Chapter 5
Multimedia Design and Situational Interest: A Look at Juxtaposition and Measurement

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Introduction

The use of images to enhance learning is a complex undertaking with a myriad of advantages and disadvantages. There are number of limitations and considerations related to static images, animations, or full simulations. Cognitive influences on the capturing of interest through the use of visuals and defining learner interest have been examined by decades of research. Cognitive processing models even go so far as to provide guidelines for consideration when employing media in learning. Nevertheless, little attention has been given to the use of specific multimedia model principles and their affect on learner interest. The problem is that many learners in multimedia learning environments experience a decreased intrinsic motivation to continue or complete lessons due to poor designs that negatively impact interest (Moreno, Mayer, Spires, & Lester, 2001). Thus, there is a need to explain the importance of learner interest and potential impact of multimedia design; essentially the way in which cognitive science research about visual images can be effectively applied to learning designs.

Educators have the ability to stimulate students or hinder their motivation all together. It stands to reason that educators who employ designs based on the study of motivation can enhance learners' desire to learn. Conversely, learning designs that fail to incorporate or consider motivation research findings may prove insufficient for expectations. The increasing prevalence of online learning in today's educational environment provides an excellent scenario in which to examine the impact of learning design on motivation. Online learning environments serve as an example that is dominated by multimedia instruction. Carr (2000) and Wojciechowski and

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Palmer (2005) indicated that online learning environments often present negative challenges for learner motivation and completion rates. Meyer (2003) further noted that a number of online learners struggle because of a lack of motivation or self-confidence. Enhancing students' interest while taking courses in online learning environments seems a probable means of promoting higher learner satisfaction and better completion rates.

Research and practice related to learning design and motivation has a variety of juxtapositions. The placement of images alongside text in manuscripts dates back to the seventh century in the *Book of Kells*, and represents the conceptual phenomenon behind the use of images to capture interest. Theoretically, there are two major approaches to consider when examining image placement and capturing interest. First, cognitive processing theories explain the ways by which we perform the complex series of actions required to receive and store information. The same theories prescribe ways in which images and media should and should not be used in order to maximize this process. Second, motivation theory provides an explanation for how and why we are driven to perform certain behaviors. Within motivation theory, interest explains a preference for certain activities. A practical application begins to emerge through an analysis of these theoretical frameworks wherein cognitive processing theories are informed by interest theory, resulting in prescriptive guidelines for designing media to target interest. The resulting conclusion is to investigate empirical studies examining the impact of media design on learner interest.

Cognitive Processing and Multimedia

Multimedia is defined here as the use of multiple types of media, particularly the presentation of words and pictures together, during a presentation of information. Multimedia learning encompasses building mental representations from words and pictures, and multimedia instruction includes words and pictures intended to promote learning (Mayer, 2005). Baddeley (1986, 1999), Chandler and Sweller (1991), and Paivio (1986, 1991) provided evidence to support the notion that there are separate channels for processing visual and auditory information, and that humans are limited in the amount of information that can be processed by each channel at one time. Wittrock (1989) studied cognitive relationships in reading comprehension and posited that comprehension is a generative process that relies upon signals, strategies, and plans to relate events to one another. Mayer (2001) expounded upon these foundations of cognitive processing to propose that humans actively engage in learning by attending to relevant incoming information, organizing selected information into coherent mental representations, and integrating mental representations with previous knowledge to be stored in long-term memory. Figure 5.1 illustrates a generalized overview of the process that occurs when media are processed by sensory memory, working memory, and long-term memory. Resulting multimedia models and guidelines begin to emerge through cognitive processing theories that can inform multimedia development.

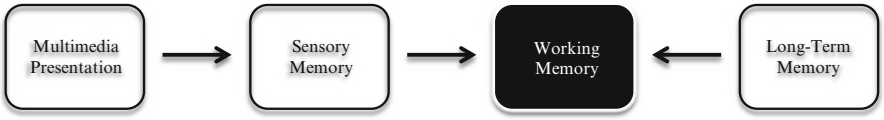

Fig. 5.1 An overview of the process proposed by the *Cognitive Theory of Multimedia Learning* (CTML)

Building upon the CTML learning process, there are design implications to take advantage of learner abilities in the context of learning with multimedia. Schnotz (2005) presented an Integrated Model of Text and Picture Comprehension (ITPC) that, in coordination with Mayer's (2001) CTML, promotes six key principles for consideration in multimedia design. First, designers should combine text with content-related images only when learners have low prior knowledge and possess sufficient cognitive abilities to process both the text and pictures. This combination is known as the *basic multimedia principle*. Second, the *spatial contiguity principle* recommends presenting written text in close spatial proximity to related images. The *temporal contiguity principle* is third and takes the concept of placement further by suggesting the presentation of spoken words in close temporal proximity to related images. Fourth, the *modality principle* proposes the use of spoken words instead of written text for animation. Related to modality, the specific *redundancy principle* clearly states that written text should not duplicate spoken words and represents the fifth principle in multimedia design. Sixth, *the coherence principle* advises against the use of extraneous words and pictures or unnecessary sound or music. The combination of the six principles represent an array of tools to be used by instructional designers and multimedia designers to maximize learners' cognitive capabilities to receive and process information; and serve as a framework for applying and evaluating the *Cognitive Theory of Multimedia Learning*.

Capturing Learner Interest Through Images

More than 20 years ago, newspapers originally addressed the concept of interest in order to better understand how readers perceived charts and graphs published with articles. Tankard (1988) showed that readers did not retain any more information from flashier graphics than from plain images, but findings did support that readers saw these "chartoons" (p. 91) and three-dimensional graphs as more appealing. This groundwork of examining the effectiveness of visuals provided an outlet for further investigation. Austin, Matlack, Dunn, Kesler, and Brown (1995), Delp and Jones (1996), Michielutte, Bahnson, Dignan, and Schroeder (1992), and Morrow and Hier (1998) found that the use of images to enhance the appeal of medical handouts led to a higher probability of the information being read and patients recalling the information provided. Further evidence supports the use of images with text in order to positively impact attention and recall of information. Houts, Doak, Doak, and Loscalzo (2006)

examined how pictures improved communication between health practitioners and patients, and found that patients with well-developed language skills found it difficult to process medical information for a variety of reasons, including unfamiliarity with terminology and emotional effects. The use of images and diagrams near medical information mitigated the observed difficulties. However, findings remain unclear about the emphasis on how and where to maximize images' effects on interest.

The reason for using static and animated images in education is based upon research related to attention and interest. Slough and McTigue (2010) noted that textbooks traditionally use images and illustrations sparingly and in a secondary role to conveying content. As learners who are accustomed to multimedia environments become more prevalent, the traditional method will not be able to gain or hold readers' attention for very long. One approach to help students understand content is to make the text more interesting through the use of visuals and graphics. Kim, Yoon, Whang, Tversky, and Morrison (2007) reported an emerging trend, which has been reported by teachers to be preferred among learners, to lay out textbooks in a way that mimics websites through use of photographs, tables, textboxes, flowcharts, and drawings. Looking across the various types of images, current technologies have allowed for an increasing use of animations with respect to learning and instructional text. Kim et al. further noted that researchers and educators initially assumed that animations would facilitate an increased interest in learning, and that while the effects of animated images on learning are still a controversial topic, the use of graphics continues to grow in popularity largely due to a belief that animations are more interesting and aesthetically appealing. Aesthetic appeal is influenced by interest, which is commonly divided into two classifications, emotional interest and cognitive interest (Kintsch, 1980). Therefore, interest effects may vary depending upon individual differences, including age and spatial ability (Kim et al., 2007). Specifically, adolescent learners prefer animations over static images and find them to be motivating. Preferences for images present several implications for designing learning content, but image use should be considered carefully, taking into account the characteristics of the intended audience.

Media Selection

Consideration for designing media must occur simultaneously with selecting media. Anglin, Towers, and Levis (1996) concluded that the effective use of graphics in designing instruction is an important facet of instructional message design. This may be due to the finding that up to 40 % of conceptual learning can be attributed to visual experience (Weber, 1922). Media largely comprise visual messages and have historically included photographs, drawings, diagrams, maps, and film. McKenzie (2005) noted that while the medium may not be the message, it is a significant part of the learning experience. Media, and specifically multimedia, can make a significant contribution to curriculum by representing real objects and ideas about reality that may not otherwise be possible (Cohen, 2010). Additionally, using images in

instructional materials is effective in supporting learning, because they can help gain a learner's attention and help learners interpret and remember the context of illustrated texts (Park & Lim, 2007). Traditionally, textbooks have used images and illustrations sparingly and in a secondary role to conveying content. As learners who are accustomed to multimedia environments become more prevalent, this method will not be able to gain or hold readers' attention for very long (Slough & McTigue, 2010). Though advancements in technology have enabled designers to broaden visual messages to include video, animations, and icons, Baker and Dwyer (2000) and Richey, Klein, and Tracey (2010) cautioned that not all elements of visuals are equally important for instruction. An example of the variance among visual elements includes the use of color to arouse interest, but using realistic details may distract learners from the primary task. Perhaps most significantly, Cohen (2010) stressed that multimedia selection and design must consider issues of cognitive load. By considering the instructional attributes of multimedia, a foundation can be created to assess when and how to specify elements in courses.

Designs that Motivate

The problem is that many learners in multimedia learning environments experience a decreased intrinsic motivation to continue or complete lessons due to poor designs that negatively impact interest. Given that positive perceptions may assist in maintaining students' interest in content, it may be worthwhile to analyze and address learners' perceptions of multimedia (Moreno et al., 2001). Therefore, there is a need to address the problem of decreased intrinsic motivation in multimedia learning environments and propose updated design guidelines.

Design principles provided through the CTML are intended to maximize student's understanding of learning materials. However, Keller (1983, 2010) and Linnenbrink-Garcia et al. (2010) suggest that motivation and interest have been neglected as an influence on understanding and achievement. Further, it is important to address making the learning experience as positive as possible, ensuring that materials are useful and engaging enough to make the learning process desirable (Yu, Jannasch-Pennell, & DiGangi, 2008; Yu, Jannasch-Pennell, DiGangi, & Kaprolet, 2009). Learners exposed to multimedia in instruction report an enhanced motivation to learn the subject matter, regardless of the topic or level of difficulty (Yu et al., 2009). Similarly, multimedia presentations that incorporate text, graphics, and animations have been shown to result in increased learner interest (Koeber, 2005; Nowaczyk, Santos, & Patton, 1998; Wekesa, Kiboss, & Ndirangu, 2006; Yaverbaum, Kulkarni, & Wood, 1997). Instructional designers influenced by an increased demand to increase learning opportunities while simultaneously reducing costs without adversely affecting instructional quality face the challenge of finding the right combination of constructive media (Holden & Westfall, 2010). Hence, research to support design considerations that enhance interest may have an impact on both practice and future research.

Motivation Theories and Learner Interest

Motivation is derived from a personal desire for specific outcomes or goals. Ryan and Deci (2000a, 2000b) define motivation as the "means *to be moved* to do something" (p. 54). Lacking an impetus or inspiration to act, a person is unmotivated. Conversely, someone who is excited or aroused towards something is considered motivated. Deci and Ryan's (2000) *Self-Determination Theory* (SDT) promoted the psychological need for competence, autonomy, and relatedness in human motivation. Deci and Ryan (1980, 1985, 1991, 2000) further proposed that types of motivation are differentiated based upon the reasons or goals that underlie the action. *Intrinsic motivation* refers to action based upon an inherent interest or enjoyment and comes from personal interest, curiosity, or values. *Extrinsic motivation* refers to doing something based upon a separable outcome, such as a reward system, grade, evaluation, or the opinions of others. More than 30 years of research has reinforced the notion that the "quality of experience and performance can be very different when one is behaving for *intrinsic* versus *extrinsic* reasons" (Ryan & Deci 2000a, 2000b, p. 55). Relatedly, Ryan and Stiller (1991) found that *intrinsic motivation* is an important phenomenon in education. Nevertheless, many learning tasks are designed with *extrinsic motivation* in mind, which can result in resentment, resistance, and disinterest if the motivation is externally propelled (Ryan & Deci, 2000a). When learners self-endorse tasks that are attached to an extrinsic motivator, the impetus to act is derived from internal volition, but the motivator itself is still external to the learner and thus extrinsic by definition. Understanding the differences between intrinsic and extrinsic motivation are important to researchers and practitioners, because the differences help identify ways in which to foster each type of motivation in learners.

Defining Learner Interest

Learner interest as a concept extends beyond the basic feeling or emotion that drives a person to action. Interest is not specifically a type of motivation, but plays a significant role in influencing motivation (Schunk, Pintrich, & Meece, 2008). Further, students interested in a topic may display motivated behaviors, such as choice of the activity, effort, persistence, and achievement. Exploring the effect of motivation on metacognition has indicated that when students attempt to complete a course, they are either interested in the content, motivated to attain a goal of importance, or both (Tobias, 2006). Incorporating motivational variables, such as interest, into multimedia design will become an important task if instruction is to provide learners with relevant learning experiences (Fletcher & Tobias, 2005). Harp and Mayer's (1997) study aimed at making scientific textbook lessons more interesting found that promoting cognitive interest could be done by adding signals for structural

understanding such as summary illustrations with captions. Research is only beginning to fully explore what interest encompasses and to how help designers can incorporate interest into the design process.

Motivation and Learner Interest

Learner motivation as a consideration within learning design has a mixed history with regard to research and application. Originally, Keller's (1987) motivational design model supported the assertion that increased motivation and time on task increases learning outcomes. However, Brooks & Shell (2006) noted that very few references have been made to motivational design in instructional design literature. Keller's ARCS model, which is largely extrinsic in design, has historically been the only mention of motivation in design (Morrison, Ross, Kemp, & Kalman, 2011). Perhaps in response to this lack of focus, Keller (2010b) revisited motivational design to produce a generalized, systematic overview of learner motivation in instructional design. The result of Keller's work is a book for designers providing an overview of motivational theory, a systematic motivational design process, and tools to support motivational design activities. Keller provides specific detail on the topic of interest as a subset of motivation in terms of establishing a psychological basis for relevance of motivation in learning design. The attention is likely due to the established positive link between individual student interest and academic achievement. Schroff and Vogel (2010) asserted that interest is one of the critical positive emotions in learning contexts. Similarly, Schraw, Flowerday, and Lehman (2001) noted that interest increases learning and believed that promoting interest increases students' intrinsic motivation to learn. These findings also relate to the correlation between positive emotions, such as interest, and cognitive processes, including cognitive processing, decision-making, and creative problem-solving (Isen, Daubman, & Nowicki, 1987; Isen, Johnson, Mertz, & Robinson, 1985; Picard, 1997). Taking into consideration earlier challenges identified with technology-enhanced learning, it appears that specifically designing media to enhance learner interest could lead to better achievement. However, first it is important to better understand the theoretical foundations of interest and how it relates to motivation.

Learning as a result of motivation has been attributed to interest. Schunk (2008) has noted that interest plays a significant role in influencing motivation. Further, Fairchild, Horst, Finney, and Barron (2005) found that interest in an activity is actually the result of intrinsic motivation. Students interested in a topic may display motivated behaviors, such as choice of the activity, effort, persistence, and achievement. Hidi and Renninger (2006) suggested that as a motivational variable, interest triggers the engagement of learners with particular classes of objects, events, and ideas over time. Thus, the effect of interest on motivation is amplified since interest is grounded in both the affective and cognitive abilities of learners. Although Deci and Ryan (2000) proposed that *intrinsic motivation* is based upon inherent

enjoyment, coming from within the learner, Hidi and Renninger (2006) found that content and environment can affect the development of interest. The information contained within a learning task, how the task is designed, and where the task is delivered all have the potential to stimulate or discourage the learner's interest.

Types of Interest

Interest, as a theory, is categorized into one of the two subgroups; individual interest and situational interest. Individual interest (II) resides within a person, associates positive feelings with a topic or activity, and attributes personal significance to the topic or activity (Rathunde, 1993; Renninger, 2000; Renninger, Hidi, & Krapp, 1992; Schiefele, 1991). Individual interest is also referred to as personal interest, because as Dewey (1913, 1933, 1938) noted, interest is an active state based on real objects with a highly personal meaning. Situational interest (SI) emerges as a response to features or effects within an environment (Hidi & Anderson, 1992; Hidi & Baird, 1986; Hidi & Renninger, 2006; Krapp, 2002). Examining situational interest further, there are attentional and affective reactions that can be differentiated into *triggered-SI* and *maintained-SI* (Hidi & Baird, 1986; Hidi & Harackiewicz, 2000; Hidi & Renninger, 2006; Krapp, 2002; Mitchell, 1993). Tr*iggered-SI* is the initiation or arousal of interest (Hidi, 2001; Hidi & Harackiewicz, 2000; Hidi & Renninger, 2006). *Maintained-SI* is where interest is held and individuals begin to connect with the content (Hidi, 2001; Mitchell, 1993). The revelation is that the way learning content is displayed has an impact on the triggering of *situational interest* and how well learners maintain their *situational interest* throughout the duration of the learning activity.

Learning design strategies that take into account individual and situational interest during the design of instruction have the potential to help students become engaged and focused on the content. The effects of *triggered-SI* can be temporary if *maintained-SI* is not adequately considered. The results of a validity study on the Situational Interest Survey (SIS) by Linnenbrink-Garcia et al. (2010) found that *triggered-SI* reflects a positive affective reaction to the manner in which material is presented and *maintained-SI* refers to the reaction learners have to the material. Based upon the positive affective reaction to material presentation, it will be important to continue to examine situational interest across educational settings to further investigate what instructional practices can be designed to promote situational interest.

Using Learner Interest

Both types of interest have the potential for a positive impact on learners. Hidi and Baird (1988) found that *situational interest*, while intrinsic in nature, is encouraged by extrinsic factors. Attempting to design materials aimed at affecting individual interest is challenging and impractical. However, improving *situational interest* in

learning environments should be a fundamental concern (Park & Lim, 2007). One method of designing for *situational interest* is through vividness of text (Schraw et al., 2001), where vividness is defined as "segments that stand out because they create suspense, surprise, or are otherwise distinctive" (p. 217). The effect of vividness was found by Schraw, Bruning, and Svoboda (1995) to be related positively to interest and recall. Hidi and Baird (1988) also noticed an increase in reading comprehension when studying *situational interest* and cognitive performance. There are specific benefits of *situational interest* related to learning. First, *triggered-SI*, which is typically supported externally, precedes the development of a predisposition to repeated engagement with content. Second, *maintained-SI* includes focused attention and persistence over time and can be preserved through meaningfulness or personal involvement (Harackiewicz, Barron, Tauer, Carter, & Elliot, 2000). Therefore, learning strategies that take *situational interest* into consideration when designing instruction have the potential to help students be engaged and focused. As learners begin to gravitate towards activities that interest them, learning interest will become harder for researchers and practitioners to consider and apply if it is not thoroughly investigated.

How to Measure Interest

Having a firm grasp on the theoretical frameworks of multimedia design and situational interest are only the beginning. Once it is clear what to design and how to design it, there still remains a task of measuring *SI*. Linnenbrink-Garcia et al., (2010) created a scale known as the SIS. The original contexts for SIS development and testing were traditional classroom environments. The first pilot study was conducted in a post-secondary introductory psychology class. The second and third pilot studies considered middle and high school classrooms as a means of broadening the applicability of the scale. After carefully considering the validity of the tool, Linnenbrink-Garcia et al. (2010) specifically noted that it would "be important to continue to test the utility of these measures in other domains and age groups" (p. 667). What then would the survey look like if applied to multimedia environments? Table 5.1 details the original SIS items and resulting modified instrument statements as they might look in the context of multimedia. The proposed new statements were submitted to the original instrument authors for evaluation in order to address initial validity concerns related to Standard 1.4 from the Standards for Educational and Psychological Testing, which holds the researcher responsible for using a scale in a way that has not been previously validated (AERA, APA, & NCME, 1999). Documented correspondence with the experts is available for review.

Future Applications

Initial attempts to use and validate the proposed *Situational Interest Survey for Multimedia* (SISM) are currently underway. The new scale has already been used in a continuing education environment for adult learners who must complete

Table 5.1 SIS Items

Interest type	Original	New
SI-triggered	1. My math teacher is exciting	1. The multimedia presentation was interesting
SI-triggered	2. When we do math, my teacher does things that grab my attention	2. The multimedia presentation grabbed my attention
SI-triggered	3. This year, my math class is often entertaining	3. The multimedia presentation was often entertaining
SI-triggered	4. My math class is so exciting it's easy to pay attention	4. The multimedia presentation was so exciting, it was easy to pay attention
SI-maintained	5. What we are learning in math class this year is fascinating to me	5. What I learned in the multimedia presentation is fascinating to me
SI-maintained	6. I am excited about what we are learning in math class this year	6. I am excited about what I learned in the multimedia presentation
SI-maintained	7. I like what we are learning in math this year	7. I like what I learned in the multimedia presentation
SI-maintained	8. I find the math we do in class this year interesting	8. I found the information in the multimedia presentation interesting
SI-maintained	9. What we are studying in math class is useful for me to know	9. What I studied in the multimedia presentation is useful for me to know
SI-maintained	10. The things we are studying in math this year are important to me	10. The things I studied in the multimedia presentation are important to me
SI-maintained	11. What we are learning in math this year can be applied to real life	11. What I learned in the multimedia presentation can be applied to my job
SI-maintained	12. We are learning valuable things in math class this year	12. I learned valuable things in the multimedia presentation

regulatory training for employment purposes. This use not only extends the original SIS beyond the original learners in middle, secondary, and post-secondary classrooms, but it also transforms the scale for an entirely new frame of reference. A reciprocal relationship exists between research and practice. Technology can enhance instruction which then provides novel opportunities for research to examine the practice and prescribe both future application and continuing research (Salomon & Almog, 1998). As studies in educational psychology continue to adapt to the ever-growing field of instructional technology, it is important that new studies provide practical application of research findings. Use of the SISM has the potential to address the earlier described problem of stimulating learner interest in multimedia environments as well as contribute to the relationship between research and practice.

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