CREATING AN EFFECTIVE ARGUMENT IN POWERPOINT: EVALUATING THE ASSERTION EVIDENCE APPROACH



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Creating An Effective Argument in PowerPoint: Evaluating the Assertion Evidence Approach

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Creating an Effective Argument in PowerPoint: Evaluating the Assertion-Evidence Approach

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ABSTRACT

Research concerning instructor methods of PowerPoint design for classroom lectures has produced mixed results in their effects on student learning. The present study compared common practice design with assertion evidence design and whether an instructor engages in passive or active instructions in their effect on immediate and delayed recall of material. Participants were 27 undergraduate students with from a variety of academic lecture disciplines. Participants were presented either a common practice or assertion evidence lecture and received either passive or active instructions. One week after the lecture, they were administered a second recall task. Results demonstrated that receiving passive instructions with common practice presentation or receiving active instructions with assertion evidence presentations yielded the highest recall of information. This suggests that how a professor uses the lecture to engage students impacts memory consolidation.

Creating an effective argument in PowerPoint: Evaluating the assertion-evidence approach

Any student today will tell you - there are few pains like sitting in a class lecture trying to make sense of a complicated lecture. When students lose interest due to frustration, boredom, or lack of understanding, they stop paying attention, and therefore stop learning (Cooper, 2009; Harp & Mayer, 1997; Mayer & Sims, 1994; Schoeneborn, 2013; Yang, Chang, Chien, Chien & Tseng, 2013; Yilmazel-Sahin, 2009). At the same time, it's challenging to figure out how to adapt the use of teaching styles and technology to fit student needs and previous research has produced mixed results (Alley & Neeley, 2005; Alley, Schrieber, Muffo, 2006; Alley, Schreiber, Diesel, Ramsdell & Borrego, 2007; Cooper, 2009; Dobson, 2006; Doumont, 2005; Gabriel, 2008; Garner & Alley, 2013).

One common agreement among researchers is that in order to promote effective learning, in-class teaching aids should incorporate principles of learning informed by cognitive processes. Adapting to those needs requires that teaching aids be tested, especially technological aids that have the potential for distraction and need to be used effectively (Mayer, Griffith, Jurkowitz & Rothman, 2008; Nouri & Shahid, 2005; Szazbo & Hastings, 2005; Tufte, 2003). In the present study, the effectiveness of common uses of Microsoft PowerPoint was compared with a relatively new approach to using PowerPoint.

Advantages to Microsoft PowerPoint as a Presentation Tool

Microsoft PowerPoint has made teaching significantly easier by providing guidance during a lecture, displaying concepts in an organized fashion, and keeping students engaged (Alley et al., 2005; Alley et al., 2006; Alley et al., 2007; Doumont, 2005; Cornwell, 2005; Garner & Alley, 2005; Susskind, 2005). It's user-friendly , and enables students to easily take notes

during a lecture. Countless studies have been conducted to demonstrate the effectiveness of Microsoft PowerPoint on long-term retention, but only when used appropriately (Alley et al., 2007; Doumont, 2005; Gabriel, 2008; Garner & Alley, 2013; Lee, Hsaio, Ho., 2014; Yilmazel-Sahin, 2009). Research on PowerPoint has certainly demonstrated it can be a useful tool, as lecturers are able to project information and images while speaking. For instance, PowerPoint helps to ensure that students and teachers are on the same level of understanding (Doumont, 2005; Fedisson & Braidic, 2007; Visser, 2009), and keeps class discussions on track (Bui & McDaniel, 2015; Dunlosky, Rawson, Marsh, Nathan & Willingham, 2013; Einstein & Hunt, 1980). PowerPoint has a direct correlation with mental organization and can simplify that process drastically for students, which aids in long-term retention (Bui & McDaniel, 2015; Einstein & Hunt, 1980; Lanir, Booth & Hawkey, 2010; Klein & Kihlstrom, 1986; Mayer & Sims, 1994). In fact, previous studies have demonstrated that effective visual organization of a slide is almost "photo-copied" into a student's memory (Alley et al., 2005; Alley et al., 2006; Alley et al., 2007; Garner & Alley, 2013; Graesser, Jeon & Dufty, 2008; Young & Bellezza,1982).

Problems with technology in the classroom

Despite the advantages that can be gained for teaching when PowerPoint is used, there are several drawbacks to using multimedia technology, specifically, there may be negative consequences of distractions and divided attention (Kane & Engle, 2000; Sweller, Tierney & Cooper, 1990). These drawbacks may interact with other factors within the classroom environment to hinder attention and memory processing, such as factors within the individual student, factors involving other students, and factors involving the instructor. With that said, these drawbacks also indicate that there is so much more going on with the use of technology in the classroom than just the design of the PowerPoint. For example, a student may be using a laptop to

take notes, which has been demonstrated to be distracting (Fried, 2008; Sana,Weston & Cepeda, 2013).While these articles call into question student use of technology in the classroom, they also raise interesting questions about an instructor's use of technology in the classroom.

The advantages and disadvantages of the use of PowerPoint have shown that it's a complex area of research, which explains the conflicting results and slow progress in improving multimedia learning. With that said, to make sense of the complexity of multimedia learning for the purpose of the present study, working memory processing were considered, followed by cognitive load theory, memory consolidation, dual-modality theory, cognitive theory of multimedia learning and several principles of multimedia learning that previous researchers have developed. This background brought insight into the lecturer's use of PowerPoint and how PowerPoint impacts long-term memory and whether there certain design styles are more effective than others.

The present study attempted to gage how instructors approach the use of PowerPoint and how "common practice" approaches compared with less traditional designs that have been presented as more conducive for cognitive processing. Specifically, the present study targeted the sentence-headline approach, which is presently known as the Assertion-Evidence Approach developed by Alley (2005).

Working Memory

The first thing to recognize in terms of information processing is the distinction between attention processing occurring in real time and memory consolidation. With that said, working memory is an important process in learning as a precursor to memory consolidation (Baddeley, 1986; Jung & Reid, 2009; Kane & Engle, 2000; Masson & McDaniel, 1981). When working memory is inhibited, cognitive load increases and the student becomes disengaged, which

prevents consolidation of information (Mandler, 2011; Rawson & Kintsch, 2002; Rawson & Overschelde, 2007). Baddeley (1986) developed a model for working memory, which provides a helpful glimpse at how a student allocates attention and processes information. Working memory is divided into three channels: the central executive, phonological loop and the visuospatial sketchpad. The phonological loop processes verbal information, the visuospatial sketchpad process visual information, and the central executive is tasked with decision-making and regulating the phonological loop and visuospatial sketchpad (Baddeley, 1986). These channels are limited in terms of how much information they can hold and for how long (Awh & Jonides, Baddeley, 2003; 2011; Miller, 1957). When working memory is inhibited or the mental capacity is disrupted, cognitive load increases (Baddeley, 1986; Kane & Engle, 2000; Rawson & Kintsch, 2002).

The Cognitive Load Theory (Chandler & Sweller, 1991; 1992; Sweller, 1998) accounts for the amount of information processing an individual can handle in a specific amount of time. Higher cognitive load is disruptive to working memory (the portion of memory that actively processes incoming information), because the student experiences higher demands on capacity. Specifically, attention resources are removed from memory consolidation and allocated to understand materials (Tufte, 2003; Vik 2004). The average working memory capacity can handle three visual items (Awh & Jonides, 2011; Baddeley, 2003; Kane & Engle 2000). Higher cognitive load occurs when this capacity is disrupted and the student loses available resources in their attention processing (Baddeley & Hitch, 1974; Baddeley, 2000). When the effective functioning of working memory is disrupted, encoding and storage of information is disrupted, and the student doesn't learn. Disruptions in attention and working memory detract from the overall

classroom experience (Alloway, Gathercole, Kirkwood & Elliot, 2008; Jung & Reid, 2009; Nuthall, 2000).

Memory Consolidation

As a student processes information, they are consolidating it for storage in long term memory. One process of consolidation is organization, which refers to how we mentally organize or map concepts (Masson & Miller, 1983; McDaniel & Masson, 1977, Tulving, 1972; Tulving & Donaldson, 1972; Young & Bellezza, 1982). Essentially, as we take in information and start to commit it to long-term memory, we create "mental outlines" of the information and begin to connect new information to previously learned information (Baddeley, 2003; Masson & McDaniel, 1981; Tulving & Donaldson, 1972). Organizing the information into headings and subheadings in our mind allows us to store that information much faster. Having information mentally organized can greatly aid in retrieval later on, allowing the connection to previously learned information to become stronger (Garner & Alley, 2013; Karafantis & Lapadula, 2011; Maki, Willmon & Pietan, 2009; McDaniel & Einstein, 2000; McNamara, 2011; McNamara & Shapiro, 2005; Muller, Bewes, Sharma & Reimannt, 2007).

For the purposes of the present study, it's important to consider how the design features of a PowerPoint presentation could either facilitate or hinder the processes of organization and consolidation. The ability to create headings and subheadings on a screen, as well as add images and other forms of multimedia allows the instructor to present information that is already organized. Having organized information presented on a screen aids in the process of encoding, which is the way in which information is stored (Chatterjee, 2012; Dalton, Robinson, Lovvorn, Smith, Alvey & Proctor, 2015; Lanir et al., 2010; Paivio, 1969; 1975; 1986; Visser, 2009). Again, this occurs by connecting newer information to previously learned information.

On the other hand, design features could hinder mental organization and consolidation. For instance, Garner and Alley (2013) indicate that the text box feature of PowerPoint allows the user to put as much text as they desire on a slide. However, as they discovered, having paragraphs of text on a slide overwhelms the student and they become disengaged (Meyer, 2001, 2005; Tufte, 2003). PowerPoint also allows for endless options in terms of color use, font use, and image use. Part of the reason that research in this area has been inconclusive is because some of these design combinations are effective and some aren't, but the combinations are endless (Lanir et al., 2010; Garner & Alley, 2013). Understanding attention and memory processing provides the foundation for effectively evaluating PowerPoint design.

Dual-Modality Theory

PowerPoint can facilitate organization effectively when it follows the dual modality theory. This theory was developed by Allan Paivio (1975) asserting that learning is most effective when information is presented both verbally and visually. This is because processing and comprehension of this information is enhanced when both channels are activated.

Therefore, in terms of PowerPoint, adding images, charts, and graphs helps present information through different modalities, increases attention, retention and aids in retrieval (Horvath, 2014; Meyer, 2001, 2005; Paivio 1975, 1986). However, when the information is not organized effectively, adding additional images can increase a student's cognitive load significantly (Garner & Alley, 2013; Mackiewicz, 2007; Mayer & Sims, 1994; Mayer, Jurkowitz, & Rothman, 2008; Visser 2009). In many cases, students are left to create their own inferences and draw their own conclusions about the relationships between concepts, how a header relates to the bullets underneath, and how the bullet points relate to each other. The resulting increase in

cognitive load is detrimental to those learning processes (Alley & Neeley 2005; Garner & Alley, 2013).

There are three types of cognitive load to consider in multimedia instruction. The first of these is *extraneous cognitive load*, where load is increased by the introduction of unnecessary information, or the ineffective presentation of material that students need to know. For instance, the use of unrelated images may distract the learner (Apperson, Laws & Scepansky, 2006; Kane & Engle, 2000; Mayer & Sims, 1994; Tangen, Constable, Durrant, Teeter, Beston, & Kim, 2011). *Intrinsic cognitive load* is related to task difficulty and how difficult the information is to understand. For example, presenting a complex chemical reaction is likely to have more intrinsic cognitive load than a simple chemical reaction. *Germane cognitive load* refers the amount of effort that the student is using to connect information in working memory with information stored in long-term memory (Baddeley 1992; Cooper 2009; Visser 2009). For instance, a student with no exposure to the information will have more germane cognitive load than a student well-versed in the subject matter (McNamara & Shapiro, 2005; McNamara, 2011). When an instructor minimizes extraneous and germane cognitive load, they are able to facilitate student learning by not exceeding working memory capacity. (Chandler & Sweller 1991, 1992; Cooper 2009; Mayer et al. 2008; Pollock, Chandler & Sweller 2002). For instance, instructors could consider presenting only necessary text or images and including opportunities for students to actively engage with the material (e.g., by developing discussion questions). Therefore, in terms of PowerPoint design, instructors should minimize the extraneous cognitive load to reduce students' germane cognitive load.

The danger of using PowerPoint to develop a lecture is that its current features make it very easy to increase cognitive load. For example, the use of bulleted lists fail to indicate the

relationships between the concepts in the list and the relationship to the slide topic. Additionally, the text box feature allows the user to present as much text as they desire, which easily increases cognitive load (Garner & Alley 2013; Meyer, 2001, 2005).

Research has sought to develop PowerPoint design to promote more effective encoding of information by minimizing cognitive load. Mayer (2001) developed the Cognitive Theory of Multimedia Learning, which offered guidelines for multimedia design to support working memory processing. He, along with several others (Alley & Neeley, 2005; Alley et al., 2006; Alley et al., 2007), sought to develop and incorporate the principles described below with careful attention to the limited capacity assumption and the dual-modality theory (Alley 2005, 2006, Baddeley 1992, Garner & Alley 2013, Mayer 2003; Paivio 1969, 1975, 1986, Visser 2009). The present study considered the Assertion Evidence Approach developed by Alley (2005).

Assertion-Evidence and Multimedia Principles of Design

Research has built off of Mayer (2001) to develop guidelines for multimedia use to reduce extraneous cognitive load under the cognitive theory of multimedia learning (Mayer 2001, 2003, 2005; Visser, 2009). This research suggested that students learn better when information is presented with images and words (known as the multiple representations principle), whether spoken or written (Garner & Alley, 2013; Mayer & Anderson, 1991; Mayer & Moreno, 2002). Similarly, the modality principle also indicates that students learn more from spoken word than reading text (Mayer & Moreno, 2002). Both of these principles extend from the dual-coding theory (Paivio, 1969).

These design principles are more effective in memory processing because they cater to attention processing. For instance, students learn when complementary information is presented verbally and visually, but not identical information to avoid divided attention (Garner & Alley,

2013; Mayer & Anderson, 1991; Sweller, Tierney & Cooper, 1990). Split-attention detracts from learning because the information being processed is no longer integrated, but separate pieces of information. Prior research also stresses the removal of non-essential information (Harps & Mayer, 1997; Kane & Engle, 2000; Mayer et al., 2008), suggesting that it may distract the learner from what is really important. Finally, researchers argue that multimedia design should offer cues as to how the information ought to be mentally organized (Mayer, 2003) to aid in coding. Garner & Alley (2013) have evaluated these principles and suggested methods of incorporating them into PowerPoint design and have developed their own design known as the Assertion Evidence Approach.

The Assertion Evidence Approach and Its Implications

Alley (2005) developed the Assertion-Evidence Approach (Garner & Alley, 2013), which in other instances has been called the Sentence-Headline Approach (Alley & Neeley, 2005; Alley, Schrieber & Muffo, 2006) as a possible way of incorporating the multimedia principles described above.

The outcomes of the assertion-evidence approach demonstrated in previous research include the reduction of cognitive load for the student, better long-term retention rates of the material presented, and higher levels of student engagement (Alley & Neeley, 2005; Alley et al., 2006; Alley, Schrieber, Diesel, Ramsdell & Borrego, 2007). The major distinctive features of this design are the use of a full sentence argument in the slide title and the body providing evidence for the argument, typically in the form of an image. These design features are, in a sense, creating a dialogue or conversation to allow more room for students to engage with the information. According to Garner and Alley (2013), ideally that evidence would come in support of an image, to adapt to the multiple representations principle (Mayer, 2005).

There are two major distinctions to keep in mind with regard to the common practice approach to designing PowerPoint lectures and the Assertion Evidence Approach. The first is that the header in the common-practice approach only introduces a topic with the use of a single word or short phrase. However, the assertion-evidence approach introduces a topic *and* makes some kind of argument about the topic in a full sentence (Alley & Neeley, 2005; Alley et al., 2006; Alley et al., 2007; Garner & Alley, 2013). The Assertion Evidence Approach was also designed around the signaling principle, placing a full sentence or question in the header, rather than just a word or short phrase (Garner & Alley, 2013).

The other distinction is that the body in the common practice approach arguably doesn't encourage the student to engage with the information as well as the Assertion Evidence Approach (Garner & Alley, 2013). Informative images reduce cognitive load as students are more effectively able to encode information for several reasons. First, images utilize mental imagery, which activates the visual-spatial sketchpad in addition to the information presented verbally, which strengthens recall (Atkins-Sayre, Hopkins, Mohundro & Sayre, 1998; Clark & Paivio, 1991; Knupsky, 2002; Szazbo & Hastings, 2000). In terms of encoding, the student is able to encode a model that correctly identifies major concepts and describes the relationships between concepts (Alley 2005, 2006; Garner & Alley, 2013) Additionally, the use of images reduces the likelihood that students will produce misconceptions concerning the information (Garner & Alley, 2013; Perry & Magnusson, 1989). The use of images also improves student perceptions of the lecture (Atkins-Sayre et al., 1998; Mantei, 2000; Szabo & Hastings, 2000). Images are often seen as more interesting and engaging to students (Mackiewicz, 2007; Sweller, 1989, 1992; Yue et al., 2013). Finally, images are more useful for problem solving because they are often able to

encompass more meaning than text (Larkin & Simon, 1987; Knupsky, 2002; Mayer & Sims, 1994; Szazbo & Hastings, 2000).

Therefore, the design of PowerPoint presentations can be used to help students engage with material. The instructor, then, plays an important role in helping students understand how to actively engage with course material. Prior research has demonstrated support for the distinctions between students' passive and active engagement in their learning processing (Basturk, 2008; McNamara & Shapiro, 2005).

There are a number of possible reasons a student may be passively engaged in lecture material. For instance, the student may be experiencing higher cognitive load, fatigue, boredom, or other individual factors impacting their attention (Gureckis & Markant, 2012; McNamara & Shapiro, 2005). The instructor has a unique role in facilitating opportunities for active learning, rather than passive learning (Basturk, 2008; Karafantis, 2009; McKenzie, Perini, Rohlf, Toukhsati, Conduit & Sanson, 2013; Norbert et al., 2009). However, research has demonstrated mixed results on whether the instructor's role in student engagement is effective (Karafantis & Lapadula, 2011; Karpicke, 2009; McDaniel & Einstein, 2000; McNamara & Shapiro, 2005; McNamara, 2011).

Active engagement is much more involved than passive learning, where students are questioning the material, thinking about prior experiences with the information, applying information to real-world concepts, or challenging the information. Active engagement falls in line with the Connectionist Model of memory, where new information is connected with prior knowledge (Barnes, Marateo, & Ferris, 2007; Lombardi, Murray & Gerdes, 2011; McNamara & Shapiro, 2005; Ratcliff, 1990; Taylor & Parsons, 2011; Visser 2009).

Further, Karafantis & Lapadula (2011) contribute an analysis of how instructors can incorporate tools that increase interactivity in the learning process. Although this study did not find significant differences in students' academic performance with the implementation of active learning strategies, it provides an important distinction between engagement strategies implemented by the instructor and strategies implemented by the student. In addition, a possible explanation for this lack of significance is that students may already be actively engaging in the course material, knowing that they will eventually be tested on it, which activates prospective memory. The testing effect demonstrates that students have a greater ability to recall information after being tested on it (Cherney, 2008; Roediger & Karpicke, 2006; Zaromb & Roediger, 2010). Since testing is such a prominent part of instruction, students may already be actively engaged on some level.

Therefore, Karafantis & Lapadula (2011) raise important considerations surrounding what constitutes the natural classroom environment. In addition, it provides further clarification to what constitutes passive and active learning. Further, McNamara and Shapiro (2005) provide an insight into the student's experience, which aids in identifying where instructors' interventions in active learning are effective and where they are detrimental. Their work demonstrates a link between students' prior knowledge and effectiveness of instructors' intervention. Depending on their level of prior knowledge, students self-regulate their learning processes accordingly (Acuna, Rodicio, & Sanchez, 2011; Perry & Magnusson, 1989). Therefore, too much or too little prior knowledge may lead to passive engagement (Acuna et al., 2011).

Further, prior research demonstrates that there is greater variability and impacts of individual differences in students' learning than we might realize. Research demonstrates that a lecturer's instruction itself can lead to passive engagement in students, either because there is too

little or too much challenge for the student (Burke-Smalley, 2014; Peruch & Wilson, 2004). A student who is spoon-fed information without having to figure anything out on their own is likely to disengage from a lecture. However, if a student is completely lost during a lecture, they are never given the opportunity to engage. Ideally, a lecture meets students at their level of prior knowledge and then offers new challenges and questions. In addition, a student's expectations of their academic success has been demonstrated to play a role in their academic engagement (Basturk 2008; Karafantis 2009; Matvey, Donlosky & Schwartz, 2006; McNamara & Shapiro 2005; Peruch & Wilson, 2004; Skinner, Wellborn & Connell, 1990).

Pilot Study: How do Allegheny Faculty se PowerPoint?

The first step in pursuing an examination of the effectiveness of the assertion evidence approach was to see what the "common practice" was at Allegheny College. Faculty across all divisions (including the Communication Arts, Biology, Chemistry, Math, Psychology, Art and Neuroscience departments) agreed to provide a sample of a PowerPoint presentation that they have used in a class. Faculty were informed that these presentations would be evaluated to inform the design of the present study.

Specifically, each presentation was analyzed for the presence of several variables. These included whether or not images were used, the kind and size of images, the size, style, and color of text font, the amount of text, and use of animations and graphs (among other features). After evaluating the PowerPoint presentations, the data was assessed in terms of which multimedia principles were most commonly violated by faculty at Allegheny. The descriptive statistics for this analysis can be found in Appendix A.

The data revealed that the two principles most commonly violated were the signaling principle (i.e., the use of bullet-point styles that don't connect concepts to each other) and the

coherence principle (i.e., the use of an irrelevant "fun fact"). Essentially, instructors were not providing, or signaling, effective visual cues as to how the information presented ought to be organized in their designs. For example, the use of bulleted lists were quite prevalent. In addition, instructors often neglected the coherence principle, which necessitates removal of non-essential information. For example, instructors commonly included "fun facts" that didn't relate to the key concepts. However, a limitation of this evaluation is that the researchers didn't have access to the spoken portion of the lecture, so there was no way to assess how the lectures were framed.

The Present Study

Based on the evaluation of the common practice at Allegheny and a review of the literature on the Assertion Evidence Approach, two manipulations were chosen for the present study. First, slide formatting was considered. Specifically, Alley's research (Alley & Neeley, 2005; Alley et al., 2006; Alley et al., 2007; Garner & Alley, 2013) structured the layout of the Assertion Evidence slides according to the criteria described previously. The common practice slides were developed in accordance with how Garner and Alley (2013) described traditional practices and with the formatting seen most often in the presentations constructed by Allegheny faculty. Specifically, that included the use of bulleted lists, short slide titles, and images on the slides.

Additionally, the type of instruction given to students concerning how to engage with the lecture was chosen as the second manipulation, comparing instructions that were passively engaging than ones that were actively engaging. The manipulations for framing the lecture were based off of prior research in passive and active learning (Basturk, 2008; Karafantis & Lapadula, 2011; McNamara & Shapiro, 2005; Norbert et al., 2009). These were chosen because the data collected from Allegheny faculty did not include the lecture given with the PowerPoint, and

because the original interest of this research questioned what the instructor could do to improve learning with PowerPoint.

Accordingly, the research question developed for this study asked, how does an instructor's type of engagement before a lecture (passive instruction versus active instruction) differ in its effects on students learning based on format of a Microsoft PowerPoint presentation (common-practice versus assertion-evidence)?

Predictions

Type of PowerPoint Overall, participants showed no difference in recall whether they received the common practice or assertion evidence conditions. For immediate recall, participants in common practice conditions were expected to do better than those in assertion evidence conditions. In contrast, for delayed recall, participants in assertion evidence conditions were expected to do better than those in common practice conditions**.** However, participants had higher ratings of perceptions of design in common practice than assertion evidence (reflecting more positive impressions of the lesson). In other words, participants were expected to respond more highly to a design they were already familiar with. Similarly, participants rated their judgments of learning higher in common practice conditions than assertion evidence conditions.

Type of Instruction. Overall, participants in the active engagement conditions would outperform participants in the passive engagement conditions on both the immediate and delayed recall tasks. There was no main effect of instruction on perceptions of design. In addition, participants in the active engagement conditions would have higher judgments of learning (reflecting more positive impressions of the lesson) than participants in the passive engagement conditions.

Interaction. When receiving the passive instructions, participants recalled more in the common practice condition than the assertion evidence condition, but only during the immediate recall task. When participants received active instructions, they recalled more in the assertion evidence condition than the common practice condition, but only in the delayed recall task.

Method

Participants. Twenty-seven Allegheny College students ages 18-21 were recruited through SONA. Participants were 8 males, 18 females, and 1 transgender participant. There were 13 first year students, 8 sophomores, 5 juniors and 1 senior. Participants came from a variety of academic backgrounds including Environmental Studies, Psychology, Philosophy, Communication Arts, Biology, Global Health Studies, Neuroscience, English, Geology, Environmental Science and History. One participant was excluded from this analysis because they did not complete the delayed recall task.

Materials

Ted Talk. The PowerPoint presentation was developed using a Ted Talk by JP Rangaswami called Information is Food Ted (2012). In this lecture, Rangaswami identified a relationship between the production and processing of food with the production and processing of information. He breaks down this relationship into several subcategories including cultivation, preparation, and consumption. This Ted Talk was chosen to develop the PowerPoint because it was well-organized, not well-known, and simple. Throughout the lecture, the organization of the major concepts and the relationships between those concepts are made very clear, which made it simple to organize the PowerPoint presentations. The lecture did not have very many views (618,000 to date), so that the likelihood of prior knowledge or exposure would be reduced, but was still simple enough to understand the first time it was viewed.

Therefore, this Ted Talk provided all the text and images used in the slides. The slides automatically advanced as Rangaswami spoke. In addition, the audio from the Ted Talk was extracted and became the voice over for the lecture. Then, the PowerPoints were turned into videos using QuickTime Player, which were shown to participants using a projector.

Common Practice. The common practice slides had one word or a short phrase in the header summarizing the topic of the slide. For example, "Information is food." This header introduced the topic, but didn't do a whole lot in terms of defining the argument behind the statement. Then, it was followed by six bullet points to explain the header. To reiterate the theory behind this, these bullet points only explained the header, they didn't offer evidence for an argument. The bullet points were verbatim phrases from Rangaswami as he spoke on that particular concept. The images included on the slides were the same images Rangaswami included in his presentation.

Assertion Evidence. The assertion-evidence conditions placed a full-sentence argument in the header. An example of this would be, "There are several parallels between how we process information and how we relate to food." Both of the PowerPoint formats are located in Appendix B. Further, every slide contained a header arguing the major concept and the image Rangaswami used for that concept. Before each presentation, participants were presented with a different type of instruction (passive engagement versus active engagement), depending on the condition. Both PowerPoint presentations can be found in Appendix C.

Immediate Recall Assessment. Immediate recall was assessed by creating an exam worth 36 points, including short answer responses, multiple choice questions, matching questions, fill in the blank questions and true or false questions. The variety of questions was used to assess cued and free recall. This assessment can be found in Appendix D.

Delayed Recall Assessment. Delayed Recall was assessed with the same type of questions, but was administered online using Survey Monkey. The questions asked were different questions, but followed the same structure and formatting as the immediate recall assessment. The recall assessment may be found in Appendix G.

Perceptions of Lecture Design Assessment. Perceptions of the lecture were assessed using a questionnaire focusing on design. The questions used were 7 point Likert scales (1= not at all, 7= completely) to assess participant ratings of layout, visual clarity, sound quality, length of lecture, slide title clarity, font clarity, appropriateness of the amount of text and appropriateness of image use. This may be found in Appendix E.

Judgment of Learning Assessment. The same formatting as the Perceptions of Design questionnaire was used in assessing participants' judgments of learning. Several 7 point Likert scales (1=not at all, 7=completely) to assess participant ratings of their ability to recall major concepts, recall the relationships between major concepts, and understand the information. In addition, participants were asked to rate how important images were in helping them learn, how important text was in helping them learn, and how important slide titles were in helping them learn. This can be found in Appendix F.

Procedure

Participants were recruited using SONA experimental system. Before coming into the classroom, they were assigned a random number to remain anonymous. When they entered the classroom, they were instructed to sit at a desk with a packet already on it. The number of participants in each session ranged from one to four. Afterward, they were instructed to read over the informed consent and ask any questions if needed. Then, they were given the appropriate instructions and shown the appropriate lecture. After the lecture, the notes that the participants

took were collected and the immediate recall task was administered. Participants were told they would have fifteen minutes to complete it and to bring it to the front when they were finished. After they were finished, they were given the perceptions of design and judgments of learning questionnaires and asked to bring them forward when they finished and sit down again. Finally, all participants were debriefed at the same time. They were told that they would receive the delayed recall task one week from the time they completed part one, and to hold on to the random number they were assigned to identify themselves on the delayed recall task.

One week after the time and day they participated, participants were sent the delayed recall task via SONA's messaging system. Since the timeslots were typically between 5:00 and 9:00 p.m., participants were asked to complete the task by 12:00 a.m. the following day and told that it would take roughly the same amount of time as the immediate recall task. At the end of the delayed recall task, participants were given a full debriefing of the experiment.

Design and Data Analysis

The present study was a 2x2x2 mixed design, with type of engagement (passive vs. active) and presentation design (common-practice vs. assertion-evidence) as between-subject variables, and time of test (immediate vs. delayed) as a within-subjects variable. Therefore, the data was analyzed using a mixed-model ANOVA to look at performance on recall, judgments of learning, perceptions of PowerPoint design and note-taking.

Results

The immediate recall data was coded using a point value system. The immediate recall task was worth a maximum of 36 points. The three free-response questions were scored separately from the rest of the task because they were allotted more points and had more than one coder. However, the free response questions were still included in the allotted 36 points. The first

question, “What are three important take away items from this lecture?” was assigned six points. Each take away item was worth two points; one point for identifying a concept and a second point for explaining why it was a take away item. The second question, “What is the expensive tissue hypothesis, and why is it important to the topic?” was worth four points; two for identifying the hypothesis and two for explaining why it was important to the topic. The third question, “How are information sell-by dates and percentage of fact related to one another? Why are they important to information consumption?” was assigned four points; two points for explaining the relationship between sell by dates and percentage of fact, and two points for explaining their importance to information consumption. Every other question on the task was worth one point.

The delayed recall task was scored the same way, but only had one free response question, which was “What are three important take away items from this lecture?” worth six points, as in the immediate recall task. Every other question was worth one point, which made the delayed recall task worth a maximum of 29 points.

Two coders scored the free response questions with an inter-rater reliability of 69.4% on 108 questions (three questions on immediate recall x 27 + 27 questions on delayed recall = 108 responses). Where coders disagreed, the average of the two scores were calculated. In addition to recall, the notes that participants took during the lecture were assessed for their quality. These were scored using a point system from 0 (no notes) to 3 (good notes) by one rater.

Recall

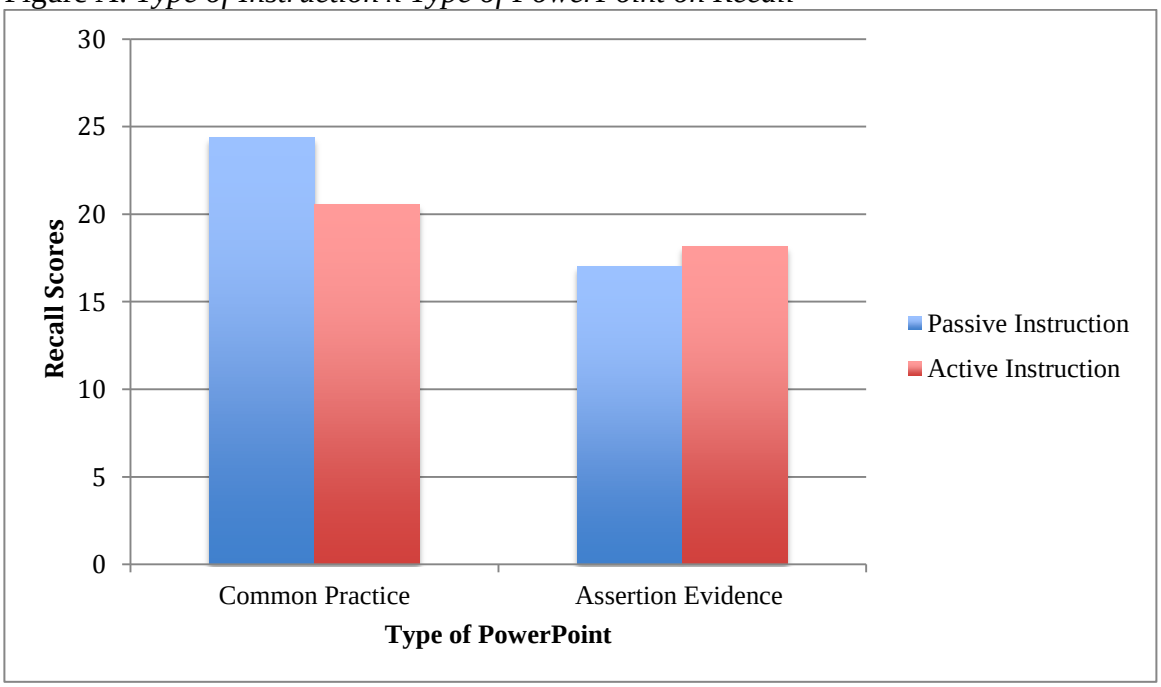
A 2x2x2 mixed ANOVA with time of recall (immediate versus delayed) as the within subjects variable and type of instruction (passive versus active engagement) and PowerPoint design (common practice versus assertion evidence) as the between subject variables was used to measure recall. There was no significant main effect of type of PowerPoint, $F(1, 27)= 2.53$,

p=.125, η^2_p=.099. Participants performed the same regardless of whether they received a common practice presentation (M=24.89, SD=5.17) or an assertion evidence presentation (M=21.61, SD=5.41).

In addition, there was no significant main effect of type of instruction, F(1, 27)=.743, p=.397, η^2_p=.031. Participants did the same regardless of whether they were asked to take an active approach (M= 22.53, SD=4.57) or a passive approach (M= 20.69, SD=1.13). There was a significant main effect of time, F(1, 27)= 56.818, p<.05,η^2_p=.712. Participants scored higher during immediate recall (M=23.19, SD=5.45) than delayed recall (M=16.78, SD=4.87).

Additionally, there was a significant interaction between type of PowerPoint and type of instruction, F(1, 23)= 9.261, p=.006, η^2_p= .287. When receiving the passive engagement instructions, participants recalled more information with the common practice presentation (M=24.38, SD= 1.65) than the assertion evidence presentation (M=17.00, SD=1.65), F(1, 12)= 2.04. Figure A shows the interaction.

Figure A: *Type of Instruction x Type of PowerPoint on Recall*



In contrast, when receiving the active engagement instructions, participants showed no significant difference in recall between the assertion evidence presentation (M=20.53, SD=1.43) and the common practice presentation (M=18.143, SD=1.53), $F(1, 13)$= 1.39. No other significant interactions were found, ps>.867 . Table 1 shows the means and standard deviations for recall across conditions.

Table 1 *Means and Standard Deviations for Recall Across Conditions*

Type of Instruction	Type of Presentation	Time of Recall	*M (SD)*
Passive Engagement	Common Practice	Immediate	28.17 (1.99)*
		Delayed	20.08 (1.77)
	Assertion Evidence	Immediate	19.83 (1.99)
		Delayed	14.17 (1.77)
Active Engagement	Common Practice	Immediate	22.07 (1.84)
		Delayed	14.21 (1.64)
	Assertion Evidence	Immediate	22.93 (1.73)
		Delayed	18.13 (1.54)

*p<.05

Judgments of Learning

Because judgments of learning were only assessed after the immediate recall session, a 2x2 independent measures ANOVA with type of instruction (passive versus active) and type of PowerPoint design (common practice versus assertion evidence) as the between subject variables was run on how participants rated their ability to recall the major concepts on a scale of 1 (not at

all) to 7 (completely). Table 2 shows the means and standard deviations for all judgment of learning measures across conditions.

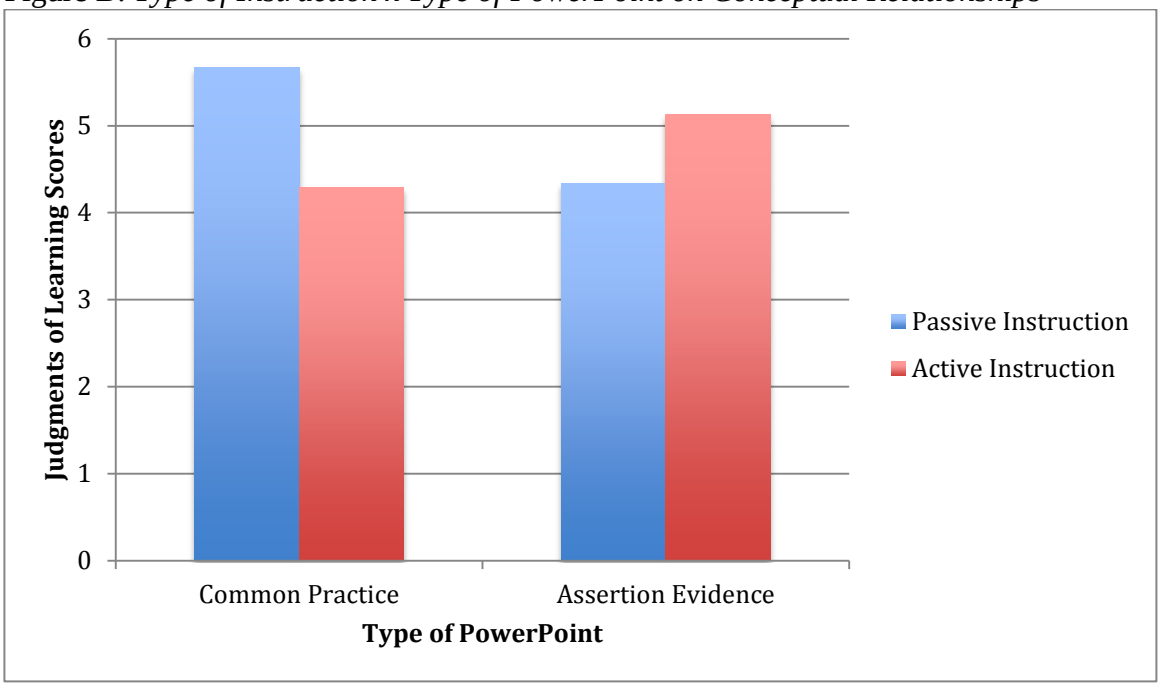
Table 2 *Means and Standard Deviations for Judgments of Learning*

Instruction	PPT	MC	RMC	UI	IMPT	IMPI	IMPST
		M (SD)	*M (SD)*	*M (SD)*	*M (SD)*	*M (SD)*	*M (SD)*
PE	CP	5.33 (.516)	5.67 (.816)*	2.50 (1.05)	4.33 (1.51)	2.67 (1.63)	3.33 (2.01)
	AE	4.17 (.983)	4.33 (1.21)	3.50 (1.38)	3.33 (2.42)	3.67 (1.97)*	3.00 (2.45)
AE	CP	4.29 (2.06)	4.29 (1.98)	4.71 (2.29)*	5.00 (1.53)	2.29 (1.80)	3.43 (1.81)
	AE	4.50 (1.46)	5.13 (.835)	4.00 (1.31)*	5.00 (1.20)	4.88 (1.37)*	3.89 (1.55)

Note. PE= Passive engagement instructions;AE= Active engagement instructions; PPT= Type of PowerPoint; MC=Recall major concepts; RMC=Recall Relationships between major concepts; UI= Understood information; IMPT=Importance of text in learning; IMPI=Importance of images in learning; IMPST=Importance of slide titles in learning, *$p<.05$

In addition, an independent measures 2x2 ANOVA was used to assess how well participants felt they could recall the *relationships* between the major concepts presented in the lecture on a scale of one (not at all) to seven (completely). There was no significant main effect of PowerPoint, $F(1, 27)=.168$, $p=.686$, $\eta^2_p=.007$. In addition, there was no significant main effect of type of instruction, $F(1, 27)=.495$, $p=.488$, $\eta^2_p=.02$. However, there was a significant interaction between type of PowerPoint and type of instruction, $F(1, 27)= 4.56$, $p= .043$, $\eta^2_p=.160$. When participants received passive instructions, they felt they could recall the relationships between the major concepts in the common practice condition more than ($M=5.67$, $SD=.422$) the assertion evidence condition ($M=4.33$, $SD=.422$), $F(1, 12)= 5.00$. However, when participants received active instructions, there was no difference in their perceived ability to recall the relationships between major concepts between the common practice ($M=4.29$, $SD=1.98$) condition and the assertion evidence condition ($M=5.13$, $SD=.835$), $F(1, 15)= 1.21$. Figure B demonstrates this interaction.

Figure B: *Type of Instruction x Type of PowerPoint on Conceptual Relationships*



A 2x2 independent measures ANOVA was run to assess how participants rated their ability to understand the information presented in the lecture. There was no significant main effect of type of PowerPoint, $F(1, 27)=.053$, $p=.819$, $\eta^2_p=.002$. However, there was a significant main effect of type of instruction, $F(1, 27)= 4.824$, $p=.038$, $\eta^2_p=.173$. When receiving active instructions, participants rated their understanding more highly ($M=4.33$, $SD=1.79$) than participants who received passive engagement instructions ($M=3.00$, $SD=1.28$). There was no significant interaction between type of PowerPoint and type of instruction, $F(1, 27)= 1.92$, $p=.179$, $\eta^2_p=.077$.

A 2x2 independent measures ANOVA was run to assess participant ratings of the importance of images on the slides in helping them learn. There was a significant main effect of type of PowerPoint $F(1, 27)=7.59$, $p=.011$, $\eta^2_p=.248$. Participants viewing the assertion evidence presentation rated image importance higher ($M=4.36$, $SD=1.692$) than the common practice

conditions (M=2.46, SD=1.67). However, there was no significant main effect of type of instruction, $F(1, 27)=.403$, $p=.532$, $\eta^2_p=.017$. In addition, there was no interaction between type of PowerPoint and type of instruction, $F(1, 27)= 1.487$, $p=.235$, $\eta^2_p= .061$.

Additionally, a 2x2 independent measures ANOVA was run to assess participant ratings of the importance of slide titles in helping them learn. There was no main effect of type of PowerPoint, $F<1$. Also, there were no main effects of type of instruction $F(1, 27)=.410$, $p=.528$, $\eta^2_p=.017$. In addition, there was no significant interaction between type of instruction or type of PowerPoint presentation, $F(1, 27)= .265$, $p=.612$, $\eta^2_p=.011$.

Finally, a 2x2 independent measures ANOVA was used to look at participant ratings of the importance of text on the slides in helping them learn. There was no significant main effect of type of PowerPoint, $F(1, 27)= .592$, $p=.450$, $\eta^2_p=.025$. In addition, there was no significant main effect of type of instruction, $F(1, 27)=3.22$, $p=.086$, $\eta^2_p=.123$. There was no significant interaction between type of PowerPoint and type of instruction, $F(1, 27)=.738$, $p=.411$, $\eta^2_p=.067$.

Perceptions of Design

Because perceptions of slide design were only measured after immediate recall, a 2x2 independent measures ANOVA with type of PowerPoint (common practice versus assertion evidence) and type of instruction (passive engagement versus active engagement) as between subjects variables was used to analyze participants' perceptions of various design aspects. Table 3 shows the means and standard deviations for perceptions of design.

Table 3. *Means and Standard Deviations of Perceptions of Design*

I	PP	VC	Layout	Font	AT	LL	SQ	ST
		M (SD)	*M (SD)*	*M (SD)*	*M (SD)*	*M (SD)*	*M (SD)*	*M (SD)*
P	CP	4.67 (1.86)	5.00 (1.10)	5.83 (1.33)	2.83 (1.17)	2.33 (.516)	6.00 (.632)*	4.50 (1.76)
	AE	5.29 (1.50)*	4.71 (1.70)	6.57 (.787)	4.43 (2.58)	2.43 (1.62)	5.71 (1.50)	4.86 (2.41)
A	CP	2.83 (1.60)	3.83 (1.72)	5.50 (1.98)	3.83 (1.94)	2.50 (1.87)	3.67 (1.37)	3.50 (1.23)
	AE	3.88 (1.13)*	4.13 (.641)	5.63 (1.51)	4.75 (1.49)	2.38 (1.92)	6.00 (.765)	4.50 (1.31)

Note. I= Type of instruction; PP= Type of PowerPoint; P= Passive Engagement, A= Active Engagement; CP= Common Practice; AE= Assertion Evidence VC= Visual Clarity; Layout= Visual layout of the slides; Font= Legibility of font; AT= Amount of text on the slides; LL=Length of lecture; SQ= Sound quality; ST= Slide title clarity. $p<.05$

A 2x2 independent measures ANOVA was run on participant ratings of sound quality. Sound Quality was assessed on a scale from one (poor) to seven (excellent). There was a significant main effect of type of PowerPoint, $F(1, 27)=5.58$, $p=.027$, $\eta^2_p=.195$. When participants received passive instructions, they rated sound quality higher in common practice conditions ($M=6.00$, $SD=.632$) than assertion evidence conditions ($M=5.71$, $SD=1.50$), $F(1, 11)=.188$. However, there was no significant main effect of type of instruction, $F(1, 27)=.188$, $p=.673$, $\eta^2_p=.017$. There was also no significant interaction, $F(1, 27)=9.124$, $p=.006$, $\eta^2_p=.284$.

Additionally, a 2x2 independent measures ANOVA was used to assess participant ratings of visual clarity. Visual clarity was assessed on a scale from 1 (unclear) to 7 (totally clear) revealing a significant main effect of type of PowerPoint presentation, $F(1, 27)=7.67$, $p=.011$, $\eta^2_p=.250$, such that assertion evidence had higher ratings of visual clarity ($M=5.00$, $SD=1.63$) than common practice ($M=3.43$, $SD=1.40$) conditions. There was no effect of type of instruction, $F(1, 27)=2.01$, $p=.170$, $\eta^2_p=.08$. There was no significant interaction between type of PowerPoint and type of instruction, $F(1, 27)=.130$, $p=.721$, $\eta^2_p=.006$.

Quality of Notes

A 2x2 independent measures ANOVA was used to assess the quality of the notes participants took during the lecture. Quality was assessed on a point system from 1 (poor notes) to 3 (good notes). There was no significant main effect of type of PowerPoint presentation, $F(1, 26)=.016$, $p=.900$, $\eta^2_p=.001$, no significant main effect of type of instruction, $F(1, 26)=.407$, $p=.530$, $\eta^2_p=.017$, and no interaction between type of instruction and type of PowerPoint presentation, $F(1, 26)=.407$, $p=.530$, $\eta^2_p=.017$. Table 4 shows the means and standard deviations for quality of notes.

Table 4: Means and Standard Deviations for Quality of Notes

Instruction	PowerPoint	*M*	*SD*
Passive Engagement	Common Practice	2.00	.632
	Assertion Evidence	2.17	.983
Active Engagement	Common Practice	2.00	.816
	Assertion Evidence	1.75	.886

Discussion

The present study demonstrated mixed outcomes of both the common practice and assertion evidence approaches to PowerPoint design. Dobson (2006) suggested that if we were to grade PowerPoint, we might only be able to evaluate on a pass-fail basis rather than on a numerical scale. This suggestion accurately reflects the mixed outcomes here. However, these outcomes clarified students' responses to lectures and future directions to consider.

When students received passive instructions, they were able to recall more information and felt more strongly about their ability to recall conceptual relationships in the common practice condition than the assertion evidence condition. These findings conflicted with previous research and predictions, which supported the assertion evidence approach (Alley & Neeley, 2005; Alley et al., 2006; Alley et al., 2007; Garner & Alley, 2013). This may be reflective of the difference in methodology for the present study, as previous research assessed each design in an actual class over an entire semester and the present study only exposed students to assertion evidence once. However, it also reflects the design style that students are used to and most comfortable with.

Since the results primarily demonstrated significant interactions between type of instruction and type of presentation, it's clear that holistically, the PowerPoint lecture is about

more than just the design itself. We also need to consider how the instructor uses their design to compliment their lecture to support learning.

Even still, the results of the present study supported some of the improvements assertion evidence attempted to make. Students had higher ratings of visual clarity and image importance in the assertion evidence condition, suggesting that at the very least, this design is visually simple and appealing (Alley & Neeley, 2005; Alley et al., 2007; Garner & Alley, 2013).

Limitations

In an attempt to move beyond a sole assessment of PowerPoint design by including the instructor's type of engagement in a lecture, this study was not able to have complete control because the manipulations included several variables (i.e., amount of text, image size, font size, etc.). Prior research has looked at these specific variables within the manipulations of this study (Apperson et al., 2006; Mayer, Griffith & Rothman, 2008; Mackiewicz, 2007; Tangen et al., 2011). Including so many variables in this analysis made it difficult to isolate which variables in each design were impacting student performance.

Since the present study was attempting to get a sense of students' perceptions of various design and learning variables, the questionnaires were very specific, which made it difficult to assess generalized attitudes. Participants were never asked to explicitly rate their experience holistically, which would have helped to gage changes in general attitudes in relation to task difficulty, judgments of learning, and overall experiences.

Future Research

Three of the most important findings to consider following up on is the interaction between PowerPoint design and instruction on recall, students' understanding of material, and conceptual relationships presented in the lecture. These findings are helpful places to start in

terms of improving the classroom environment to facilitate student learning. The manipulation of instructor's lecture instruction built off of previous research and needs further exploration. The way that an instructor shapes their lecture using presentation design leaves a significant impression on students, as the results reflected how students have adapted to traditional PowerPoint practices. Therefore, research should follow up on this interaction to clarify this understanding.

One way that future research could build on this understanding could be assessing what students are paying attention to. In the effort of starting this process, all that is presented here are the four different methods of presenting a lecture, and their respective impacts on memory and comprehension. By moving in this direction, we may be able to assess exactly what participants are paying attention to, rather than trying to make inferences based on perceptions of design and judgments of learning. Then, with an assessment of what students are actually paying attention to, we can start to look into how an instructor can tailor their PowerPoint design to fit the framework of the lecture.

Additionally, this interaction may be dependent on the type of information being presented. Previous research on assertion evidence design has considered the approach using procedural information (i.e., engineering) in the effects the design had on learning (Alley et al., 2007; Garner & Alley, 2013). However, the present study assessed assertion evidence design with semantic information and found little support for assertion evidence. Therefore, research could manipulate type of information, type of PowerPoint design and type of instruction in their effects on student learning to clarify the interaction found in the present study.

Despite having the limitations of being the first step, the present study showed encouraging future directions as the first step. As we reflect on the support that assertion evidence

has had over time with procedural information and the support common practice received in the present study, we may be able to clarify the confusion over PowerPoint design. Here, we recognize what Dobson (2006) suggested- there may not be a final word on PowerPoint design. We also recognize that there's more going on in the presentation of a lecture than PowerPoint design alone, which has provided promising directions for further consideration.

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Appendix A

Allegheny College PowerPoint Descriptives Statistics

Table 1

Descriptive Statistics: ART 111: Survey of Art History II

	N	Min	Max	Mean	Std. Deviation
Number of Color Objects	49	0	0	.00	.000
Number of BW Objects	49	0	0	.00	.000
Number of Words in Body	49	0	64	2.71	12.793
Number of Words-Image	49	0	11	.4	1.916
Number of Equations	49	0	0	.00	.000
Number of Questions	49	0	0	.00	.000
Number of Emphasis-Words	49	0	9	.18	1.286
Number Colored Words	49	0	0	.00	.000
Number of Errors	49	0	1	.02	.143
Number Appear Animations	49	0	0	.00	.000
Number SE Animations	49	0	0	.00	.000
Number of Colored Images	49	0	3	1.08	.640
Number of BW Images	49	0	1	.16	.373
Number of Colored Graphs	49	0	0	.00	.000
Number of BW Graphs	49	0	0	.00	.000
Number of SM Images	49	0	0	.00	.000
Number of MED Images	49	0	3	.41	.762
Number of LG Images	49	0	2	.78	.468
Number of IMGs with Text	49	0	1	.08	.277
Number of IMGs with No Text	49	0	3	1.10	.653
Number of Irrelevant Images	49	0	0	.00	.000
Number of Essential Images	49	0	3	1.20	.577
Number of Supportive Images	49	0	2	.04	.286
Number of Captions	49	0	2	.51	.582
Valid N (listwise)	49				

Table 2

Descriptive Statistics: ART 247: Avante-Garde

	N	Min	Max	Mean	Std. Deviation
Objects-Color	13	0	0	.00	.000
Objects-BW	13	0	0	.00	.000
Number of Words-Text	13	0	142	10.92	39.384
Number of Words--Picture	13	0	0	.00	.000
Number of Equations	13	0	0	.00	.000
Number of Qs	13	0	0	.00	.000
Number of Emphasis	13	0	0	.00	.000
Number of Color-Words	13	0	0	.00	.000
Number of Errors	13	0	0	.00	.000
Number of Appear Animations	13	0	0	.00	.000
Number of Special Effect Animations	13	0	0	.00	.000
Number of Color Images	13	1	2	1.62	.506
Number of BW Images	13	0	0	.00	.000
Number of Color Graphs	13	0	0	.00	.000
Number of BW Graphs	13	0	0	.00	.000
Number of Small Images	13	0	0	.00	.000
Number of Medium Images	13	0	2	.46	.877
Number of Large Images	13	0	2	1.15	.801
Number of Images w Text	13	0	1	.08	.277
Number of Images no Text	13	1	2	1.54	.519
Number of Irrelevant Images	13	0	0	.00	.000
Number of Essential Images	13	0	2	1.46	.660
Number of Supportive Images	13	0	2	.15	.555
Number of Captions	13	0	2	1.38	.650
Valid N (listwise)	13				

Table 3

Descriptive Statistics: BIO 220: Organismal Physiology/ Ecology

	N	Min	Max	Mean	Std. Deviation
Objects-Color	22	0	3	1.14	.710
Objects-BW	22	0	4	.59	1.221
Font size of body text	22	0	2	1.05	.653
Number of Words-Text	22	0	111	41.45	37.268
Number of Words--Picture	22	0	50	5.95	13.004
Number of Equations	22	0	0	.00	.000
Number of Qs	22	0	1	.05	.213
Number of Emphasis	22	0	29	5.73	7.497
Number of Color- Words	22	0	16	3.64	4.435
Number of Errors	22	0	0	.00	.000
Number of Appear Animations	22	0	0	.00	.000
Number of Special Effect Animations	22	0	0	.00	.000
Number of Color Images	22	0	1	.32	.477
Number of BW Images	22	0	1	.14	.351
Number of Color Graphs	22	0	1	.05	.213
Number of BW Graphs	22	0	0	.00	.000
Number of Small Images	22	0	0	.00	.000
Number of Medium Images	22	0	1	.05	.213
Number of Large Images	22	0	1	.41	.503
Number of Images w Text	22	0	1	.36	.492
Number of Images no Text	22	0	1	.09	.294
Number of Irrelevant Images	22	0	0	.00	.000
Number of Essential Images	22	0	1	.41	.503
Number of Supportive Images	22	0	1	.05	.213
Number of Captions	22	0	1	.27	.456
Valid N (listwise)	22				

Table 4

Descriptive Statistics: BIO 221: Genetics Development/Evolution

	N	Min	Max	Mean	Std. Deviation
Objects-Color	13	0	0	.00	.000
Objects-BW	13	0	0	.00	.000
Number of Words-Text	13	0	87	27.15	30.052
Number of Words--Picture	13	0	106	21.62	28.907
Number of Equations	13	0	0	.00	.000
Number of Qs	13	0	0	.00	.000
Number of Emphasis	13	0	21	6.38	6.826

Number of Color- Words	13	0	29	10.46	9.588
Number of Errors	13	0	0	.00	.000
Number of Appear Animations	13	0	1	.15	.376
Number of Special Effect Animations	13	0	0	.00	.000
Number of Color Images	13	0	3	1.15	.899
Number of BW Images	13	0	0	.00	.000
Number of Color Graphs	13	0	1	.08	.277
Number of BW Graphs	13	0	0	.00	.000
Number of Small Images	13	0	2	.15	.555
Number of Medium Images	13	0	2	.15	.555
Number of Large Images	13	0	2	.92	.641
Number of Images w Text	13	0	2	.92	.641
Number of Images no Text	13	0	2	.31	.751
Number of Irrelevant Images	13	0	2	.15	.555
Number of Essential Images	13	0	2	.92	.641
Number of Supportive Images	13	0	2	.15	.555
Number of Captions	13	0	2	.23	.599
Valid N (listwise)	13				

Table 5

Descriptive Statistics: CHEM 345: Quantum Chemistry

	N	Min	Max	Mean	Std. Deviation
Object-Color	22	0	0	.00	.000
Object-BW	22	0	9	1.50	2.940
Number of Words-Text	22	0	97	25.32	28.167
Number of Words--Picture	22	0	0	.00	.000
Number of Equations	22	0	5	1.59	1.943
Number of Qs	22	0	1	.55	.510
Number of Emphasis	22	0	4	.82	1.468
Number of Color- Words	22	0	18	1.95	4.884
Number of Errors	22	0	0	.00	.000
Number of Appear Animations	22	0	0	.00	.000
Number of Special Effect Animations	22	0	0	.00	.000
Number of Color Images	22	0	0	.00	.000
Number of BW Images	22	0	0	.00	.000
Number of Color Graphs	22	0	0	.00	.000
Number of BW Graphs	22	0	0	.00	.000
Number of Small Images	22	0	0	.00	.000
Number of Medium Images	22	0	0	.00	.000
Number of Large Images	22	0	0	.00	.000
Number of Images w Text	22	0	0	.00	.000
Number of Images no Text	22	0	0	.00	.000
Number of Irrelevant Images	22	0	0	.00	.000
Number of Essential Images	22	0	0	.00	.000
Number of Supportive Images	22	0	0	.00	.000

Number of Captions	22	1	1	1.00	.000
Valid N (listwise)	22				

Table 6

Descriptive Statistics: COMRT 325: The Revolutionary Stage

	N	Min	Max	Mean	Std. Deviation
Objects- Color	35	0	0	.00	.000
Objects-BW	35	0	0	.00	.000
Number of Words-Text	35	0	0	.00	.000
Number of Words--Picture	35	0	3	.09	.507
Number of Equations	35	0	0	.00	.000
Number of Qs	35	0	0	.00	.000
Number of Emphasis	35	0	0	.00	.000
Number of Color- Words	35	0	0	.00	.000
Number of Errors	35	0	0	.00	.000
Number of Appear Animations	35	0	0	.00	.000
Number of Special Effect Animations	35	0	0	.00	.000
Number of Color Images	35	0	1	.37	.490
Number of BW Images	35	0	1	.63	.490
Number of Color Graphs	35	0	0	.00	.000
Number of BW Graphs	35	0	0	.00	.000
Number of Small Images	35	0	0	.00	.000
Number of Medium Images	35	0	0	.00	.000
Number of Large Images	35	1	1	1.00	.000
Number of Images w Text	35	0	1	.11	.323
Number of Images no Text	35	0	1	.89	.323
Number of Irrelevant Images	35	0	0	.00	.000
Number of Essential Images	35	1	1	1.00	.000
Number of Supportive Images	35	0	0	.00	.000
Number of Captions	35	0	0	.00	.000
Valid N (listwise)	35				

Table 7

Descriptive Statistics: GEO 108: Environmental Geology

	N	Min	Max	Mean	Std. Deviation
Objects- Color	32	0	2	.22	.491
Objects-BW	32	0	2	.13	.421
Number of Words-Text	32	0	56	16.47	19.690
Number of Words--Picture	32	0	56	14.88	14.901
Number of Equations	32	0	0	.00	.000
Number of Qs	32	0	4	.72	1.464
Number of Emphasis	32	0	38	4.59	7.758
Number of Color- Words	32	0	61	18.91	18.939
Number of Errors	32	0	0	.00	.000
Number of Appear Animations	32	0	2	.25	.508

Number of Special Effect Animations	32	0	0	.00	.000
Number of Color Images	32	0	3	.78	.792
Number of BW Images	32	0	1	.03	.177
Number of Color Graphs	32	0	1	.31	.471
Number of BW Graphs	32	0	1	.03	.177
Number of Small Images	32	0	2	.19	.592
Number of Medium Images	32	0	3	.31	.780
Number of Large Images	32	0	1	.66	.483
Number of Images w Text	32	0	3	.88	.660
Number of Images no Text	32	0	2	.28	.634
Number of Irrelevant Images	32	0	2	.19	.592
Number of Essential Images	32	0	1	.69	.471
Number of Supportive Images	32	0	3	.19	.592
Number of Captions	32	0	1	.06	.246
Valid N (listwise)	32				

Table 8

Descriptive Statistics: MATH 320: Linear Algebra

	N	Min	Max	Mean	Std. Deviation
Objects- Color	11	0	1	.73	.467
Objects-BW	11	0	0	.00	.000
Number of Words-Text	11	5	42	11.91	10.290
Number of Words--Picture	11	0	0	.00	.000
Number of Equations	11	0	10	6.09	3.113
Number of Qs	11	0	0	.00	.000
Number of Emphasis	11	0	0	.00	.000
Number of Color- Words	11	0	5	.45	1.508
Number of Errors	11	0	0	.00	.000
Number of Appear Animations	11	0	0	.00	.000
Number of Special Effect Animations	11	0	0	.00	.000
Number of Color Images	11	0	0	.00	.000
Number of BW Images	11	0	0	.00	.000
Number of Color Graphs	11	0	0	.00	.000
Number of BW Graphs	11	0	0	.00	.000
Number of Small Images	11	0	0	.00	.000
Number of Medium Images	11	0	0	.00	.000
Number of Large Images	11	0	0	.00	.000
Number of Images w Text	11	0	0	.00	.000
Number of Images no Text	11	0	0	.00	.000
Number of Irrelevant Images	11	0	0	.00	.000
Number of Essential Images	11	0	0	.00	.000
Number of Supportive Images	11	0	0	.00	.000
Number of Captions	11	0	0	.00	.000
Valid N (listwise)	11				

* This course does not use Microsoft PowerPoint, but uses a similar presentation program for mathematics called LaTex Beamer.

Table 9

Descriptive Statistics: NEURO 120: Foundations of Neuroscience

	N	Min	Max	Mean	Std. Deviation
Objects- Color	14	0	1	.14	.363
Objects-BW	14	0	6	1.86	2.179
Number of Words-Text	14	0	24	9.00	9.624
Number of Words--Picture	14	0	36	9.21	13.913
Number of Equations	14	0	0	.00	.000
Number of Qs	14	0	4	.64	1.082
Number of Emphasis	14	0	9	2.50	3.757
Number of Color- Words	14	0	9	.64	2.405
Number of Errors	14	0	0	.00	.000
Number of Appear Animations	14	0	0	.00	.000
Number of Special Effect Animations	14	0	0	.00	.000
Number of Color Images	14	0	10	2.00	2.481
Number of BW Images	14	0	1	.29	.469
Number of Color Graphs	14	0	1	.07	.267
Number of BW Graphs	14	0	0	.00	.000
Number of Small Images	14	0	10	1.14	2.713
Number of Medium Images	14	0	3	.71	.914
Number of Large Images	14	0	1	.43	.514
Number of Images w Text	14	0	3	.86	.864
Number of Images no Text	14	0	10	1.29	2.673
Number of Irrelevant Images	14	0	10	1.21	2.694
Number of Essential Images	14	0	1	.29	.469
Number of Supportive Images	14	0	3	.64	1.082
Number of Captions	14	0	1	.21	.426
Valid N (listwise)	14				

Table 10

Descriptive Statistics: CHEM 231: Organic Chemistry: Form and Function

	N	Min	Max	Mean	Std. Deviation
Objects- Color	36	0	6	.58	1.519
Objects-BW	36	0	5	.56	1.157
Number of Words-Text	36	0	98	25.17	32.187
Number of Words--Picture	36	0	264	23.11	61.942
Number of Equations	36	0	20	1.67	5.409
Number of Qs	36	0	4	.19	.710
Number of Emphasis	36	0	28	5.92	9.028
Number of Color- Words	36	0	15	1.86	2.987
Number of Errors	36	0	0	.00	.000

Number of Appear Animations	36	0	0	.00	.000
Number of Special Effect Animations	36	0	1	.03	.167
Number of Color Images	36	0	3	.69	.822
Number of BW Images	36	0	2	.36	.593
Number of Color Graphs	36	0	1	.14	.351
Number of BW Graphs	36	0	2	.11	.465
Number of Small Images	36	0	3	.64	.931
Number of Medium Images	36	0	2	.25	.604
Number of Large Images	36	0	1	.39	.494
Number of Images w Text	36	0	2	.47	.560
Number of Images no Text	36	0	3	.75	.937
Number of Irrelevant Images	36	0	2	.39	.688
Number of Essential Images	36	0	2	.50	.609
Number of Supportive Images	36	0	3	.42	.770
Number of Captions	36	0	1	.19	.401
Valid N (listwise)	36				

Table 11

Descriptive Statistics: CHEM 332: Organic Chemistry II

	N	Min	Max	Mean	Std. Deviation
Objects- Color	53	0	2	.09	.405
Objects-BW	53	0	9	.58	1.669
Number of Words-Text	53	0	95	10.75	23.904
Number of Words--Picture	53	0	51	5.98	11.776
Number of Equations	53	0	3	.15	.601
Number of Qs	53	0	1	.13	.342
Number of Emphasis	53	0	36	2.85	7.816
Number of Color- Words	53	0	30	2.83	6.098
Number of Errors	53	0	0	.00	.000
Number of Appear Animations	53	0	0	.00	.000
Number of Special Effect Animations	53	0	0	.00	.000
Number of Color Images	53	0	7	.75	1.142
Number of BW Images	53	0	4	.42	.745
Number of Color Graphs	53	0	1	.17	.379
Number of BW Graphs	53	0	2	.43	.694
Number of Small Images	53	0	6	.57	1.217
Number of Medium Images	53	0	3	.17	.509
Number of Large Images	53	0	2	.81	.652
Number of Images w Text	53	0	2	.89	.751
Number of Images no Text	53	0	7	.66	1.413
Number of Irrelevant Images	53	0	1	.09	.295
Number of Essential Images	53	0	4	1.21	.840
Number of Supportive Images	53	0	6	.26	.902
Number of Captions	53	0	1	.30	.463
Valid N (listwise)	53				

Table 12

Descriptive Statistics: PHYS 020: Astronomy

	N	Min	Max	Mean	Std. Deviation
Objects- Color	19	0	4	1.26	1.147
Objects-BW	19	0	0	.00	.000
Number of Words-Text	19	0	58	22.11	17.929
Number of Words--Picture	19	0	20	1.05	4.588
Number of Equations	19	0	2	.47	.697
Number of Qs	19	0	2	.47	.612
Number of Emphasis	19	0	4	.79	1.084
Number of Color- Words	19	0	58	17.00	19.562
Number of Errors	19	0	1	.11	.315
Number of Appear Animations	19	0	1	.05	.229
Number of Special Effect Animations	19	0	0	.00	.000
Number of Color Images	19	0	1	.21	.419
Number of BW Images	19	0	2	.37	.684
Number of Color Graphs	19	0	1	.05	.229
Number of BW Graphs	19	0	0	.00	.000
Number of Small Images	19	0	0	.00	.000
Number of Medium Images	19	0	2	.58	.692
Number of Large Images	19	0	1	.05	.229
Number of Images w Text	19	0	2	.26	.653
Number of Images no Text	19	0	1	.37	.496
Number of Irrelevant Images	19	0	1	.05	.229
Number of Essential Images	19	0	2	.42	.692
Number of Supportive Images	19	0	1	.16	.375
Number of Captions	19	0	1	.21	.419
Valid N (listwise)	19				

Table 13

Descriptive Statistics:PSYCH 110: Foundations of Psychology

	N	Min	Max	Mean	Std. Deviation
Objects- Color	47	0	9	1.66	2.407
Objects-BW	47	0	9	.94	2.240
Number of Words-Text	47	0	73	20.68	18.041
Number of Words--Picture	47	0	3	.21	.657
Number of Equations	47	0	0	.00	.000
Number of Qs	47	0	5	.19	.770
Number of Emphasis	47	0	4	.36	.919
Number of Color- Words	47	0	0	.00	.000
Number of Errors	47	0	0	.00	.000
Number of Appear Animations	47	0	0	.00	.000
Number of Special Effect Animations	47	0	0	.00	.000

Number of Color Images	47	0	1	.34	.479
Number of BW Images	47	0	4	.40	.771
Number of Color Graphs	47	0	0	.00	.000
Number of BW Graphs	47	0	0	.00	.000
Number of Small Images	47	0	1	.26	.441
Number of Medium Images	47	0	4	.45	.829
Number of Large Images	47	0	1	.04	.204
Number of Images w Text	47	0	1	.11	.312
Number of Images no Text	47	0	4	.64	.819
Number of Irrelevant Images	47	0	1	.15	.360
Number of Essential Images	47	0	4	.26	.736
Number of Supportive Images	47	0	2	.34	.562
Number of Captions	47	0	0	.00	.000
Valid N (listwise)	47				

Table 14

Descriptive Statistics: PSYCH 110: Foundations of Psychology

	N	Min	Max	Mean	Std. Deviation
Objects- Color	50	0	6	.48	1.129
Objects-BW	50	0	7	1.66	2.639
Number of Words-Text	50	0	358	63.14	90.609
Number of Words--Picture	50	0	119	10.32	26.060
Number of Equations	50	0	0	.00	.000
Number of Qs	50	0	6	1.54	2.296
Number of Emphasis	50	0	15	2.08	4.198
Number of Color- Words	50	0	49	6.00	13.441
Number of Errors	50	0	1	.10	.303
Number of Appear Animations	50	0	2	.30	.580
Number of Special Effect Animations	50	0	0	.00	.000
Number of Color Images	50	0	3	.78	.815
Number of BW Images	50	0	0	.00	.000
Number of Color Graphs	50	0	1	.04	.198
Number of BW Graphs	50	0	2	.10	.364
Number of Small Images	50	0	1	.08	.274
Number of Medium Images	50	0	3	.60	.857
Number of Large Images	50	0	1	.24	.431
Number of Images w Text	50	0	2	.24	.476
Number of Images no Text	50	0	3	.66	.688
Number of Irrelevant Images	50	0	1	.06	.240
Number of Essential Images	50	0	3	.38	.697
Number of Supportive Images	50	0	3	.48	.707
Number of Captions	50	0	1	.06	.240
Valid N (listwise)	50				

*Two separate professors submitted PowerPoints for two separate sections of Psychology 110.

Appendix B

Research Participation Informed Consent
Examining Student Perceptions of Lectures
Allegheny College Department of Psychology

DESCRIPTION/PROCEDURE: The purpose of this study is to assess student perceptions of lecture designs. In this study, you will be asked to view a video-recorded lecture and offer your feedback. After viewing the following eight-minute lecture, you will be asked to fill out a questionnaire evaluating your perceptions of the lecture's designs. In addition, you will be asked to fill out a questionnaire to describe how much you felt like you have learned from the lecture. In addition, you will be asked to take a recall test on the information presented in the lecture. Your participation in this study will take approximately forty-five minutes. In addition, you will be contacted one week from today with a link to a delayed recall task to complete. This should take no longer than twenty minutes.

RISKS: I will be viewing a screen-projected lecture for the first ten minutes of the study. In addition, I recognize that I may experience boredom or fatigue.

BENEFITS: My participation in this research will bring a greater understanding of the use of Microsoft PowerPoint in classroom lectures. My participation in this study may provide educational benefits for myself. In addition, at the conclusion of this study I have the opportunity to ask questions about conducting research. I will also learn the purpose of the study, which will be an educational opportunity for myself.

ALTERNATIVE PROCEDURES: I understand that at any point in the study I may choose to withdraw, and not be penalized for doing so. In order to withdraw from this study, I understand that I will be given the option to end the survey and close out of the web page.

CONFIDENTIALITY: I understand that my participation in this study is anonymous and confidential. I understand that my responses to the appropriate questionnaires will be analyzed using a random number generator and that my name will not be used. I consent to publication of the results of this study without my name being used.

CONTACT INFORMATION: If I have questions upon the conclusion of this study, I may contact Dr. Aimee Knupsky at aknupsky@allegheny.edu. Also, if I have any questions, comments or concerns about the treatment of participants in this study, I can contact the Institutional Review Board Chair, Dr. Jialu Streeter at jliu@allegheny.edu.

VOLUNTARY PARTICIPATION: I understand that my participation in this study is strictly voluntary. Although I may be receiving monetary compensation for participation in this study, I

understand that I will not receive any compensation directly from the experimenter. With this, I understand that I may withdraw from the study at any point. I acknowledge that I am of age (18 years or older) and can legally participate in the study.

I understand the description of the experiment and procedures, and have been provided a copy of this informed consent. My questions have been answered, and I agree to participate in the study. I wish to receive the results of this study: _ Yes _ No
Signature_____
Date_____

Research Participation Informed Consent
Examining Student Perceptions of Lectures
Allegheny College Department of Psychology

DESCRIPTION/PROCEDURE: You will be asked to follow the Survey Monkey link to complete a short recall task. You will be asked to recall information presented in the lecture "Information is Food." Your participation in this part of the study should take approximately 20 minutes.

RISKS: I realize that I may experience difficulty trying to recall information presented to me in the first part of this study.

BENEFITS: My participation in this research will develop a more effective use of Microsoft PowerPoint in classroom lectures. My participation in this study may provide educational benefits for myself. In addition, at the conclusion of this study I have the opportunity to ask questions about conducting research. I will also learn the purpose of the study, which will be an educational opportunity for myself.

ALTERNATIVE PROCEDURES: I understand that at any point in the study I may choose to withdraw, and not be penalized for doing so. In order to withdraw from this study, I understand that I will be given the option to end the survey and close out of the web page.

CONFIDENTIALITY: I understand that my participation in this study is anonymous and confidential. I understand that my responses to the appropriate questionnaires will be analyzed using a random number generator and that my name will not be used. I consent to publication of the results of this study without my name being used.

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I understand the description of the experiment and procedures, and have been provided a copy of this informed consent. My questions have been answered, and I agree to participate in the study.
I wish to receive the results of this study: _ Yes _ No
Signature_____
Date_____

Appendix C

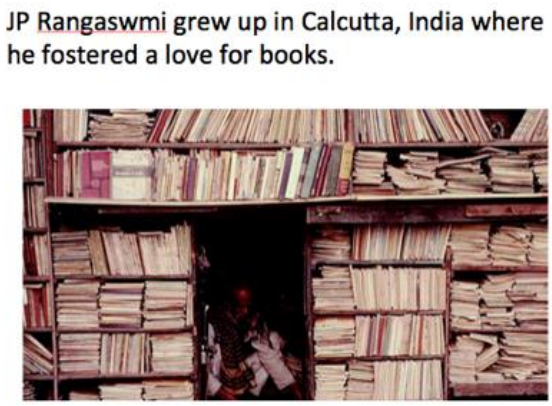
Lectures and Instructions

Passive Engagement Assertion-Evidence Condition

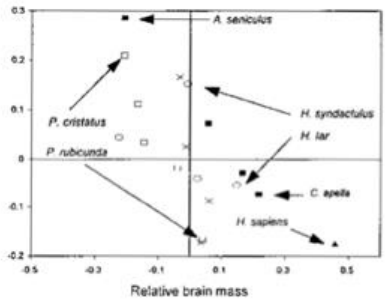
Instructions: "The purpose of this study is to assess perceptions of lecture design. Please follow along with the lecture and take notes as you would in a class. After viewing the lecture, you will be asked to recall information from the lecture and fill out questionnaires offering lecture feedback."

Lecture:

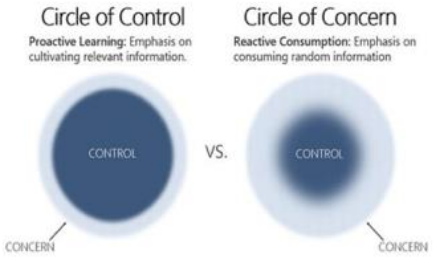




There is an established relationship between brain and stomach mass, and information and food.



There is a conflict between the farmer and hunter-gatherer approaches to information cultivation.



Some think you separate information to extract its value, while others think you combine it.



There are several different similarities between food and information consumption.



As with food, we are prone to "overeating" information and may need to diet ourselves.



Passive Engagement Common-Practice Condition

Instructions: "The purpose of this study is to assess perceptions of lecture design. Please follow along with the lecture and take notes as you would in a class. After viewing the lecture, you will be asked to recall information from the lecture and fill out questionnaires offering lecture feedback."

Lecture:

Information is Food



JP Rangaswami

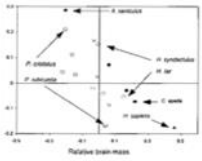
Rangaswami's Background

- South Indian
- Born in Calcutta
- Father and Grandfather were journalists
- Grew up with books everywhere
- Has 38,000 books now
- Spent a lot of time in Bengal



The Robot

- For a robot, both information and food were the same thing
- Energy came to it in some formal shape
- Data came to it in some formal shape
- Energy and information as input
- Food and information are similar
- Expensive tissue hypothesis: for a given body mass of a primate, the metabolic rate was static, but the balance of available tissue changed



Competition between farmers and hunter gatherers

- Cultivation of information and food
- We were hunter-gatherers and then farmers and cultivators
- Doesn't fit with intellectual property battles
- Free-Flow information vs. structured and controlled
- There will always be tension
- Huge fights between cultivators and hunter-gatherers



Distill vs. Ferment Information

- We prepare information for consumption
- Distill: extract value by separating information
- Ferment: bring information together and mash it up to extract value
- Conflicting approaches to preparation



- Some scholars advocate distillation
- Other scholars advocate fermentation

Consuming Information

- Consumption occurs after preparation
- Ways to consume food: raw ingredients, cook it, have it served to you, go to restaurants
- Information has sell-by dates
- Negative effects of using out-of-date information



- Information could have a percentage of fact associated with it
- We could start labeling information for that percentage

Overconsumption

- No such animal as information overload
- Filter failure
- Overeating food is never a production issue
- Overeating information is a consumption issue
- We need to create "diet and exercise" within ourselves
- You can have diseases, toxins, a need to balance diet



Active Engagement Common-Practice Condition

Instructions: The purpose of this study is to assess perceptions of lecture design. Please follow along with the lecture and take notes as you would in class. As you follow along with the lecture, please consider what three main points might be most important to take away from this lecture.

After viewing the lecture, you will be asked to recall information from the lecture and fill out questionnaires offering lecture feedback."

Lecture: Same as Passive Engagement Common-Practice Condition

Active Engagement Assertion-Evidence Condition

Instructions: "The purpose of this study is to assess perceptions of lecture design. Please follow along with the lecture and take notes as you would in class. As you follow along with the lecture, please consider what three main points might be most important to take away from this lecture. After viewing the lecture, you will be asked to recall information from the lecture and fill out questionnaires offering lecture feedback."

Lecture: Same as Passive Engagement Assertion-Evidence Condition

Appendix D

Immediate Recall Test

1. What are three important take-away items from this lecture?

2. What is the expensive tissue hypothesis, and why is it important to this topic?

3. How are information sell-by dates and percentage of fact related to one another? Why are they important to information consumption?

4. Where was JP Rangaswami born?

a. Bengal, India
b. Calcutta, India
c. Bangalore, India
d. Modi, India
e. Bijapur, India

5. Rangaswami began his comparison between information and food with

a. a microwave
b. a robot
c. a theatre in Bangalore
d. one of his 38,000 books
e. a kindle

6. How did Rangaswami describe our current intellectual property battles?

a. as farmers pitted against cultivators

b. as freedom to pick up information versus freedom to gather information
c. as hunter-gatherers pitted against free roamers
d. as farmers pitted against hunter-gatherers
e. as wealth and structure pitted against settlement

7. Which of the following is mentioned as a possible method of preparing information?

a. cultivation
b. inputting data
c. fermentation
d. consumption
e. compilation

8. Which of the following describes the expensive tissue hypothesis?

a. an inconsistency between nervous tissue and digestive tissue
b. an inverse relationship between eating and thinking
c. a tradeoff between information consumption and food consumption
d. the start of a lifelong exploration of information and food
e. the input of information as though it were food

9. Which of the following does Rangaswami not suggest is a limitation to information consumption?

a. sell-by dates
b. controlling information ownership
c. people using information that is out of date
d. possible information famines
e. possible need for percentage of fact labels

10. What term does Rangaswami use to describe overconsumption?

a. production issue
b. diet and exercise
c. cultivation
d. filter failure
e. fermentation

11. For each of the following, choose the answer from the column on the left that best fits each description.

___ a film depicting a robot requiring data input	a. distillation
___ term for docu-dramas and mock-u-mentaries	b. fermentation
___ separating information to extract its value	c. Short Circuit

___ creating ownership and wealth from information d. percentage of fact

___ compiling information to extract its value e. cultivation

12. There is a conflict between the _____ and the hunter-gatherers of information.

13. The _____ refers to the conflict between the brain and the stomach.

14. Filter failure is a problem with information production. T / F

15. To distill information, we combine all of the ingredients. T / F

16. "Farmers" want to create wealth and structure in information. T / F

17. Rangaswami was born in Bengal, India. T / F

18. Fermenting information means combining all of the ingredients. T / F

19. Information cannot have expiration dates. T / F

20. It is possible to "overeat" information. T / F

21. "Hunter-gatherers" desire free-flow of information. T / F

Appendix E

Perceptions of Design Questionnaire

Please fill out the following questionnaire indicating how much you liked the design of the presentation "Information is Food."

1. The presentation was visually clear.

1 2 3 4 5 6 7
Not at all Completely

2. The layout of the material made sense to me.

1 2 3 4 5 6 7
Not at all Completely

3. The font was easy to read.

1 2 3 4 5 6 7
Not at all Completely

4. The amount of text on the slides was appropriate.

1 2 3 4 5 6 7
Not at all Completely

5. The lecture was too long.

1 2 3 4 5 6 7
Not at all Completely

6. The sound quality was decent.

1 2 3 4 5 6 7
Not at all Completely

7. The slide titles made sense to me.

1 2 3 4 5 6 7
Not at all Completely

8. How important were the images in helping you learn?

1 2 3 4 5 6 7
Not at all Completely

9. How important was the text in helping you learn?

1 2 3 4 5 6 7
Not at all Completely

10. How important were the slide titles in helping you learn?

1 2 3 4 5 6 7
Not at all Completely

Appendix F

Judgments of Learning Questionnaire

Please fill out the following questionnaire indicating how much you feel that you have learned from the presentation "Information is Food."

1. I can easily recall the major concepts presented in the lecture.

1 2 3 4 5 6 7

Not at all Completely

2. I can easily comprehend the relationships between the major concepts presented in the lecture.

1 2 3 4 5 6 7
Not at all Completely

3. I had trouble understanding the information presented in the lecture.

1 2 3 4 5 6 7
Not at all Completely

4. What was most useful in helping you learn?

5. What was least useful in helping you learn?

Appendix G

Delayed Recall Retention Test

Please answer the following questions based on what you recall from the lecture "Information is Food."

1. What are three important take-away items from this lecture?

2. How did Rangaswami describe distillation of information?

a. as a process of consuming information
b. as farmers pitted against cultivators
c. as the combining of information to extract value
d. as wealth and structure pitted against settlement
e. as separating information to extract value

3. The preparation of information for consumption involves

a. cultivation
b. distillation and fermentation
c. creating structure and settlement
d. the expensive tissue hypothesis
e. a desire for input

4. Which of the following was the first theory Rangaswami encountered on the relationship between food and information?

a. the input of information as though it were food
b. expensive tissue hypothesis
c. a tradeoff between information consumption and food consumption
d. the distilling of information
e. filter failure

5. Which of the following does Rangaswami suggest creates a time limit on information?

a. possible need for percentage of fact labels
b. sell-by dates
c. people using information that is out of date
d. possible information famines
e. information overload

6. Hunter-gatherers of information seek to do which of the following?

a. ferment information
b. distill information
c. input data
d. create ownership, wealth and structure surrounding information
e. freely cultivate and gather information

7. Rangaswami points out that overconsumption is never a _____ issue.

a. diet and exercise
b. filter failure issue
c. production issue
d. distillation issue
e. cultivation issue

8. Where did Rangaswami develop his passion for sweet dishes?

a. Modi, India
b. Bengal, India
c. Calcutta, India
d. Bijapur, India
e. Bangalore, India

9. For each of the following, choose the answer from the column on the left that best fits each description.

___ a place in India that likes sweet foods a. hunter-gatherers vs. farmers

___ term for docu-dramas and mock-u-mentaries b. percentage of fact

___ the amount of truth associated with a statement c. Calcutta

___ the conflict over information cultivation d. Bengal

___ the conflict over information preparation e. distillation vs. fermentation

10. _____ is a film with an experimental robot.

11. An issue related to the overconsumption of food where information is incorrectly processed is _____.

12._____ is the Indian City where Rangswami was born.

13. The _____ describes the relationship between the mind and brain.

14. The process related to the combination of information to extract its value is _____.

15. Filter failure is a problem with information production. T / F

16. Farmers desire free-flow of information. T / F

17. "Farmers" want to create wealth and structure in information. T / F

18. Rangaswami was born in Bangalore, India. T / F

19. Cultivating information means combining all of the ingredients. T / F

20. The robot discussed by Rangaswami cried, "Give me data." T / F

21. Rangaswami grew up in a family of dieticians. T / F

Appendix H

Research Participation Debriefing Form
Examining Student Perceptions of Lectures
Allegheny College Department of Psychology

Purpose of Research:
The purpose of this study was to explore the effects of PowerPoint Design and a lecturer's level of engagement on student learning. Previous research has demonstrated that current uses of PowerPoint design violate our understandings of cognitive load theory and multimedia principles

of learning. (Alley 2005, 2006, 2011; Garner & Alley 2013). Therefore, this study compared traditional uses of Microsoft PowerPoint with a new approach developed by Michael Alley called the assertion-evidence approach, which reduces violations of cognitive load theory and multimedia principles of learning in PowerPoint by removing the use of bulleted lists, replacing body text with an image, and placing a full sentence in the slide title. This approach caters to working memory as well, by adhering to the effectiveness of presenting information both using text and images, in addition to verbal and visual presentation. In addition to comparing two different presentation styles, this study compared a lecturer's attempts to engage students in their learning process. Specifically, this study compares passive engagement, where an instructor simply begins a lecture and expects students to know how to engage with the material and active engagement, where an instructor includes prompts, discussion questions or specific tasks for the student to focus on and engage with during a lecture (Basturk 2008; Karafantis 2011; Minhas 2012). Research has demonstrated that student long-term retention rates are much higher with the utilization of the assertion-evidence approaches to design (Garner & Alley 2013). In addition, research has demonstrated that student overall retention rate is much higher when active engagement techniques and opportunities are implemented in the classroom (Basturk 2008; Karafantis 2011). This study aims to examine the effects of PowerPoint design and type of engagement on immediate recall, long-term retention, perceptions of lecture design and student judgment of learning.

Compensation:
Participants will be awarded three course credits through SONA for their full participation in this study.

Confidentiality:
All data obtained from the study will remain anonymous throughout the full duration of the study to the termination of the data when it is no longer needed. Participants will be assigned a random number and that number will only be documented on the data obtained which is separate from consent forms.

Additional Sources of Information:

Basturk, R. (2008.) Applying the many-facet Rasch model to evaluate PowerPoint presentation performance in higher education. *Assessment & Evaluation in Higher Education*. 33:4, 431-444.

Garner, J. Alley, M. (2013.) How the design of presentation slides aff ects audience comprehension: A case for the Assertion–Evidence approach. *International Journal of Engineering Education.* 29 (6). 1564–1579.

McNamara, D., Shapiro, A. (2005). Multimedia and Hypermedia Solutions for Promoting

Metacognitive Engagement, Coherence and Learning. *Journal of Educational Computing Research*. 33(1). 1-29.

Norbert, M., Cater, J., Varela, O. (2009). Active versus passive teaching styles: An empirical study of student learning outcomes. *Human resource development quarterly*. 20(4). 397-418.

Yilmazel-Sahin, Y. (2009). A comparison of graduate and undergraduate teacher education students' perceptions of their instructors' use of microsoft PowerPoint. *Technology, Pedagogy and Education, 18*(3), 361.

Contact Information:

If for any reason you have any questions or concerns regarding the study, conduct of the study, or your health as a result of the study, feel free to contact any of the individuals listed.

Primary Researcher – Devon Bradford
Email bradfordd@allegheny.edu

Faculty Advisor – Dr. Aimee Knupsky
Email aknupsky@allegheny.edu

Chair of the Allegheny College Institutional Review Board (IRB): Dr. Jialu Streeter at jliu@allegheny.edu.

Allegheny College Counseling Center at 814-332-4368.

Allegheny College Medical Center (Winslow Health Center) at 814-332-4355.

Research Participation Debriefing Form
Examining Student Perceptions of Lectures
Allegheny College Department of Psychology

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Allegheny College Counseling Center at 814-332-4368.

Allegheny College Medical Center (Winslow Health Center) at 814-332-4355.