 2007, p. 593; Gabb, 2006; Ho & Chiu, 1994; Hwang, Francesco, & Kessler, 2003; Marsella, DeVos, & Hsu, 1985; Triandis, Bontempo, Villareal, Asai, & Lucca, 1988; Weisz, Rothbaum, & Blackburn, 1984). Indeed, significant cultural variations may be related to cognitive variations. By extension, these variations may characterize the nature of differences implied by cultural changes such as Western-style schooling (Cole, Gay, Glick, & Sharp, 1971).

Cultural Awareness Training in the United States

As a feature of the cultural wealth of the United States, it is not surprising that its schools are becoming increasingly culturally and linguistically diverse. A testament to this trend is the increase in teacher preparation programs across the United States to train new and existing teachers in cultural awareness (Lim, Maxwell, Able-Boone, & Zimmer, 2008). What is lacking, however, is an understanding of effective multimedia design for e-learning content to be delivered to culturally and linguistically diverse audiences. According to the 2005-2009 American Community Survey, 12.4% of the US population, or 38,440,000 are foreign-born. Additionally, 19.6%, or 60,760,000 speak a language other than English at home (U.S. Census Bureau, 2009).

Resources. The United States spends approximately $631 billion for primary and secondary schools (Ruth, 2010). Despite this enormous expenditure, approximately 73% of high school students graduate as a nationwide average; in some regions the figure is around 50% or lower. According to the Sloan Consortium's report on K-12 online learning, primary school e-

learning is still in its infancy (Allen & Seaman, 2009). However, the Sloan study noted that e-learning solutions are critical for poorer, rural school districts.

With some school districts seeing fewer qualified educators, e-learning solutions may enable schools to draw on expertise located elsewhere and accessible online (Ruth, 2010). Patrick and Powell (2006) found that online course enrollments have increased in the United States by approximately 30% since 2003. This highlights the utilitarian aspect of online learning that is most beneficial to those students residing in rural areas or districts with educator shortages (Gibbs, Lane, & Lane, 2007). Picciano and Seaman (2009) reported enrollment in online courses had risen to over one million students. Watson, Gemin, Ryan, and Wicks (2009) also reported the growth of online learning in all but five states in the US. Similarly, Schaeffer and Konetes (2010) highlight the promise of online programs to provide opportunities for students to enroll in a wider range of courses not usually available at traditional schools.

Calls for more research in e-learning design. Rice (2009) surveyed distance education stakeholders to identify priorities in distance education for 2009-2014. The chief priority was 'evaluation of course design and delivery'. These influential online education stakeholders advocate research in effective course design and for online delivery and usage. Barbour and Reeves (2009) and Barbour (2010) endorse online course design to follow the structure of research methodology. Their recommended strategy shares similarities with the ADDIE model of instructional design which incorporates analysis, design, development, implementation, and evaluation (Dean, 2002), but involves iterative procedures to test and refine the course. Clearly, in order to maintain a productive and nurturing online learning environment for K-12, higher education, private sector and government training, more research is needed in course design.

Individualist and Collectivist Cultures

Given the interest in this study to examine cultural dimensions it is appropriate to use Hofstede's (2001) and Triandis's (1995) individualist and collectivist categories, also referred to as the I-C construct (Triandis, 1996). The results may show that students from an individualist culture score differently than students from a collectivist culture in an online learning environment when instructional content has been designed according to the coherence principle. Conversely, students from a collectivist culture may score differently than students from an individualist culture when instructional content has *not* been designed according to the coherence principle. There is no discussion of culture in the research on cognitive theory of multimedia instruction, of which the coherence principle is a part.

Limitation in using cultural dimensions. There is a hazard in classifying a given culture as either individualist or collectivist to imply that members of the identified culture exhibit uniform behavior. This researcher realizes that individualism and collectivism may vary at the individual, group, or national levels (Hui & Triandis, 1986) and that it is crucial to avoid generalizing and stereotyping cultures.

As Strauss (2000) notes, there is a tendency for assumptions to pervade the I-C construct. Upon reflection of the existence of these assumptions, it is important to realize that a given national culture (such as U.S. American culture) is neither universally individualist nor is it devoid of collectivist traits. Critics of the I-C construct compare attempts to posit a cultural dichotomy comprised of Western and non-Western (or Occidental and Oriental) divisions to early anthropological mass society or grand theories to explain differences between folk communities and civilization, such as Durkheim's *mechanical* and *organic solidarity* or Tonnies'

Gemeinschaft and *Gesellschaft* (Strauss, p. 88). However, the use of the I-C construct in this dissertation serves a critical purpose.

Individualism and collectivism in research. As mentioned by Ayyash-Abdo (2001) and according to Triandis (1995), the individualism-collectivism (I-C) cultural construct has formed the core of numerous studies that represent a variety of disciplines. I-C has been analyzed within the context of economics (Adelman & Morris, 1967), ethics (Schweder, 1982), and individual behavior according to religion (Bakan, 1966), but perhaps with the greatest regularity in psychological and anthropological studies of cross-cultural nuances (Fiske, 1990; Gudykunst, Ting-Toomey, & Chua, 1988; Hofstede, 1980; Schwartz, 1990; Smith & Bond. 1993; Triandis, 1995; 1996). There is an inherent danger that in classifying a culture as an individualist or collectivist cultural dimension, one necessarily implies that members of the given culture possess and exhibit uniform behavior. In fact, individualism and collectivism varies in a given culture.

The I-C construct is perhaps best understood as a cultural pattern (Triandis, 1996) that inheres particular types of behavior, beliefs, forms of expression, values, and worldviews around a given idea or topic, such as the attitudes Russian people have of the employee-boss relationship when compared to the way Chinese people view the same interaction. These outward and inward ways of perceiving such matters appear common to some cultural groups (such as those that comprise the individualist or collectivist continuum of representative countries). Research on this construct has provided insights into the way different cultures perceive matters (values, beliefs, etc.) and serves those interested in becoming interculturally literate.

Individualism and collectivism as national cultures. Several countries are typically identified as illustrating either individualist or collectivist characteristics. As Jandt (2007) discusses in examples based on Hofstede's (1984; 2001) research, individualism tends to be

dominant in the following countries: the United States, Australia, Great Britain, New Zealand, Canada, The Netherlands, Belgium, the Scandinavian countries, Germany, Switzerland, and South Africa (Jandt, 2007; Neuliep, 2006). The collectivist cultural dimension is common in (South) Korea, Thailand, Taiwan, Singapore, China, Bangladesh, and Japan, among other countries (Jandt, 2007, p.161; Neuliep, 2006).

Universal Grammar & Linguistic Relativity

The cognitive process of the brain contains structures that exist as a means for the assemblage of grammatical items. Language is the medium through which the principles and guidelines of grammar realize ideational forms of thought. However, grammar is enacted through the existence of a structure or faculty that enables the acquisition of language, formation of grammatical rules and order, and the development of knowledge. This structure makes linguistic acquisition and expression possible.

Universal Grammar

Universal Grammar (UG) is a trait of the human organism's faculty to acquire language (Chomsky, 1965; 1986, p.5). Generative grammar emphasizes the role of knowledge that is to be acquired through use of language (1965). Traditional and structuralist approaches to explaining grammar deal more with elements of a given language and not with knowledge that can be attained once those elements have been acquired.

Chomsky and I-language. Chomsky (1986) argues that in considering language knowledge, *knowledge* is not ability but rather a state of mind. It is this state of mind that is common to the human species; UG is the theory of this initial state. In other words, Grammar X for Language X is understood as a theoretical articulation of an I-language, or internalized language. This I-language may be seen as following the initial state that allows the acquisition of

language. I-language is the system of knowledge that an individual acquires post-UG. Within this I-language objects in the observable world are assigned status and names as needed and numerous possibilities for assignment exist.

In other words, uniformity exists in the faculty of language acquisition as it is an isomorphic structure common to the human species. However, *diversity* exists in the assignment of meaning to elements in reality. This diversity is addressed further below, but following it is a discussion of that which UG inheres across all languages.

Harmony and discord for diversity in language. Arguments have been made by those supporting UG and those in disagreement with its fundamentals about whether there is an infinite or finite diversity in human speech. The important factor in this review is the acknowledgement of diversity in language. Inherent in UG is the sense that there is something common, or universal, to all languages. It assumes that human language possesses common structures which in and of themselves are not necessarily learned, but that each human being possesses these structures as a matter of course. It is perhaps best understood as a normative faculty that enables a person to acquire a language. Echoed in the words of Martin Joos, William Dwight Whitney, and Edward Sapir is the sense of variation. These thinkers posit diversity in human speech and that this diversity is infinite. Chomsky (1986, p. 21) disagrees about an infinite diversity, but acknowledges the need for empirical support.

UG provides a sustainable framework for further argument and exploration as to the nature of human language and thought and how these interact with respect to reality. Implicit in its interaction with human language is some sense of diversity. Perhaps UG is a framework that is structurally malleable to allow for any number of combinations, or perhaps it is restricted to only a certain number. Thus, while the tools may be the same, the product may be different. In

other words, grammars may share similarities (most if not all [natural and artificial] human languages have nouns and verbs) but the languages themselves are unique, especially when compared to each other. While German, *Hochdeutsch* and *Plattdeutsch*, shares some remarkable similarities with Dutch, these are distinct languages whose speakers articulate meaning in operationally similar ways, but with dissimilar organization, phrases, or culturally-nuanced terminologies. The internalized language in each of these examples is the product of a diverse arrangement of meaning-making following the initial state of being that is characterized by UG.

UG and generative grammar. In recalling Humboldt's (1836) contribution in *Über die Verschiedenheit des Menschlichen Sprachbaues* [On the Diversity of Human Linguistic Structure] Chomsky acknowledges (1987, p.152) that while the laws of a language may be fixed, the generative principles are unfettered by the free creation of the individual. For Chomsky the generative aspect is genetic. Indeed, Humboldt's term *erzeugen* (to create) implies the *creation* of a thing from materials dissimilar to the product. What we refer to as *language* is the generative ability of the cognitive structure to create new combinations of linguistic elements that become distinct units of larger systems of communication and meaning-making. Implied is the notion that the human brain is inhabited by a pre-coded or preprogrammed faculty that epigenetically works to acquire language. This metaphor of the mind as a computer is common to Cognitivism.

A cognitive structure for language. Regardless of the actual source of language and thought and how human beings articulate these in reality, the sphere of origination of language in the brain *may* contain within it a preprogrammed structure. Irrefutable are the distinctive products of thought among the varied cultures and languages in our world. These products are the verbal and non-verbal forms of expression that emanate from the brain. Chomsky (1965;

1986; 1987) argues that UG explains the constitutive aspect of the initial state as being common to all people, yet the outcome of this initial state is perceived in terms of different grammars and languages which ultimately determine meaning in similar or dissimilar ways. In other words, what starts as common to all emerges as being unique to those who share the same internalized language or grammar.

In this Piaget (1983) agrees with Chomsky that innate in humans is the capacity to develop knowledge and learn successively based on prior experience, behavior, or observation. Piaget (1983, p. 111) states that his perspective rejects not the assertion that there are hereditary structures [presumably those that correspond with language and meaning-making] but that these structures are charged primarily with the "construction of intelligence itself". Whether hereditary structures do or do not possess specific capacities, there appears to be some agreement about the existence of hereditary isomorphic structures, also alluded to by Hofstadter (1979).

UG: Summary

Fundamentally, Chomsky's (1965) UG asserts that human beings possess a similar structure that permits the acquisition of language. For example, if one language has a word for blue, according to UG another language should also have a word for red. Thus, the underlying structure of the brain appears to be able to articulate words for the colors (or other perceivable phenomena) which the human mind observes.

Human beings are only able to learn language(s) assuming a linguistic infrastructure in the brain. However, as Cole, Gay, Glick, and Sharp (1971) point out, thought processes in UG are functionally and structurally equivalent across cultures; yet the influence of language on thought is not explicitly refuted.

An Isomorphism Tolerant of Cultural Impact

Uniformity in UG is parallel to asserting an isomorphic cognitive structure. In *Gödel, Escher, Bach: An Eternal Golden Braid* Hofstadter (1979) offers the explanation that while the structure of the brain is isomorphic, culture and language still manage to influence thought. He argues that the brain is isomorphic, or structurally identical to other human brains, which Chomsky (1965) implies in UG with reference to language acquisition. While Hofstadter (1979, p. 376-7) undermines the impact language has on thought, he acknowledges the degree to which cultural perception, reference, or association can mold thought.

Whether this structure is hereditary and is concerned with intelligence construction per Piaget (1983) or whether it possesses specific characteristics, its existence aids in explaining how human beings are able to acquire language in the first place. If UG is valid and there are innate linguistic-acquisition structures in human beings (Chomsky, 1965; 1986), there should be little or no discrepancy between one's thought and its articulation. Yet this is the thesis of linguistic relativism, also referred to as linguistic relativity (Tse & Altarriba, 2008).

Linguistic Relativism

Extreme versions of linguistic relativism posit that all aspects of language influence or shape all aspects of thought. This implies that unique differences exist between peoples and cultures, and that one's perception of the world is shaped by the language(s) one speaks. Less extreme versions simply suggest that languages differ in significant ways (Pederson, 2007).

Modular view of the brain. Problematic is the need for and dearth of replicable empirical evidence to support, or refute, linguistic relativism. Linguistic relativism appears tenable assuming a modular view of the brain (Fodor, 1983). Specifically, a module of the brain that handles spatial or temporal reasoning, for example, may influence thought differently for

different speakers of various languages. By extension a different module, let's say one that handles sound, may not have any impact on thought with respect to different languages. Thus, linguistic relativism may be the correct explanation for some modular activity, but not for all cognitive-linguistic interaction. It is important to understand the history of the linguistic relativism hypothesis.

History of linguistic relativism: Sapir-Whorf. The Sapir-Whorf hypothesis suggests that individuals make sense of reality through the medium of language. Specifically, this notion places the role of perception and comprehension of reality in the language spoken by a particular person regardless of the time or place (Whorf, 1956).

Brown and Lenneberg (1954) adapted Whorf's linguistic relativity principles and formulated them into the Sapir-Whorf hypothesis for investigation. Brown and Lenneberg conducted experiments to ascertain whether there is any variance in the way color is perceived across speakers of languages which classify colors differently. Speakers of two languages which categorize colors differently (English and Zuni) performed tasks of color recognition. Differing color categories of the two speakers determined an ability to recognize color category nuances. Brown and Lenneberg found that Zuni speakers who classify green and blue together as a single category experienced trouble recognizing and remembering nuances within the green-blue category. This study started a tradition of investigation on linguistic relativity through color terminology. However, Berlin and Kay (1969) demonstrated in an experiment that color terminology is subject to universal semantic constraints; accordingly, the Sapir-Whorf hypothesis was claimed invalid.

Brown's weak and strong suppositions. Brown (1954) posited two suppositions, one weak and one strong, about the nature of the Sapir-Whorf hypothesis. Both underwent later

study, scrutiny, and examination. The weaker variant suggests that syntactic or grammatical differences between linguistic systems (as in a single language or entire language family) parallel non-linguistic cognitive differences in native speakers of a given language. In other words, the weak version suggests that an individual's usage of language and linguistic categories influence thought and certain kinds of non-linguistic behavior. The stronger view, which is decidedly linguistic determinist, proposed that the structure of anyone's native language influences or determines worldview. The stronger tenet harkens back to a 19th century claim made by German scientist and founder of the Humboldt Universität, Karl Wilhelm von Humboldt in that differentiation of language systems is not a diversity of signs and sounds, but rather of world view or *weltanschauung* (Humboldt, 1836).

Re-examining linguistic relativity. Lakoff (1996), Gumperz and Levinson (1996), Slobin (1996), and more recently Boroditsky (2001; 2010), have re-examined linguistic relativity. Lakoff proposed four parameters that discuss criticisms and issues with regard to the Sapir-Whorf hypothesis. Each parameter presents a difference in opinion reflecting prior research; for example, the fourth parameter asks whether to view the locus of linguistic relativity as being in the language or in the mind. However, Pinker (1994) insists that the Sapir-Whorf hypothesis, as well as linguistic relativity, is not to be taken seriously. Pinker asserts a meta-language (or *mentalese*) as that linguistic medium whereby humans conduct their thinking. He insists that we do not think in natural language, i.e. as in that language we use to communicate with others in text, talk, video, audio, song, etc.

Gumperz and Levinson (1996) edited a tome that brought together both cognitive scientists and psycholinguists sympathetic to linguistic relativity but also included the voices of the Universalists (those adhering to a UG perspective). Boroditsky's experiments and other

research indicates that language appears to have some influence on thought, but in more limited ways that those speculated by Whorf and von Humboldt. In a reaction to Boroditsky's experiments and conclusions several researchers attempted to replicate her findings.

Kousta, Vinson, and Vigliocco (2008) explored gender in Italian-English bilinguals to find no tenable argument at the conceptual level. January and Kako's (2007) study replicated six experiments with English monolinguals in an exploration of spatial metaphor to find nothing to support Boroditsky's (2001) findings. Tse and Altarriba (2008) replicated Boroditsky's design in an experiment with Chinese-English bilinguals and English monolinguals to study spatial metaphors again to find no support for the linguistic relativism hypothesis. Although these studies were unsuccessful in their attempt to replicate Boroditsky's findings, voices abound in the support of the linguistic relativity hypothesis.

Voices in support of linguistic relativity. Tohidian (2009) reviews a history of work done on linguistic relativity to conclude that language indeed influences thought and one's world view, but that these are not governed by language. This is a unique and important distinction that harkens back to the difference between extreme and less extreme versions of the hypothesis. An earlier study by Hoffman, Lau, and Johnson (1986) found that language in bilingual English-Chinese speakers appeared to have some impact on the use of stereotypes. Hunt and Agnoli (1991) argued that for some languages, certain thoughts are more parsimonious than their verbal counterparts in another language. This suggests that while language may not directly impact or determine thought, it is potentially easier or more difficult to conceptualize something in one language as opposed to another. The German word *Schadenfreude* is an appropriate example. Economically encapsulated in one word it denotes in English 'taking joy in another's pain or

suffering'. Thus, it is more parsimonious to use the German phrase than the less parsimonious English version.

Casasanto (2008) acknowledged the difficulty in providing empirical evidence for linguistic relativity, but discussed the results of an experiment testing the impact that language has on spatial and temporal reasoning. He found that native English and native Greek speakers think about time differently and this difference corresponds to culture or language-specific metaphors of each group (2008, p. 75). Scott (1989) found similarities in the ways English and Mandarin speakers conceptualize and describe time. As Boroditsky (2003; 2011) later notes, those results do not suggest linguistic determinism as in the tradition of the Sapir-Whorfian sense but imply that language is an element in shaping thought (thereby suggesting that there are potentially other elements). Further, habitual thought is nuanced by one's native language and its associative culture. Lucy and Gaskins (2001) found evidence to support the thesis that certain grammatical aspects may shape the way English and Yucatec Mayan speakers conceptualize shapes and substances of objects. Reines and Prinz (2009) provide further partial support of the linguistic relativity hypothesis.

Visual Communication

The first subdivision pertains directly to notions within linguistic relativity (Boroditsky, 2001; 2011; Fuhrman & Boroditsky, 2010; Whorf, 1965) that there is an interaction between language, thought, and culture. As individuals arrange the spaces they inhabit, they do so by calling on their own cultural traditions. Assuming that language shapes thought, there should be perceptible differences and similarities specific, perhaps, to linguistic and cultural nuances. However, as these are nearly impossible to empirically support, it is sufficient to examine advertising and architecture.

Just as languages can be read and understood, the visual communication of architecture is a way for cultures to convey those values or beliefs that are most important for a particular culture (Turner, 1996). The design of advertisements across cultures illustrates specific differences depending upon the culture in question (Beichan & Cherian, 2010; Cutler & Javalgi, 1992). These characteristics of advertising and architecture support the general hypothesis that individuals across cultures learn in differing ways given the shared propensity for dissimilar forms of expression, in this case, advertisement and architecture.

Visual Communication of Advertising

Advertisements tend to reflect dominant assumptions unique to a particular culture based on the individualist-collectivist construct. Recently, researchers found that cultural differences in perception exist between Americans and Chinese. In a study of abstract and concrete thinking and imagery generation from advertisements, researchers found that while Chinese subjects prefer concrete stimuli, American subjects are equally able to use concrete and abstract stimuli in the generation of images from advertisements (Beichen & Cherian, 2010). In a study of fairness perceptions between U.S. and Chinese consumers, researchers found that cultural differences exist (Bolton, Keh, & Alba, 2010). In a series of studies, they demonstrated that collectivists (Chinese) were more sensitive to in-group differences (as opposed to out-group) and that there were critical differences in the ways individualists viewed the buyer-seller relationship. An unrelated study found differences in advertisement size, presence of black and white images, frequency of photography usage, and the use of metaphor between the U.S. and several European countries (Cutler & Javalgi, 1992). Zhang, Song, and Carver (2008) recently detected changes in the importance of modern values and health issues in Chinese television commercials. A content analysis of 263 advertisements in U.S. and Japanese versions of the *Seventeen* magazine revealed

that while the individual tends to be celebrated or promoted in the U.S. edition, co-subjectivity of individual interests was found to be common in the Japanese issues. This implies support for Hofstede's (2001) thesis that collectivist countries (Japan) place greater emphasis on group interests and harmony. Additional studies (Bjerke & Polegato, 2001; Albers-Miller & Gelb, 1999) provide further evidence that perceived differences in advertisements exist; however, these may be due to actual differences in culture. Alternatively, these may pertain to subtle differences in communication style.

Visual Communication of Architecture

Architecture is a process that defines the juncture between human beings and the physical spaces they inhabit. By extrapolation, architecture is similar to a manuscript. A given culture *writes* the manuscript for the benefit of other members of the same culture. The meaning that is ascribed to its content is dependent upon the culture in which it is written. Similarly, certain structures that fill the spaces we inhabit further govern our actions and understanding of the world (Hooker, 1996). Turner (1996) posits an architectural language that communicates regional traits, geology, ethnographic histories, traditions and customs, industrial lineage, faith, aspirations, personality, local preferences, and restraints. Perhaps architecture accomplishes this style of communication through metaphor.

Jencks (1984) echoes this sentiment in commenting on Kisho Kurokawa's *Nakagin Capsule Building*, Tokyo, 1972 (see *Figure 1*). The basic design of the structure mimics a proposal made by Walter Gropius, most often associated with German *Bauhaus* design, in 1922 (Jencks, 1984, p. 40). From the point of view of a Westerner, the building appears to suggest sugar cubes or bricks given the stacked, corrupted uniformity of the building.

Figure 1. Nakagin Capsule Building by Kisho Kurakawa.

This metaphorical suggestion shares a similarity with Sweller's (1994) schema construction discussed earlier. Perhaps cultural expression, acceptance, and transfer are achieved at an architectural level similar to the manner by which new knowledge is attained by referencing known paradigms. From these architectural examples the specific referents in a given culture may guide a reading of a structure, and inversely, of that culture. By extrapolation, these referents may guide one's approach toward learning.

Jencks (1984, p. 42) acknowledges what he terms "code restrictions based on learning and culture" thus implying a version of linguistic relativity. He discusses further (1984, p. 54) that architecture possesses the capacity to translate into connotative terms. In this way, language

and architectural words are based on the shared meaning that comprises a culture and learned conventions.

Time Travel Genre across Culture

It is important to provide evidential support that the topic of time travel is at least of interest to the cultures under investigation. Based on a review of the literature, it appears that the time travel topic is as popular or interesting in the English-speaking world as it is elsewhere. While literature, films, and television programs have incorporated time travel as a part of their storylines, the content of this module will be unique given that subjects in this study will not previously have been exposed to the exact topic of the module as it will have been designed specifically for this study. Considering that the majority of collectivist subjects gathered for this study were from The People's Republic of China, it is perhaps relevant to include information about the recent (April 13, 2011) official ban of time travel films and shows by the government in Beijing (PRC State Administration of Radio, Film, and Television, 2011). There was, however, no threat to this study since the experiments were carried out in February, 2011.

Method of Travel through Time

Time travel as a filmic genre extends across cultures in terms of the similarities in references or storylines in each particular film. While some films may employ the use of a time travel device, as in a physically stationary machine or a mobile vehicle, others may portray movement through time due to an unknown temporal anomaly or other reason. The South Korean film *Calla* (1999) is artistically similar to *Frequency* (Hoblit, 2000) with references to *Back to the Future* (Zemeckis, 1985). The repetition of a single day or series of events in a single day is common to both *Calla* and the Polish film *Blind Chance* (Kieslowski, 1987), *Groundhog Day* (Ramis, 1993), and the German *Run Lola Run* (Tykwer, 1998). Martin-Jones (2006; 2007)

argues that while the time travel narrative is an internationally tested filmic genre and as such has had measurable success in South Korean cinema, its use in that national cinema is for the purposes of negotiating matters unique to South Korean concerns.

Thematic Traits

Romantic engagements across time or stories that were cast across historical time periods became popular in South Korean national cinema after the success of its *The Gingko Bed* (1996) which was for its time the highest grossing film in South Korea's film industry's history. *The Butterfly Effect* (Bress & Gruber, 2004) grossed more profit in South Korea than in either the United Kingdom or France (Martin-Jones, 2007). It appears that these time travel-themed films fed into an appetite for such narratives not only in South Korea, but also in Japan and China, where the time travel South Korean *Ditto* (Kim, 2000) was remade for those national audiences.

Penley (1986) argues that the appeal of the time loop paradox or time travel in narratives presents itself in film and literature, and used James Cameron's (1984) *The Terminator* as an example of a film that upon first viewing is a tale of despotic cyborg machines. In actuality, Penley suggests, the film is about time travel. Further, she posits that cinema itself possesses the characteristics of a time machine given its ability to manipulate the flow of apparently linear events and further to manufacture perception of time.

Literature and Time Travel

The time travel genre is not secluded to film. Literary references to travel through time suggest purposes varying from idealized changes in an otherwise undesirable timeline to reinvention by proxy. Winthrop-Young (2001) uses Levett's *Verirrt in den Zeiten* [Lost in Time] to illustrate that while European literature does not abound with explicit time travel examples, the changing of or redirection of past events necessarily leads to a change in the future. The

existence of alternate history in texts produces doubt for Winthrop-Young as to whether the present is malleable at all. Cooperson (1998) argues that the time-travel genre dates as far back in the Arabic cultural and literary traditions as in the English traditions. Its presence in these genres per Cooperson is due to a necessity for peoples to confront historicity, the quality of being both part of recorded history as well as being history, as opposed to myth or fable. Chikhi (2007) acknowledges the role which motifs play in Algerian and Algerian-French literature to transgress time and space in a manner akin to time travel in science fiction but for the purposes of ameliorating a temporal malaise in the genre. Torres (2004) presents a French account of time as a recreation of itself in the genre of time travel in film. Lagerkvist (2010) argues that in its attempts to reinvent and modernize itself by presenting it as a futurity of the contemporary, Shanghai, China encourages visitors and residents to travel through time as it continues to draw on the past by advancing toward the future. Firchow (2004) acknowledges the elements of time travel of flirtations with present, past, or future time in texts other than H.G. Wells's Time Machine such as Edward Bellamy's *Looking Backward* (1888) and Mark Twain's *A Connecticut Yankee in King Arthur's Court* (1889).

CHAPTER THREE: RESEARCH DESIGN AND METHODOLOGY

Introduction

In order to maintain parity with prior studies in this field, the researcher used an experimental design (Harp & Mayer, 1997; Mayer & Anderson, 1991; Moreno & Mayer, 2000; Renninger, Hidi, & Krapp, 1992). This study sought to contribute new knowledge to the discipline of communications within the larger field of the social sciences by examining the impact of cultural dimensions and the coherence principle on the achievement of educational objectives in an e-learning environment. The following sections provide a critical and in-depth discussion of each aspect of the research design.

This study necessitated the creation of an e-learning module in order to test the tenability of the coherence principle of multimedia instruction in culturally diverse groups. The instructional content of the module as well as the audio and image adjuncts chosen for the experimental (non-coherence principle) versions are discussed. The manner by which the researcher intends to test for reliability as well as to attest for the module's validity is described in detail. The method of data collection, a timeline of the collection of such data, level of Alpha risk set, and the type of statistics proposed for analysis precede a culminating discussion of ethics and informed consent. The following sections provide a critical and in-depth discussion of each aspect of the research design. A Gantt chart of the entire research project proposed for this dissertation is available in *Appendix A*.

Experiments

The researcher conducted two experiments using undergraduate and graduate students from the Indiana University of Pennsylvania (N= 67). Another way to understand the structure of

experimentation is to view it as one experiment for each cultural dimension, collectivist and individualist. The first experiment involved a randomized sample of undergraduate and graduate students from collectivist cultures (n = 36), and the second experiment used a randomized sample of undergraduate and graduate students from an individualist culture (n = 31).

Experiments for Collectivist and Individualist Cultural Dimensions

This study necessitated the creation of an e-learning module (please see screenshots in *Appendix F*). Control groups received the module designed according to the coherence principle. The control module was the core module; it was designed according to the coherence principle which means that it lacked non-essential information. Its instructional content was identical to the experimental modules; the differences across the three modules are only in design. Conversely, there were two modules for the experimental groups. Each experimental group was divided into two subgroups. One subgroup received a module *not* designed according to the coherence principle; it had audio adjuncts. The other subgroup received a similarly designed module, but with image adjuncts. Control groups received the same module except that its version will be designed according to the coherence principle: it lacked the aforementioned non-essential audio and image adjuncts. The procedure was repeated for the individualist experiment. The specific audio and image adjuncts included in each of the non-coherence principle modules are detailed in subsequent sections.

Population and Non-Probability Sampling

The researcher identifies enrolled undergraduate and graduate students at the Indiana University of Pennsylvania as the population for this study. The researcher gathered a sample of 67 subjects using a combination of convenience and volunteer non-probability sampling. This research investigated whether cultural dimensions affect post-test scores on three versions of an

instructional module that have been, respectively: (1) designed according to the coherence principle (control module), (2) not designed according to the coherence principle by adding auditory adjuncts (first experimental module), or (3) not designed according to the coherence principle through adding visual (image) adjuncts (second experimental module). The module, its design, and content as well as the non-coherence adjuncts, are discussed in a later section.

Sampling Procedure

The researcher used nonprobability convenience and volunteer sampling to gather subjects. It was required that individualist and collectivist subjects be enrolled undergraduate or graduate students at the Indiana University of Pennsylvania. The researcher visited classes and worked with faculty in the Departments of Communications Media, English, Business, and also the Office of International Education to gather subjects. Each potential subject acknowledged awareness of informed consent by email. Interested potential subjects were encouraged to fill-out a brief online questionnaire (https://iup.qualtrics.com/SE/?SID=SV_03rKyO7FPxARTpO) linked to the Qualtrics™ website (screenshots of the questionnaire are included in Appendix C). It included demographic questions as to the major, age, gender, GPA, name, and IUP email address. Additional questions were included to aid the researcher in planning the best day and time to suit the most potential subjects. Two days were suggested, February 20th and 21st, 2011.

Each subject was permitted to select one of the two days and also indicated which time of day was best for participation in the study. Each subject provided the researcher with an email notification that included a statement attesting to the subject's understanding of the informed consent, willingness to participate, name, and phone number. A week prior to the planned experiments on February 20th and 21st, 2011, the researcher followed up with each volunteering

subject. In the communication, the subjects were expected to indicate the specific time on either February 20th or 21st.

The researcher provided a series of 30 minute timeslots on each day from which each subject selected one, which served as a kind of appointment with the researcher. This functioned well in that there were approximately 69 individual subjects who indicated intention to come to the experiment at a specific time during February 20th or 21st with a total of 67 subjects starting and finishing the experiment and post-test.

Individualist subjects. The researcher sought a convenience-volunteer nonprobability sample of undergraduate or graduate students currently (as of spring semester, 2011) enrolled in courses at the Indiana University of Pennsylvania. The researcher also issued invitations to participate to undergraduate and graduate students enrolled in courses in the Department of English and the Eberly College of Business and Information Technology.

Collectivist subjects. The researcher utilized the culture and language organizations at the Indiana University of Pennsylvania as chief sources for the required collectivist subjects as listed on the IUP website (Student interest organizations, 2010). These clubs were presumed active and are as follows as they appeared on the website: Asian Club, Chinese Student Association, India Students Association, JAPASO (Japanese Student Association), Korean Student Association, Language and Culture Exchange Club (LCEC), Malaysian Student Association, and Taiwanese Student Association. Additionally, the researcher contacted the Department of Business and the Department of English at IUP as there is a tendency for individuals from collectivist cultures (such as India, Bangladesh, Taiwan, or South Korea) to be enrolled in courses offered by those departments. The Office of International Education was particularly helpful in gathering approximately 1/3 of the collectivist subjects.

Gatekeepers. According to Schensul, Schensul, and LeCompte (1999) it is advisable to seek out gatekeepers as they are most likely to be in possession of information or resources useful to the researcher. Accordingly, this researcher used the information provided on the Student Interest Organization website to identify the gatekeepers for each club. The researcher described the nature and scope of the research investigation and sought their input as to finding the subjects needed for the experiments. Potential subjects received the letter of informed consent and the link to the Qualtrics™ online questionnaire.

Incentive to participate. The researcher offered a chance for a monetary incentive to participants. Two chances to win 100 USD were offered to those subjects who completed the instructional module and post-test. One prize was eligible for one person in the individualist group; the other was for the collectivist group. Subjects were strongly encouraged to attend the debriefing. Subjects choosing not to attend the debriefing were still eligible to receive the chance to win the prize.

Randomization. Subjects were gathered using convenience-volunteer sampling. Randomization of subjects occurred at the time subject assignment to experiment and control groups. It was important for each cultural dimension to be exposed as equally as possible to each module design type to allow for some breadth in the interpretation of results. While it will be imprudent to generalize the results given the limitation in the size of subjects to be collected for this study, randomization made it permissible to use inferential statistics, such as the *t*-test and analysis of variance.

Procedure. Randomization occurred in the following way. As each subject informed the researcher about the preferred day to come to the experiment, the researcher assigned one of the three modules to the subjects, one at a time. Starting with the control module and continuing with

the two experimental modules (referred to during random assignment as module #1, #2, and #3, respectively) the researcher randomly assigned the modules to all subjects in both cultural dimensions. Thus, there was no way to predict which person would take the module with extraneous audio, for example, or either the control or other experimental module.

Introduction to Module

Muller, Lee, and Sharma (2008, p.211) note that interest in the instructional domain "may mitigate the effects of the coherence principle" for instruction carried out in authentic settings. However, characteristics of learners in Mayer's (2001) controlled experiments were (1) little, (2) no prior knowledge or (3) little interest in the topic of instruction. In view of that, this researcher chose a topic of instruction that implies little or no prior knowledge to test the coherence principle in a laboratory setting.

The module's content was designed around a topic that implies no prior knowledge within the subject pool. Accordingly, time travel represents such a topic. While literature, films, and television programs have incorporated time travel in scripts, the content of this module is unique since subjects in this study were not previously exposed to the exact topic of the module as it was designed specifically for this study. The subject matter was completely hypothetical and was not based on any science fact or fiction knowledge. The researcher created the subject matter.

Manipulation and Deception

There was no manipulation of subject behavior, and this research did not involve any stress to subjects. There was a deception given that subjects received differently designed modules. While this deception existed, there was no manipulation of behavior. The researcher

hereby identified a sufficiently benign deception not associated with more than minimal-level risk.

Instructional Content of Module

The content of the instructional module, as discussed above, is time travel. Specifically, the module instructed each learner how to use a time travel device. As mentioned previously, the time travel narrative was appropriate given that subjects would not likely have any prior knowledge as to the specific mechanics and temporal laws behind the time travel device as depicted in the module.

Rationale for Using Adobe Captivate 4 to Develop Module

The module was designed using the Adobe Captivate (version 4) e-learning platform. This particular platform was especially helpful when creating e-learning solutions for academic, professional, and personal uses. The researcher chose to use Captivate given the flexibility it offers as an e-learning platform. Specifically, this study required the creation of three thematically identical modules; one control designed according to the coherence principle and two experimental, one with background music and the other with extra background images. Captivate made the duplication of modules and the addition of extraneous content (audio and image adjuncts) uncomplicated.

Caveat. References in the next paragraph to the *module* are understood as the control module, that is, the module that is designed *according to the coherence principle*. It was this control module that was modified to create the non-coherence versions with audio and image adjuncts, respectively. However, each module had as its instructional core the time travel narrative defined and described in detail in the subsequent paragraph.

Time travel module specifications. The purpose of the module (for screenshots of the entire control module, please see Appendix F) from an instructional point of view was to educate the subject as to how to use the time travel device and to become familiar with its associative temporal laws. The module began with a brief introduction as to the nature of the device. Following this was a cursory lesson on laws associated with time travel. It is important to note that while the content of the module is mostly fictional, the laws are rooted in a mixture of science fact, conjecture, and science fiction.

The laws are as follows (1) time is a fourth dimension and is better understood as *spacetime*: with the time travel device one may relocate oneself to another time as well as to another place; (2) it is impossible to relocate to another time prior to the existence of the time travel device; and, (3) any changes made to the timeline results not in a change to the timeline of the traveler's origin, but the instantiation of an alternate timeline (or timelines).

The time travel device has several components whose arrangement or setting determines the steps in an initialization sequence. These steps include, in order, (1) creation of artificial singularity (black hole) as power source; (2) creation of temporal shell; (2) regulation of temporal plasma; (4) measurement of chronotons; (5) intermix regulation of inverse chronoton flow (for relocating in *spacetime* to the future); and (6) intermix regulation of obverse chronoton flow (for relocating in *spacetime* to the past). In order complete the first step, the subject must learn both the procedure and the significance of the procedure. In this case, the procedure was to select a series of symbols (represented by an artificial language) whose correctly input sequence leads to the creation of the artificial singularity (black hole), the first step. During the post-test, subjects were expected to demonstrate the proper sequence of terms to be entered into the time travel device. This process was repeated similarly for subsequent steps.

Non-Coherence Adjuncts

The non-coherence adjuncts added to the modules not designed according to the coherence principle were music and images. According to Clark and Mayer (2003, p.118), adding background music does not improve, and is likely to impede, learning. Mayer and Moreno (2000) tested the coherence principle by creating a narrated animation explaining the process of lighting formation. They designed two non-coherence versions of a module. For the audio adjuncts, the researchers chose 'an unobtrusive instrumental piece' as background music and environmental sounds to accompany animation of lightning, such as crackling sounds (Clark & Mayer, p.118). This study will incorporate an unobtrusive musical piece with no lyrics and only one instrument. This is explained in the following paragraph. Clark and Mayer also argue that extraneous images should be excluded from instructional content. Accordingly, non-essential images were included in the second experimental version. This is explained further in subsequent paragraphs.

Extraneous audio. Specifically, the audio adjuncts to be included in one of the two experimental modules are segments of *Song to the East* by Ferenc Snetberger, Hungarian guitarist (Snetberger, 2001). A variety of songs and music styles were considered including, but not limited to: Mile Davis' *So What*; Pink Floyd's *Set the Controls for the Heart of the Sun* and *Echoes*; Bedrich Smetana's *Die Mulde*; the Pilgrim's Chorus from Richard Wagner's *Die Tannhäuser*; Jerry Garcia and David Grisman's *Arabia*; Rhattan Mohan Sharma's interpretation of *Ram Dhun*; Bach's *Goldberg Variations*; and music performed by the (former) Red Star Red Army Chorus. However, *Song to the East* by Ferenc Snetberger was chosen due to technique and style. Snetberger's song is a fine example of multiple cultural styles within one track. While the guitarist is Eastern European, the song connotes Latin, Middle Eastern, Indian, and Asian

imagery. The researcher used less than thirty seconds of the song in keeping with copyright restrictions for educational use. The segment was edited as a repetitive loop using Cubase LE software.

Music chosen for extraneous audio. The music selected for the experimental module with extraneous audio should not signify or connote any aspect of the cultural dimensions under investigation as that may influence subjects in undesired ways. Accordingly, the song selected by the researcher is *Song to the East* by Ferenc Snetberger, Hungarian guitarist. While composed and performed by an Eastern European, *Song to the East* has been consciously chosen as it exhibits neither Western nor Eastern-dominant rhythms, in the opinion of the researcher. It serves the purpose as an unobtrusive musical piece used as extraneous audio in direct incongruity to the prescriptions of the coherence principle. It is important to note that this song shares nothing with the time travel narrative. This is not the case with image adjuncts chosen for the other experimental module. However, this is in keeping with the types of audio and image adjuncts chosen in experimental testing of the coherence principle (Harp & Mayer, 1997; Clark & Mayer, 2006; Mayer, 2001).

Implementation. The control (and both experimental) version(s) of the instructional module has audio narration. Headphones were required to use the module, regardless of the version. In this way, subjects receiving the audio adjuncts were not exposed to a different learning situation compared to all other subjects in the study, except for the obvious fact that those subjects receiving the module with extraneous audio were the only ones receiving said module.

Extraneous images. Using images as adjuncts in an instructional module is strongly advised against by Clark and Mayer (2003). Studies have used both computer and paper-based

instruction to test whether the coherence principle is tenable (Harp & Mayer, 1997; Mayer, Heiser, & Lonn, 2001). These studies posit that the addition of images to enhance the content of an instructional lesson, computer or paper-based, will prevent students from being able to learn deeply. Accordingly, this study incorporated seven extraneous images that pertain to time travel. Included non-essential images in this experimental module appear as *Figures 2* through *8*.

Image adjuncts chosen for this module reflect the time travel narrative; however, three of the seven image adjuncts come from countries identified as individualist and four come from collectivist countries. These countries are defined as collectivist or individualist per Hofstede (1984; 2001), Hofstede and Hofstede (2005), and Triandis (1995). The three individualist countries are: France, Germany, and the United States. The four collectivist countries are: India, Japan, Russia, and South Korea.

Figure 2. Guests from the Future, [Гостья из будущего, Gostya iz budushchego] – USSR time travel miniseries (1985).

Figure 3.France's (1993) Les Visiteurs or The Visitors, a time travel comedy.

Figure 4. Germany's hit film *Lola Rennt* or *Run Lola Run* (1998).

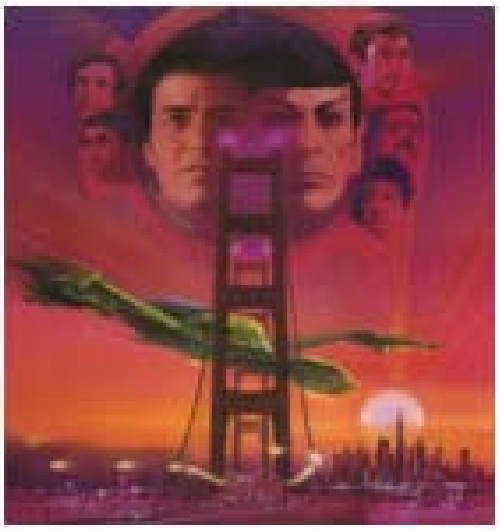

Figure 5. Star Trek IV: The Voyage Home from the USA.

Figure 6. The South Korean film *My Mother, the Mermaid* from 2004.

Figure 7. Japan's (2009) *Decade Neo Generations the Movie: The Onigashima Warship.*

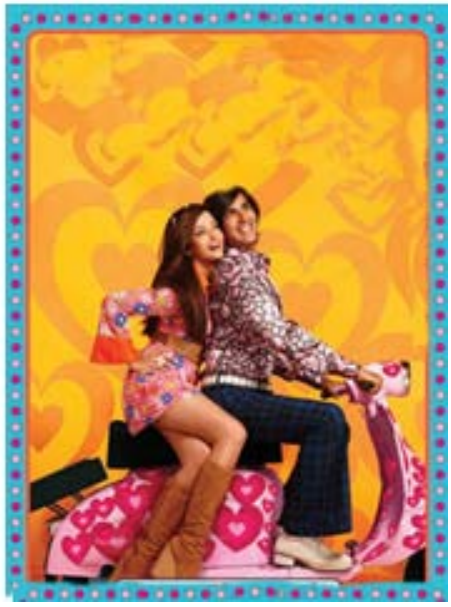

Figure 8. India's (2010) *Action Replay.*

Debriefing

As with all experimental designs a debriefing is essential. Immediately following the experiment and post-testing of the module content for all groups (experimental and control), I conducted a short debriefing to inform participants of the nature of the study. The debriefing informed all subjects of the purpose of the study and notified them about the interest in the cultural background of the subjects. Participation in the debriefing was not obligatory. During the debriefing, the researcher revealed to subjects that their cultural background was a basis of their selection for the study.

Reliability and Validity

Buddenbaum and Novak (2001) note that as a first step toward ensuring quality control in research it is important to be certain that the study is reliable. Validity is impossible to gain without a reliable study. It is important to measure whether the post-test created for this study possesses stability and consistency. The test-retest reliability technique is appropriate to measure for this in each version of the module, and it is the starting point for experimental investigations. Additionally, the test-item analysis technique was used to determine the reliability of the post-test. A Kuder-Richardson formula 20 (KR20) statistic was computed to determine the how subject scores on individual items correlated with the score each subject received for the total set of all questions. The KR20 was .78 which suggests that most items on the post-test were likely variations of the same cognitive skill(s).

The module's reliability was ascertained by administering the module to a small convenience sample of doctoral students from the researcher's department. This did not occur until after Institutional Review Board (IRB) approval had been granted. The timeframe for reliability testing was December 2010 – January 2011.

Rationale to include only Individualist Subjects in Test-Retest of Reliability

The purpose of this study was to determine whether the design of the instructional module interacts with the cultural background of the students to impact learning outcomes. Consequently, it was the argument of the researcher that no students from a collectivist culture be included in the test-rest reliability step. This position is due to the limited number of collectivist subjects available at IUP, according to the Office of International Education at IUP. Given the shortage of potential collectivist subjects, it was likely that exposing a small group of these students to the three instructional module versions could threaten internal validity by increasing awareness of the three versions among these potential subjects at IUP.

Internal Validity

There are several issues to take into consideration when planning an experiment. The greatest challenge in ensuring quality control is when the experiment group receives a manipulation that "addresses the concept underlying the independent variable and is uncontaminated by other factors" (Buddenbaum & Novak, 2001, p. 133). As discussed earlier, the purpose of the module is to instruct the subject to understand the basic features of a time travel device and associative laws.

These three versions were given to two experts for the purposes of conducting an audit. The experts provided information to the researcher after each had reviewed the manipulation and control versions of the module. Valeri R. Helterbran, Ed. D., reviewed the versions of the module and the post-test for this purpose. She is Professor of Professional Studies in Education in the College of Education and Educational Technology at IUP. In addition, David Porter, from Distance Learning and Continuing Education at IUP, reviewed the modules and the post-test.

Both individuals offered valuable insights into the module and post-test. The suggestions were used to align the post-test with the educational objectives of the module.

After the review of the post-test, the researcher modified or eliminated a few questions to ensure that the questions in the post-test met the educational objectives. Given the feedback from the audit, several questions that contained information which could be used to answer other questions in the same post-test were edited or eliminated accordingly. Additionally, changes in the module included more narration to explain the time travel laws and the combination of the two starter symbols into one symbol button. Also a key or legend was added to the post-test to explain the function of the various initialization steps to operate the time travel device (see the Post-Test located in Appendix D). These did not include the symbol sequences, only explanation of the meaning behind the particular steps.

Internal validity and cultural dimension independent variables. The researcher identified the investigation of culture as a benign deception. The researcher disclosed the following points in the letter of informed consent [please see Appendix B] (1) the experiment tests the coherence principle of instruction, (2) the time travel narrative was chosen to secure that each subject has an equal (zero) level of prior topic knowledge, and (3) the experiment tests whether adding extra (interesting) material (audio, image, or text) leads to less retention of instructional content.

Testing. There was no pretest given that the narrative of the module instructs the subjects on how to use a hypothetical time travel device. Therefore, there was no risk that subject post-test scores would be impacted by prior knowledge. The post-test was administered in paper form (bubble answer sheets). The post-test was comprised of two sections: the symbol sequences section and the time travel laws section (please see Appendix D and Appendix E for more

information). The former had seven questions to reflect the seven initialization steps of the time travel device; the latter section had five questions to reflect the three time travel laws and the related corollaries. The post-tests scores were assessed by calculating the number of right responses on each of the two sections, as if it were an examination for a course. Post-tests were administered once subjects completed the module.

Instrumentation. Subjects were aware of the different versions of the module, but each subject only took one of the versions. The researcher explained that the experiment aimed to test the effectiveness of the module's design. The deception is such that the cultural background of the subject was a variable in the study, and the researcher did not disclose this until the debriefing. The researcher posits that disclosing the existence of module variations in design did not impact the results of the study given that the researcher did not discuss how the modules differ and why these differences exist.

Selection criteria. The assignment to experiment and control groups per cultural dimension and version of the module is illustrated in Table 1. According to the 2010-2011 IUP Undergraduate Catalog, a student with a grade point average (GPA) of 2.0 or higher on a 4.0 scale is considered in good academic standing. For this reason, this researcher only included those students with a GPA of 2.0 or higher. For students who are new to IUP and did *not* have a GPA, such as international students enrolled in ESL courses but not a degree program, the researcher included these students (n = 2) under the assumption that their admission to IUP as equivalent falling in the 'good academic standing' range. However, graduate student good standing is understood as a GPA of 3.0 or higher. GPAs among graduate students included in the sample tended to be at or above 3.0.

Table 1

Subject assignment to control and experiment groups

Cultural Dimensions	Control Groups *Module designed according to coherence principle*	Experiment Groups *Module designed with audio adjuncts*	Experiment Groups *Module designed with image adjuncts*
Individualist (n = 31)	10	10	11
Collectivist (n = 36)	12	10	14
Totals (N = 67)	22	20	25

Data Collection Method

Data were collected using a variety of methods. Specifically, an initial Qualtrics™ online questionnaire asked potential subjects to self-report data on major, age, gender, GPA, name, phone number, and IUP email address. Three final questions asked which days and times best suited the potential subjects to participate in the experiment. The main sources of data used in statistical analyses were the post-test scores.

Primary Source of Data in this Study

The main source of data for this investigation was the post-test which subjects took after each had completed the module. The questions pertained to the instructional content of the module (please see Appendix D for the post-test questions about the symbol sequences and Appendix E for the time travel laws and demographic questions). There were twelve content questions. It is important to note that while there were dissimilar modules in terms of design,

each subject in the sample received the same post-test. Eleven demographic post-test questions asked subjects to report their cultural background (country of origin, native language, years resided in the United States, years resided in another country, and the culture with which the subject identifies), experience with online courses, program of study, and grade point average.

Method of Data Analysis

Following Campbell and Scott (1963), the Independent Samples *T-test* was used to detect significant differences between experimental and control group means for each cultural dimension separately (individualist and collectivist). The Independent Samples *T-test* between means is the correct statistic given that each group has $n < 30$ (Reinard, 2006). Consulting a *t* table to determine the critical value given the appropriate degrees of freedom is a necessary step following the *T-test* calculation. If the *t* value were greater than the critical value listed, the researcher would reject the null hypothesis. However, statistical significance only shows the implausibility of the null hypothesis when compared to sample results. It is important to determine the size of the statistically significant effect as large or small.

An analysis of variance (*ANOVA*) showed any differences among the six means (one mean for each control group, and four for each of the experimental groups). One-way analyses of variance and a single two-way analysis of variance were computed to test the hypotheses and also to detect interaction effects, if any. Effect sizes were also reported. To reveal where the differences were, the *Dunnett's* multiple comparison test was used. It was appropriate given that each control group was compared against the two experiment groups (Buddenbaum & Novak, 2001).

Ethics, Approval, and Informed Consent

It is important to note and reflect upon proper ethical procedure when conducting research. Accordingly, all participants in this study were given an informed consent as to their rights. Only data from subjects who concluded the module and post-test were included in the study. Fortunately, all subjects who started the experiment completed their assigned module and took the post-test. Privacy of subjects was safeguarded through guaranteed non-disclosure of subjects' identity. The researcher protected the identity of subjects in the study by not revealing such information. The researcher informed the subjects about their right and freedom to withdraw from participating in the experiment at any time and without any penalty from the researcher or university.

CHAPTER FOUR: RESULTS

Introduction

This chapter summarizes the post-test results and demographic information from all subjects gathered for this study. This section contains information about how each cultural group, individualist and collectivist, performed on the post-tests which were distributed after each subject had finished their randomly assigned module. In addition included in this section is a detailed description of the sophistication in design of the module used in this investigation. The analysis includes results from independent samples *t* tests and analyses of variance. The results are used to determine the tenability of the four research hypotheses. A summary discussion reviews the results of the experimental data and concludes this chapter.

Three e-learning modules were created; each shared the same instructional content: time travel. A post-test measured subjects' knowledge of the time travel device. The coherence principle of multimedia instruction stipulates that the addition of extraneous audio, images, or text hurts learning. The results from this study describe the interaction of this e-learning design principle and the cultural background of the subjects on the post-test scores.

Research Hypotheses

Each research hypothesis is followed by a contextualized explanation as to why the researcher poses the particular hypothesis. It is important to note that in each of the research hypotheses 'score' refers to the total score on *the overall score* of the post-test, which had two sections, one for the time travel laws and one for the symbol sequences.

The first section of the post-test (please see Appendix D) has seven questions pertaining to the accurate order of symbols sequences for the time travel device. The second section of the

post-test (please see Appendix E) contains five questions on the time travel laws. Whereas the first section relies on the correct identification of symbol sequences for each of the time travel device initialization steps, the second section required subjects to demonstrate an understanding of the time travel laws.

For the purposes of data analysis and interpretation, the researcher ran statistical tests on the overall scores of the post-test *as well as* each section separately. The researcher aims to provide a clear and thorough critical analysis of the results from the post-tests for each of the two control and the four experimental groups, with respect to the two cultural dimensions in this study.

The research hypotheses are as follows:

H1*: Individualist subjects will achieve a similar score as the collectivist subjects on the control module.*

The basis for this hypothesis is actually rooted in the coherence principle itself. While this study does not refute the importance of good design for good multimedia learning, it is interested in the inclusion of cultural differences as they relate to achievement on the experimental modules. Accordingly, the researcher anticipates scores on the control module to be similarly high in both cultural groups.

H2*: Individualist subjects will achieve a similar score on the experimental module with audio adjuncts as compared to collectivist subjects.*

Research on the coherence principle and the cognitive theory of multimedia learning in general is without consideration of cultural differences. This study hypothesizes that subjects from collectivist cultures may not be affected in the same way as individualist subjects to the module with audio adjuncts. My second (and third) hypotheses are also based on cross-cultural

learning and linguistic relativity. Specifically, if students from different cultures use different learning strategies, and if language influences thought (even to a small degree), there is reason to suspect that a uniform design of multimedia instructional content might not apply to all individuals respective of linguistic and cultural diversity.

According to the coherence principle, including extraneous audio will hurt learning. Thus, both the individualists and collectivists should achieve lower scores on this module. However, if collectivist scores are higher than individualist scores, this may suggest that the coherence principle applies to individualist but not to collectivist cultures. If both groups score similarly (either low or high scores) this also is new knowledge given that culture and linguistic diversity have not been investigated previously in the context of the cognitive theory of multimedia learning.

H3*: Individualist subjects will achieve a similar score on the experimental module with image adjuncts as compared to collectivist subjects.*

The logic underlying this hypothesis is essentially identical to that presented under the second hypothesis. The coherence principle asserts that non-essential image adjuncts included in instructional content hurts learning. If the collectivists' scores are equal to the individualists' scores on the experimental module with image adjuncts, then the interpretation may reveal that the coherence principle does not necessarily apply to both cultural groups included in this study.

H4*: Individualist subjects in the control group will score differently than individualist subjects in either experimental group.*

The rationale behind this hypothesis bases itself in the logic of the coherence principle. While its relevance to diverse cultures is under investigation in this study, the researcher posits that it is likely to be valid for individualist subjects. This is based on the visual communication

and cross-cultural learning literature. Since the coherence principle has been tested previously on presumed individualist populations, it is expected to apply to this cultural group.

Demographics of the Sample

This investigation used a convenience-volunteer sample of 67 undergraduate and graduate students enrolled in courses at the Indiana University of Pennsylvania during the spring semester of 2011. Overall there were 36 undergraduate or graduate students from collectivist cultures and 31 students from an individualist culture.

Before focusing on each subset of the demographic information, it is important to have an understanding of the overall appearance of the individuals who participated in this study. It is worth mentioning that cultural information was gathered from questions appearing at the end of the post-test. This is based on a recommendation from Dr. Richard Mayer, theorist behind the coherence principle, to avoid priming cultural biases in the subjects (personal communication, June 12, 2010).

The following demographic information was collected from each of the subjects in the sample: gender, age, native language, country of origin, degree sought at the time of the study, grade point average (GPA), program of study, and online course experience. If the student had indicated experience in online courses, each was asked to list how many were taken. Tables 2 and 3 illustrate some frequencies and descriptive statistics for gender, age, degree, and GPA for the two cultural dimensions and the three e-learning modules. Percentages refer to the particular module. In each of the modules overall, more females participated than males.

The majority of the individualists (87%) were undergraduates seeking a Bachelor degree. The majority of the collectivists (53%) were graduate students seeking Master or Doctoral degrees. The differences in age between the two cultural dimensions followed this pattern.

Whereas in the collectivist group most of the participants were aged 22 years or older, among the individualists the most common age range for all modules was 18 – 21.

Grade point average is indicative of the same pattern. Frequencies show that among the collectivists for all modules, the vast majority of subjects (83%) had a GPA of 3.5 or higher, including 47% with a 4.0. By contrast the frequencies among the individualists indicate that 55% had a GPA that fell between 2.0 and 3.49; only 29% had a 3.5 – 3.9 and 16% had a perfect 4.0 grade point average.

The disparity in GPA scores between the two cultural dimensions suggests that students enrolled in graduate-level courses in the sample had higher grade point averages than undergraduate students. This may be due to the higher percentage of graduate students in the collectivist sample than in the individualist sample. Graduate students at Indiana University of Pennsylvania are in 'good standing' when they have a GPA of 3.0 or higher, whereas undergraduates are expected to have a GPA of 2.0 or higher. However, it is unlikely that this disparity had an impact on the results of the post-test given that all participants had little to no prior knowledge of the time travel subject matter.

Table 2

Overall Demographics of Collectivist Cultural Dimension per the Three Modules

Collectivists		**Control Module**	**Experimental Module 1 (Music)**	**Experimental Module 2 (Images)**
Gender	Female	83% (10)	60% (6)	65% (9)
	Male	17% (2)	40% (4)	35% (5)
Age	18-21	25% (3)	60% (6)	43% (6)
	22-26	67% (8)	20% (2)	21% (3)
	27-35	8% (1)	20% (2)	21% (3)
	36-40	0	0	14% (2)
Degree	Bachelors	50% (6)	50% (5)	38% (5)
	Masters / Doctoral	50% (6)	50% (5)	61% (8)
GPA	2.5-2.9	0	11% (1)	0
	3.0-3.49	17% (2)	11% (1)	0
	3.5-3.9	33% (4)	43% (4)	38% (5)
	4.0	50% (6)	33% (3)	61% (8)
Ranked GPA 7=4.0; 6=3.5-3.9; 5=3.0-3.49; 4=2.5-2.9; 3=2.0-2.49	Mean	6.33	6.2	6.71
	SD	.77850	1.135	.61125
	Median	6.5	6.0	7.0

Table 3

Overall Demographics of Individualist Cultural Dimension per the Three Modules

Individualists		**Control Module**	**Experimental Module 1 (Music)**	**Experimental Module 2 (Images)**
Gender	Female	70% (7)	30% (3)	27% (3)
	Male	30% (3)	70% (7)	73% (8)
Age	18-21	50% (5)	70% (7)	81% (9)
	22-26	50% (5)	20% (2)	0
	27-35	0	10% (1)	18% (2)
Degree	Bachelors	90% (9)	90% (9)	81% (9)
	Masters / Doctoral	10% (1)	10% (1)	18% (2)
GPA	2.0-2.49	20% (2)	10% (1)	36% (4)
	2.5-2.9	20% (2)	0	18% (2)
	3.0-3.49	10% (1)	30% (3)	18% (2)
	3.5-3.9	50% (5)	40% (4)	0
	4.0	0	20% (2)	27% (3)
Ranked GPA 7=4.0; 6=3.5-3.9; 5=3.0-3.49; 4=2.5-2.9; 3=2.0-2.49	Mean	4.9	5.6	4.63
	SD	1.286	1.173	1.689
	Median	5.5	6.0	4.0

Gender

The majority of the sample was female (56.7%) with 43.3% male. There were 25 female participants in the collectivist group with the males accounting for 11 of that cultural dimension.

A total of 13 females comprised the individualist group with males accounting for 18 in that group. Table 4 illustrates these figures for the entire sample, and Tables 2 and 3 present each cultural dimension separately by module assignment.

Table 4

Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
	Female	38	56.7	56.7	56.7
	Male	29	43.3	43.3	100.0
	Total	67	100.0	100.0	

Age

Ages were more evenly spread in the collectivist group than in the individualist group. This is due to the enrollment of over 50% of the collectivist sample in graduate programs, as indicated in Table 2. The individualist subjects are mainly undergraduates with a few graduate students. The majority of the participants (53.7%) in both cultural groups were between the ages of 18 and 21. In the collectivist group 42% of the participants were between the ages of 18 and 21, which was the majority age range in the collectivist group. Participants aged 24 – 30 made up 33.3% which was a second segment of the collectivist group, with 11.1% making up the third age range for those between 31 and 40. In the individualist group 83.8% of the subjects were between the ages of 18 and 23 with the remaining 16.1% falling between 24 and 35. There were no individualist subjects older than 35 years of age.

Native Language and Country of Origin

Native language varied more in the collectivist group than in the individualist group, shown in Table 5. All 31 of the individualist students listed English the native language and the

United States as country of origin. English was the native language for 47.8% of the overall sample. It may be of interest to note that only one of the collectivist subjects cited English as the native language and Jamaica as the country of origin. However, the second most common native language in the overall sample was Mandarin Chinese (38.8%). In the collectivist group Chinese (either Mandarin or Taiwanese) comprised 75% of the native languages among participants.

Each subject listing Mandarin Chinese as the native language noted the People's Republic of China as the country of origin. Numbering only one subject per language, collectivist subjects noted the following native languages (country of origin is in parentheses): Saudi Arabic (Saudi Arabia), Hindi (India), Japanese (Japan), Korean, Punjabi (India), Spanish (Peru), Taiwanese (Taiwan), Thai (Thailand), and Vietnamese (Vietnam), as shown in Table 5.

Table 5

Native Language

Language	Frequency	Percent	Valid Percent	Cumulative Percent
Arabic	1	1.5	1.5	1.5
Chinese	26	38.8	38.8	40.3
English	32	47.8	47.8	88.1
Hindi	1	1.5	1.5	89.6
Japanese	1	1.5	1.5	91.0
Korean	1	1.5	1.5	92.5
Punjabi	1	1.5	1.5	94.0
Spanish	1	1.5	1.5	95.5
Taiwanese	1	1.5	1.5	97.0
Thai	1	1.5	1.5	98.5
Vietnamese	1	1.5	1.5	100.0
Total	67	100.0	100.0	

Degree

Of all the available degree programs at IUP (Bachelors of Arts, Science; Masters of Arts, Sciences, Education; Masters of Business Administration; Masters of Fine Arts; Doctor of Education; and Doctor of Philosophy) the majority of the overall sample (64.2%) indicated pursuit of a Bachelor of Arts or Bachelor of Sciences, as shown in Table 6. None of the subjects was working on a Masters of Fine Arts degree. A smaller portion of the subjects (34.3%) specified graduate degrees, with one subject (1.5%) indicating no current pursuit of a degree. Subjects pursuing graduate degrees break down further into those seeking Masters-level degrees (22.4%) and those seeking Doctoral-level degrees (11.9%) of the overall sample.

Table 6

Proportion of Sample Enrolled in Degree Program Type

		Frequency	Percent	Valid Percent	Cumulative Percent
Programs	Bachelors	43	64.2	64.2	64.2
	Masters	15	22.4	22.4	86.6
	Doctoral	8	11.9	11.9	98.5
	None	1	1.5	1.5	100.0
	Total	67	100.0	100.0	

The proportion of undergraduate to graduate degree-seeking students was more evenly spread in the collectivist sample when compared to the individualists. Among the collectivist subjects, 16 indicated current pursuit of Bachelors-level degrees, 19 were seeking Masters or Doctoral-level degrees. Thus, 44% of collectivist students were undergraduates while 53% were graduate students. Among the individualists, 27 noted current work on a Bachelors-level degree, three were seeking a Masters degree, and one was a Doctoral-level student. In terms of

proportions 87% of the individualists were undergraduates and 13% were graduate students. One of the collectivist subjects indicated no specific degree program, but was accepted to IUP's American Language Institute (ALI) to improve the level of English proficiency prior to becoming enrolled in a particular course of study.

Grade Point Average

In order to be permitted to participate in the experiment, students had to be in good academic standing. As noted earlier in the research design and methodology, a GPA of 2.0 or higher is classified at IUP as good academic standing for undergraduates and 3.0 for graduate students.

Table 7

Grade Point Average

		Frequency	Percent	Valid Percent	Cumulative Percent
GPA	2.0 - 2.49	7	10.4	10.4	10.4
	2.5 - 2.9	5	7.5	7.5	17.9
	3.0 - 3.49	9	13.4	13.4	31.3
	3.5 - 3.9	22	32.8	32.8	64.2
	4.00	22	32.8	32.8	97.0
	N/A or Don't Know	2	3.0	3.0	100.0
	Total	67	100.0	100.0	

All participants in the study were of good academic standing with the exception of two students: one did not have an accumulated GPA at the time of the study due to entering the degree program in the spring 2011 semester and another is improving English proficiency in the ALI prior to commencing a degree program. The latter student was in the advanced group of English learners and is expected to start a degree program in the fall semester 2011. However,

the researcher considers each of these international students as in good academic standing given that each was accepted to pursue study at IUP pending an acceptable level of achievement in English proficiency in the ALI at IUP.

Each subject volunteered information about his or her GPA on the post-test administered after each person completed their assigned module. Considering the subjects in the overall sample Table 7 shows the percentages for each GPA range. A preponderance of the overall sample (65.6%) had a GPA that fell in the range of 3.5 – 3.9, 4.0. Half of these subjects, or 32.8% of the overall sample, had a GPA of 4.0.

Referring back to Tables 2 and 3, the overall *ranked mean* for the collectivists is 6.4 and for the individualists 5.0. This suggests that the collectivists as a general group had GPA scores closer to 4.0 than the individualists. A majority of the collectivists, 53% or 19 subjects, were enrolled in graduate programs. Given that graduate student good standing is a GPA of 3.0, the higher grade point averages among collectivists is no surprise. Conversely, the individualists' GPA scores were more evenly spread with over half of the scores falling in the 2.0 – 2.49, 2.5 – 2.9, and 3.0 – 3.49 ranges and the other half falling in the 3.5 – 3.9 and 4.0 ranges. The differences may be explained by the degree programs in each cultural dimension.

Program of Study / Major

A majority of the overall sample (30%) listed Communications Media as major. This is likely due to the researcher's invitation to undergraduate students enrolled in courses in the Department of Communications Media to participate in the study. However, the rest of the sample (69%) noted majors in a number of other programs of study, as illustrated by the bar chart in *Figure 9*. One subject (1.5%) listed no major as this individual is working on improving English proficiency prior to pursuing a major at IUP.

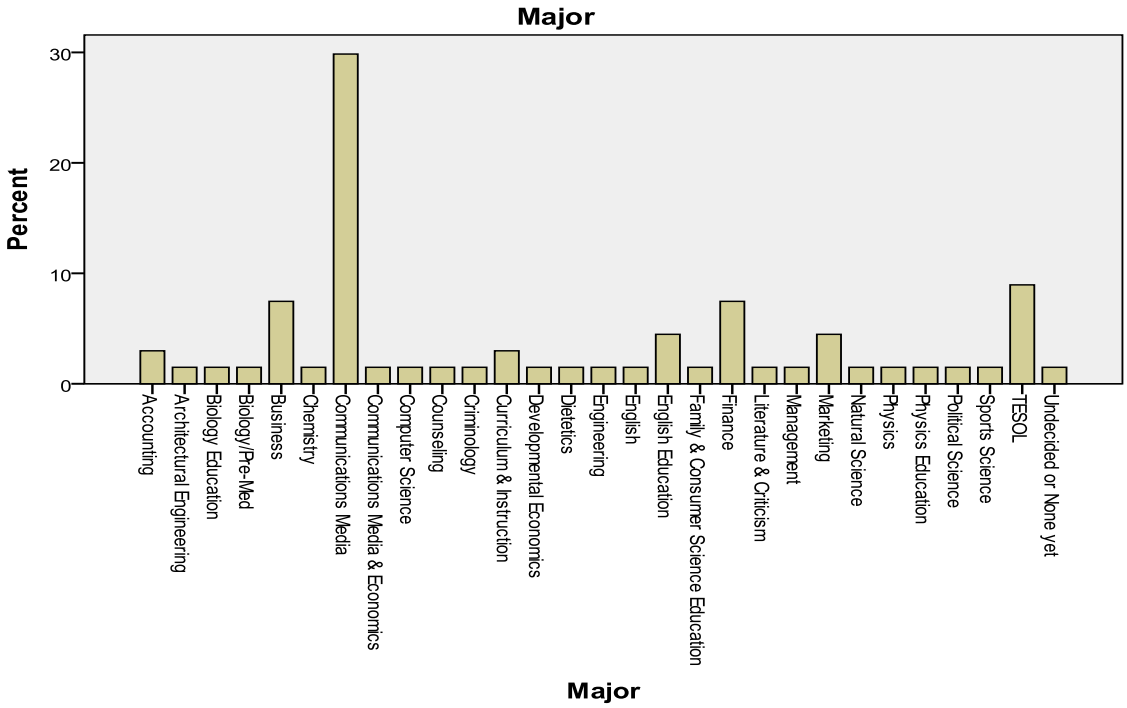

Figure 9. Program of study / major.

Students enrolled in Finance (13.9%) or TESOL (16.7%) comprised the majority of collectivist students. Business, Communications Media, and Marketing each had 8.3% of the collectivist sample. Accounting and Curriculum & Instruction each had 5.6% of the collectivist sample with the following majors comprising 2.8% each for the collectivist sample: Architectural Engineering, Biology/Pre-Med, Chemistry, Computer Science, Developmental Economics, Dietetics, Engineering, Literature & Criticism, Management, Physics, Sports Science, and Undecided or No Major.

As noted earlier, Communications Media majors formed the largest group in the overall sample, but also among the individualist subjects with 54.8% listing that major. English Education majors (9.7%) made up the second largest group in the individualists, with Business majors (6.5%) coming in third place. Biology Education, Counseling, Criminology, English,

Family & Consumer Science Education, Natural Science, Physics Education, and Political Science had one student each (3.2%) listing it as the major.

Online Course Experience

Of the entire sample, 21 or 31.3% students indicated current or prior experience in an online course. Students were asked whether they had ever taken an online course. Online was defined in the post-test demographic section as 100% online; students were asked to answer 'no' if any of their current or previous courses had some amount of face-to-face or traditional teacher-student contact. Of the 21 students from the overall sample who had taken an online course, 13 subjects had one online course, five subjects listed two online courses, one student listed three online courses. Another student listed five online courses, and one listed six online courses.

Table 8

Experience with Online Courses - Collectivists

Online Course Experience?	Collectivists			
	Control	Experimental Module 1 (Music)	Experimental Module 2 (Images)	Total
Yes	8% (3)	5.5% (2)	8.3% (3)	22% (8)
No	25% (9)	22% (8)	30.5% (11)	78% (28)

Table 9

Experience with Online Courses – Individualists

Online Course Experience?	Individualists			
	Control	Experimental Module 1 (Music)	Experimental Module 2 (Images)	Total
Yes	19% (6)	12.9% (4)	9.6% (3)	42% (13)

No	12.9% (4)	19% (6)	25.8% (8)	58% (18)

Online course experience was more common in the individualist group than among collectivists. Only eight or 22.2% collectivist subjects indicated that they had taken an online course, with the remaining 28 77.8% stating no such experience. A majority of the collectivists with online experience 75% indicated only one online course with the remainder 25% showing experience with two online courses.

Individualist subjects had the most experience compared to collectivists with online courses. There were 13 or 41.9% of the individualists with online course experience. Of these seven or 22.5% of the individualists indicated experience with one online course. Experience with three, five, or six online courses was restricted to one person each or 3.2% of the sample of individualists.

Statistical Analyses

In order to test the tenability of the four research hypotheses proposed earlier, it was necessary to run independent, two-tailed *t* tests. The independent *t* test was the appropriate statistic to use given that the means were drawn from different groups of individuals sharing no discernible relationship (Norušis, 2008). The output from these statistical tests accompanies a discussion of the results. In addition to the *t* tests, the researcher ran one-way analyses of variance to compare the same groups as indicated in each of the hypotheses. The intention behind this action was to provide further evidence to support or fail to support the given research hypothesis. In order to examine the interaction effect of the two main effects (cultural dimension and the coherence principle), the researcher computed a general linear model univariate two-way analysis of variance.

Before running an analysis of variance (ANOVA) it is advisable to ensure that the study meets three assumptions. First, the samples should be independent. Since there is no discernible relationship among, within, or between the groups the first assumption is met. Second, the populations should share normal distribution. Third, population variances should be equal. Given that the ANOVA is not wholly dependent on the assumption of normality and since the data gathered do not indicate any extreme nonnormality, the researcher feels that the second assumption is also met. Finally, to test for equality of variances it is general practice to compute the Levene test for equality of variance. However, since the number of cases in each group is relatively similar, it is not necessary to compute this statistic as equal variances can be assumed (Norušis, 2008).

Guide to the Tables

For each of the data tables, COLL refers to the collectivists, and IND is an abbreviation for individualists. As mentioned earlier, a statistically significant difference between scores on the overall scores shows that research hypotheses are untenable which posit similarities between groups. Accordingly, if there is no statistically significant difference the given hypothesis is *supported*.

For the sake of diligence, the analysis of data also present statistics for the two sections separately, symbol sequences and time travel laws. Any differences of statistical significance will be reported. In all tests of statistical significance the researcher set the alpha-risk at .05 or $p < .05$. Thus, if a t or F statistic is computed and the significance level is below .05, a statistically significant difference is found.

First Hypothesis

H1: Individualist subjects will achieve a similar score as compared to collectivist subjects on the control module. The first hypothesis suggests that the mean scores will be similar between the two groups. Further, the argument is that there will be no significant difference between the two control groups. The descriptive statistics in Table 10 indicate no large differences between the two control groups. The number of events in both groups is relatively similar with 10 individualist subjects and 12 collectivist subjects each receiving the same control module with no audio, text, or image adjuncts.

The means (*M*) for each group in Table 10 for the section on symbols (IND: *M* = 6.80; COLL: *M* = 6.50 COLL) appear relatively similar, however the COLL control group standard deviation (*SD*) is (1.00) compared to that of the IND group (.42) suggests more variability in the scores of the COLL control group. The section on time travel laws (COLL: *SD* = .49; IND: *SD* =.00) and on the overall score (COLL: *SD* = 1.11; IND: *SD* = .42) shows a similar amount of variability in scoring in the COLL control group. This difference indicates that the scores for the two sections separately and their total in the IND control group were much closer to the mean than the scores in the COLL control group. It is unlikely that these differences are due to the COLL control group having two more participants than the IND group.

Table 10

Post-test Descriptive Statistics for Control Groups

Post-test	Control Module	N	Mean	Std. Deviation	Std. Error Mean
Symbols	IND	10	6.8000	.42164	.13333
	COLL	12	6.5000	1.00000	.28868
Time Travel Laws	IND	10	5.0000	.00000	.00000

	COLL	12	4.6667	.49237	.14213
Overall Scores	IND	10	11.8000	.42164	.13333
	COLL	12	11.1667	1.11464	.32177

Table 11

Independent Samples T *Test for IND x COLL Control Groups*

Post-test (IND * COLL)	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Symbols	.943	15.341	.360	.300	.31798
Time Travel Laws	2.345	11	.039	.333	.14213
Overall Scores	1.693	20	.106	.633	.37409

An independent samples *t* test compared the means in both control groups. Table 11 reveals no significant difference detected between the control groups on either the symbol sequences section (t (15) = .943, p = .36) or the overall post-test (t (20) = 1.693, p = .10). While it is normal practice to seek a statistically significant difference in order to reject the null hypothesis (normally the opposite of the stated research hypothesis), the researcher argues that given no statistically significant difference between control groups on the overall post-test, the research hypothesis is supported. However, a statistically significant difference (shown in Table 11) was detected between the control groups on the time travel laws section (t (11) = 2.345, p = .039). This finding indicates that collectivists achieved lower post-test scores on the time travel laws section when compared to the individualists. It was anticipated that both groups would achieve similar high scores given that the design of the module excluded non-essential items (audio or images). Since there was a significant difference in scores, this may require more examination of the cultural and linguistic composition of the collectivist control group.

A one-way analysis of variance between the control groups delivered similar results as the *t* test seen in Table 12. No significant differences were found between the control groups on the overall post-test (F (1, 20) = 2.866, p = .106) or on the symbol sequences section (F (1, 20) = .779, p = .388). As the *t* test found, a statistically significant difference was detected (F (1, 20) = 4.545, p = .046) on the time travel laws section, shown in Table 12. An eta-squared (η^2 = .1253) resulted in an effect size of 12.53%. This indicates that the variability in the post-test scores for both control groups may be partially impacted by knowledge of variability in the cultural dimension of the subject.

Table 12

One Way ANOVA – IND x COLL Control Groups

Section		Sum of Squares	df	Mean Square	F	Sig.
Symbol Sequences	Between Groups	.491	1	.491	.779	.388
	Within Groups	12.600	20	.630		
	Total	13.091	21			
Time Travel Laws	Between Groups	.606	1	.606	4.545	.046
	Within Groups	2.667	20	.133		
	Total	3.273	21			
Overall Scores	Between Groups	2.188	1	2.188	2.866	.106
	Within Groups	15.267	20	.763		
	Total	17.455	21			

Interpretation. Each subject may have assigned meaning to each symbol sequence. This assigned meaning then took the form of the particular initiated sequence of the time travel device. Whereas the individualists may have perceived the symbols as letters, the collectivists

may have understood the symbols as logograms or ideograms especially among Chinese native speakers in the collectivist group (75%). The important matter is that each group may have acted similarly in acquiring the unfamiliar symbols and their associative meaning. Each individual in both control groups possessed the faculty of language acquisition; this may have enabled the subjects to learn sequences in relatively similar ways. However, diversity in retaining the knowledge about the time travel laws led to the differences between control groups. This discussion continues in the following chapter under the first hypothesis sub-heading.

Second Hypothesis

H2: Individualist subjects will achieve a similar score on the experimental module with audio adjuncts as compared to collectivist subjects. Shown in Table 13, the means for the symbol sequences section (IND: 6.8; COLL: 6.3) and time travel laws section (IND: 5.0; COLL: 4.5) both show slight variations between the respective means. There is more variation between the standard deviations (IND: .00; COLL: .70) on the time travel laws section than in the section on symbol sequences (IND: .42; COLL: .82). Also, the means and standard deviations on the overall post-test (IND: 11.8; .42; COLL: 10.8; 1.47) show more variation which suggests that the scores in the COLL experimental group were more dispersed than scores in the IND group.

Table 13

Post-test Descriptive Statistics for Experimental Groups with Music

Post-test	Control Module	N	Mean	Std. Deviation	Std. Error Mean
Symbols	IND	10	6.8000	.42164	.13333
	COLL	10	6.3000	.82327	.26034

Time Travel Laws	IND	10	5.0000	.00000	.00000
	COLL	10	4.5000	.70711	.22361
Overall Scores	IND	10	11.8000	.42164	.13333
	COLL	10	10.8000	1.47573	.46667

Table 14

Independent Samples T *Test for IND x COLL Experimental Groups with Music*

Post-test (IND * COLL)	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Symbols	1.709	18	.105	.500	.29250
Time Travel Laws	2.236	9	.052	.500	.22361
Overall Scores	2.060	10.46	.065	1.0	.48534

An independent samples *t* test compared the means in both experimental groups that received the module with extraneous audio. No significant difference was detected between the groups on the overall post-test (t (10.46) = 2.06, p = .065). The research hypothesis is supported. The section on time travel laws (t (9) = 2.236, p = .052) indicates no statistically significant difference, but the proximity to showing a difference is evidenced by the p value of .052, thus suggesting caution. An ANOVA was run to detect significant differences.

As indicated in Table 15, no significant difference was found between the IND and COLL experimental groups with music on its overall post-test (F (1, 18) = 4.245, p = .054). Similarly, no significant difference was detected on the symbol sequences section (F (1, 18) = 2.922, p = .105). However, while the *t* test indicated no statistically significant difference between the IND and COLL experimental groups with music on the time travel laws section, the

ANOVA resulted in a statistically significant difference (F (1, 18) = 5.000, p = .038), shown in Table 15. This finding indicates that collectivists achieved lower post-test scores on the time travel laws section when compared to the individualists on the experimental module with music. It was anticipated that both groups would achieve similar low scores given that the design of the module included non-essential audio. Since there was a significant difference in time travel law scores, this may be explained by the cultural and linguistic composition of the collectivist control group. An eta-squared (η^2 = .1908) showed that while the F statistic indicated no significant difference between both experimental groups (music) on the overall post-test, the effect size was 19.1%. This indicates that the variability in the post-test scores for both experimental groups (music) may be partially impacted by knowledge of variability in the cultural dimension of the subject.

Table 15

One Way ANOVA – IND x COLL Experimental Groups with Music

Section		Sum of Squares	df	Mean Square	F	Sig.
Symbol Sequences	Between Groups	1.250	1	1.250	2.922	.105
	Within Groups	7.700	18	.428		
	Total	8.950	19			
Time Travel Laws	Between Groups	1.250	1	1.250	5.000	.038
	Within Groups	4.500	18	.250		
	Total	5.750	19			
Overall Scores	Between Groups	5.000	1	5.000	4.245	.054
	Within Groups	21.200	18	1.178		
	Total	26.200	19			

Interpretation. The significant difference on the time travel laws section is likely due to the way in which the e-learning module presented the laws. In addition, the quantity of Chinese native speakers (60%) in this collectivist experimental group may explain lower post-test scores on the time travel laws section due to differences in temporal perception, as discussed under the first hypothesis testing. This is discussed further in the following chapter under the second hypothesis sub-heading.

Third Hypothesis

H3: Individualist subjects will achieve a similar score on the experimental module with image adjuncts as compared to collectivist subjects. Descriptive statistics in Table 16 show major differences in the standard deviations of post-test scores on all sections between individualist and collectivist subjects. Each participant in the IND group achieved perfect scores, while score variation was present in the COLL group. As shown in Table 16, for the IND group on all sections the means are higher and standard deviation is lower (M = 7.0, 5.0, 12.0; SD = .00) compared to the COLL group (M = 6.57, 4.64, 11.21; SD = .937, .744, 1.188). It may be of interest to note that 61% of the collectivists who took the module with adjunct images were graduate students, thus English language proficiency may not be a likely factor to explain the divergence in scores.

Table 16

Post-test Descriptive Statistics for Experimental Groups with Images

Post-test	Control Module	N	Mean	Std. Deviation	Std. Error Mean
Symbols	IND	11	7.0000	.00000	.00000
	COLL	14	6.5714	.93761	.25059

Time Travel Laws	IND	11	5.0000	.00000	.00000
	COLL	14	4.6429	.74495	.19910
Overall Scores	IND	11	12.0000	.00000	.00000
	COLL	14	11.2143	1.18831	.31759

Table 17

Independent Samples T *Test for IND x COLL Experimental Groups with Images*

Post-test (IND * COLL)	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Symbols	1.710	13	.111	.42857	.25059
Time Travel Laws	1.794	13	.096	.35714	.19910
Overall Scores	2.474	13	.028	.78571	.31759

In order to test the third research hypothesis, a *t* test was calculated, shown in Table 17. A statistically significant difference was found (t (13) = 2.474, p = .028) on the overall post-test. The third research hypothesis is not supported. However, no differences of statistical significance were detected in either of the two sections upon separate analysis. The variation in COLL group post-test scores is greater than in the IND group which demonstrated no post-test score variation. This means that while the individualists achieved perfect scores on the overall post-test, the scores for the collectivists varied. According to the literature on the coherence principle, scores should have been lower (presumably for both cultural groups) given the addition of non-essential images.

A one-way analysis of variance was computed to detect any differences between the IND and COLL experimental groups with images, shown in Table 18. A statistically significant

difference was found between the groups on the total score for the overall post-test (F (1, 23) = 4.765, p = .040). No significant differences were found for either of the two sections when analyzed separately, symbol sequences: (F (1, 23) = 2,277, p = .145) and time travel laws: (F (1, 23) = 2.505, p = .127). An eta-squared (η^2 = .1716) showed that while the F statistic indicated a significant difference between both experimental groups (images) on the overall post-test, the effect size was 17.6%. This indicates that the variability in the post-test scores for both experimental groups (images) may be partially impacted by knowledge of variability in the cultural dimension of the subject.

Table 18

One Way ANOVA – Experimental Groups with Images

Section		Sum of Squares	df	Mean Square	F	Sig.
Symbol Sequences	Between Groups	1.131	1	1.131	2.277	.145
	Within Groups	11.429	23	.497		
	Total	12.560	24			
Time Travel Laws	Between Groups	.786	1	.786	2.505	.127
	Within Groups	7.214	23	.314		
	Total	8.000	24			
Overall Scores	Between Groups	3.803	1	3.803	4.765	.040
	Within Groups	18.357	23	.798		
	Total	22.160	24			

Interpretation. Both cultural groups may have been interested in the module's subject matter, the addition of non-essential images resulted in lower scores only among collectivists. Including extra images may or may not hurt learning among individualist subjects, considering

the research on the coherence principle together with the new information from this investigation. The addition of non-essential images made no measurable negative impact on learning among the individualists. However, collectivist subjects were vulnerable to the non-essential images possibly due to two separate reasons. This is also discussed in further detail in the subsequent chapter under the third hypothesis sub-heading.

Fourth Hypothesis

H4: Individualist subjects in the control group will score differently than individualist subjects in either experimental group. Descriptive statistics in Table 19 indicate no significant differences in mean or standard deviations between the control and either of the two experimental groups. A similar hypothesis of the collectivist control compared to the two experimental groups was not stated given that previous investigations of the coherence principle were carried out with presumably individualist subjects. Dr. Richard Mayer, theorist behind the coherence principle) did not collect data on the cultural background of the subjects (personal communication, June 12, 2010).

Separate *t* test results showed no statistically significant differences between the IND control and either of its two experimental groups. These results do not support the fourth research hypothesis. Differences were expected given the research on the coherence principle. Since the two experimental modules included audio and images, respectively, it was hypothesized that the control group scores would be higher than both of the experimental groups. In fact, the individualist group receiving the module with non-essential images achieved the highest post-test scores overall. These findings stand in stark contrast to prior research on the coherence principle. No *t* test statistic (*) could be computed for the time travel laws section. As the standard deviations indicate, each IND group scored perfectly on the time travel laws section.

Table 19

Post-test Descriptive Statistics for IND Control & IND Experimental Groups

Post-test	IND	N	Mean	Std. Deviation	Std. Error Mean
Symbols	Control	10	6.8000	.42164	.13333
	Exp / Music	10	6.8000	.42164	.00000
	Exp / Images	11	7.0000	.00000	.00000
Time Travel Laws	Control	10	5.0000	.00000	.00000
	Exp / Music	10	5.0000	.00000	.00000
	Exp / Images	11	5.0000	.00000	.00000
Overall Scores	Control	10	11.8000	.42164	.13333
	Exp / Music	10	11.8000	.42164	.13333
	Exp / Images	11	12.0000	.00000	.00000

Table 20

Independent Samples T Test for IND Control Group and IND Experimental Group with Music

Post-test (Control * Exp/Music)	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Symbols	.000	18	1.000	.00000	.18856
Time Travel Laws	*	*	*	*	*
Overall Scores	.000	18	1.000	.00000	.18856

Table 21

Independent Samples T Test for IND Control Group and IND Experimental Group with Images

Post-test (Control * Exp/Images)	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Symbols	-1.577	19	.131	-.20000	.12679

Time Travel Laws	*	*	*	*	*
Overall Scores	-1.577	19	.131	-.20000	.12679

In the interest of exploring any differences or similarities between the *collectivist* control and experimental groups, the researcher calculated *t* tests between the collectivist control and each of its experimental groups. Table 22 presents descriptive statistics for the collectivist control and each of the two experimental groups. Table 23 presents results from the *t* test that compared the collectivist control and the experimental group with music. Table 24 presents results from the *t* test on the collectivist control and the experimental group with images. No statistically significant differences were found. There has been no previous investigation of the coherence principle and culturally and linguistically diverse students audiences. These results indicate that for the collectivists in this study, subjects performed similarly and achieved moderate to high scores in the control and two experimental versions. In other words, the potential distractions presented by the non-essential audio and images did not lead to lower post-test scores compared to the control group for those subjects in the collectivist cultural dimension.

Table 22

Post-test Descriptive Statistics for COLL Control & COLL Experimental Groups

Post-test	COLL	N	Mean	Std. Deviation	Std. Error Mean
Symbols	Control	12	6.5000	1.0000	.28868
	Exp / Music	10	6.3000	.82327	.26034
	Exp / Images	14	6.5714	.93761	.25059
Time Travel Laws	Control	12	4.6667	.49237	.14213
	Exp / Music	10	4.5000	.70711	.22361
	Exp / Images	14	4.6429	.74495	.19910

Overall Scores	Control	12	11.1667	1.11464	.32177
	Exp / Music	10	10.8000	1.47573	.4667
	Exp / Images	14	11.2143	1.18831	.31759

Table 23

Independent Samples T Test for COLL Control Group and COLL Experimental Group with Music

Post-test (Control * Exp/Music)	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Symbols	.505	20	.619	.2000	.39592
Time Travel Laws	.650	20	.523	.16667	.25631
Overall Scores	.664	20	.514	.36667	.55222

Table 24

Independent Samples T Test for COLL Control Group and COLL Experimental Group with Images

Post-test (Control * Exp/Images)	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Symbols	-.188	24	.853	-.07143	.38030
Time Travel Laws	.094	24	.926	.02381	.25242
Overall Scores	-.105	24	.917	-.04762	.45443

Interpretation. It is likely that consistency and interest-level were both factors that led to similarly high post-test scores among individualists. This is not to suggest that multimedia designers should add images and audio to their instructional modules without consideration of the potential for negative impact on learning. Rather, these results merely indicate that given the individualist subjects collected for the study, non-essential image and audio adjuncts did not

detract from the learning experience. For the collectivists, the post-test results suggest that for this cultural group the non-essential images and audio did not distract the subjects from learning the instructional content. Perhaps consistency and interest-level were also factors that led to the similarly moderate to high scores among collectivists. This also provides new information with regard to the coherence principle and culturally and linguistically diverse students. This is discussed further under the fourth hypothesis sub-heading the in following chapter.

Interaction Effects (Cultural Dimension * Coherence Principle)

The researcher computed a two-way analysis of variance to examine the interaction between the independent variables in this study, namely, cultural dimension and the coherence principle (module design). Each independent variable is categorical. The cultural dimension variable is comprised of the collectivists and individualist categories. The coherence principle variable is comprised of the three module types (control and two experimental).

No interaction effect (F (2) = .113, p =.893) was found. Viewing the coherence principle as a main effect (F (2) = .304, p = .739), the results in Table 25 indicate that learning about the content from one of the three modules did not influence achievement on the post-test. Culture as a main effect (F (1) = 11.399, p = .001) indicates that the cultural background (or perhaps the native language of the subject) influenced achievement on the post-test. The R^2 (.167) shows that (16.7%) of the total variability in post-test scores can be explained by culture and the coherence principle. This percentage leaves much of the observed variability unexplained, although culture and the coherence principle are not significantly related to achievement on the post-test.

Table 25

Tests of Between-Subjects Effects with the Total Score on the Post-test as the Dependent Variable

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta^2
Corrected Model	11.099[a]	5	2.220	2.441	.044	.167
Intercept	8739.599	1	8739.599	9611.215	.000	.994
CP[b]	.553	2	.276	.304	.739	.010
Culture[c]	10.365	1	10.365	11.399	.001	.157
CP * Culture	.206	2	.103	.113	.893	.004
Error	55.468	61	.909			
Total	8847.000	67				
Corrected Total	66.567	66				

a. R^2 = .167 (Adjusted R Squared = .098)

b. CP = Coherence Principle

c. Culture = Cultural Dimensions

Interpretation. This finding is likely due to the high achievement among individualist subjects and moderate to high achievement among collectivists. While differences and similarities of importance were detected as per the specific hypotheses, the design of the module in terms of the coherence principle did not influence achievement on the post-tests. In contrast, culture as a main effect was detected at a significance level of (p = .001) to suggest that the cultural background or the native language of the subjects influenced achievement on the post-test. This is discussed in the following chapter in further detail under the interaction effects sub-heading.

Residual Differences

In order to be certain whether further differences of statistical significance exist, the researcher computed an analysis of variance inclusive of all control and experimental groups. A statistically significant difference was found (F (61, 66) = 2.613, p = .033), shown in Table 26. No differences of statistical significance were found in either of the two sections when analyzed separately, as shown in Table 26.

Table 26

One Way ANOVA – All Groups (Controls and Experimentals for both Cultural Dimensions)

Section		Sum of Squares	df	Mean Square	F	Sig.
Symbol Sequences	Between Groups	3.376	5	.675	1.298	.277
	Within Groups	31.729	61	.520		
	Total	35.104	66			
Time Travel Laws	Between Groups	2.694	5	.539	2.285	.057
	Within Groups	14.381	61	.236		
	Total	17.075	66			
Overall Scores	Between Groups	11.743	5	2.349	2.613	.033
	Within Groups	54.824	61	.899		
	Total	66.567	66			

The ANOVA resulted in an F that shows that a statistically significant difference exists between or among the two control and four experimental groups, shown in Table 26. In order to detect where this difference is located, a two-sided *Dunnett's t* test was computed. The *Dunnett's t* is the appropriate statistic to use when an a priori comparison is assumed and when one group is treated as a control and is used to compare against all other groups. A mean difference of

(-1.20000) with statistical significance of (p = .022) was found between the IND experimental group with images and the COLL experimental group with music.

Interpretation. Differences in achievement on the post-test between the individualist experimental group receiving the module with images and the collectivist experimental group with music are shown by the distance between each group's score. The cause for the distance in scores is likely due to cultural or linguistic variability rather than the explicit design of the module. This is not to suggest that the inclusion or exclusion of extraneous audio or images did not influence the achievement on the post-test. This is discussed further in the next chapter under the residual differences sub-heading including more information about the demography of each group (the collectivists receiving the module with music and individualists receiving the module with images).

Summary

This chapter presented the results from two concurrent experiments, each with one control and two experimental groups. Demographic information provided a critical look into the sample in terms of gender, age, grade point average, degree, major, experience with online courses, native language, and country of origin.

Disproportions in GPA scores between the two cultural dimensions suggest that students enrolled in graduate-level courses held higher grade point averages than undergraduate students in the sample. This may be due to the higher percentage of graduate students in the collectivist than in the individualist sample. However, since the individualist subjects scored higher on all three modules (control and both experimental versions: audio and images), GPA likely played little or no role in how subjects in either cultural group performed on the post-test. The cultural and linguistic composition of the subjects (in this case, among the collectivists) is the likely

candidate to explain the difference in post-test scores. In other words, the module itself was educationally neutral: one's GPA could not be useful in predicting performance on the post-test. This information also helps to provide further support for the validity of the instrument.

English was the native language for 47.8% of the overall sample, with the United States as the chief country of origin for the individualists. However, the second most common native language in the overall sample was Mandarin Chinese (38.8%), with the People's Republic of China listed as the most common country of origin among collectivists, with one exception being a person from Taiwan.

Individualist subjects had the most experience with online courses compared to collectivists. Only eight or 22.2% collectivist subjects indicated that they had taken an online course, with the remaining 28 (77.8%) stating no such experience. A majority of the collectivists with online experience (75%) indicated only one online course with the remainder (25%) showing experience with two online courses.

The first hypothesis (control groups, no extraneous image or audio) and second hypothesis (experimental group with audio) were supported since no significant differences were detected in either *t* tests or analyses of variance. A significant difference was found in a *t* test and ANOVA for the third and fourth research hypothesis for the overall post-test. Significant differences were also found on the time travel laws section for the first and second research hypotheses.

For the first hypothesis (control groups), no significant difference was detected between the control groups (t (20) = 1.693, p = .10). However, a statistically significant difference was detected between the control groups on the time travel laws section. The t value was t (11) = 2.345 with statistical significance (p = .039). The ANOVA resulted in identical findings.

For the second research hypothesis, no significant differences were detected between the groups on the overall post-test (t (10.46) = 2.06, p = .065) as well as on either section analyzed separately. An ANOVA resulted in similar findings (F (1, 18) = 4.245, p = .054) with the exception of the time travel laws section (F (1, 18) = 5.000, p = .038).

The third research hypothesis (experimental group with images) is not supported given the statistically significant difference of (t (13) = 2.474, p = .028). An ANOVA resulted in a statistically significant difference between the groups on the total score for the overall score (F (1, 23) = 4.765, p = .040).

To test the fourth research hypothesis (comparing IND control with its two experimental groups), the researcher computed a separate t test. Its result showed no significant differences between the IND control and either of its two experimental groups, which does not support the fourth hypothesis. To explore the same relationship (control and two experimental groups) in the collectivists, descriptive statistics and t test results compared the COLL control and experimental groups. No statistically significant differences were found.

In order to examine the interaction effect of the two independent variables a general linear model univariate analysis of variance was computed. Results suggest that while there was no interaction effect between culture and the coherence principle on post-test scores, culture was a statistically significant main effect. It influenced the achievement on post-test scores.

To detect any further differences an ANOVA compared all control and experimental groups and resulted in a statistically significant difference (F (5, 61) = 2.613, p = .033) between or among the two control and four experimental groups. A *Dunnett's t* showed a mean difference of (-1.20000) with statistical significance of (p = .022) between the IND experimental group with images and the COLL experimental group with music.

CHAPTER FIVE: CONTRIBUTIVE INTERPRETATION AND DISCUSSION OF RESEARCH FINDINGS

Introduction and Purpose of the Study

The purpose of this study was to gather information about how individuals from two different cultural dimensions (Hofstede, 2001) score on three differently designed e-learning modules. Specifically, this investigation sought to understand whether individualist undergraduate and graduate students learn differently from instructional content that has been designed according to the coherence principle than collectivist undergraduate and graduate students. Collectivist or collectivism is not a political concept but represents a dimension of national or real cultures and pertains to those societies which emphasize harmony and group interests. Individualist or individualism is the conceptual opposite of collectivism and implies societies that have loose ties between individuals in the sense that the individual is expected to see to oneself or to one's immediate family (Hofstede & Hofstede, 2005; Triandis, 1995). Each concept forms a part of the individualist collectivist (I/C) construct (Triandis, 1995).

Each of the three e-learning modules shared the same instructional content: time travel. The purpose of using time travel was to restrict the probability of prior knowledge among the subjects of the instructional content. No pre-test was necessary given that subjects in the sample had little or no prior knowledge in the time travel instructional content. It is important to mention that the researcher created the time travel content; it was entirely fictional. It is highly unlikely that any amount of exposure to science fiction would prepare someone to score well on the post-test without having taken one of the modules. A post-test (please see Appendix D and Appendix E) measured retained knowledge in subjects from both cultural dimensions on each of the three differently designed e-learning modules. The control module was designed according to the

coherence principle of multimedia instruction which stipulates that the addition of extraneous audio, images, or text hurts learning. Accordingly, the two experimental versions were not designed according to the coherence principle; one had background music, the other extraneous images. The interpretation of results presented in this chapter contextualized the interaction of the coherence principle and the cultural background of the subjects as they relate to post-test scores as well as to applied multimedia design.

Synopsis of Findings

This study contributes new knowledge in the areas of cognitive theory of learning and cognitive linguistics. Cognitive theory of learning applies to this discussion given the relevance of cognitive load and information processing theories. Cognitive linguistics applies to this discussion given the role of linguistic relativity in the interpretation of collectivist achievement on the time travel laws section of the post-test. Cross-cultural learning strategies are also a part of this discussion. Table 27 presents a summary of findings according to each research hypothesis and subsequent statistical tests of difference. No previous studies examined whether designing an e-learning module according to the coherence principle interacts with the cultural or linguistic diversity of the learner.

Table 27

Hypotheses and Subsequent Tests of Difference with a Summary of Results

First hypothesis: Individualist subjects will achieve a similar score as compared to collectivist subjects on the control module.	• IND and COLL control groups achieved similar high scores in total of sections on post-test • Significant difference detected between COLL and IND subjects on time travel laws section

Second hypothesis: Individualist subjects will achieve a similar score on the experimental module with audio adjuncts as compared to collectivist subjects.	• COLL and IND experimental groups with music achieved similar high scores in total of sections on post-test • Significant difference detected between COLL and IND subjects on time travel laws section
Third hypothesis: Individualist subjects will achieve a similar score on the experimental module with image adjuncts as compared to collectivist subjects.	• Significant difference detected between COLL and IND subjects in total of sections on post-test
Fourth hypothesis: Individualist subjects in the control group will score differently than individualist subjects in either experimental group.	• No significant differences detected between IND control and either IND experimental group
Interaction effects: The researcher computed a two-way analysis of variance to examine the interaction between the independent (categorical) variables. The cultural dimension variable is comprised of the collectivists and individualist categories. The coherence principle variable is comprised of the three module types (control and two experimental).	• Culture identified as significant main effect
Residual differences: In order to be certain whether further differences of statistical significance exist, the researcher computed an analysis of variance inclusive of all control and experimental groups.	• Significant difference detected between IND experimental group with images and COLL experimental with music

The first hypothesis posited that individualist subjects would achieve a similar score as compared to collectivist subjects on the control module. Results from testing it indicated that collectivist as well as individualist subjects benefitted from the module designed according to the coherence principle as there were no significant differences in post-test scores. The second hypothesis proposed that individualist subjects would achieve a similar score on the experimental

module with audio adjuncts as compared to collectivist subjects. Results from it were fairly similar as compared to result from the first hypothesis. Given the research on the coherence principle of multimedia instruction, results from testing the first and second hypotheses should *not* be similar. Further, the lower post-test scores for collectivists on the time travel laws section on all three module types suggests that culture or native language influenced achievement due to the way time was presented in the module. The researcher acknowledges that other factors may have led to the lower post-test scores on the time travel laws sections. These include: higher reasoning needed for understanding the laws and the level of language used in the explanation. This is discussed in greater depth in a subsequent section of this chapter.

The third hypothesis stated that individualist subjects would achieve a similar score on the experimental module with image adjuncts as compared to collectivist subjects. Results from testing it indicated a significant difference. Non-essential images deterred collectivist subjects from learning deeply thus leading to lower post-test scores. For the fourth research hypothesis, no significant differences were detected between the individualist control and either of its experimental groups.

In order to explore any interaction effects, a two-way analysis of variance was computed. Culture was found to be a significant main effect to explain achievement on the post-test (Table 27). To facilitate detection of any residual differences between or among the control and experimental groups, one final analysis of variance was computed. A final significant difference was detected between the individualist group that attained the highest score (the experimental group with image adjuncts) and the collectivist group with the lowest score (the experimental group with music).

The coherence principle asserts that the addition of extraneous material impairs learning. Thus, the individualist control group should have scored the highest than either of its experimental groups; it did not. Achievement on the post-test for the individualist control group was not as high as expected. Likewise, the collectivist and individualist groups receiving the experimental modules should have scored lower than their respective control groups; this was not found.

Finally, this investigation contributes new knowledge with regard to e-learning design principles and culturally and linguistically diverse learners. In particular, while this study is limited in its usefulness to generalize to the population of individualist and collectivist cultures, culture may be a variable to influence achievement in online learning. Variability in post-test scores on the different module types per cultural group indicates a possibility that the normative aspect of the coherence principle should be duly modified to reflect diverse learners depending on the situation, design objectives, and topic of instructional content.

Interpretation of Results and Discussion

First Hypothesis

The first hypothesis posited similarity in scores between the two control groups. Similarity in scores implies no significant difference between the two control groups' post-test results. It was anticipated that both control groups would score similarly given that their module contained only essential information. This hypothesis was supported as no significant difference was detected between the control groups on the overall score of the post-test. When analyzed separately, the scores from the section on symbol sequences showed no significant difference However, the collectivists scored significantly lower on the time travel laws section when

compared to their individualist counterparts. An analysis of variance delivered analogous results.

Explanation of post-test scores on symbol sequences section. The symbol sequences section of the module required that subjects learn an unknown system of symbols. Symbols were taken from the Visitor language from the ABC television series *V* and were free to download and use (Sorenson, 2009). Figure 10 illustrates the console of the time travel device as depicted in all e-learning modules. Presentation of the symbols was consistent throughout the module. Learning the symbol sequences enables one to operate the time travel device. Symbol sequences were explained in the context of the sequences necessary to enter into the console in order to operate the device. Certain symbols were present in each sequence; most were unique to a particular sequence, such as initializing chronoton flow or creating the artificial black hole for power.

Figure 10. Console of time travel device as depicted in all e-learning modules designed for this study.

Subjects in both control groups gained similar high scores on the post-test section on symbol sequences as each subject had to make sense of the symbols to understand how to

operate the time travel device. Similar to learning new vocabulary and associating those words with certain ideas, subjects learned the symbols in the context of correctly entering sequences to initialize particular operational steps of the time travel device. The argument that subjects learned patterns without context or making sense of the symbols themselves seems untenable given the uniqueness of the instructional content and the implicit need for sense-making. There is no way to determine if the subjects learned the symbols in context or whether subjects simply memorized patterns according to specific operational steps of the time travel device. Universal Grammar (UG) offers a way to explain how subjects may have learned the symbol sequences. UG is a linguistic theory and is most often associated with Noam Chomsky, but earlier versions of it asserted that common or universal concepts are shared by all human beings. Chomsky (1965; 1986) and Chomsky and Peck (1987) explain that cognitive structures form a faculty of language acquisition whereby language learners inherently know incorrect from correct expressions. In other words, uniformity exists in the faculty of language acquisition as it is an isomorphic structure common to the human species. However, *diversity* exists in the assignment of meaning to elements in reality.

Uniformity in acquisition of the symbols occurred in both control groups regardless of native language given the high post-test scores on the symbol sequences section in both groups. The uniformity assumed by the language acquisition faculty in Universal Grammar (UG) plays a role here. Each subject may have assigned meaning to each symbol sequence. This assigned meaning then took the form of the particular initiated sequence of the time travel device. Whereas the individualists may have perceived the symbols as letters, the collectivists may have understood the symbols as logograms or ideograms especially among Chinese native speakers in the collectivist group (75%). The important matter is that each group may have acted similarly in

acquiring the unfamiliar symbols and their associative meaning. Each individual in both control groups possessed the faculty of language acquisition; this may have enabled the subjects to learn sequences in relatively similar ways. However, diversity in retaining the knowledge about the time travel laws led to the differences between control groups.

Explanation of post-test scores on time travel laws section. In order to operate the time travel device correctly and safely, it was not enough to enter the symbol sequences in the correct order. Subjects also had to learn about the three time travel laws. The difference in scores on the time travel section may be due to the dissimilar ways human beings perceive and articulate time as an abstract concept. Not all people understand time in homogeneous ways. The uniformity in UG presupposes that since one human language conceptualizes time, another will likely allow for some concept for time. The diversity in applying the concept of time is due to differences in the ways speakers of some languages perceive time compared to speakers of other languages. Contrasting with this explanation is the notion that a different cognitive reasoning process may have been necessary to learn the time travel laws. The time travel laws section may have required more of the subjects than the symbol sequences section in terms of abstraction, language level, reasoning, etc. However, that argument does not explain why individualists scored well in that section in all three module types, except that all individualists were native speakers of English.

Summary of time travel laws. The first law proposes that time is a fourth dimension; that space and time actually exist as one dimension. The second law suggests that while it is possible to travel back in time, it is impossible to travel to a point in time prior to your first use of the device. If you have used the device for the first time at 5:00 p.m. on Tuesday, you would be able to travel up to that minute, but not a second before. The third time travel law states that making

changes to past events in one's original timeline leads to the creation of an alternate timeline. The second and third laws each had additional slides in the module for further explanation.

Time expressed as a linear concept. Figures 11 and 12 illustrate the timeline used for explaining more about the second and third time travel law respectively. What each slide contains is a linear representation of time with an implicit understanding of "back" or "before" to mean the past and "ahead", "front", or "then" to signify the future.

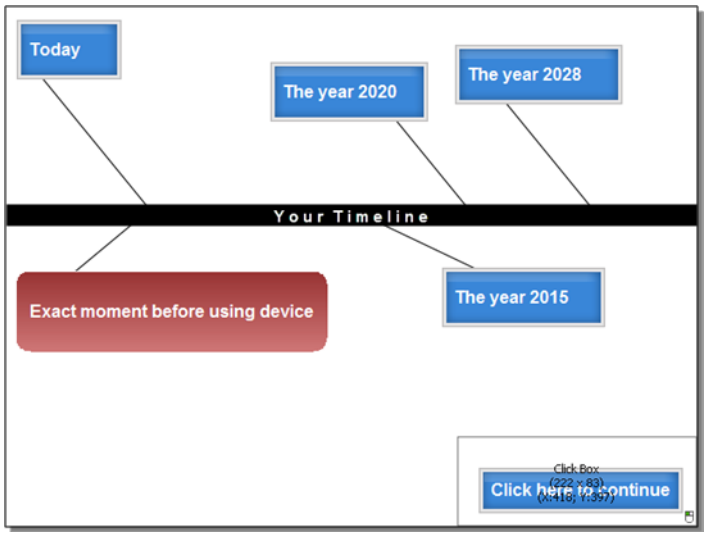

Figure 11. Further information on second time travel law.

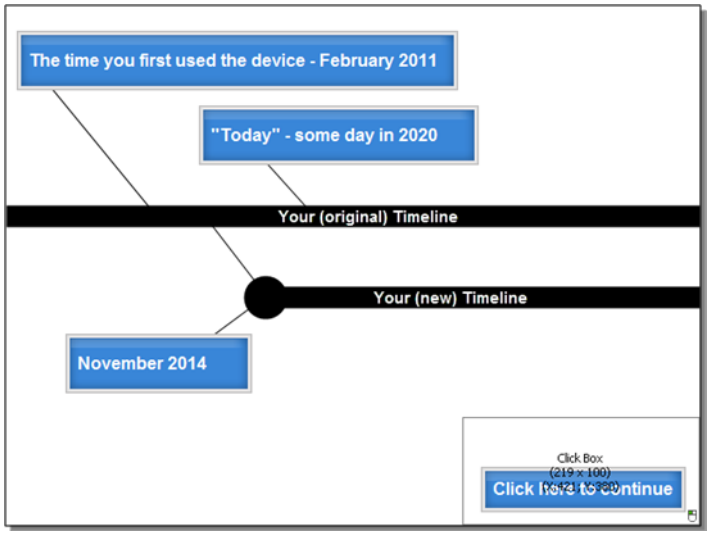

Figure 12. Further information on third time travel law.

Native speakers of Chinese (83%) outnumbered all other native languages among collectivists in the control module, not to mention the two experimental modules as well. There is a tendency for long-term planning among Chinese people, and the orientation toward time in Confucian cultures suggests a flexible attitude and one that is multidimensional. It has a focus on the past which is connected to the importance of tradition in Confucianism (Hofstede & Hofstede, 2005; Nisbett, 2003; Li, 2008). In experiments seeking to understand whether language shapes thought, Boroditsky (2001) found that speakers of Mandarin Chinese perceive time in horizontal *as well as* vertical ways. By contrast, English native speakers conceptualize time in strictly horizontal ways. In other words, English native speakers view lunch, for example, as linearly coming before dinner but after breakfast. The native speaker of Chinese understands this order vertically. Lunch is perceived as in the middle with breakfast on top and dinner below. The upper part of the vertical way of seeing time for Chinese speakers is relegated to the past; the bottom is for the future.

Ten of the twelve collectivists (83%) in the control group were native speakers of Chinese. The lower post-test scores on the time travel laws section is likely explained by the difference in how Chinese speakers perceive time. The time travel laws were instructed using a Western or individualist orientation toward time with a linear, horizontal left-right timeline. Events on the left side were understood as the past; those on the right are generally the future, relative to the point indicated as the present. The collectivist group scored lower on the time travel law section because the instruction was geared for an individualist orientation toward time, even though the subject matter was entirely fictional.

Given the proposition that differences in the way Chinese speakers perceive time led to lower post-test scores among collectivists on the time travel laws sections in all three groups (control and two experimental), it is helpful to take a look at the non-Chinese people in the collectivist groups. In the control group, 83% of the participants were native speakers of Chinese with the remaining two subjects (17%) being native speakers of Punjabi and Hindi, respectively. Neither of the two non-Chinese people made any errors on the time travel laws section. However, 60% of the Chinese speakers made errors on the section.

On the experimental module with music, there were ten total collectivist subjects with 60% native speakers of Chinese and 40% non-Chinese. These were comprised of one Jamaican whose native language is English; one Saudi Arab whose native language is Arabic; one Peruvian Spanish speaker; one person from Vietnam whose native language is Vietnamese. Only one of the Chinese speakers made an error on the time travel laws section. Among the non-Chinese, the Jamaican, Saudi Arab, and Peruvian all made mistakes on the time travel laws section. It is important to note that the Saudi Arab likely made an error due to the right-to-left orientation in Arabic. Reading and writing in Arabic is done from the right to the left with the

exception of numbers; it is likely that the orientation toward time is also from the right to the left. Time was instructed linearly in the module, but from the left to the right, in keeping with the directionality of the English language. The Peruvian student is incidentally the only person who scored the lowest overall when compared to all other subjects in the study (total score 8/12, with 5/7 on the symbols section and 3/5 on the time travel laws section). It is likely that this person's English proficiency was not sufficient to perform well in the post-test. It is unknown why the Jamaican scored low on the time travel laws section even though this person reported English as the native language.

On the experimental module with images there were 79% Chinese and 21% non-Chinese person; specifically, there was one person each from Thailand, Japan, and South Korea. None of the non-Chinese people scored less than perfect on the time travel laws section; however, 27% or three of the eleven Chinese subjects achieved low scores on the time travel laws section. These findings support the proposition that the presentation of time in a linear, left-to-right manner may not have been clear or easy to understand for the native speakers of Chinese as well as for the native speaker of Saudi Arabic.

Second Hypothesis

The second hypothesis proposed no differences would be detected between the experimental groups receiving the module with background music. Incidentally, the song selected by the researcher is *Song to the East* by Ferenc Snetberger, Hungarian guitarist (Snetberger, 2001). The researcher used less than thirty seconds of the song in keeping with copyright restrictions for educational use. The segment was edited as a repetitive loop using Cubase LE software. While composed and performed by an Eastern European, *Song to the East* was consciously chosen as it exhibits neither Western nor Eastern-dominant rhythms, in the

opinion of the researcher. It serves the purpose as an unobtrusive musical piece used as extraneous audio in direct incongruity to the prescriptions of the coherence principle. It is important to note that this song shares nothing with the time travel narrative.

Similarity in scores suggests no significant difference between the two experimental groups' post-test results. This hypothesis was supported as no significant difference was detected between the control groups on the overall score of the post-test. When analyzed separately, no differences were detected on either the symbol sequences or the time travel laws section. An ANOVA detected no significant differences between the experimental groups on both post-test sections together and the symbol sequences separately. However, while the *t* test indicated no difference on the time travel laws section, the analysis of variance resulted in a statistically significant difference.

The significant difference on the time travel laws section is likely due to the way in which the e-learning module presented the laws. In addition, the quantity of Chinese native speakers (60%) in this collectivist experimental group may explain lower post-test scores on the time travel laws section due to differences in temporal perception, as discussed above.

The second research hypothesis is supported for a critical reason. Research on the coherence principle of multimedia learning informs us that the addition of non-essential music (or other audio adjuncts) hurts learning. Neither statistical test revealed a significant difference on the overall score of the post-test. Yet literature and prior research have indicated that adding extraneous music is detrimental to learning. Why was there no significant difference between the groups? Further, why did both groups score highly relative to each other on the overall post-test (IND: $M = 11.8$; COLL: $M = 10.8$)? The answer may lie in the inherent interest level in the instructional content of the e-learning module. Many of the subjects remarked at how much they

enjoyed the module, how interested they were in learning the symbol sequences, and about the general topic of time travel. I received such comments from both collectivists and individualists. In fact, one subject in particular sent a follow-up email indicating a willingness to participate in future experiments since this one was so enjoyable (personal communication, February 20, 2011).

If the level of attention in the instructional content was high, subjects may have been aroused by the content of the e-learning module. The level of interest may have neutralized the non-essential music distraction. Interest in subject matter may also explain the high level of subject performance in the symbol sequences section.

Garner, Gillingham, and White (1989), Sanchez and Wiley (2006), Kozma (1991), Weiner (1990) speculated about the inclusion of seductive details to enhance the interest in the instructional content. Formulated as arousal theory, this conceptual approach advocates the *inclusion* of entertaining text, images, or auditory adjuncts to amplify the interest level so that learning is improved. The important difference between the assumptions behind arousal theory and my interpretation of these results is that the subject matter of the module may have compensated for the potentially harmful effect of the audio adjuncts.

As the time travel subject matter was perhaps sufficiently interesting for the participants, the addition of non-essential information did not hurt learning in either group. The non-essential music added to the module should not be construed as a seductive detail. The music had no connection to the module's subject matter.

Clark and Mayer (2003; 2008) are not alone in providing empirical evidence against adding non-essential items. However, perhaps the time travel *subject matter* was interesting enough for the participants to maintain a high enough level of attention to permit good learning. I

do not posit that the music adjuncts were a seductive detail; rather, I propose that the module itself was stimulating enough to engage the subjects to maintain a level of attention throughout the module regardless of the addition of music.

It is not advisable to generalize this finding to all individualist and collectivist cultures around the world. It is advisable, however, to posit that the selected music was not distracting enough because the time travel subject matter likely captured the attention of the participants and nullified the potential harm brought about by the music.

This was not a study to determine how distracting one can make an e-learning module, nor was it the purpose of this investigation to test listening to different musical style while learning. Rather, this investigator sought to understand whether the coherence principle applies to culturally and linguistically diverse students. A contribution from this study is the suggestion that non-essential music adjuncts may not hurt learning if the instructional content is interesting to the learner and that music is non-distracting or not overpowering for different people upon consideration of the task at hand. Further, this applies to both individualists and collectivists.

Both groups' high scores translate into no viable concern about the music's ability to hurt learning for subjects in this study. I would hardly propose based on these findings that one should commence adding music to multimedia presentations and e-learning modules. I propose instead that future studies examine the degree to which interest in the instructional content may nullify the potential influence of seductive details or non-essential information. There was no measurement of the interest-level each participant had in the module, and this is a limitation. As mentioned previously, many of the subjects remarked at how much they enjoyed the module, how interested they were in learning the symbol sequences, and about the general topic of time travel.

In summary, the music chosen for the experimental module served the purpose as unobtrusive, extraneous audio. The coherence principle advises against adding non-essential sound effects or background music to educational content as they can potentially hurt learning. It is possible that the music was not distracting enough, as alluded to above. Narration throughout all modules made listening to the music necessary on that experimental module. Narration explained critical details about the time travel device and guided the flow of the module. It is highly unlikely that a subject would have scored well on the post-test had the audio on the module been muted. The interest-level of the subject matter may explain why both cultural groups similarly achieved high scores.

Third Hypothesis

The third research hypothesis posited no significant difference between the two experimental groups receiving the module with image adjuncts. Interestingly, the difference between individualist and collectivist group scores was found to be statistically significant on the overall post-test, as well as on the two sections when analyzed separately. Unique to this module was score variability among collectivist subjects; there was no variability in the individualist scores.

Consistency as explanation of significant difference on post-test. The significant difference detected between collectivist and individualist groups is partially explained by the consistency of non-essential images throughout the module. It is likely that the consistency of the type of distraction did not deter individualist subjects from retaining knowledge on the overall post-test. As Figures 13 and 14 demonstrate, the image adjuncts appear in the background at a transparency rate of 50%. Larger versions of these and more screenshots for the module with images are also available in Appendix G.

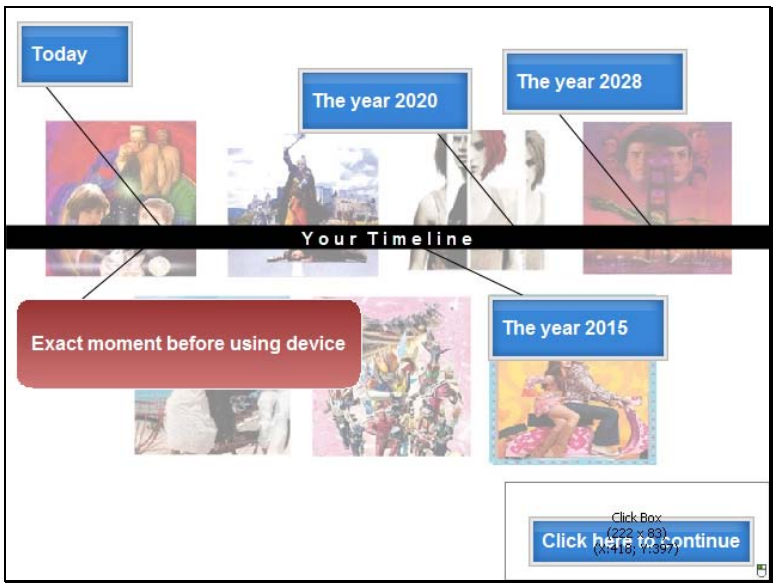

Figure 13. The images were consistent throughout the module (except in a few slides in which the size of a text box or image covered the image adjuncts).

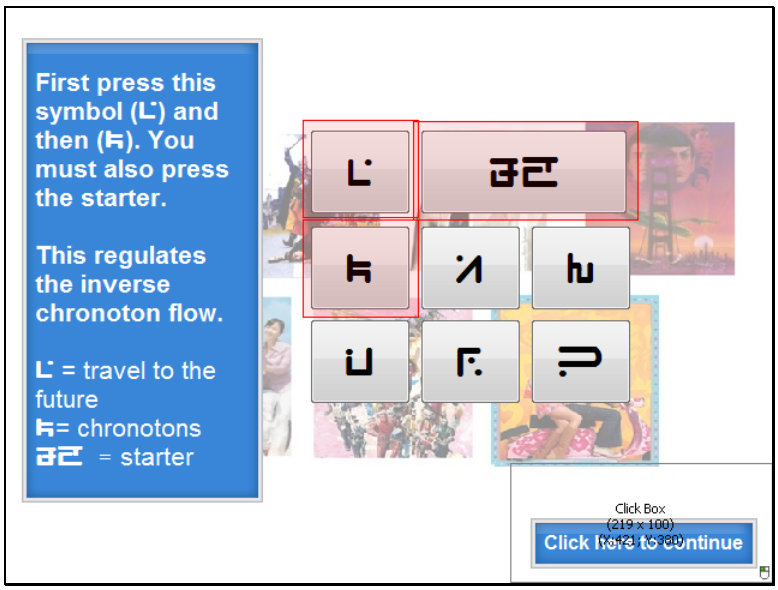

Figure 14. These images are visible enough to provide some distraction thus qualifying them as non-essential adjuncts; as such they should be removed from instructional content according to Clark and Mayer (2003).

It is important to recall the previous discussion on perceptual differences of time between native speakers of English and Chinese. Lower scores on the time travel laws section among the collectivists (79% of which were Chinese) may be explained by the compounding nature of both the image adjuncts and the left-right linear approach to explaining the time travel laws.

A discussion of why the collectivists scored significantly lower in the module with image adjuncts should likely begin with the theories behind the coherence principle. Yet, that discussion would ignore the perfect scores among individualist subjects on the same module. Culture or native language must be a factor to explain the difference in scores.

Differences in perception of non-essential images. The significant difference in post-test scores may also be explained by the manner of presentation of the image adjuncts. Individualist subjects may have perceived the image adjuncts as *part* of the experience. The consistency of the images helped the module to appear as a single unit to the individualists.

In contrast, collectivist subjects (79% of which were Chinese native speakers) achieved lower post-test scores probably due to the incongruity in the manner by which the module presented instructional content. The individualist subjects were unaffected by the inclusion of the image adjuncts. The images likely distracted the collectivist subjects on both sections to result in a statistically significant difference when compared to individualist post-test scores. Given the difference in scores on the symbol sequence section of the post-test, it is likely that the addition of images served as a greater distraction than music. Considering the results from testing the second hypothesis, the audio adjuncts did not distract either group of subjects. The image adjuncts therefore distracted collectivist subjects enough to perform poorly on both sections thus leading to a significant difference between cultural groups.

***Color vision deficiency*.** It is also possible that color vision deficiency may have interfered with how an unknown proportion of collectivist subjects perceived instruction on the various symbol sequences given the red highlight boxes illustrating the correct order of sequences (see Figure 14 for more detail). According to Okabe and Ito (2008), red-green dichromatism is common among 5% of Asian males and not common among Asian females. However, given that 65% of the collectivists assigned to the module with image adjuncts were female, this means that all males (35%) in the same module would have to have been color vision deficient in order for this to explain the differences in post-test scores. Accordingly, this possibility is acknowledged but not likely.

Discussion of third research hypothesis testing. Culture, interest-level in the module, and consistency in the design or presentation of non-essential information are all relevant to the interpretation of results from testing the third research hypothesis. While both cultural groups may have been interested in the module's subject matter, the addition of non-essential images resulted in lower scores among only collectivists. Including extra images may or may not hurt learning among individualist subjects, considering the research on the coherence principle together with the new information from this investigation. The addition of non-essential images made no measurable negative impact on learning among the individualists. However, collectivist subjects were vulnerable to the non-essential images due to two separate reasons.

First, collectivist subjects may have been interested in the module, but the addition of non-essential yet consistent images throughout the module impaired learning. The second reason is an extension of the first. The culture and native language of the collectivist subjects are the likely factors that interacted with the non-essential images in the module.

On the time travel laws section, collectivist subjects were presented with a left-to-right, linear approach to time, as discussed earlier, which is an artifact of the native language (English) of the researcher. Combined with the distraction afforded by the non-essential images, this may explain the lower post-test scores. Perhaps the addition of non-essential images confused the collectivist subjects due to the inundation of visual-verbal information and the highlight boxes which cued the correct sequence of symbols. Individualist subjects may have benefitted from the highlight boxes even though non-essential images were in the background. While the amount of visual cues led to extraneous cognitive load only among the collectivists, the same factor together with the consistency in presentation of the non-essential images led to germane cognitive load among individualists. This finding is unique to this investigation.

Fourth Hypothesis

The fourth hypothesis served to test the tenability of the coherence principle. Differences were expected in individualists' post-test scores between the control and both experimental groups. Past research on the cognitive theory of learning has not discussed cultural or linguistic diversity of subjects used in such studies. There was therefore no basis to hypothesize such similarities or differences between the control and experimental groups for the collectivist subjects. However, descriptive statistics and *t* tests shown in Tables 22, 23, and 24, respectively, show no significant differences between the collectivist control and either of its experimental groups.

Results indicate no significant difference between the control and both experimental groups for individualist subjects. According to the findings from numerous studies (Harp & Maslich, 2005; Harp & Mayer, 1998; Mayer, 1998; Mayer, 2001; Moreno & Mayer, 2000; Mayer & Anderson, 1991; Mayer, Heiser, & Lonn, 2001; Renninger, Hidi, & Krapp, 1992;

Robinson, 2002) evidence suggests that the addition of extraneous audio or images hurts learning. The findings from this investigation are in stark contrast to the previous research. The control and both experimental groups achieved similarly high scores on both sections of the post-test.

Explanation of uniformity of post-test scores. It is likely that consistency and interest-level were both factors that led to similarly high post-test scores among individualists, and perhaps also among collectivists. This is not to suggest that multimedia designers should add images and audio to their instructional modules without consideration of the potential for negative impact on learning. Rather, these results merely indicate that given the individualist subjects collected for the study non-essential image and audio adjuncts did not detract from the learning experience. This appears to apply to the collectivists as well. Further, this suggests some variability within the implied confines of the coherence principle. Before discussing this further, it is important to finish the interpretation of results for the final two statistical test results, the interaction effects, the residual differeences, and to present the concluding discussion. A part of that discussion is a recommendation for a *flexible coherence principle*.

Interaction Effects (Cultural Dimension * Coherence Principle)

Results from a two-way analysis of variance revealed no interaction effect between the cultural dimensions and the coherence principle. This suggests that according to these results the differences and similarities in post-test scores cannot be explained by knowledge of variability in the interaction between the cultural background of a subject and the design of the module. The two-way analysis of variance also revealed no significance in module design (understood as designed either *according to* the coherence principle or *not*) as a main effect. This finding is

likely due to the high achievement among individualist subjects and moderate to high achievement among collectivists.

While differences and similarities of importance were detected as per the specific hypotheses, the design of the module in terms of the coherence principle did not influence achievement on the post-tests. In contrast, culture as a main effect was detected at a significance level of ($p < .001$) to suggest that the cultural background or the native language of the subjects influenced achievement on the post-test. This can be interpreted in two separate ways.

First, scores among the individualists were consistently high across the three module types (control and experimental with music $M = 11.8$; experimental with images $M = 12$). In consideration of the native language and culture which the researcher shares with the individualist sample, the design of the instructional modules appealed to *fellow* individualists.

Second, scores among collectivist subjects were not as consistent as their individualist counterparts (control $M = 11.16$; experimental with music $M = 10.8$; experimental with images $M = 11.21$) across the three module types. In the control and both experimental groups, 83% of collectivists reported grade point averages between 3.5 – 3.9 and 4.0. Also, a majority of collectivists (53%) in all three modules were enrolled in masters or doctoral programs at IUP. Thus neither English language proficiency nor grade point average can explain the variability in post-test scores for the collectivists. It is more likely that culture or native language influenced achievement among collectivist subjects in post-test scores. Relevant to both interpretations, this implies that if language shapes thought, the native language and culture of the multimedia designer may influence the design and delivery of e-learning solutions and may impact the learning experience of the intended audience.

Residual Differences

A *Dunnett's t s*howed that the difference lay between the individualist experimental group with images and the collectivist experimental group with music. This finding is largely due to the nature of the difference detected. Whereas the individualist group receiving the image adjuncts achieved a perfect score the collectivist group that scored the lowest was the group which received the module with audio adjuncts.

Differences in achievement on the post-test between the individualist experimental group receiving the module with images and the collectivist experimental group with music are shown by the distance between each group's score. The cause for the distance in scores is likely due to cultural or linguistic variability rather than the explicit design of the module. However, it is important to realize that the significant difference was detected between these two groups since the individualist group with images achieved *perfect* scores and the collectivist group with music achieved the *lowest* post-test scores for the overall sample. Grade point averages were actually higher in the collectivist group with 11% falling between 2.5 to 2.9, and, 3.0 to 3.49, with the remaining 76% having a GPA that fell between 3.5 and 4.0. The difference in GPA scores among the collectivists is explained by 50% being undergraduate students with the other (50%) graduate students. As mentioned previously, 'good standing' at the Indiana University of Pennsylvania is a GPA of 2.0 or higher for undergraduates and 3.0 or higher for graduates. Individualists had a GPA that ranged from 2.0 to 2.9 (56%) and 3.0 to 3.49 (18%). Among individualists, 81% were undergraduates. This is not to suggest that the inclusion or exclusion of extraneous audio or images did not influence the achievement on the post-test. Culture and language impacted achievement on the post-test; the fundamental assumptions within the cognitive theory of learning should include a proviso that allows for the incorporation of the

multimedia designer's own cultural or linguistic background into the presentation of instructional content. In other words, the consistency of non-essential image adjuncts and the manner by which symbol sequences and time travel laws were presented may explain achievement of perfect scores among individualists.

The collectivists scored the lowest on the module with music adjuncts when compared to their results from all other groups. This highlights the potential damage to learning that can result when adding non-essential music or other audio to instructional content. However, individualist scores were comparably high on the same module. Culture or native language may again be paramount to understanding this variation in post-test scores.

The variability in post-test scores across the three collectivist groups implies that culture or language influenced post-test achievement, as indicated by the two-way analysis of variance. However, the argument here is that the influence of culture or language was not one-way. Indeed it is likely that the manner by which the instructional content was created together with the cultural and linguistic diversity of the collectivist subjects both led to variability in post-test scores across all collectivist groups. Also, language proficiency among the collectivists receiving the module with audio may have been too weak to allow for comprehension of the information on the time travel laws. However, and as mentioned previously, the linguistic composition and country of origin of the collectivist experimental group receiving the module with audio included native speakers of Chinese (60%) with the remaining four individuals native speakers of Vietnamese (Vietnam), Arabic (Saudi Arabia), Spanish (Peru), and English (Jamaica). Differences in temporal perception, as discussed in the context of Chinese subjects in the study is also relevant to the Arabic speaker, who achieved a lower score on the post-test section on time travel laws. Arabic is read and written from the right to the left; accordingly time is perceived

from the right to the left. Similar to English being a left-to-right language, time is understood as flowing from the left to the right. Similar results were discovered by Fuhrman and Boroditsky (2010) with regard to Hebrew, another language read and written from right to left. To explain the low score achiever by the speaker of Spanish (Peru) it is helpful to note that this person also scored the lowest on both sections in comparison to all other subjects in the overall study. Thus, that person's English language ability may not have been high enough to comprehend the instructional content.

Concluding Remarks

Limitations

There were several limitations in this study. The pilot test for this study was conducted using doctoral level students from the researcher's home university department. Advice against this was based on the logic that doctoral-level students may score higher than undergraduates on a given test. However, since the content of the module(s) precluded the need for a pretest, this limitation is duly noted yet not acknowledged as severe. The limitation here is that the majority of the individualists (87%) were undergraduates seeking a Bachelor degree, while the majority the collectivists (53%) were graduate students seeking Master or Doctoral degrees. A related limitation is due to the disparity in GPA scores. Given that the collectivists were largely comprised of graduate students (53%) and since 'good standing' at the Indiana University of Pennsylvania (IUP) is 3.0 for graduate students, they may have higher aptitudes than the individualists. However, given the differences in scores this is not seen as a major limitation.

The size of the sample overall is a limitation. While inferential statistics were used to analyze data and to detect significant differences between and among group means, it is not advisable for the research to use the results from this study to generalize to larger populations of

entire cultural groups. In addition it is good to mention that small samples and short tests can make it more difficult to get statistically significant differences. The post-test used in this study only contained twelve items.

The proficiency level of English among the collectivist participants is a minor limitation, but one that deserves acknowledgement. While graduate students with high grade point averages comprised the majority of the collectivists, there was no opportunity to access each student's level of English proficiency. However, the researcher has experience in assessment, materials development, and teaching English as a Second Language (ESL) and would rate the level of English necessary to understand any of the modules as novice high or intermediate low.

The experiments were conducted over the course of two consecutive days, Sunday February 20, and Monday February 21, 2011. It would have been ideal to run the entire experiment on one day to ensure little to no threats to internal validity. This is not a major limitation since students did not all come from the same segment of the university; subjects came from several different departments and programs throughout the Indiana University of Pennsylvania.

The version of the post-test administered to subjects after taking the assigned module was in hard-copy form. It was initially proposed to use Qualtrics™ online software to create the post-test and present it in each of the module types as a hyperlink to the online post-test. However, given the non-traditional symbols used in the time travel device e-learning module, the researcher was unable to include these symbols in the Qualtrics™ post-test. Accordingly, hard copies of the post-test were distributed to subjects, collected, and their data entered into SPSS 19.0 software for data analysis.

There was no measurement of the interest-level for each participant per module, and this is a limitation. This information would be helpful to understand the degree to which individuals in the experiment were interested in the instructional content. In turn this knowledge may have helped to explain how the module's subject matter interest-level nullified the potential harm of the non-essential adjuncts.

Recommendations for Further Research

This investigation supports a general call for more research on cultural and linguistic differences that may influence achievement in online learning environments. Specifically, the additional multimedia elements principles in Clark and Mayer (2003; 2008) deserve to be studied in the context of the cultural dimensions as in this investigation. However, future studies could examine the coherence (or other) principle(s) in the following separate ways:

1. Choose an instructional topic. Have an individualist and a collectivist develop two separate modules. Use both versions of the module in individualist and collectivist samples to determine changes in design and achievement based on cultural and linguistic diversity of both the learners and the designers. Studies may take the following shape:
    a. Coordinate and manage two separate cultural groups. These may be individualist and collectivist or more specific, Western and Eastern European, for example.
    b. Assign to each group the task to create a module that instructs how to use a time travel device and about its associative laws. Each group is given the basic parameters (symbols, time travel laws, etc.).
    c. Each group is to design the module for their respective culture.
    d. The manner by which one cultural group designs the module will likely invariably differ from the other cultural groups, yet may conform to certain cultural or

linguistic restraints of the particular group (as in the display of the time travel laws).

e. The study could be replicated with the single change being that each group is to design the module for a culture different from their own or an undefined audience.

f. Findings would likely yield reason and areas for further study.

2. Include image and audio adjuncts in an additional module to determine whether the compounding nature of the non-essential adjuncts hurts learning, but also to see if the adjuncts serve as reinforcement or distraction in the learning experience.

3. Incorporate the learner in the presentation flow of the instructional content and embed different kinds of non-essential adjuncts to determine if user-direction may neutralize the potential for decreased learning. In other words, adapt a *Which-Way Adventure* approach (one that allows the participant to choose the direction of the particular story regardless of genre) to the design and presentation of e-learning content alongside non-essential adjuncts. Perhaps self-direction of modularly presented instructional content may neutralize any perceived harm caused by the adjuncts.

Drawing on research in the area of cognitive linguistics it is advisable to explore cross-cultural influences on language and learning by following the pattern set forth by this investigation. Future studies may wish to consider the following research topics:

1. Explore abstract metaphors of time, space, and more by permitting the learner to choose the manner of presentation in order to see if this placement of direction into the hands of the learner leads to improved retention. For example, time was presented horizontally in the modules in this study; would the post-test scores among the collectivists have been

higher had they been offered the choice to learn about the time travel laws by means of a vertical presentation of time?

2. Explore the manner by which certain concepts are taken as granted and expressed in incongruent ways. This may be especially applicable to assessment practices. Specifically, future studies may examine (a) temporal representations, (b) noun gender and associated attitudes toward certain objects or ideas across cultures, or (c) personal or professional characteristics.
    a. Temporal representations include any discussion or presentation of time. Studies may look at how certain cultures place greater emphasis on the past compared with those that place emphasis on the future. How would these cultures perform in the establishment of a general business plan?
    b. Noun gender studies may investigate how speakers of certain languages regard items or ideas in specific ways due to the inherent gender of the signifier. For example, attitudes could be measured to learn more about the words people choose to describe certain activities, objects, or ideas depending on whether a given language has noun gender and, if so, what gender the particular noun possesses.
    c. Cultures vary with regard to emphases on certain professional characteristics depending on a given situation. For example, a study may wish to look at how collectivist and individualist cultures regard ‘leadership’, what words are used to define and describe it, and how these attitudes would be measured or conveyed in certain languages as opposed to others.

Lastly and by no means the least worthy of further research, it would be helpful to empower the learner and designer by embedding a metric whereby the learner informs the designer of the perceived interest-level. By extension the tracking process common in online commercial enterprises, such as Amazon.com which follow the user's preferences to formulate the suggested books, CDs, or other media, should be explored as a way to re-define e-learning, online learning, or distance learning. Stagnation in contemporary e-learning initiatives suggests a lack of innovation between teacher or multimedia designer of instructional content and learner. Research into effective instructional content tracking may hasten a shift from e-learning to *I-learning*. However, the limitation inherent in that suggestion is the individualist sentiment given the Western cultural background of the researcher. This is an open challenge to those interested in building, strengthening, and re-defining e-learning for the next decade and beyond.

Summary of Findings

Key contributions included the following findings:

5. The cultural and linguistic composition of the multimedia designer is perhaps just as important to consider as the intended learner audience;
6. The choice to present abstract information (such as a timeline) may be predicated by one's cultural background. This in turn may have contributed to lower achievement among collectivists than individualists for a sub-section of the post-test;
7. Consistency (in terms of volume, tonality, and genre) in the arrangement of non-essential audio adjuncts coupled with interesting instructional content may have neutralized the potential for decreased learning in both cultural groups;

8. The results for both collectivists and individualists for each respective control and experimental groups suggest modifications to the traditional coherence principle albeit given the limited scope of this investigation.

Concluding Discussion

Our shared faculty of human language illustrates the limits by which we are able to define ourselves and our experiences. Chomsky's contribution to explaining how or why human beings have language, and by extension how certain linguistic forms are possible while others are avoided due to their incongruity with established grammar of a given language, is encapsulated by universal grammar. However, we would do ourselves a disservice to halt the discussion at the acknowledgment of this universality. Instead, I would like to challenge this perspective given the findings of this study but also of the work of those in the area of cognitive linguistics that seek to understand the degree to which language shapes thought.

At the core of this supposition is the interaction of culture and language. Indeed, throughout this document I have endeavored not to divorce language from culture. It is imperative that this is clear. Ample evidence supports the hypothesis that differences exist between and among individuals from dissimilar cultures. It is, however, not the motivation of this inquiry to highlight the diversity and conclude with that action. Rather, it is important to maintain a sufficient level of curiosity about this difference as that will likely lead to further inquiries, discovery, testing, revision, and exploration. Let us turn to the practical contributions of this investigation.

Relative to design, development, and delivery of e-learning modules or other multimedia instructional tools the findings from this investigation inform several key areas of interest. In our

diverse world it seems unlikely that a standard approach to the design of multimedia instructional content is appropriate or advisable.

Multimedia designers must reflect on the impact which their culture and language have on the design of instructional content. Specifically, a rigid interpretation of the coherence principle is not advisable. Rather, a flexible coherence principle permits the re-evaluation of multimedia design in terms of essential and non-essential instructional items. A flexible coherence principle allows for the addition of non-essential audio or image adjuncts given a consistent presentation of non-essential adjuncts and engaging instructional content. Further, the culture and native language of the multimedia designer impacts the way in which instructional content is presented. In this way, intercultural awareness implies the avowal of one's own weltanschauung as it relates to the way others view and interpret the world around them.

Specific advice taken from this investigation and extrapolated to online learning or computer-mediated communication includes the following examples. The manner by which time is represented online reflects a Western or individualist perspective. As discussed earlier, Confucian cultures of the collectivist cultural dimension possess vertical metaphors for time. Perhaps multimedia designers may wish to present time (duration of videos, podcasts, etc.) vertically for Confucian cultures. This is an option given the findings from this study and research from the field of cognitive linguistics.

Non-essential images used to enhance instructional content may not hurt learning for individualist cultures given a consistent presentation of such images and interesting content. However, consistency and interesting content did not help collectivist subjects in this study to perform well on the module with non-essential images. A flexible coherence principle implies the conscious consideration of one's intended audience along with one's own cultural and

linguistic composition. The coherence principle as presented by Clark and Mayer (2003; 2008) argues against the inclusion on such non-essential elements. We now know that for the subjects in this investigation not adhering to the coherence principle had little or no effect on learning among individualists. However, ignoring the results for that group for a moment, if the module with image adjuncts had been designed according to the coherence principle it is likely that the collectivists would have achieved higher scores.

Clearly, a normative standard of multimedia design (in this case the coherence principle) does not apply to a group of culturally and linguistically diverse learners. A flexible coherence principle requires the multimedia designer to do more work than design and develop instructional content; attention must be given to the cultural and linguistic composition of the intended audience. If such knowledge is unknown, however, it is advisable to adhere to the traditional coherence principle given the results from the controls for both cultural groups.

A flexible coherence principle would also allow for the inclusion of non-essential music or audio given the proviso that the instructional content is of interest to the learners. It may be difficult to ascertain whether a given e-learning module, for example, is going to interest its intended audiences. Generally speaking, if designing a module for a group of culturally or linguistically diverse learners it is advisable to adhere to the traditional coherence principle even though the results from this study did not present a significant difference in post-test scores on the module with music adjuncts. This advice is based on the careful selection of the music for the module to reflect no one particular culture.

Cognitivism and our immediate concerns. The cognitivist paradigm uses the metaphor of the computer to explain and understand how learning is accomplished in the mind. Knowledge is comprised of schema or symbolic mental constructions based on the individual items of

instructional content. The cognitive theory of multimedia learning draws on the cognitivist paradigm to posit separate auditory and visual channels for information processing, a limited capacity in the learner, and that learning is an active process of filtering, selecting, organizing, and integrating information. This theory is the basis for design principles to which the coherence principle belongs. Similar to another cognitive theory, Universal Grammar, the cognitive theory of multimedia learning assumes a similitude in the structure of the human mind. This similitude is helpful to explain why learners are able to acquire new knowledge by means of integration with prior knowledge or how linguistic units such as expressing time, space, or color in one language means that those same units can be found in another language due to the uniform structure of the mind for all human beings. However, the impact that a particular language has on the learning process is ignored. Further, the influence of one's cultural background is also absent from discussion.

Multimedia designers should continue to draw on cognitivist contributions and the continued constructive exchange of ideas, experiences, and best practices. Given the findings from this study multimedia designers should also consider the contribution that culture, understood as not separated from language, necessarily impacts the design of instructional curricula. Common to individualist culture is the use of individual interests, competitiveness, and perspectives (Dunn & Griggs, 1995). Considering the design of multimedia instructional content, individualism may not apply to a collectivist emphasis on group cooperation. The collectivist subjects in the experiment with the module that had non-essential image adjuncts may have scored better given an opportunity to collaborate. This is not suggested as a way to make it easier for collectivist cultures; rather, this suggestion reflects the implicit nature of the collectivist cultural paradigm.

A *Flexible* Coherence Principle

The findings from testing the second and fourth hypothesis indicate a dichotomy. The interest-level of the module's subject matter indicates its ability to *attract* attention thus highlighting the inability of the non-essential audio or images to *distract* participants. This dichotomy explains the similarly high scores among individualist subjects in the three groups. A *flexible coherence principle* allows for the addition of non-essential audio or image adjuncts given a consistent presentation of non-essential adjuncts and engaging instructional content.

Cognitive load re-visited. One of the underlying assumptions within the coherence principle is that human beings possess a limited amount of processing capacity in the visual and verbal channels (Baddeley, 1992; Chandler & Sweller, 1991; Miller, 1956; Sweller, 1999). This line of thinking is rooted in the idea that adding too much visual or verbal content may lead to cognitive overload thus hurting the learning experience. Extraneous cognitive load refers to the design and delivery of instructional content, whereas intrinsic load refers to the difficulty of subject matter and the interconnectedness between instructional items. A flexible coherence principle implies that extraneous cognitive load may not be as damaging to learning given that non-essential adjuncts are kept consistent. Further, intrinsic cognitive load would be less of a concern provided that the instructional content is of interest to the learner.

Uniformity in cognitive structures to acquire language may explain the achievement on the symbol sequences section. While auditory and visual information are processed along separate channels, native language may have impacted how subjects learned the symbol sequences in this study. Individuals with a particular native language may not have as limited a capacity as other individuals with a different linguistic or cultural background. Universal

Grammar posits a shared faculty of language acquisition, yet the potential for cognitive load may be linked to differences among learners due to native language and culture.

Similarly, while Baddeley's visuospatial sketchpad, one of the subsystems of the central executive, is involved in learning spatial and visual information, linguistic differences may mean that the duration and manner of information storage and its manipulation may be dependent upon a person's native language. Given that the visuospatial sketchpad shares most of its cognitive right hemisphere location with language (Baddeley, 2000), the language a person speaks (and by extension one's culture) may encourage the sketchpad to store information in a way that is unique to the particular language. While the visuospatial sketchpad explains the storage and manipulation of spatial and visual information, it should not be assumed that these procedures are as uniform as the faculty of language acquisition common to all human beings.

In conclusion, cultural variation may be related to cognitive variation. The between and among group similarities suggest, upon consideration of the two cultural dimensions and the restrictions in knowledge retention outlined in the cognitive theory of learning, an independent universality or a dependent diversity of linguistic forms. An independent universality posits a re-affirmation of Chomskyian universal grammar. However, a dependent diversity of linguistic forms proposes a re-affirmation of a modular view of linguistic relativity. The differences and similarities between and among the cultural groups in this study suggest a dependent diversity of linguistic forms. If language had no impact on thought, scores would have likely been evenly spread throughout the control and experimental groups. Individuals from different cultures are impacted not only by their own linguistic and cultural composition but also by the implied cultural and linguistic background of the multimedia designer whose instructional content may be used for educational purposes. The connection between post-test scores and linguistic

investigation is rooted in the essential element of cultural variability. It is likely that an independent universality is compatible with a dependent diversity of linguistic forms. Further, an independent universality would house isomorphic structures such as the central executive and the faculty of language acquisition. A dependent diversity simply provides for variation in consumption and production of visual-verbal-aural information. The challenge is to determine the inherent proportions of this balance according to individual differences.

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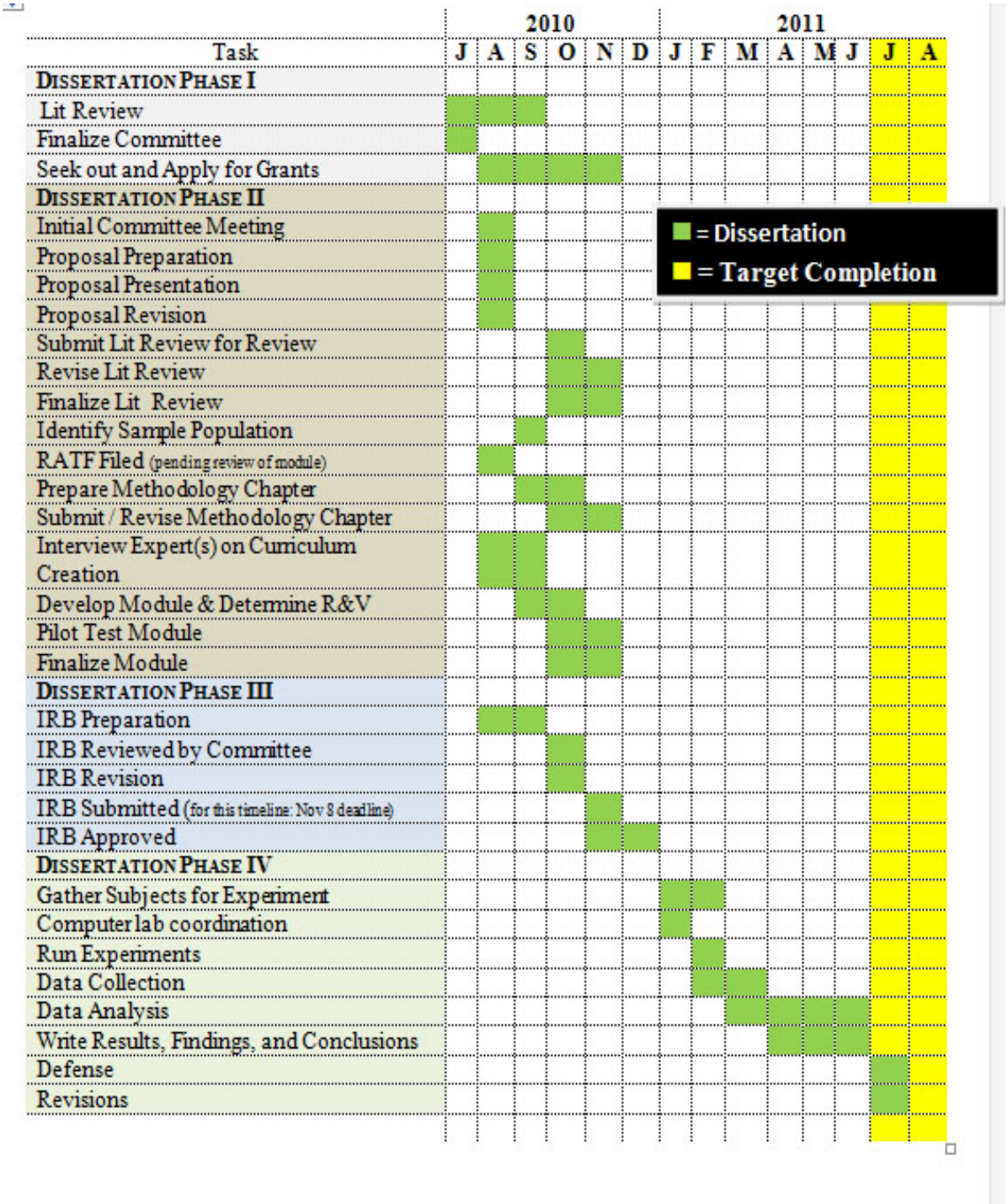
APPENDICES

Appendix A: *Timeline for proposed dissertation project*



Appendix B: Informed consent

Informed Consent Form

You are invited to participate in a research study. The following information is provided in order to help you to make an informed decision whether or not to participate. If you have any questions please do not hesitate to ask. You are eligible to participate because you are an undergraduate or graduate student enrolled in courses at the Indiana University of Pennsylvania (IUP).

The **purpose of this study** is to test the design of eLearning instructional content on different populations. Participation in this study will require approximately 30-45 minutes of your time and is not considered a part of any course you may be enrolled in. First you will take a questionnaire consisting of 10 multiple choice or fill-in-the-blank questions. You will then receive information about the date, time, and location of the experiment so that you can arrive on time.

At the experiment, you will be randomly assigned (similar to a flip of a coin) to one of three eLearning modules. Each module will teach about how to use a time travel device. There are only differences in design between the three modules. At the end of the eLearning module you will be asked to complete a post-test consisting of approximately 25 multiple-choice or true/false questions. Finally, you will be asked to attend a short debriefing of the experiment. You are not required to attend the debriefing.

Participation (taking and completing the eLearning module and post-test) will give you a chance to win $100 US dollars in cash. There will also be food provided. The information gained from this study may help us to better understand the interaction of culture and the design of an eLearning module.

Your participation in this study is voluntary. You are free to decide not to participate in this study or to withdraw at any time without adversely affecting your relationship with the investigators or IUP. Your decision will not result in any loss of benefits to which you are otherwise entitled. If you choose to participate, you may withdraw at any time by notifying the Project Director or informing the person administering the test. Upon your request to withdraw, all information pertaining to you will be destroyed. If you choose to participate, all information will be held in strict confidence and will have no bearing on your academic standing or services you receive from the University. Your responses will be considered only in combination with those from other participants. The information obtained in the study may be published in scientific journals or presented at scientific meetings but your identity will be kept strictly confidential.

If **you are willing to participate** in this study, please send an email to **b.e.wiggins@iup.edu** with the following information:
(1) your name, (2) phone number where you can be reached, (3) that you have read and understand this form, and (4) that you wish to volunteer to be a subject in this study.
If you choose **not** to participate, take **no** action.

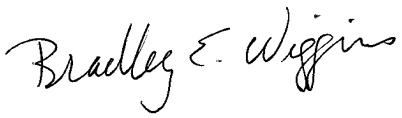
After you send me the email, please use the following link to answer a few questions about yourself: https://iup.qualtrics.com/SE/?SID=SV_03rKyO7FPxARTpO

This research is part of a dissertation for the Ph.D. in Communications Media & Instructional Technology. The research is conducted by Bradley E. Wiggins, a doctoral student at IUP. His dissertation advisor is Dr. Allen Partridge; he may be contacted at allen.partridge@iup.edu or 724-357-3781.

Project Director: Mr. Bradley E. Wiggins
Ph.D. Candidate / Teaching Associate
Department of Communications Media
1175 Maple Street, 121 Stouffer Hall
Indiana, PA 15705
Phone: 724/357-2492
Email: b.e.wiggins@iup.edu

This **project** has been **approved** by the **Indiana University of Pennsylvania Institutional Review Board** for the Protection of Human Subjects (Phone: 724/357-7730).

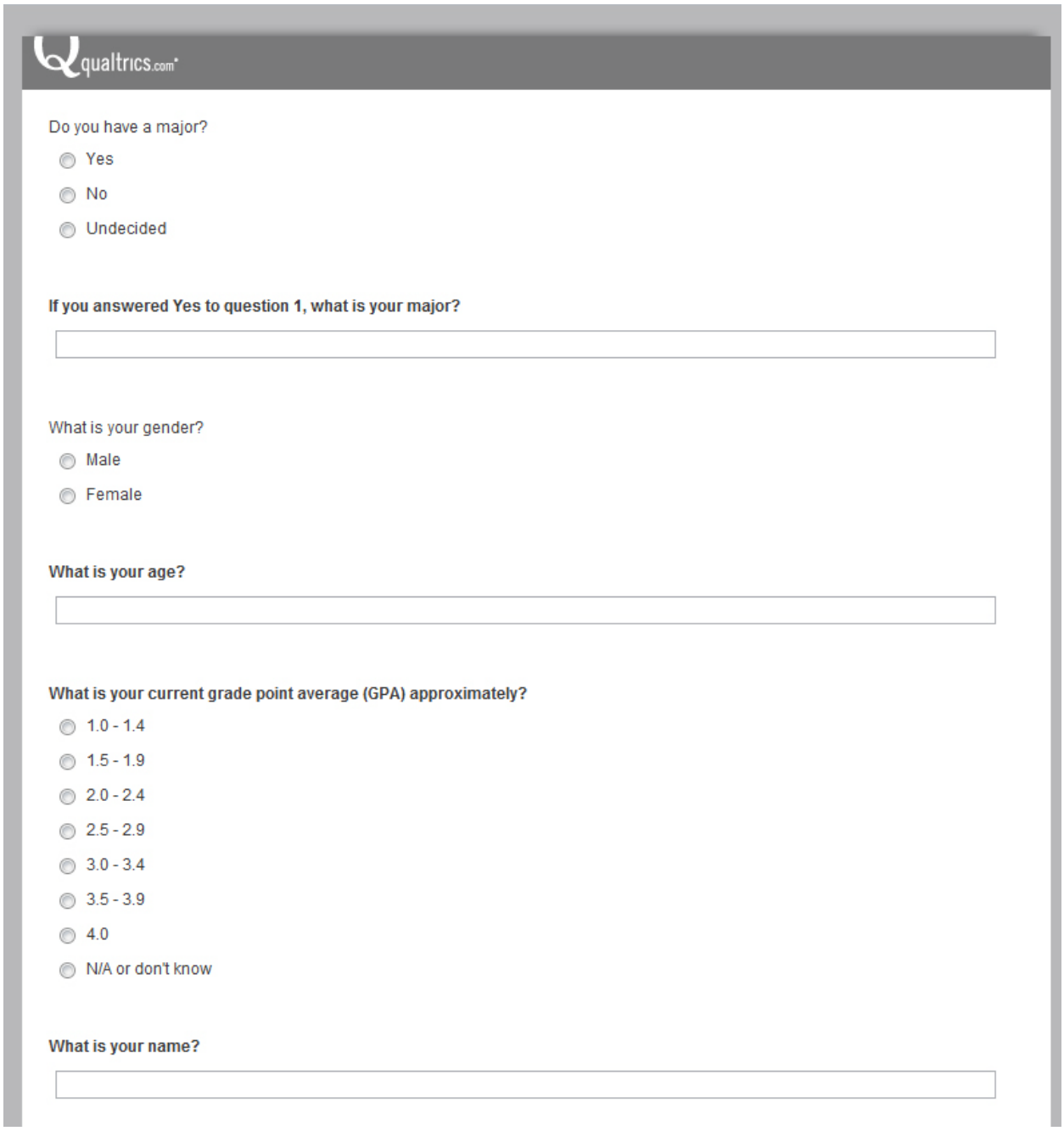
I, Bradley E. Wiggins, certify that I have explained the nature and purpose, the potential benefits, and possible risks associated with participating in this research study, and will answer any questions that have been raised.



01/05/2011

Date **Investigator's Signature (Bradley E. Wiggins)**

Appendix C: ***Screenshot of Qualtrics™ questionnaire given to potential subjects during the recruitment process (continued on next page).***



What is your name?

What is your IUP email address? If you use another email more often that your IUP address, please enter that as well. Please separate emails with a comma (,).

May I contact you to participate in this research study? If you agree, your participation in the study will take place February 20 or 21, 2011. I will contact you with more information if you wish to participate.

- Yes
- No

Please indicate which day is better for you to participate in the experiment.

- Sunday, February 20, 2011
- Monday, February 21, 2011

Please indicate which time is better for you to participate in the experiment.

- morning
- afternoon
- evening

>>

Appendix D: ***Post-test – Time Travel Symbol Sequences***

TIME TRAVEL QUIZ

DEFINITION OF TERMS
Black hole = this is the source of power for the time travel device.
Chronoton measurement = this allows you to measure chronotons, which are spacetime particles. Their direction indicates the flow of time.
Chronotons = their direction (either inverse or obverse) indicates the flow of time (either to the future or the past).
Inverse chronoton flow regulation = this allows you to travel to the future
Obverse chronoton flow regulation = this allows you to travel to the past
Power flow regulation = after creating the black hole, it's important to regulate the flow of power.
Starter = this starts or engages the previously entered symbol(s).
Temporal plasma = this makes it possible to maintain a temporal shell.
Temporal shell = this makes it possible to travel through spacetime.

1. The symbols highlighted in **red** are for…

a. Regulation of temporal plasma
b. Creation of artificial black hole
c. The starter

2. The symbols highlighted in **red** allow you to…

a. Create the black hole
b. Regulate temporal plasma
c. Measure chronotons

3. The symbols highlighted in **red** allow you to…

a. Create a temporal shell
b. Regulate the flow of power
c. Measure chronotons

4. The symbols highlighted in **red** allow you to…

a. Create the black hole
b. Measure chronotons
c. Create the temporal shell

5. The symbols highlighted in **red** allow you to…

a. Regulate temporal plasma
b. Travel to next week
c. Create chronotons

6. The symbol highlighted in **red** represents…

a. The Black Hole
b. The Time Travel Device
c. Chronotons

7. The symbols highlighted in **red** allow you to…

a. Regulate inverse chronoton flow and travel to the future
b. Regulate obverse chronoton flow and travel to the past
c. Create chronotons

Appendix E: ***Post-test Answer Sheet***

TIME TRAVEL QUIZ
ANSWER SHEET

Part 1: Please enter the letter (A, B, or C in the spaces below for the time travel device questions)

1. _____ **5.** _____

2. _____ **6.** _____

3. _____ **7.** _____

4. _____

Part 2: Please circle the correct answer

1. The first law on time travel concerns time and space. According to this law, the fourth dimension is better understood as…
a. Space
b. The Universe
c. Spacetime

2. It is best to think of Spacetime as…
a. Only space
b. Space and Time together as a dimension
c. Only time

3. The second law on time travel states that it is impossible to travel into the past before the first time you used the device.
a. True
b. False

4. If you first used the time travel device on February 5, 2011, could you travel to January 4, 2011?
a. Yes
b. No

5. The third law on time travel states that making changes to the timeline results in an alternate timeline.
a. True
b. False

Part 3: Please answer the following questions about your background

6. What is your country of origin (native country)?
_____

7. How many years have you lived in your country of origin? _____

8. What is your native language? _____

9. Other than English, which languages do you speak fluently?
_____

10. How many years have you lived in the United States? _____

11. Which culture(s) do you identify with? For example, a person from India may identify with Indian culture and/or with American culture. Please list as many that apply to you:
_____
_____

12. Have you ever taken an online course? Please mark 'yes' only if your online course was 100% online. Please mark 'no' if your course was a hybrid (mixture of online and in class) or 100% in class.
a. Yes
b. No

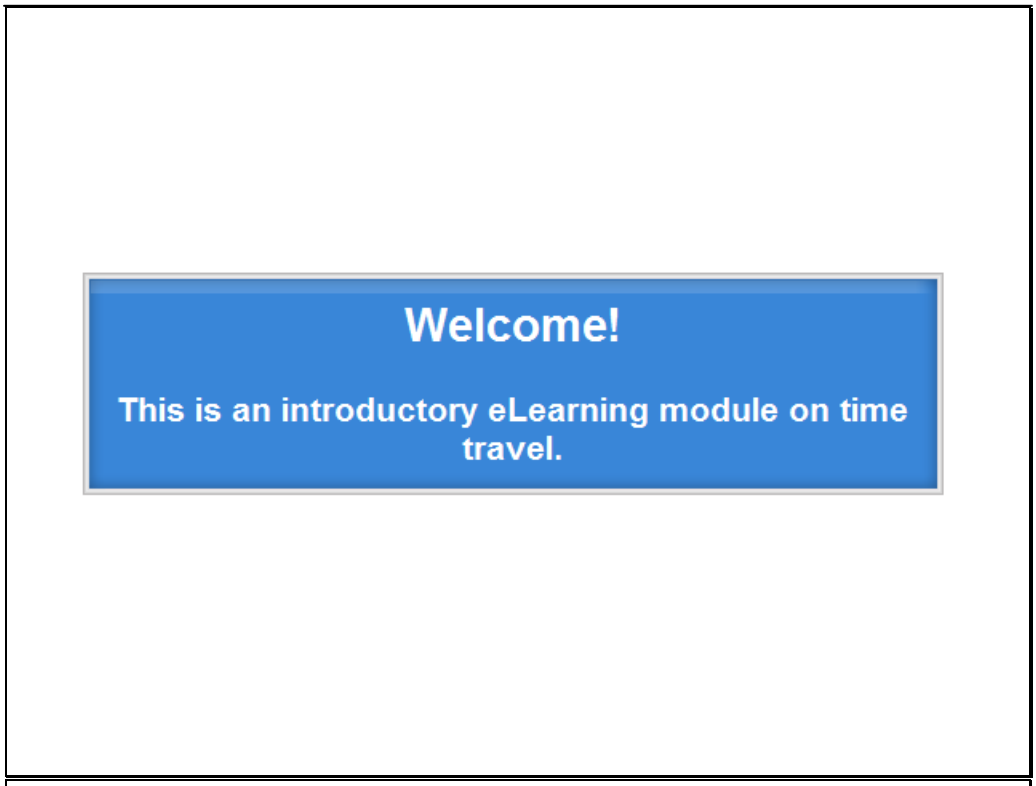
13. If you answered 'yes' to question 12, please indicate how many online courses you have taken:
_____

14. What degree are you currently working on?
a. Bachelors of Arts or Science (B.A. or B.S.)
b. Masters of Arts, Science, or Education (M.A., M.S., or M.Ed.)
c. Masters of Business Administration (M.B.A.)
d. Master of Fine Arts (M.F.A.)
e. Doctor of Education (D.Ed.)
f. Doctor of Philosophy (Ph.D.)
g. Other (Please specify: _____)

15. What is your major? _____

16. What is your current grade point average (GPA) approximately? Circle one.
1. 1.0-1.49
2. 1.5-1.9
3. 2.0-2.49
4. 2.5-2.9
5. 3.0-3.49
6. 3.5-3.9
7. 4.0
8. N/A or not known/don't know

Appendix F: ***Screen Shots of Control Module***



By the end of this course you will be able to:

1. Articulate the basic laws on time travel
2. Identify the correct sequences of symbols to operate the time travel device

Law #1

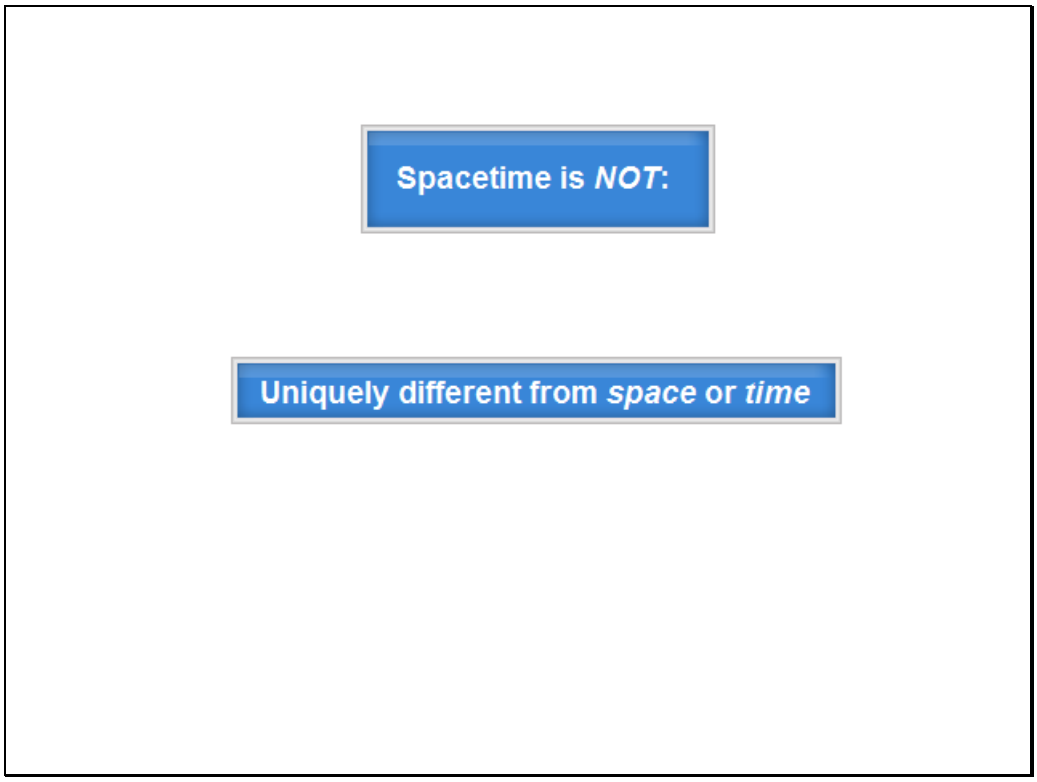
- Time is a fourth dimension. It is perhaps better understood as *spacetime.*
- It's good to understand what *spacetime* is not...

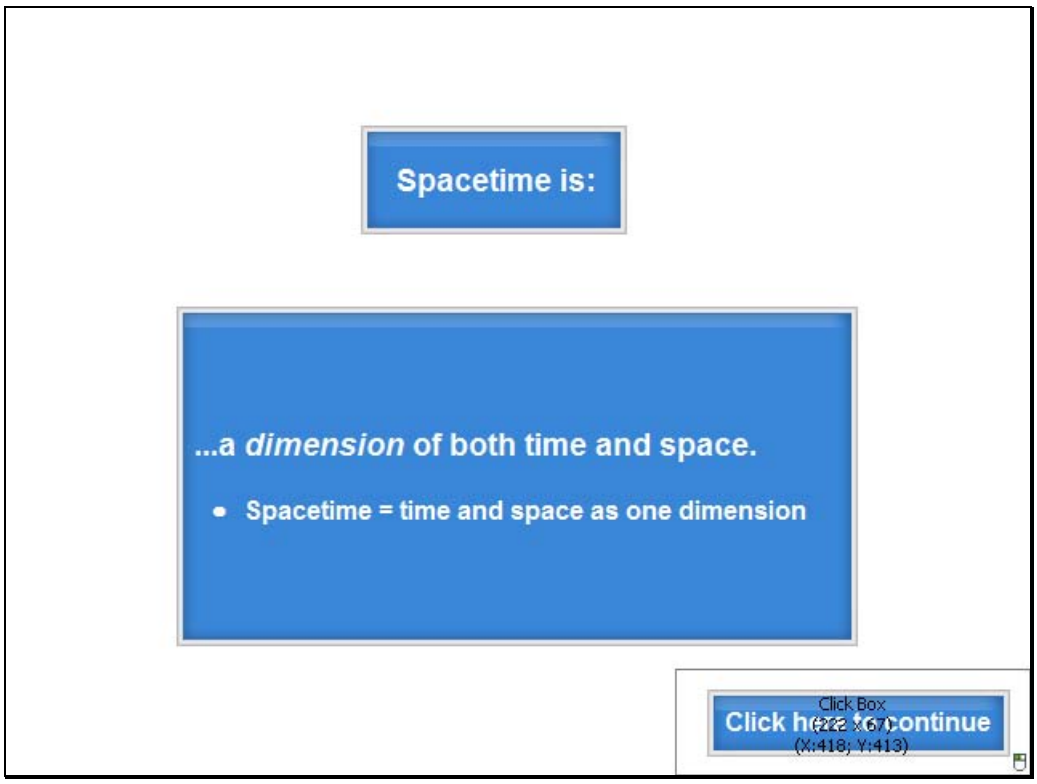
Click here to continue

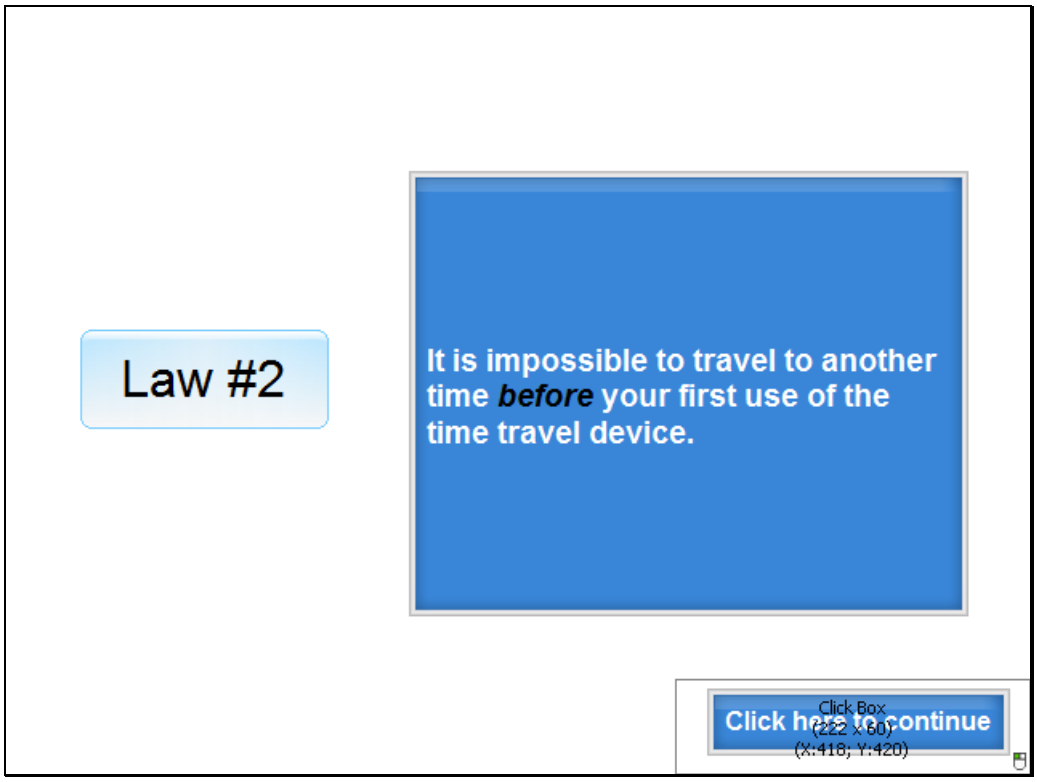
Click Box
(219 x 60)
(X:421; Y:420)

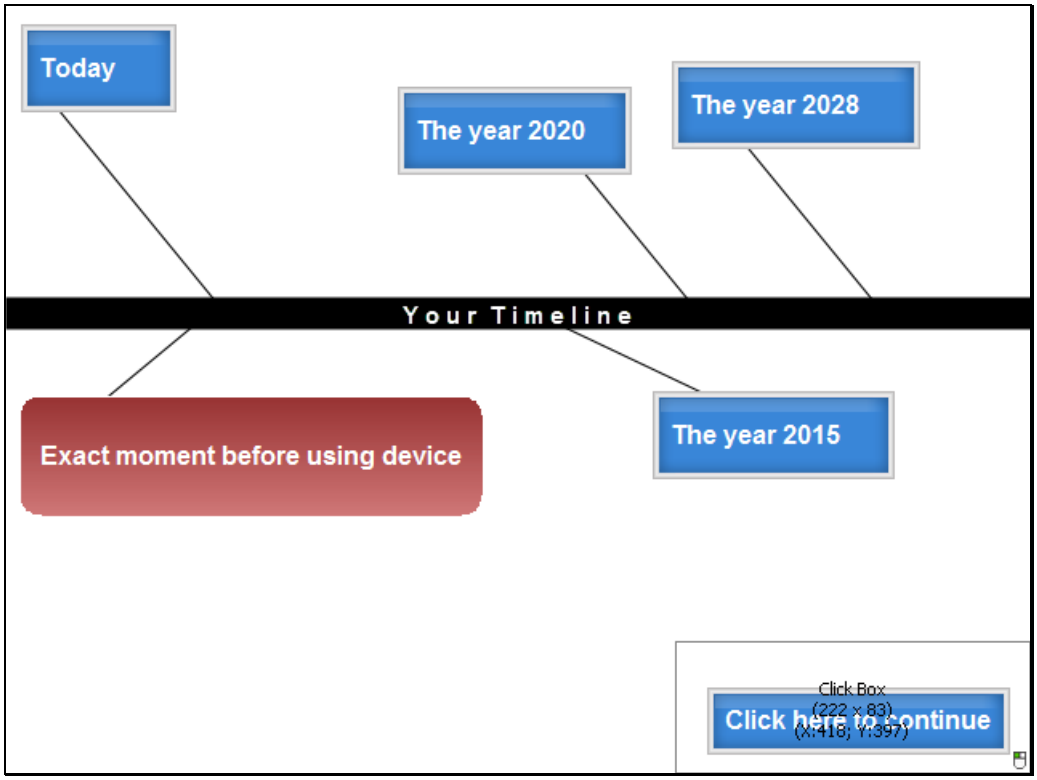
Spacetime is *NOT*:

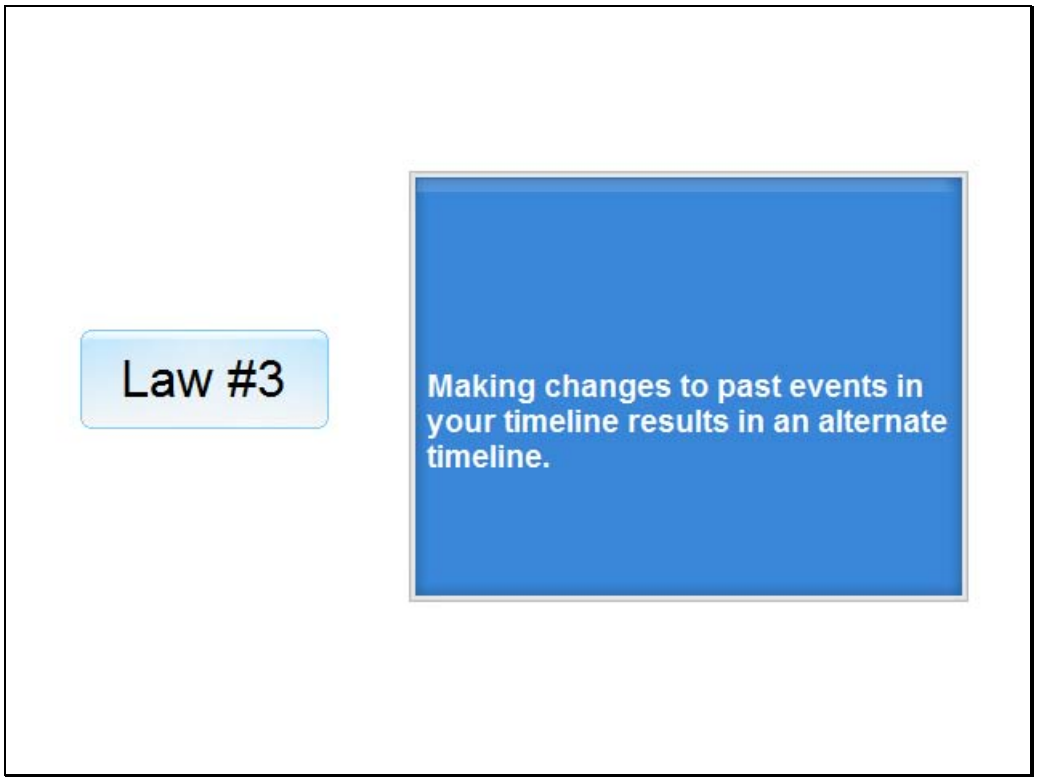
Spacetime is *NOT*:

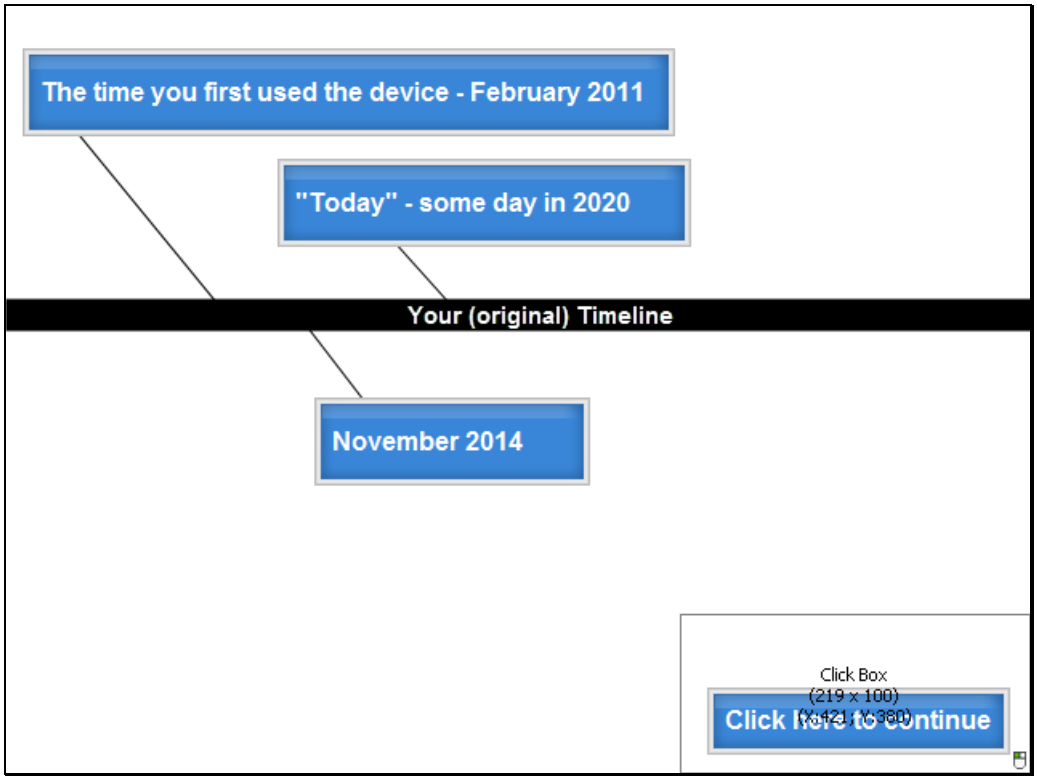

Spacetime is *NOT*:
Uniquely different from *space* or *time*

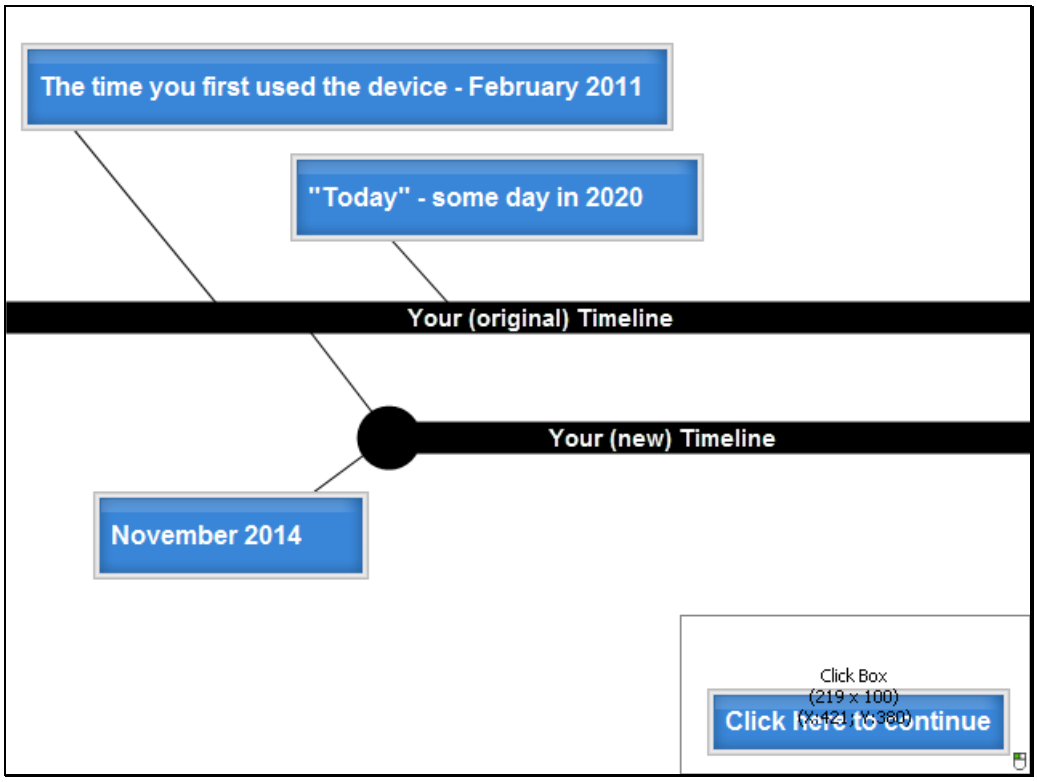

Spacetime is:
...a *dimension* of both time and space.
• Spacetime = time and space as one dimension
Click Box
(222 x 67)
(X:418; Y:413)
Click here to continue

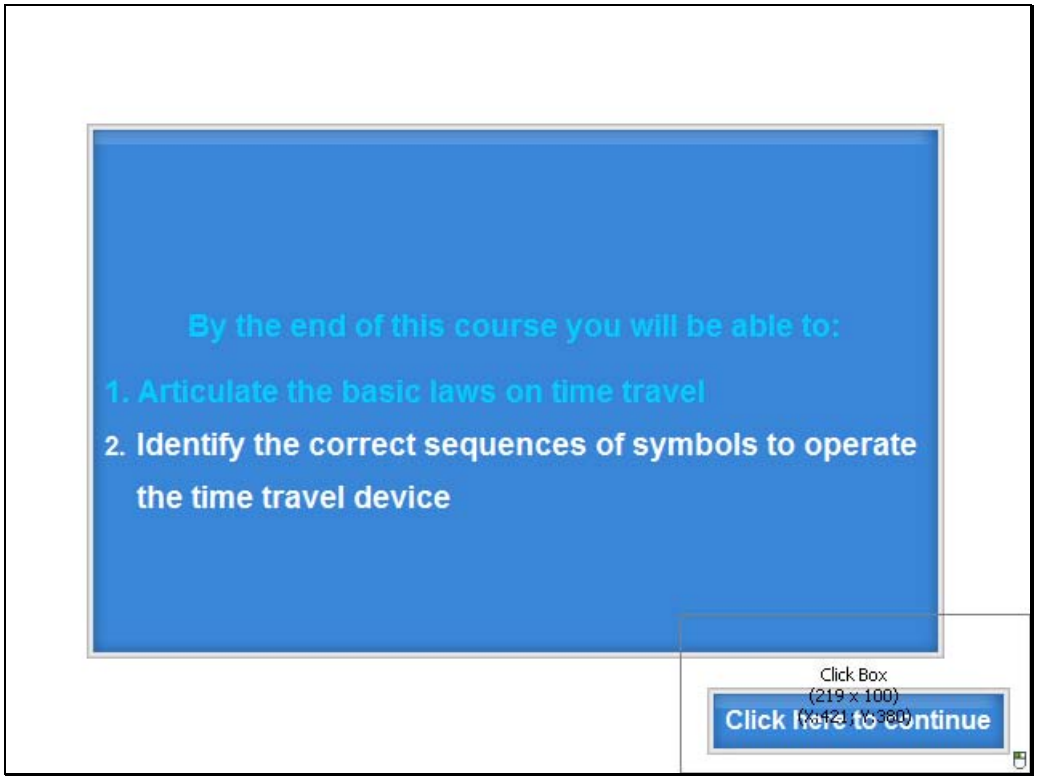

Law #2
It is impossible to travel to another time *before* your first use of the time travel device.
Click here to continue
Click Box
(222 x 60)
(X:418, Y:420)

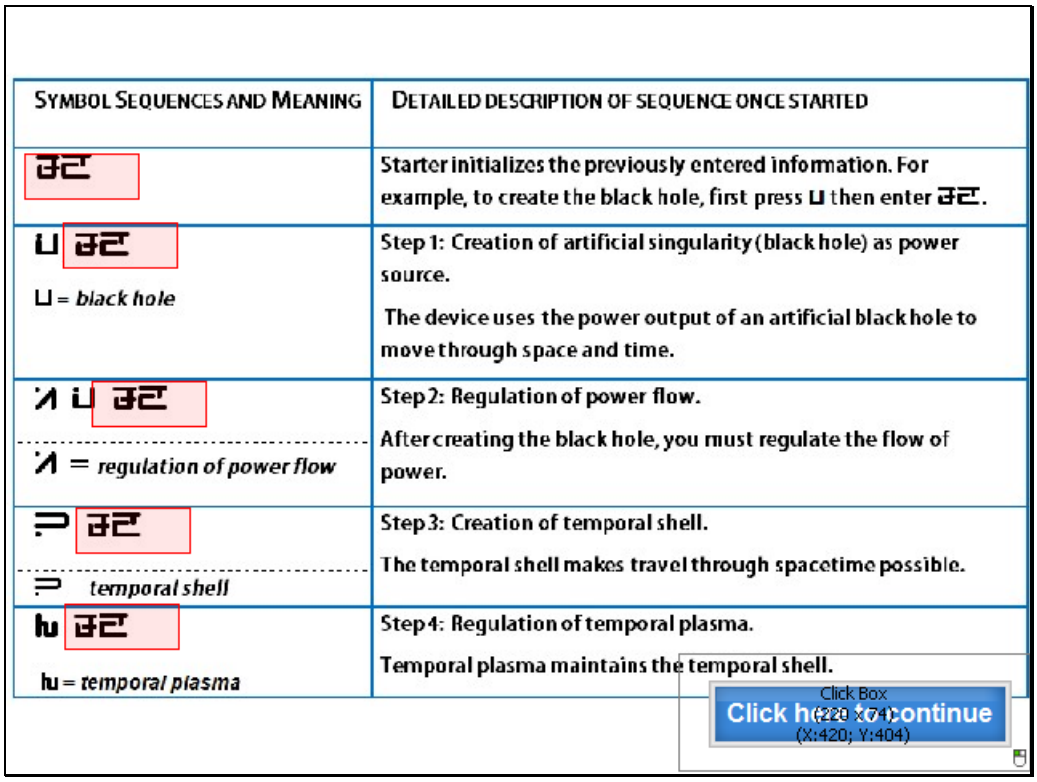

Today
The year 2020
The year 2028
Your Timeline
Exact moment before using device
The year 2015
Click here to continue
Click Box
(222 x 83)
(X:418, Y:397)

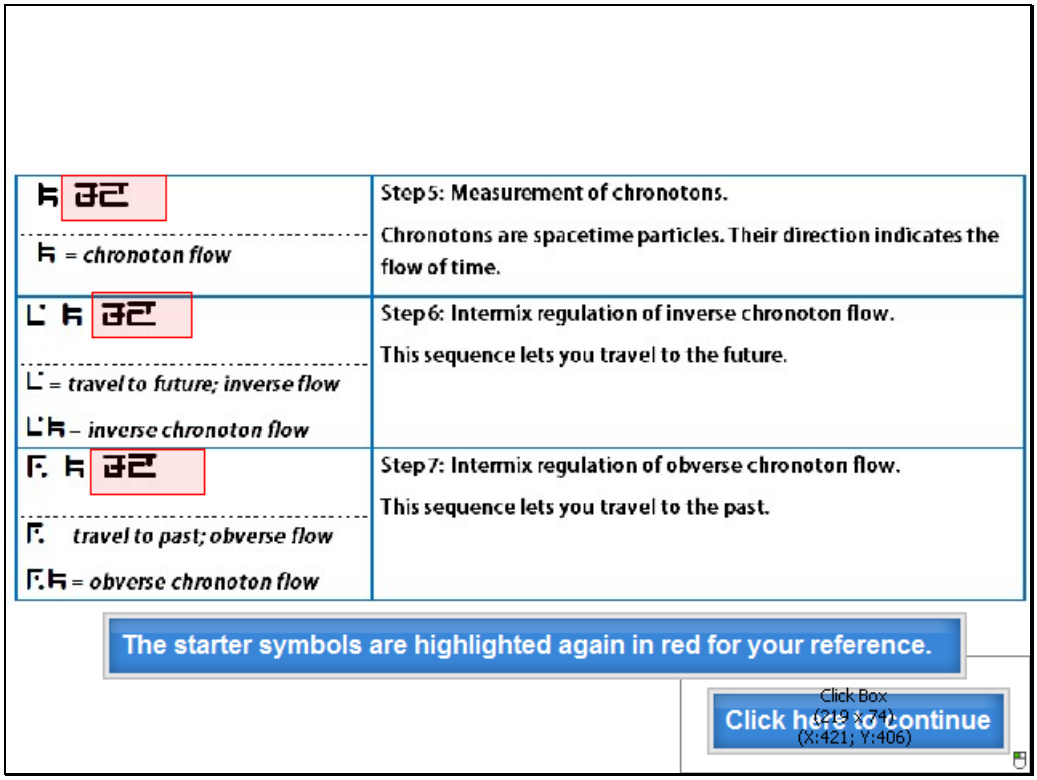

Law #3
Making changes to past events in your timeline results in an alternate timeline.


The time you first used the device - February 2011
"Today" - some day in 2020
Your (original) Timeline
November 2014
Click Box
(219 x 100)
Click here to continue

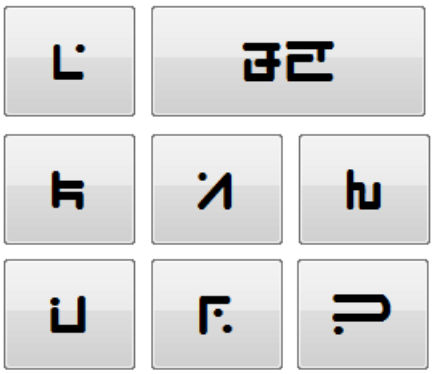

The time you first used the device - February 2011
"Today" - some day in 2020
Your (original) Timeline
Your (new) Timeline
November 2014
Click Box
(219 x 100)
Click here to continue


By the end of this course you will be able to:
1. Articulate the basic laws on time travel
2. Identify the correct sequences of symbols to operate the time travel device
Click Box
(219 x 100)
Click here to continue


SYMBOL SEQUENCES AND MEANING
DETAILED DESCRIPTION OF SEQUENCE ONCE STARTED
Starter initializes the previously entered information. For example, to create the black hole, first press ⊔ then enter ⋰⊏.
⊔ ⋰⊏
⊔ = black hole
Step 1: Creation of artificial singularity (black hole) as power source.
The device uses the power output of an artificial black hole to move through space and time.
⋋ ⊔ ⋰⊏
⋋ = regulation of power flow
Step 2: Regulation of power flow.
After creating the black hole, you must regulate the flow of power.
⊐ ⋰⊏
⊐ temporal shell
Step 3: Creation of temporal shell.
The temporal shell makes travel through spacetime possible.
hu ⋰⊏
hu = temporal plasma
Step 4: Regulation of temporal plasma.
Temporal plasma maintains the temporal shell.
Click Box
Click h continue
(X:420; Y:404)


⊢ ⋰⊏
⊢ = chronoton flow
Step 5: Measurement of chronotons.
Chronotons are spacetime particles. Their direction indicates the flow of time.
⊑ ⊢ ⋰⊏
⊑ = travel to future; inverse flow
⊑⊢ – inverse chronoton flow
Step 6: Intermix regulation of inverse chronoton flow.
This sequence lets you travel to the future.
⊏ ⊢ ⋰⊏
⊏ travel to past; obverse flow
⊏⊢ = obverse chronoton flow
Step 7: Intermix regulation of obverse chronoton flow.
This sequence lets you travel to the past.
The starter symbols are highlighted again in red for your reference.
Click Box
Click h continue
(X:421; Y:406)

This is the control panel of the time travel device. Notice the symbols.



In order to use the device, certain symbols must be pressed in the correct order.

Click Box
(219 x 100)
Click here to continue

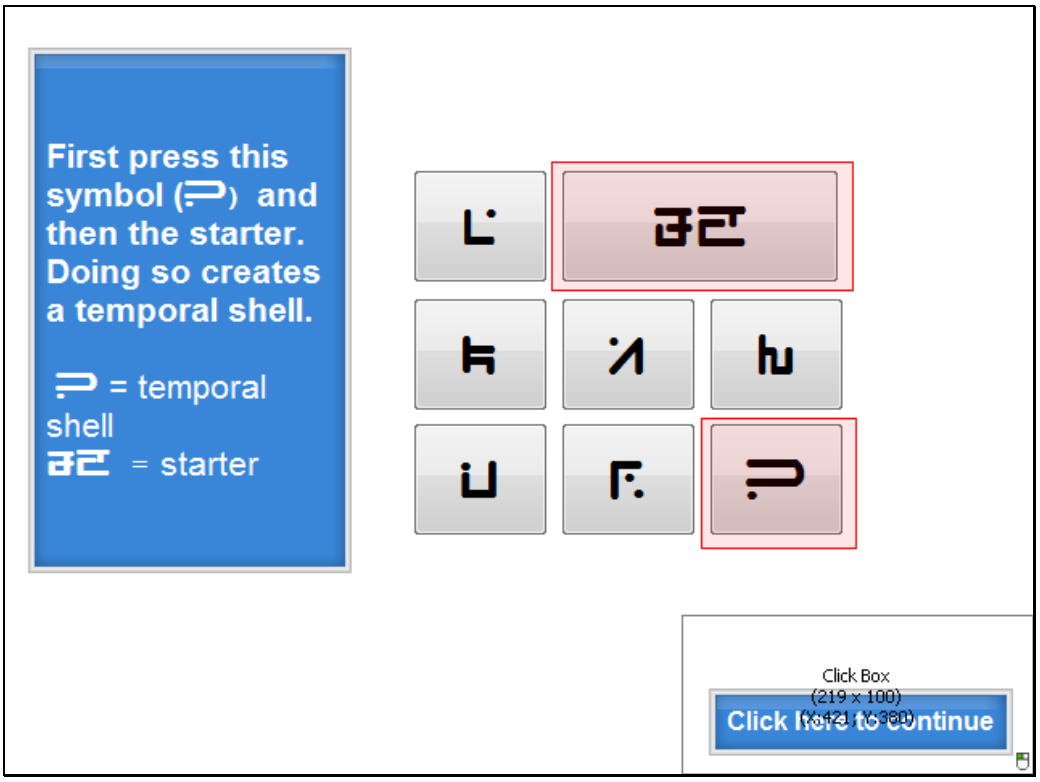
For example, this symbol represents the artificial black hole.

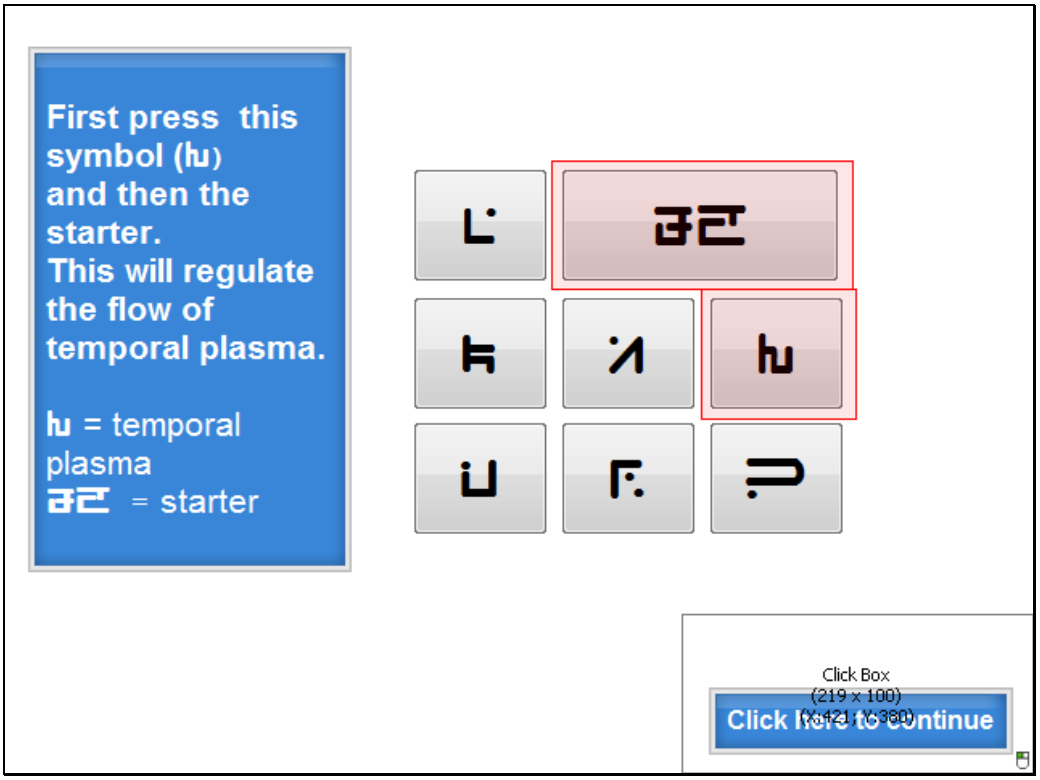
Click Box
(219 x 71)
(X:421; Y:409)
Click here to continue

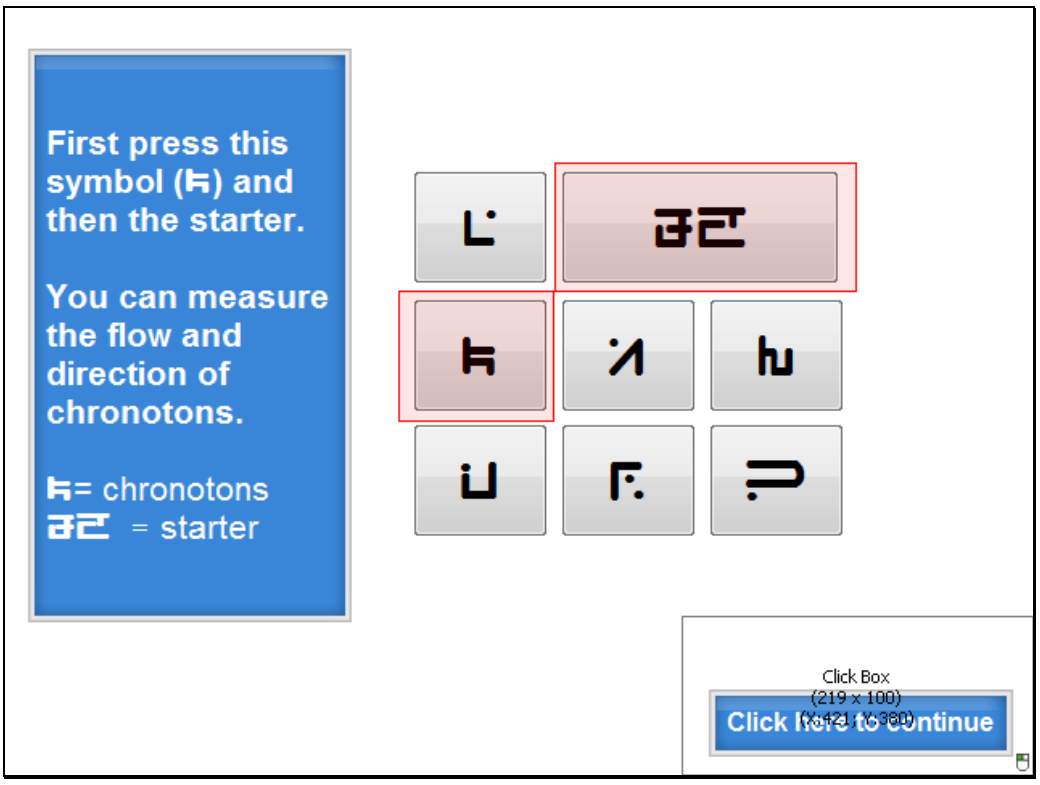
To regulate power flow, first press this symbol (), then (), and finally press the starter.

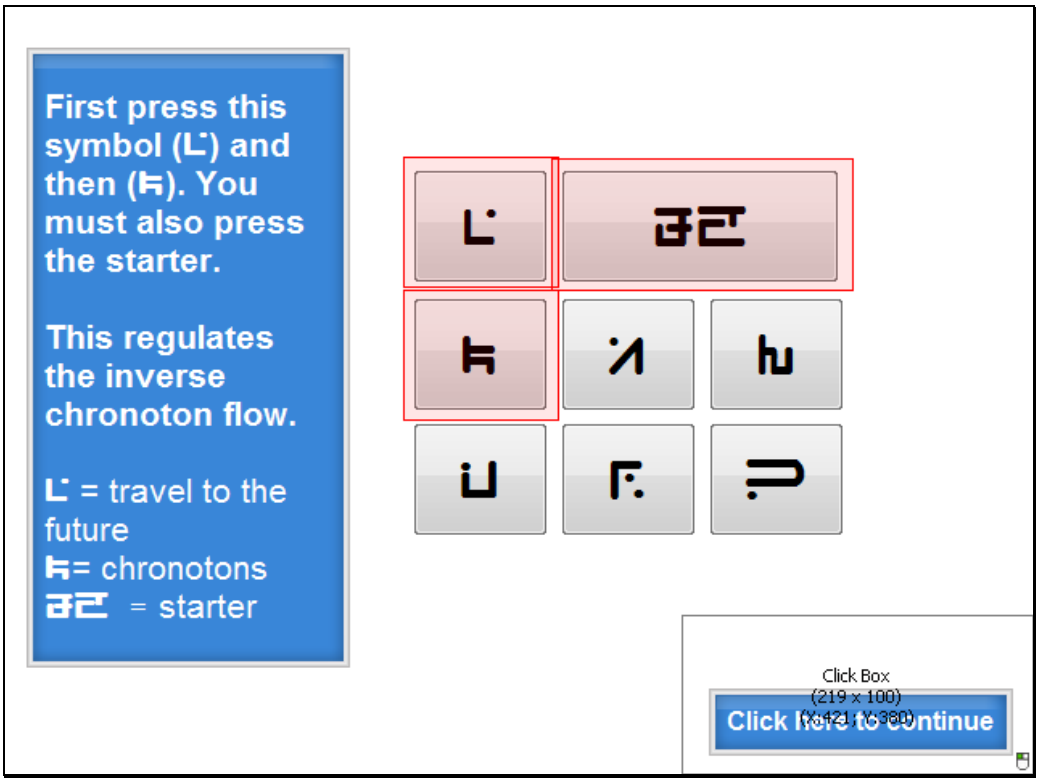
 = power flow regulator
 = black hole
 = starter

Click Box
(219 x 100)
(X:421; Y:380)
Click here to continue


First press this symbol ( ) and then the starter. Doing so creates a temporal shell.
= temporal shell
= starter
Click Box
(219 x 100)
Click here to Continue


First press this symbol ( ) and then the starter. This will regulate the flow of temporal plasma.
= temporal plasma
= starter
Click Box
(219 x 100)
Click here to Continue


First press this symbol (ϟ) and then the starter.
You can measure the flow and direction of chronotons.
ϟ= chronotons
ϡ = starter
Click Box
(219 x 100)
Click here to continue


First press this symbol (ϟ) and then (ϟ). You must also press the starter.
This regulates the inverse chronoton flow.
ϟ = travel to the future
ϟ= chronotons
ϡ = starter
Click Box
(219 x 100)
Click here to continue

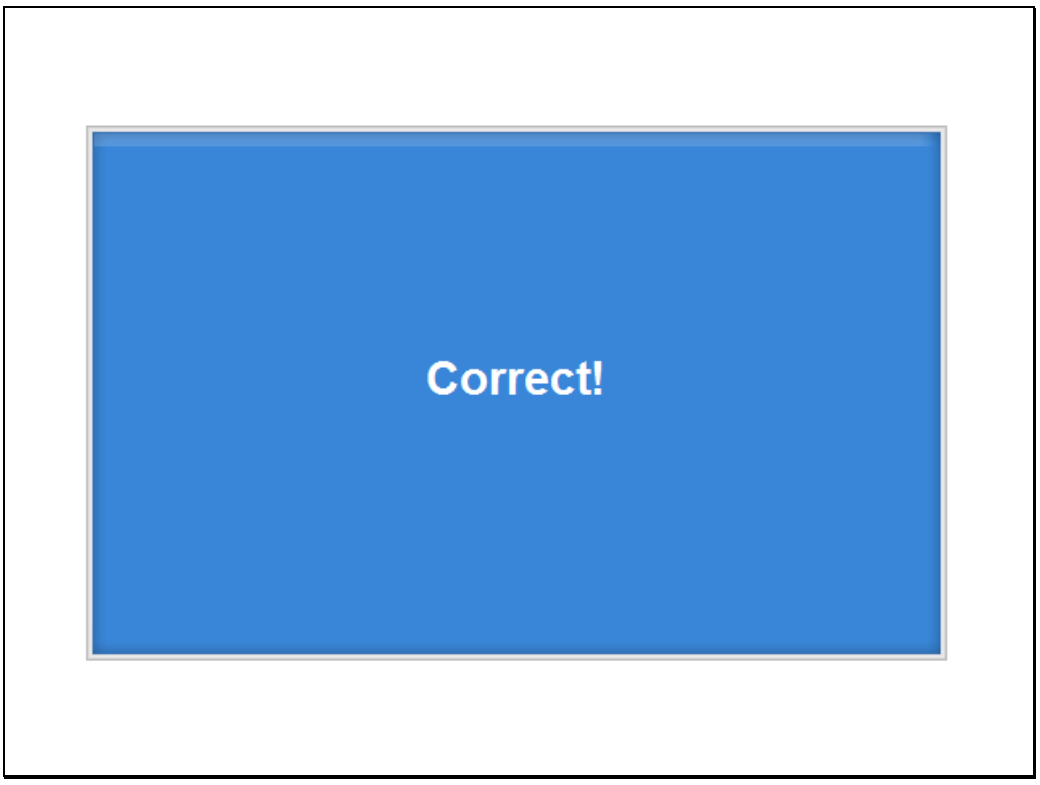
First press this symbol (F.) and then (h). You must also press the starter.

This regulates the obverse chronoton flow.

F. = travel to the past
h= chronotons
= starter

Click Box
(219 x 100)
(X:421 Y:380)
Click here to continue

It's time for you to practice your knowledge of the control panel.

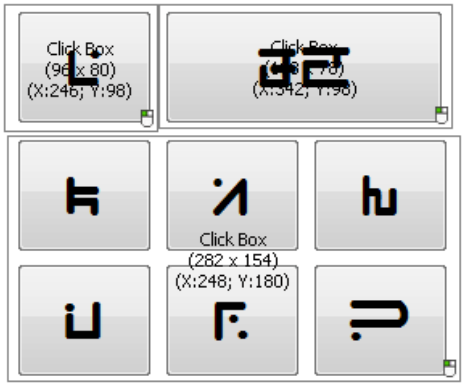

Correct!


Correct! Very good.
Keep up the good work!

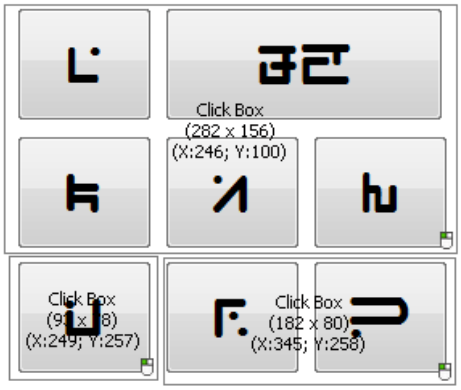
Wrong Answer,

Please try again.

Press the symbol for the starter.



Press the symbol for the black hole.

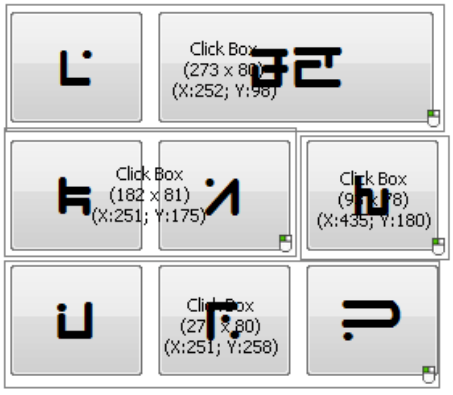


After starting the black hole it is important to regulate the power flow of the black hole.

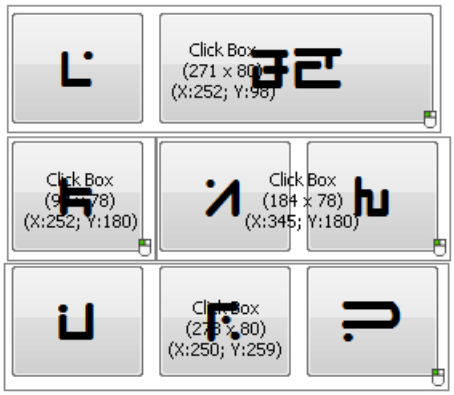
Which symbol regulates its power flow?

Press the symbol for the temporal shell.

Press the symbol for the temporal plasma.



Press the symbol for the chronotons.



Press the symbol for the inverse chronoton flow - this symbol lets you travel to the <u>future</u>.

Press the symbol for the obverse chronoton flow - this symbol lets you travel to the past.

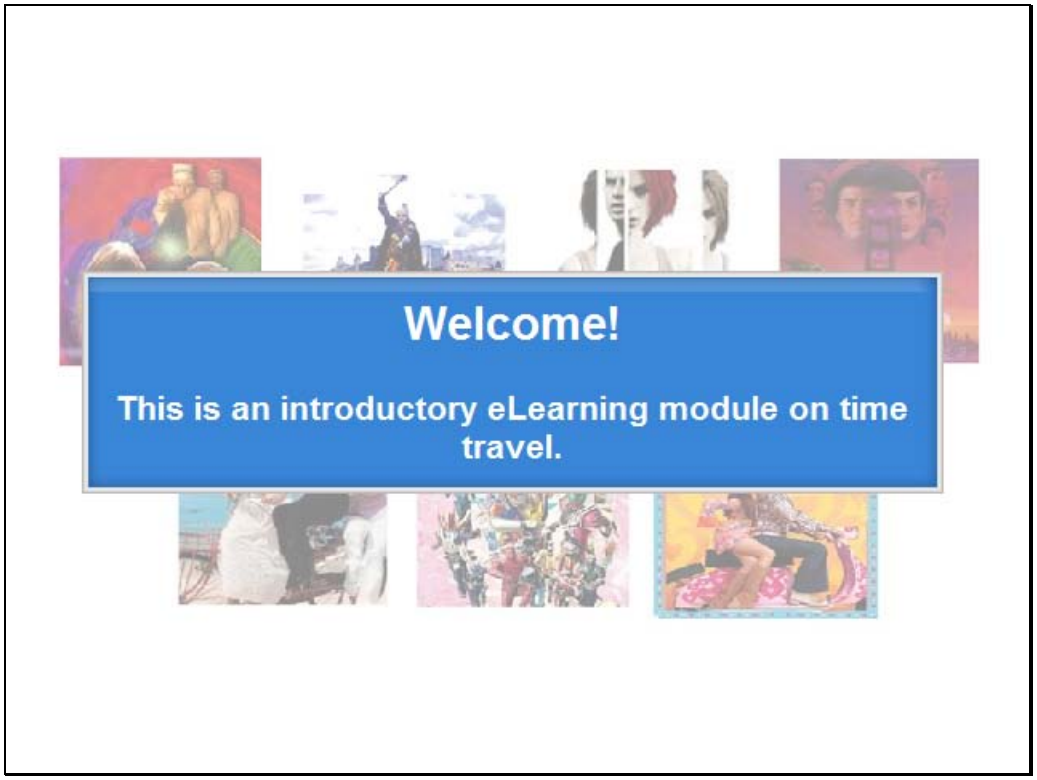
CONGRATULATIONS!

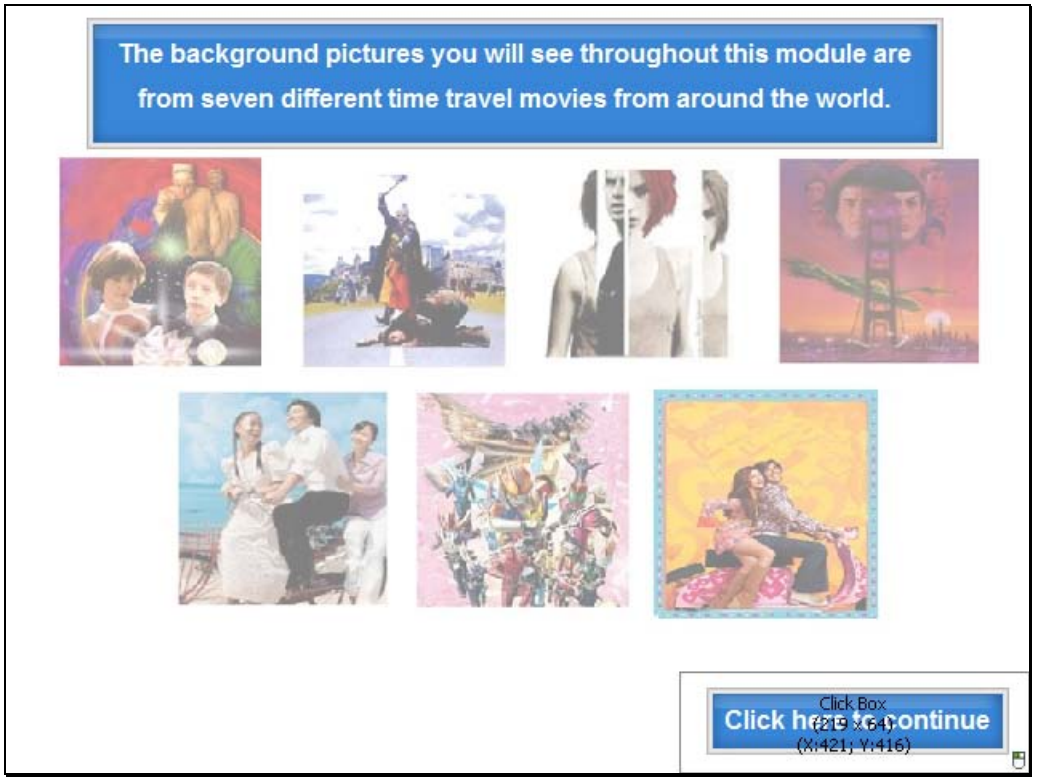
You are now ready to be tested on your knowledge of the time travel device.

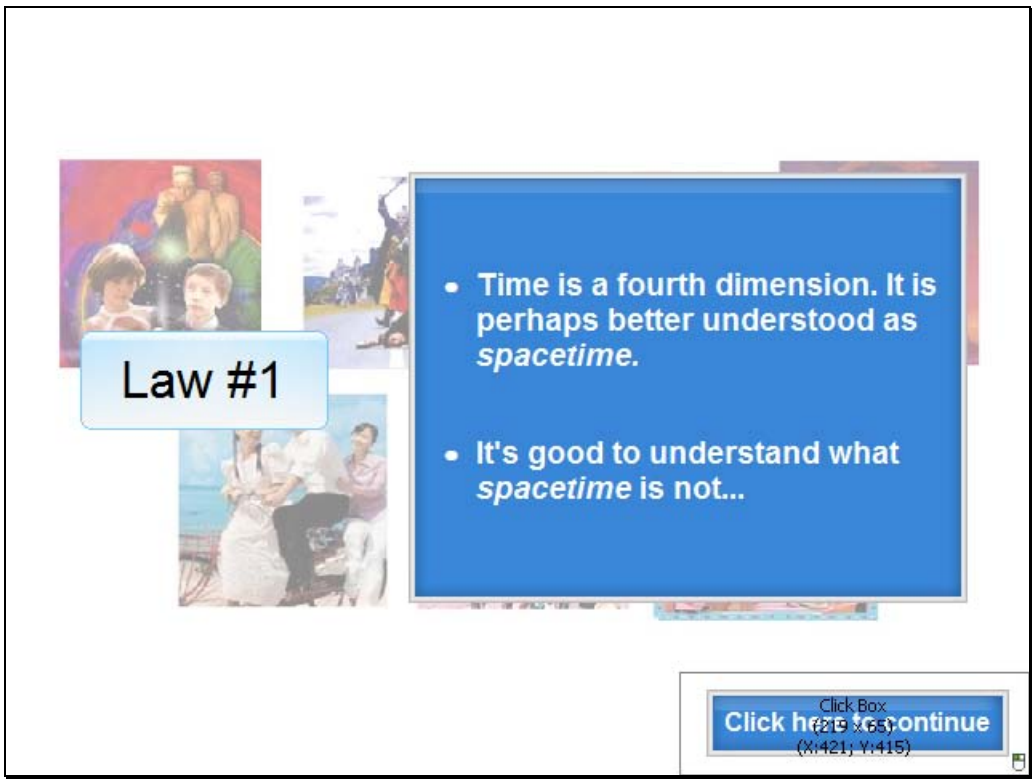
You may take the test now.

Close the module when you are ready to take the test.

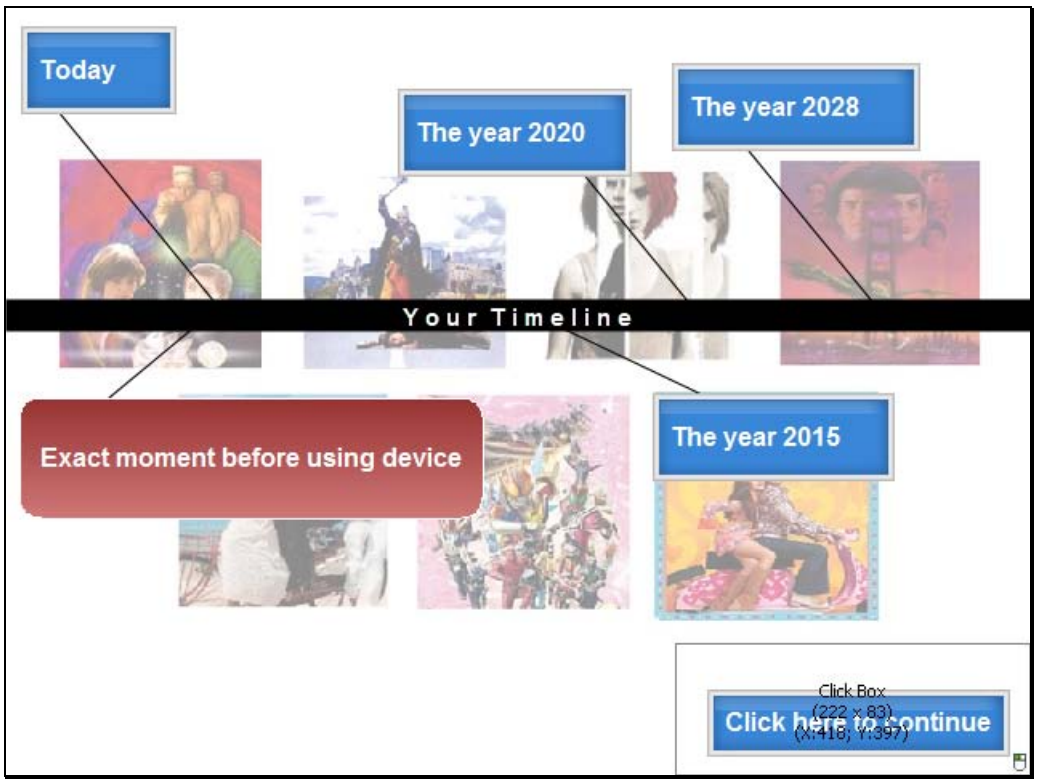
Appendix G: ***Selected screenshots of experimental module with images***



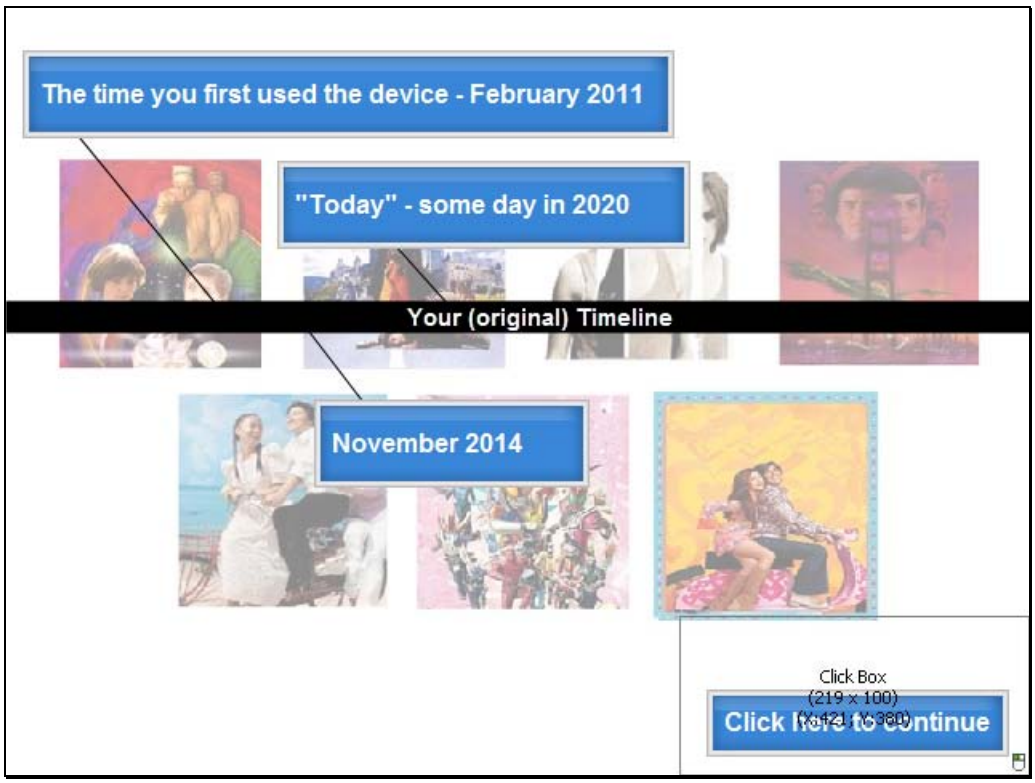


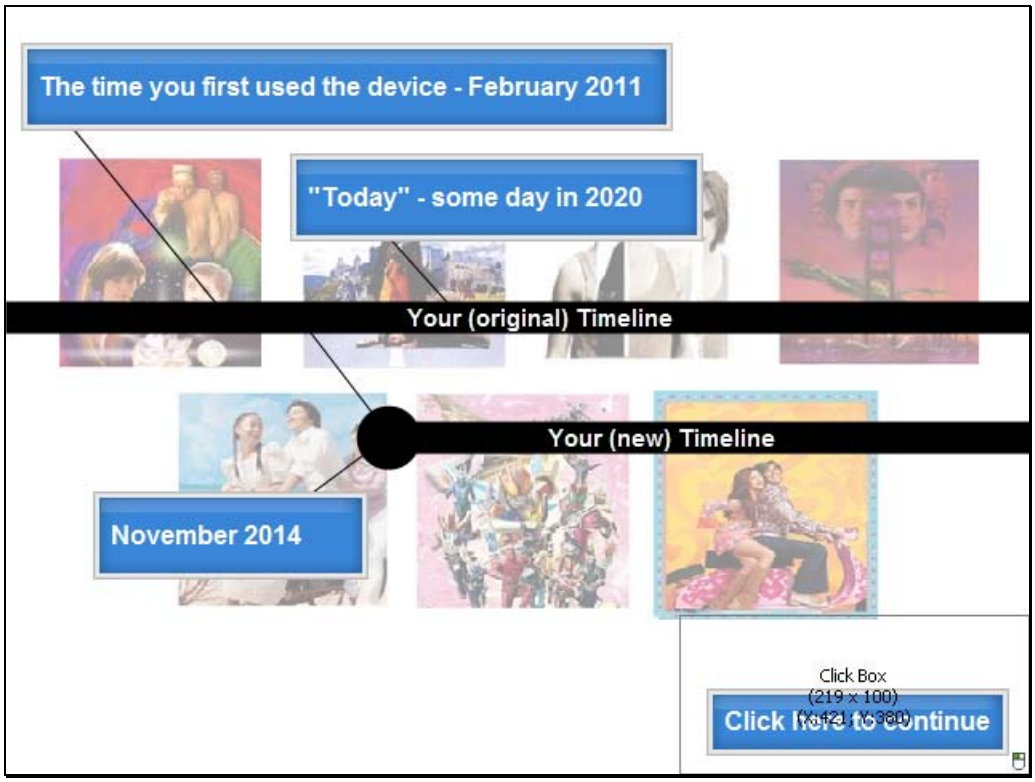

Law #1
Time is a fourth dimension. It is perhaps better understood as *spacetime.*
It's good to understand what *spacetime* is not...
Click here to continue
Click Box
(219 x 65)
(X:421; Y:415)


Law #2
It is impossible to travel to another time ***before*** your first use of the time travel device.
Click here to continue
Click Box
(222 x 60)
(X:418; Y:420)


Today
The year 2020
The year 2028
Your Timeline
Exact moment before using device
The year 2015
Click Box
(222 x 83)
(x:418, y:397)
Click here to continue


Law #3
Making changes to past events in your timeline results in an alternate timeline.

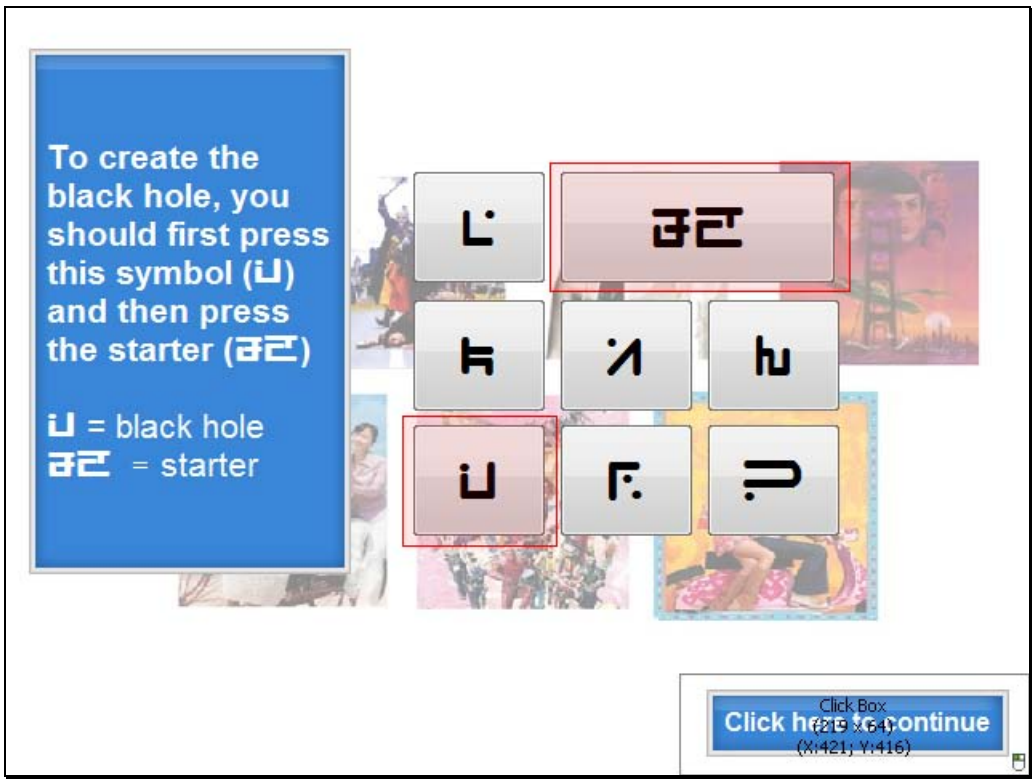

The time you first used the device - February 2011
"Today" - some day in 2020
Your (original) Timeline
November 2014
Click Box
(219 x 100)
Click here to continue

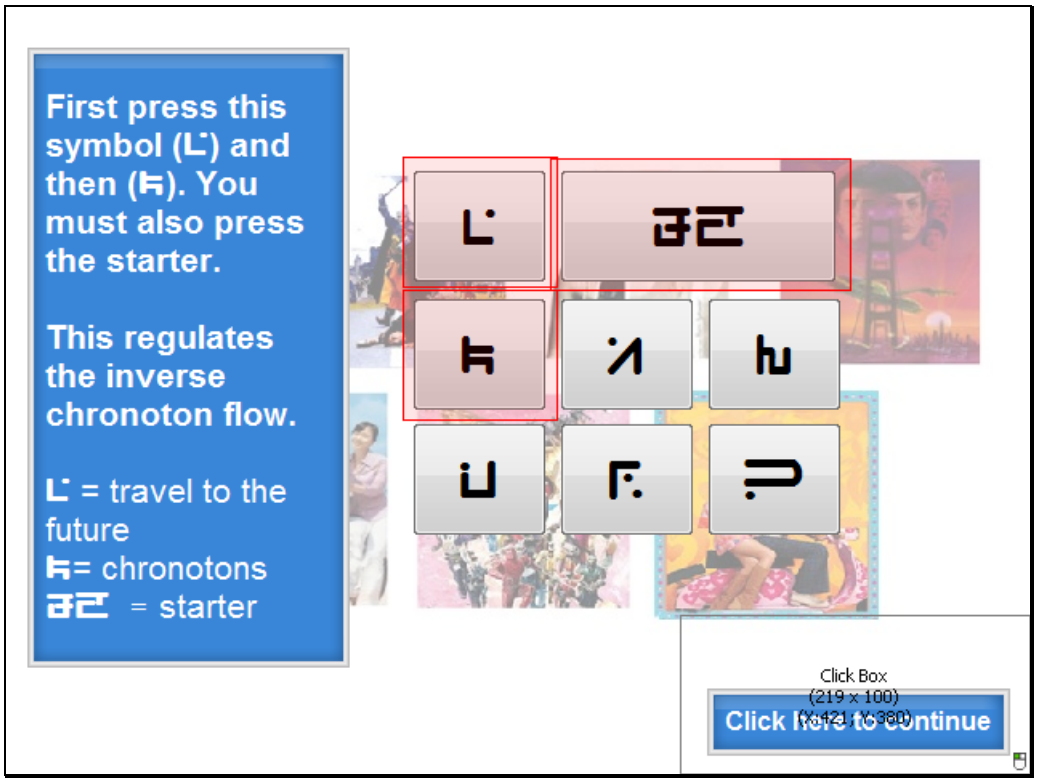

The time you first used the device - February 2011
"Today" - some day in 2020
Your (original) Timeline
Your (new) Timeline
November 2014
Click Box
(219 x 100)
Click here to continue

This is the control panel of the time travel device. Notice the symbols.

In order to use the device, certain symbols must be pressed in the correct order.

Click Box
(219 x 100)
Click here to continue


To create the black hole, you should first press this symbol (𐤉) and then press the starter (𐤀𐤓)
𐤉 = black hole
𐤀𐤓 = starter
Click Box
(219 x 64)
(X:421; Y:416)
Click here to continue


First press this symbol (𐤋) and then (𐤇). You must also press the starter.
This regulates the inverse chronoton flow.
𐤋 = travel to the future
𐤇= chronotons
𐤀𐤓 = starter
Click Box
(219 x 100)
(X:421; Y:380)
Click here to continue