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EDUCATIONAL HANDHELD VIDEO: EXAMINING SHOT COMPOSITION,
GRAPHIC DESIGN, AND THEIR IMPACT ON LEARNING

by

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ABSTRACT

Formal features of video such as shot composition and graphic design can weigh heavily on the success or failure of educational videos. Many studies have assessed the proper use of these techniques given the psychological expectations that viewers have for video programming (Hawkins et al., 2002; Kenny, 2002; Lang, Zhou, Schwartz, Bolls, & Potter, 2000; McCain, Chilberg, & Wakshlag, 1977; McCain & Repensky, 1972; Miller, 2005; Morris, 1984; Roe, 1998; Schmitt, Anderson, & Collins, 1999; Sherman & Etling, 1991; Tannenbaum & Fosdick, 1960; Wagner, 1953). This study examined formal features within the context of the newly emerging distribution method of viewing video productions on mobile handheld devices. Shot composition and graphic design were examined in the context of an educational video to measure whether or not they had any influence on user perceptions of learning and learning outcomes. The two formal features were modified for display on 24 inch screens and on 3.5 inch or smaller screens. Participants were shown one of the four modified treatments, then presented with a test to measure whether or not the modified formal features had any impact or influence on learning outcomes from a sample of 132 undergraduate college students. No significant differences were found to occur as a result of manipulation of formal features between the treatment groups.

This work is dedicated to my family – my father, brother, and late mother – whose support and love helped guide me through those dark little tunnels that I sometimes found myself stumbling through during the course of this journey.

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LIST OF ACRONYMS/ABBREVIATIONS

ANOVA	Analysis of Variance
CRT	Cathode Ray Tube
CU	Close Up
DVD	Digital Video Disc
ECU	Extreme Close Up
ELS	Extreme Long Shot
LCD	Liquid Crystal Display
LS	Long Shot
MLS	Medium Long Shot
MP3	MPEG Audio, Level 3
MPEG	Moving Picture Experts Group
MS	Medium Shot
NTSC DV	National Television Systems Committee Digital Video
PDA	Personal Digital Assistant
TV	Television
USB	Universal Serial Bus
VHS	Video Home System

CHAPTER ONE: INTRODUCTION

Introduction

Researchers have long studied the variety of influential effects that video and motion pictures can have on both individuals and groups of people (Palmer, 1998; Roe, 1998). The emergence of the digital age has morphed the forms of traditional video and motion pictures in ways too numerous for researchers to keep up with (Ward & Greenfield, 1998). Videos can now exist as components of websites, software packages, CD-Roms, and public kiosks. Further, many mobile devices such as personal digital assistants (PDAs) and cellular phones are now capable of playing video programming formatted for small screens. The emergence and increasing efficiency of wireless networks capable of sending video content to these devices is resulting in a plethora of consumer options for viewing video content (Wagner, 2005).

Developers are investing substantial sums of money to build the infrastructure necessary to support mobile video. In 2004, telecommunications industry revenues totaled \$145 billion (Telecommunications Industry Association, 2007). Blum (2006) predicted that the global telecommunications market will expand by nine percent in 2009 in the United States alone. Global increases are estimated even higher at 10%, producing a staggering \$3.6 trillion in predicted revenues. If met, these rates of growth will surely fuel the availability of expanded wireless services.

Wireless handheld communications devices are evolving in tandem with the growth of these networks. Cell phones, PDAs, and handheld multimedia tools are

converging in ways that are about to forever change the viewing of video content. PDAs evolved from calculators in the mid 1970s (Koblentz, 2005). As computer chips and circuitry became smaller and more powerful, successive generations of calculators were able to offer more advanced tools and functions such as organizers and word processors. Consumer demand for increasingly sophisticated, portable devices led to innovative technologies such as pocket-sized digital cameras and cellular telephones, miniature music players, and small, portable digital video players. More recently, these items have begun to merge. Nearly all modern cell phones have cameras, video recorders, and some form of software-supported organizational tools built into them. The quality and resolution of these items increases with each generation. Many are also now incorporating full MP3 audio players. The convergence of these media devices will ultimately lead to the creation of new tools for viewing video content.

Mobile TV will increasingly be delivered by a device with multiple multimedia functions. Features such as radio, music player, camera and video recorder are already available on mobile devices. With these new multimedia functions mobile TV will offer a more active, interactive and personal viewing experience than that of traditional television. (Orgad, 2006, p. 2)

“Everyone agrees that cell phone cameras will offer better quality and expanded storage with time, making mobile video a force to contend with in the future”

(Grotticelli, 2006a, p. 36). Huge technological leaps toward this vision have been made recently with the introduction of devices such as LG Electronics’ KE850 Prada phone (available only in European countries) and Apple’s iPhone. Both products are fully functioning phones with touch-screen control panels, internet access, video playback capabilities, mp3 music players, and high resolution still cameras built into them. The

iPhone has a fully functional iPod portable music player built into it, up to eight gigabytes of storage space, and sports a two megapixel camera. The touch-screen interface allows easy use of multiple software tools such as word processors, personal organizers, and internet mapping systems (Apple, 2007). The iPhone's ability to play video on its 3.5 inch screen makes it one of the most sophisticated mobile communications devices currently on the market. Of course, other industries are already following suit in mimicking the robust features of LG's and Apple's creations.

With an expanding infrastructure and more sophisticated devices, the industry clearly believes that the proliferation of mobile video is on the horizon. "Robert Iglar, CEO of the Walt Disney Company, said his company sold 125,000 movie downloads worth \$1 million in revenue through Apple's iTunes store during the first week downloads were offered" (Grotticelli, 2006b, p. 34). Orgad (2006) stated that "According to forecasts, by 2011 demand will explode with more than half a billion customers subscribing to video services on their mobile phones" (p. 1). Feuiherade (2006) projected more modest numbers, stating that, "According to analysts Informa Telecoms and Media, more than 210 million people across the world will be watching TV on mobile devices by 2011" (§ 4).

Regardless of the forecast number, the direction of growth remains the same. This leads educators to wonder how to leverage this technology as a tool for learning. "As mobile connectedness continues to sweep across the landscape, the value of deploying mobile technologies in the service of learning and teaching seems both self-evident and unavoidable" (Wagner, 2005, p. 42).

If educators are seeking ways to utilize handheld video as a tool for learning, then research into the aesthetic design factors appropriate for small screen viewing is necessary in order to produce content which maximizes viewer learning potential. These design factors are called ‘formal features’: the elements of video programming that result from production techniques such as shot composition, editing pace, and graphic design (Huston et al., 1983; Kozma, 1991; Roe, 1998). Anderson and Burns (1991) stated that “There appears to be something special about within-program formal features... that increase cognitive processing of content” (p. 13).

Producers use formal features for a number of reasons. They can influence the mood, perception, and overall feel of a video. For instance, producers can utilize different techniques of editing and pace to influence how a viewer interprets events depicted on screen. One editing technique often used to convey a sense of urgency or that a number of events have happened over a very short period of time is called a montage. This is a series of edits of different scenes which occur very quickly to increase the emotional intensity or anxiety of events within a story (Hickman, 1991; Metallinos, 1996). Conversely, a producer may choose to convey a sense of boredom, prolonging, or even isolation through the extended use of a static shot with no edits and little or no motion happening within the frame.

Shot composition is another formal feature which can be used in a number of different ways to convey information or affect viewers in psychological manners (Kozma, 1986; McCain, Chilberg, & Wakshlag, 1977; McCain & Repensky, 1972; Zettl, 1998). Even similarly composed shots can have different psychological effects on

viewers based on the angle of the camera. Roe (1998) suggested that objects shot from low camera angles appear stronger, more foreboding, and can even produce “increased sensations of threatening force and/or increased speed” (p. 62) in viewers.

Television graphics are yet another formal feature warranting consideration during program development. Graphic design can influence the mood of viewers and their interpretation of messages being communicated (Las-Casas, 2006). This is another reason why it is important to scrutinize suggestions which force designers into certain choices for their designs. It is not new for graphic designers to have to work within limitations of certain technologies (Las-Casas). However, the implications of suggested graphic sizes, if taken at face value without any form of scientific inquiry, could impact the message, emotion, or interpretation that the producer wishes to exert with a given program. It is important to understand the limitations of a certain medium, and to work within them in order to ensure that every element of a communicated message is being received by the viewer (Hodges, 1996). If graphic elements are so small that they are unreadable, then they will fail to convey information that a producer has deemed necessary for full communication of the program’s message.

While the basic form of video content appears to remain relatively unchanged, little research has been conducted on whether or not differences in the physical size of the screen have any effect on how producers should design content for viewing on the smallest of these aforementioned devices: PDAs and cell phones.

Many professionals in the industry have already formed opinions which influence the methods that producers use to shape the messages they are tasked to

communicate via these small-screen devices. Some (Grotticelli, 2006b; Orgad, 2006; Wang, Houqing, & Fan, 2006) feel that mobile video programs should minimize the use of long shots (LS) and utilize mainly medium shots (MS) and close ups (CU) to convey visual information on portable handheld video players. Others (Grotticelli, 2006b; Plummer, 2007) have addressed the issue of graphic design for such programming, stating that graphic elements should take up a significant portion of the screen to ensure viewer legibility.

Video programming on personal mobile devices has the potential to positively impact the usage and effectiveness of educational videos. Waggoner (n.d.) stated that “mobile video probably has the most promise in training, where people learning how to do a specific task can actually carry their training video in their pockets and refer to it whenever needed” (¶ 7). Information seeking and retrieval is expected to be a main usage of mobile video.

Consumers are likely to use their mobile televisions to seek time and place sensitive information, especially in situations when they are on the go, do not have internet access on a desktop PC, and need real time access to information. (Orgad, 2006, p. 6)

Zettl (1998) established that formal features are the foundation for how information is constructed by producers, and conversely, interpreted by viewers. He even argued that proper usage of formal features could allow for accurate and reliable predictions of viewer perceptions. If educational videos have a role to play within the context of the coming mobile video revolution, then producers of educational video content need to have sound scientific research to draw from in order to maximize the potential of transferring knowledge to viewers.

Given the importance and impact of producer choices on the formal features of any given educational video program, the researcher intended to expand on the robust body of knowledge concerning formal features by looking at their impact on knowledge retention in the context of viewing on small-screen mobile playback devices. The researcher's intent herein was to test the claims that others have made on proper formal features to utilize for mobile video production and distribution. By scientifically validating or disproving these claims, the hope was to shed some amount of light on proper methodologies and paradigms for future video professionals who will create content to be viewed within this new handheld theater.

Review of the Literature

A review of the literature reveals that many scientific studies on the cognitive and psychological effects of formal features are conducted by isolating the components in question and examining quantitatively measured differences. There are opposing academic views on studies which utilize this methodology. Silbergleid (1992) questioned the effectiveness of studies on individual formal features, stating that "it is important to remember that a television program is more than just individual shots or sounds working independently of one another" (p. 8). Tannenbaum and Fosdick (1960) stated that "there is always a risk of generalizing from such experimental investigations" (p. 261). These arguments arise from Gestalt psychology which asserts that the whole is greater than the sum of its parts (Berryman, 1990; Koffka, 1999; Metzger, 2006).

Arguments that video programs should only be analyzed as whole parts are problematic to the art of scientific inquiry. When comparing individual programs in their

entirety, an extreme number of variables is introduced that cannot be accounted for with current methods of quantitative analysis. As such, the current scientific method is the best measure that researchers have for a given set of variables – assuming, of course, that all other components are equal. Goldner (as cited in Wagner, 1953) supported this methodology, stating that “Only by dissection, analysis, and definition can we hope to get closer to understanding and creating the special film that is to be the sharp and dependable tool for training” (p. 28).

Research on formal features of film and video is not a new body of scientific inquiry. Around the beginning of World War II “serious experimental research done specifically relating to production techniques in educational films” (Wagner, 1953, p. 25) began to emerge. Since that time researchers have isolated and examined such formal features as lighting angles (Tannenbaum & Fosdick, 1960), the use of fades and transitions (Mercer, 1952), differences in camera angles (McCain, Chilberg, & Wakshlag, 1977; McCain & Repensky, 1972), the use of animation and graphics (Miller, 2005; Morris, 1984), editing techniques and imagery (Sherman & Etling, 1991), editing and pacing (Hawkins et al., 2002; Kenny, 2000; Lang, Zhou, Schwardtz, Bolls, & Potter, 2000; Schmitt, Anderson, & Collins, 1999) and many more.

Handheld video is still a very new technology; however, its roots derive from traditional video. Orgad (2006) noted that mobile video technologies have not evolved in a vacuum; rather, they have been built “upon existing platforms, primarily those of television, mobile telephony, and the Internet” (p. 1). Inevitably, this change in technology will bring with it modifications in the paradigms that drive the way that

videos are produced. For leaders in educational media development settings, this will require new thinking in terms of the style and manner of educational media production, as well as variations in distribution methodologies for produced content. As such, prior research on the aesthetic factors of traditional video can properly guide investigations into the development of educational video and multimedia content for a small screen format. This study added to the body of research on the effects that formal features have on viewers by isolating and comparing several specified features within an educational video distributed and viewed on handheld devices as well as standard television sets.

Formal Features

Shot Types

Wagner (1953) stated that “good film form is basic to all the uses to which motion pictures may be put” (p. 12). Thus, a study on design issues within educational media must include a discussion on what makes ‘good form.’ One way that producers shape the visual form of messages in video productions is by determining the type of shot that conveys information during a particular point in time. In general, there are three basic categories of shots (Burrows, Wood, & Gross, 1992; Hickman, 1991; Millerson, 1990; Wagner, 1953). The *long shot* (LS) is far away enough from the main subject or subjects that the viewer can obtain a sense of setting. Often times, this shot is referred to as an establishing shot, as it establishes the orientation of the subjects within a setting to one another. The *close up* (CU) is the exact opposite of the long shot. Hickman (1991) stated “The close-up normally includes just the face or head of the

subject, from the top of the hair to the neckline” (p.139). Viewers will be more attuned to the nuances of human expression if they view a close up shot of a person saddened or enraged than viewing the same expressions in a long shot. Of course, close up shots – like any shot – can consist of more than human subjects. One goal of close up shots is to convey a sense of intimacy to the subject at hand. They can also serve to convey information. For instance, a program about the craftsmanship of miniature ship modeling will communicate the minutia of this art more effectively with close up shots than with long shots.

The third type of shot is the medium shot (MS). These are shots which split the difference in extremities between long and close up shots. Medium shots can be used to convey a restrained sense of setting; allowing viewers to see events or objects within the immediate vicinity of the subject. They can also be used to vary the pacing of programming. Figure 1 illustrates the differences between the basic categories.



Figure 1: Comparison among LS, MS, and CU Shot Compositions (Hutchens, 2007a)

Shot designations within a given program are relative. Burrows, Wood, & Gross (1992) stated that:

what is a long shot for one dramatic segment may be considered a medium shot in another situation. Generally, a medium shot of a person includes most of the body, perhaps cutting the talent off slightly above or below the waist. (p.151)

There are, of course, variations on the degree to which shots differ from one another. Designations such as extreme close ups (ECU), extreme long shots (ELS), and medium long shots (MLS) are conventions used in television production, but the three main shot styles discussed are the basis for all visual shot compositions in video production.

Composition

An important aspect of professional video is the proper composition of imagery. This refers to the alignment of objects within an image to produce an aesthetically pleasing picture. Aiello (2000) stated that “Composition is at the heart of making attractive video...” (p.16). One very useful guideline to use when one composes camera shots is the ‘rule of thirds.’ This is a concept that most professional photographers and videographers utilize.

It has been widely held among classical artists throughout history that painting objects on a rectangular canvas at certain predictable points causes the eye to flow more easily across the canvas, resulting in greater harmony among the painting’s visual elements. (Aiello, 2000, p.16)

Aiello is referring to the ancient Greeks’ “Divine Proportion”, which is a mathematical ratio that has been used through the ages to design famous sculptures, buildings, and artwork (Metallinos, 1996). The rule of thirds is a simpler, modernized version of this concept, and is widely applied by artists and photographers alike when composing imagery. The presence or absence of this composition technique can often

differentiate professional work from that of amateurs. In fact, some companies manufacture cameras that feature auto-focus points based on its intersecting lines (Leong, 2004).

The rule of thirds divides images into three vertical and horizontal columns (see Figure 2). When areas of interest or separation are placed at the lines of the grid, the imagery will often have a more naturally pleasing aesthetic feel. It can be applied to any type of shot composition to improve the professional look of the production.



Figure 2: The Rule of Thirds (Hutchens, 2007b)

In a study such as this, it is important to note the use of composition techniques to distinguish that the video being assessed as a tool for knowledge retention follows production standards and paradigms inherent in professional video production. Picciano (2002) stated that “A video that has the look or feel of amateurism will not be effective in any learning environment” (p. 149). As such, it would likely prove difficult to assess end user knowledge retention in educational video if the audience is unable to focus on key messages due to the poor production values of the material being presented to them.

Similarly, one must distinguish the use of variations in shots (such as LS, MS, CU) when discussing educational video for handheld devices. Historically, research has

shown that variations in video image composition influence viewer interpretations of meaning and attraction. McCain, Chilberg, and Wakshlag (1977) found “a near perfect linear relationship between camera angle and perceived composure, sociability and competence.... As the camera angle was raised, so too was a speaker’s perceived credibility” (p. 39). McCain and Repensky (1972) found that the use of long, medium, and close-up shots on comedians yielded significant differences in viewer attraction depending on which type of shot was used on a given comedian.

Graphic Design in Television

“Captions and titles are a basic requirement of television” (Hurrell, 1973, p. 7). In order to create effective graphics, “the designer needs to know in depth the perceptual capabilities of his target audience” (Berryman, 1990, p.6). For handheld mobile video devices, the most obvious perceptual consideration is that the viewing screen is in the vicinity of three inches wide. This can have an impact on the legibility of graphic communications content for video on handheld devices.

There is a large body of research on text, font-sizes, readability and legibility. Historically, the classical era of this research applied to printed type in the 1920s to 1940s (Geske, 2000). The advent of television in the 1950s introduced a new medium in which designers had to contend with displaying lettered content to viewers. The basis for design theory from this era was drawn from previous studies in print until a body of knowledge specific to the television medium existed which designers could draw from

(Hurrell, 1973). Later, in the 1980s, the personal computer emerged, adding yet another genus of research on text and typographic displays as applied to computers.

Of course, graphics in video have evolved their own conventions over the years. While there are many different types and styles of graphics used in post-production, the two basic styles of graphics that will be tested herein are *full screen* graphics (those which take up the entire screen to convey information) and *lower-thirds* (graphics which appear on the bottom third of the screen; often for identification purposes). Specifically, this study is interested in whether or not size reduction due to compression will reduce legibility, and consequently have a negative effect on knowledge retention.

While most typographical research for print and computers tends to revolve around readability *and* legibility, video lends itself more to the concerns of legibility.

Williams (1996) offered a very succinct comparison of the two concepts:

Readability... refers to whether an extended amount of text – such as an article, book, or annual report – is easy to read. **Legibility** refers to whether a short burst of text – such as a headline, catalog listing, or stop sign – is instantly recognizable. (p. 43)

For video productions, legibility is usually the primary concern. The nature of the medium is temporally based, therefore quick, easily readable text is necessary to convey information. Most videos utilize graphical information for identification or full screen displays (see Figure 3). Only occasionally in cinema does one find lengthy textual exposition. Even then it is used sparingly, such as the opening scenes for the popular Star Wars films where multiple paragraphs of text are used to inform the viewer of the context of the storyline that follows.



Figure 3: Full Screen Graphic Compared with a Lower Third Graphic (Hutchens, 2007c)

Much of the research conducted for legibility of onscreen computer type has been concerned with the characteristics of characters (size, serif vs. sans-serif, capitalization, etc.), formatting, contrast and color, and dynamic text (moving text) (Mills & Weldon, 1987).

Isaacs (1987) made a number of observations on the proper use of text in multimedia applications. He suggested that type color, size, style, and line length all have effects on legibility. Further, the layout and design of any style of any document, printed or electronic, can significantly impact the speed and depth of end-user comprehension. Chandler (2001) noted that Isaac's study, having been conducted in 1987, uses displays as small as 320x200 pixels, and that modern computer monitor technologies far exceed this resolution. Interestingly, the screen display resolution of the monitors used in Isaac's study closely resembles that of portable handheld devices being used today. However, in terms of color-depth, the monitors used by Isaacs were far inferior to any handheld device on the market today with video playback capabilities. The monitors used in his study only supported 16 colors. Modern personal video devices

are capable of producing images with millions of colors. Additionally, while the physical size of the screen is not documented in his paper, it is likely that the screens being utilized were much larger than a two or three inch monitor, which is common for handheld monitors. So, while aspects of Isaacs' research can be taken into consideration when studying graphics in handheld video, advancements in the quality of displays must also be taken into account.

From Print to Digital

Effective graphic design practices for television are derivative of traditions in printed design. Hurrell (1973) stated that, "The standard demanded of a typographer in a printing house is the basis of all lettering produced for television" (p. 8). That said, Bringhurst (1996) stated:

The typographer's one essential task is to interpret and communicate the text. Its tone, its tempo, its logical structure, its physical size, all determine the possibilities of its typographic form. The typographer is to the text as the theatrical director to the script, or the musician to the score. (p. 20)

Hurrell's (1973) deference to print design is interesting in that in many cases, it appears that this sentiment has been lost over the years. For instance, Millerson (1990) stated that, "Titling is there to inform your audience. They should be able to read it quickly, easily, and unambiguously. If they cannot, it has failed in its purpose" (p. 348). He made no mention or reference to utilizing a visual design to synch graphics with the overall style of a production. Instead, he focused the remainder of the chapter to discuss only the technical considerations for creating graphics for video. Burrows, Wood, and Gross (1992) probed slightly deeper into topics such as kerning (the adjustment of space

between individual letters) to achieve a more visually appealing design. However, neither text spent the amount of time and effort devoted to the subtle elements of design as have many texts on typography. Some typographers approach a nearly spiritual conviction when expounding on the fundamentals of the art:

Some of what a typographer must set, like some of what any musician must play, is simply passage work. Even an edition of Plato or Shakespeare will contain a certain amount of routine text: page numbers, scene numbers, textual notes, the copyright claim.... But just as a good musician can make a heart-wrenching ballad from a few banal words and a trivial tune, so the typographer can make poignant and lovely typography from bibliographical paraphernalia and textual chaff. The ability to do so rests on respect for the text as a whole, and on respect for the letters themselves. (Bringhurst, 1996, p. 24)

Spacing (the act of organizing information within a fixed space), leading (adjusting space between lines of text), kerning and alignment of elements are examples of considerations which typographers concern themselves with that often fail to appear in television production texts. This is unfortunate, as frequently on projects with smaller budgets the post-production editor must also act as the graphic designer. Even experienced editors tasked with designing graphics for their own project may undermine the ability to communicate key concepts due to the fledgling, unprofessional look of the graphic elements they are tasked to create. This is especially important given the cultural expectations that viewers have for different modes of media (Lupton, 2004). When editors do not have a functional grasp of effective typographic design, they risk negatively impacting viewer impressions of their programmed content.

While often lacking in aesthetic principles of design, television production texts usually offer some minimal guidelines for graphic design, mostly based on the technological limitations of the medium itself. Burrows et al. (1992) suggested that font

sizes for on-screen type should not be smaller than one fifteenth of the size of the screen. One reason for this general rule-of-thumb relates to the affect that thin lines (one pixel or smaller) have on the NTSC signal. When elements of a font are reduced to one pixel or smaller a visual flickering will occur that can be distracting to the viewer. This effect occurs as a result of the structure of the NTSC signal, which will be explored in-depth in Chapter Two. The important point herein is that the same phenomenon does *not* occur with handheld video because the signal is fundamentally different than that of a standard NTSC DV signal. In the end, small font sizes may still affect legibility on handheld media viewing devices. Millerson (1990) suggested using fonts no smaller “than about 1/10 to 1/25 of the picture height” (p. 349). However, as with other older production texts, these guidelines are based on viewing content on common television set displays, not handheld screens.

Statement of the Problem

Though portable wireless handheld video is new, industry practitioners are already forming opinions of the proper types of shots and graphics that should be used for producing content for small screens. Wang, Houqiang, and Fan (2006) stated that “users often feel that the display resolution greatly affects their perceptual experience with the limited screen size” (p. 565). Orgad (2006) stated that “Because of the small size of the screen mobile TV programmes are likely to lend themselves to focusing on talking heads, where viewers will be able to watch close-ups and see the details, rather than capture a wide scene” (p. 7). Grotticelli (2006b) stated that for handheld video, lower-third graphics should “appear on the full lower half of the screen on a cell phone”

(p. 34). If these statements are true, then producers should follow these guidelines in order to ensure that messages are being adequately communicated to viewers. If, on the other hand, they are simply based on false speculation, then producers following these guidelines are being limited in the types of formal features that can be used to convey intended messages. This, in turn, may hamper their ability to communicate messages in the most effective manner.

While these recommendations are being made by experts in the field, they have not been tested via quantitative or qualitative measures. Despite the absence of formal research on these ideas, their general acceptance is already changing how digital video is produced and compressed for handheld distribution. Indeed, engineers are already testing tools which would automatically reconfigure scenes from long shots to close ups when converting video for playback on handheld devices (Wang, Houqiang, & Fan, 2006).

The problem to be addressed in this research was whether or not these prescribed stylistic formulas were necessary. There was a need for formal research into these ideas before widespread shifts within the industry locked producers into inefficient or ineffective paradigms that would negatively affect the messages being communicated via this new medium.

Research Questions

- 1) What differences, if any, exist between self-perceptions of learning with video training materials formatted for handheld devices compared to large screen delivery mediums?

- 2) Is there a difference in learning outcomes based on shot composition and graphic design formatting for educational videos being viewed on 3.5 inch screens (or smaller) compared to 24 inch monitors? (See Table 3 for grouping.)
- 3) Is there a relationship between user learning preferences for viewers watching educational video content on handheld devices or televisions and viewer frequency of watching educational videos on handheld devices?
- 4) What are the relationships, if any, between the user frequency of viewing videos on handheld devices and learning outcomes?

Definition of Terms

Close up (CU): a shot composed as a close view of the subject (Burrows et al., 1992)

Full Screen: graphics which fill the television screen with information about content being presented (Hickman, 1991)

Kerning: the act of vertically organizing text information within a fixed space (Williams, 1996)

Legibility: the ease with which a short burst of text is recognizable (Williams, 1996)

Lower Third: graphics which appear in the lower third portion of a screen; usually to identify content being presented (Burrows et al., 1992)

Long Shot (LS): a shot composed as a far away view of the subject (Zettl, 1976)

Master Sommelier: the highest level of certification achievable in the wine profession (Court of Master Sommeliers, 2007)

MP3 (MPEG Audio, Level 3): a popular digital audio recording format (Wooton, 2005)

Medium Shot (MS): a shot composed as a medium view of the subject (Burrows et al., 1992)

NTSC DV: National Television Systems Committee Digital Video – the standard digital television signal used by the United States and Japan (Symes, 1998)

Personal Digital Assistant (PDA): a handheld electronic organizer which often has multimedia capabilities such as cameras, video players, text editing software, etc. (Koblentz, 2005)

Readability: the ease with which an extended amount of text can be read (Williams, 1996)

Spacing: the act of horizontally organizing text information within a fixed space (Williams, 1996)

Full Screen Graphic: a graphic image which fills a television screen (Burrows et al., 1992)

Methodology

This study utilized a mixed method consisting of both quantitative and qualitative feedback via a proprietary test instrument. Participants viewed a ten minute video about the basics of professional wine tasting. The subject matter within the video and test instrument was reviewed and confirmed accurate by a Master Sommelier. This distinction is awarded by the Court of Master Sommeliers and is regarded as one of the highest professional merits within the wine trade. Only 158 individuals worldwide hold this title (Court of Master Sommeliers, 2007). The same sommelier also provided instruction within the educational video as the on-camera talent.

Pilot Study

The test instrument was tested for reliability with a pilot study (n = 48). The goal of the pilot study was to test the effectiveness the instrument. Participant ages ranged from 21 to 67 years, and all had either normal vision or vision that was properly corrected with either glasses or contacts during viewing of their respective treatments. Participants viewed the ten minute instructional video then took an 18 question paper test. Average scores for the test were 88.54. Data for the pilot study were analyzed with Chronbach's Alpha. During this process, eight questions were removed (see Table 1).

Table 1

Removed Questions

Number	Question
3	Which choice best describes a horizontal tasting? a) When the bottles are placed horizontally beside one another b) When the glasses are placed horizontally beside one another c) When one compares a single type of wine bottled in different years d) When one compares the same type of wine and same vintage among different producers
4	Which choice best describes a vertical tasting? a) When one compares the same type of wine and same vintage among different producers b) Comparing a single type of wine bottled in different years c) When one is given no information about a wine, but must identify it as closely as possible based on its characteristics d) Comparing a general hodge-podge of wines
5	Which choice best describes a blind tasting? a) Comparing different wines that were bottled in the same year b) Comparing a single type of wine bottled in different years c) When one is given no information about a wine, but must identify it as closely as possible based on its characteristics d) Comparing a general hodge-podge of wines
7	What are the three stages of wine tasting? a) Sight, aroma, and taste b) Sight, dampness, and taste c) Acidity, crispness, and feel d) Touch, taste, and sound
10	What is a reason for swirling wine in a glass? a) To release the aromas for evaluation b) To look sophisticated c) To remove bubbles from the wine d) To gauge the refractivity of the wine

Number	Question
12	<p>Which of the following is not a characteristic that one should consider when evaluating a wine's appearance?</p> <p>a) Clarity b) Bubbles (presence of gas) c) Gradience d) Color</p>
13	<p>Most of taste is actually...</p> <p>a) Texture b) Smell c) Taste-buds d) Myopic</p>
14	<p>The tongue is capable of detecting four primary flavor characteristics. Which of the following is not a flavor that the tongue can detect?</p> <p>a) Sweetness b) Earthiness c) Saltiness d) Bitterness</p>

Upon removal of the eight questions, the resulting reliability score was stronger (see Table 5), although not quite at researcher's desired level of strength. The decision was made to rework the instrument as a ten-item test which would then be put before a panel of experts for review.

Table 2

Reliability after Removing Five Questions

Chronbach's Alpha	Chronbach's Alpha based on Standardized Items	N of Items
.643	.671	10

Once the questions were removed and the posttest was reworked, it was presented to a panel of eight experts in the field of educational research for review. A number of modifications were made to both the quantitative section of the instrument, as well as to the qualitative sections designed to collect demographic information and user preferences and opinions of learning with various media formats. Upon receiving feedback on ways to improve the instrument, the researcher implemented the recommended changes to create the instrument used to collect data for the study. While the Chronbach's Alpha scores from the initial pilot study were not quite where the researcher desired them to be, it was anticipated that the power of the test instrument would increase given a larger sample size.

Research Procedures

The researcher looked at other similar research into formal features and their cognitive effects to establish a similar sample size. Based on previous similar research by Kenny (2002) and Roe (1998) the sample size consisted of approximately 150 individuals. Recruiting took place from the student body at the University of Central Florida. Participants were scheduled in groups of approximately twenty individuals at a time to view their assigned treatment in laboratory settings. Each group was randomly assigned to one of the four treatments.

During the study, participants watching on handheld devices viewed their segments on iPods loaned to the researcher by Apple Inc. specifically for use in this study. Since all participants viewed their individual devices within the same room, each was provided headphones so as not to distract the others around them.

After watching a randomly selected video treatment, participants took the test instrument. Quantitative data collected via the instrument was analyzed to determine the answers to the stated research questions. Qualitative feedback was solicited by means of open-ended questions within the instrument which explored learning preferences and reasons for viewing educational video content on handheld mobile devices. The information collected was used for additional insight into participants' overall experiences with the material.

In total, there were four treatments for the study. See Table 3 for details.

Table 3

Four Proposed Treatments for this Study

Treatment Number	Shot Composition & Graphic Formatting	Delivery Medium
1	Standard Television shots & graphics	Standard Television
2	Handheld shots & graphics	Handheld Device
3	Standard Television shots & graphics	Handheld Device
4	Handheld shots & graphics	Standard Television

Significance of the Study

Metallinos (1996) stated that studies on the techniques used to communicate messages via the “medium of television provide the basis on which the standards for picture recognition in particular, and visual learning in general, should be built” (p. 117). As noted earlier, writings have already been published about the nature of effective

formal features within this medium: particularly with regard to the types of shot compositions that should be used, as well as the design of informational graphics within mobile video programming. However, not all of these claims have been made on the basis of scientific inquiry. This study was designed as an empirical analysis to test these assumptions; specifically for educational video products where knowledge retention is the goal. The aim was to directly test these assumptions in the context of handheld video as an educational tool. Shot compositions and graphics were manipulated to measure for the presence of any possible relationships to knowledge retention in an educational video. The outcome of these findings was intended to expand upon the body of research on video formal features by exploring their impact within the context of mobile, handheld viewing.

Limitations

This study was designed to expand upon prior research into the formal features of video programming. As the medium of handheld video was new, no prior studies examining formal features of programming on small screens existed to draw from. Instead, methodologies used in older studies examining formal features in standard television formats were studied and modified to develop a methodology for this research. Additionally, a proprietary test instrument was developed for use in this study. Efforts were made to maximize its reliability, as documented in the section on methodology.

The study was conducted using a sample of college students studying communications and digital media. The subject matter of the instructional video was

specifically chosen to, hopefully, capture a general level of interest across populations. However, not everyone, even college students, was likely to have found interest in the practice of wine tasting. This may have affected their level of involvement in the training, and subsequently, their scores on the test instrument. Conversely, it was assumed that some taking this module may already have an advanced knowledge of the topic, which might also have influenced test instrument scores. It was assumed that participants with either of these characteristics (non-interest in the topic or advanced knowledge of the topic) were evenly distributed throughout the treatments through the process of random sampling.

Since the participants took the test instrument immediately after viewing the instructional video, this study did not take into account any potential long-term learning retention. It represented a measurement of knowledge immediately retained by viewers based on key points accentuated within the video through the methodical use of the formal features described herein. Their affects on long-term learning and/or application of the skills presented within the video were beyond the scope of this study.

Summary

The contents of this chapter have consisted of an introduction to topics and ideas which are the crux of this proposed study. A review of literature was presented which substantiates the relevance of this investigation: its goal being to further the robust body of research on formal features of mobile, handheld video programming. Research questions have been presented along with a proposed methodology for investigating them.

The following chapter is a comprehensive review of the relevant literature regarding this proposed study. It begins with a discussion of the vast monetary backing and predictions of the eminent growth of the mobile video market. Differences in the underlying technology between standard television and portable handheld video signals are discussed during the section on compression. Formal features such as shot type, composition, and graphic design will be further explored. Additionally, the technological differences underlying NTSC DV and handheld mobile video signals are reviewed to offer deeper insight into the paradigm and design differences between them. Finally, leadership considerations for producers and leaders in video and multimedia production environments are discussed.

The third chapter contains a thorough description of the methodology used to develop the study and collect the appropriate data. Chapter Four features an analysis of the collected data. Chapter Five consists of a discussion of interpretations of the analyzed data, limitations of the study, and recommendations for further research.

CHAPTER TWO: REVIEW OF THE LITERATURE

The Ease and Convenience of Handhelds

Handheld computers allow access to immense amounts of information and organizational tools literally in the palm of one's hand. Reference materials such as books, videos, audio, and software, as well as email, voice, and internet communications are all accessible through the use of these devices. A myriad of professional disciplines are finding success through educational programs which utilize the technology to teach and train members of their profession. Colevins, Bond, and Clark (2006) demonstrated how providing handheld personal digital assistants (PDAs) for nurses returning to the field, who for various reasons had not been practicing for over five years, resulted in successful reintegration back into their profession. Students with little experience using handhelds were able to easily overcome learning gaps and dramatically improve comfort levels with the technology over a relatively short period of time. "The percentage of those who felt very comfortable with handheld rose from 22 percent to 66 percent" (Colevins, Bond, & Clark, p. 46). Torre and Wright (2003) documented how students in internal medicine residency programs found PDAs useful due to the ease of retrieval of medical information and practical guidelines when diagnosing patients. Educators in the same program reported that PDAs allowed them to evaluate their own performance in training sessions and compare them to student evaluations. The insight which they gained from these comparisons afforded them opportunities to modify their own teaching practices as necessary to improve instruction.

Walther (2005) discussed how one K – 12 school system found numerous applications for improving education with the use of PDAs. For instance, science classes used probes which attached directly to PDAs via Universal Serial Bus (USB) ports to collect data on temperature, humidity, and motion. Students then exported the data to spreadsheets for analysis. While collecting water samples from local streams, they also used the wireless internet capabilities of the devices to research various bacterial strains known to exist within regional tributaries.

Literature classes can also benefit from accessibility to PDAs. The advent of e-books can allow students access to entire libraries of publications on their handheld device. E-books, though broadly defined, are electronic books that can be downloaded and reviewed on handheld devices in a multitude of formats (McGraw, Burdette, Seale, & Ross, 2002). Walther (2005) described how students can make notes and highlight passages directly in an e-book. He also noted that students were able to use the search functions within the software to instantly locate quotations or areas of text related to a given topic.

Rivard (2005) documented how certain courses at the University of South Dakota successfully implemented PDAs in disciplines such as law, medicine, and computer science. Educators at the University had the ability to send quiz or test materials to students remotely. Students were then able to take the examinations and submit them back to instructors where the content could be instantly graded and logged into a database for compiling student progress (Liebiger, 2002).

Thornton and Houser (2005) examined methods of using cell phones and PDAs for Japanese college students studying English as a second language. First, they compared email frequency between personal computer (PC) users and mobile device users. Their findings are intriguing. Students in their study emailed their peers more frequently about course issues with their phones or mobile devices than with personal computers.

They also examined the use of ‘push-learning’ with mobile devices: sending frequent text lessons to students as refresher lessons. They looked specifically at the differences between push learning on PCs compared to mobile devices. Three times each day during the duration of the study, students taking English courses were emailed mini-lessons of 100 words of text or less that were formatted to be read on cell phone screens. The lessons introduced up to five new vocabulary words per week in differing contexts, and contained reviews of previously learned vocabulary words. The learning cycle lasted for two weeks, and pre and post tests were used to measure gains in knowledge. They found that not only did students prefer receiving these lessons on mobile devices, but there was a significant difference in performance between the two groups. Those receiving lessons on mobile devices outperformed those receiving lessons on PCs.

Industries are looking hard at the usage of PDAs to enhance their client experiences. In particular, the restaurant industry is exploring the technology to improve guest experiences (Manion & DeMicco, 2004). Scenarios have been painted where customer preferences are collected and stored on customer appreciation cards. These cards, containing Radio Frequency Identification Devices (RFIDs) can then translate

guest preferences to host and server handheld devices upon the customer's return to the restaurant. The type of information available to hosts and servers could allow them to provide an ultra-personalized experience for guests, as well as increase the speed of service. The positive effects of this have the potential to trickle through restaurant operations. Orders taken via handhelds could be instantly transmitted to kitchen staff, thereby eliminating the lag time required for a server to take an order then physically move to a Point of Sale (POS) system to input orders so that they appear for kitchen staff to begin preparing. The increased expediency could lead to higher guest satisfaction as well as increased table turnover. This would equate to more guests being served through the duration of a day, thus more overall profits for a restaurant (Kimes, 2003; Kimes & Thompson, 2004).

The usage of such systems is already seeing positive results through emerging restaurant concepts such as Seasons 52 based out of Orlando, Florida. Panettieri (2003) stated that Seasons 52's handheld order-taking system is:

...functional and flexible. And for good reason: Seasons 52 is test-marketing a rotating weekly menu with seasonal food prepared a variety of ways. Waiters and waitresses who can't keep track of the menu need merely reach for their Pocket PCs. (p. 54)

Overall, more and more industries are using handheld devices in various ways to improve efficiency within their respective trades. Trucking and shipping companies are using PDAs to record and upload tire wear and damage to company databases for analysis by mechanics. This allows them to determine if a vehicle requires maintenance without the need to constantly bring trucks to repair shops for physical inspections (Carretta, 2008). Military recruitment personnel are also finding uses for handheld

devices during ‘on-the-road’ recruiting shows to retrieve collected data from prospective recruits and personalize pitches to encourage people to sign up for service (Voight, 2007). Continental Airlines has also been testing PDAs via a program where passengers can board their planes without having to use a paper ticket. Instead, the airline sends a barcode to an individual user’s cell phone or PDA, which can then be scanned from the instrument’s screen (DeLollis, 2007). The use of handhelds in dietary monitoring and recording has been explored for weight-loss programs (Yon, Johnson, Harvey-Berino, Gold, & Howard, 2007). Law enforcement agencies dealing in information, security, and fraud make extensive use of handheld devices to quickly analyze data while working in the field (Ayers & Jansen, 2004).

Clearly industries are finding a number of fresh business uses for handheld devices. Video content providers are responding to business and consumer demand by pumping billions of dollars into an expanded infrastructure capable of supporting hundreds of millions of subscribers by the end of the decade (Blum, 2006; Feuiherade, 2006; Orgad, 2006; Telecommunications Industry Association, 2007; Wagner, 2005).

Given the ever-expanding business, industrial, and consumer applications for PDAs and handheld devices, it makes sense that educational video producers should look to capitalize on the instant accessibility which these devices proffer. Other methods of educational video delivery generally limit viewing options for end users. Viewers are limited to static settings when accessing video players not designed for transit. Video Home System (VHS) tapes offer the least mobility. The tapes are bulky, as are the playback devices. While this technology is still moderately in use, it's market dominance

has almost completely succumbed to newer disk-based media. Digital Video Discs (DVDs) offer some mobility. The disks themselves are smaller and more manageable for transit. Small, portable DVD players exist for those willing to pay several hundred dollars for them. While these portable players are designed for mobility, they are generally only slightly smaller than a standard laptop computer, and therefore require a relatively large amount of space for transport and usage. They are, by and large, best suited for long-duration trips such as long-distance flights or train rides where the user will be sitting stationary for long periods of time. Further, one has to physically load media into either of the two devices in order to access a given program: a seemingly small effort, but one which may contribute to a decision to not view any given program due to general inconvenience for the end user.

Handheld devices with video playback capabilities, on the other hand, do not offer the same constrictions. The devices themselves are small enough to fit in one's pocket. Therefore traveling with them does not require lofty amounts of space on one's person. Video content on these devices can be viewed virtually anywhere at any time. There are no bulky disks or tapes required to load into them. Media can be downloaded onto the devices wirelessly and played back at the user's convenience. The combined size and ease of accessibility make the devices ideal for viewing during both long-distance travel, or short distance commutes. Consider a scenario of the daily commute of a subway patron. The traveler must wait in a crowded tunnel for the arrival of their tram, then board the tram with standing room only for a 20 minute ride to their exchange or final destination. At no point during that scenario does it make sense for the traveler to

unpack a portable DVD player, select and load a disc of educational programming, and attempt to watch the chosen video while standing among a crowd of people. However, with a smartphone, PDA, or other mobile device, one merely has to reach into one's pocket and retrieve the device, then access the desired program that has already been downloaded or stored on it. A small set of earbuds will solve any problems one has with hearing the programming in a noisy situation. When the subway comes to a stop, the user merely presses pause on the device, slips it back into a pocket, and easily moves along with the crowd to the next phase of transit.

Clearly this example illustrates the advantages that such devices have in terms of mobility and convenience. Educators looking to teach via the medium of video should be weighing the implications of the ability to take advantage of the ease, convenience, and increasing proliferation of this new technology. Of course, when dealing with new, emerging technologies, fresh questions inevitably spring forth. Should producers looking to make their educational programming available on handheld devices alter the stylistic elements of a program to take advantage of the obvious differences in screen size? No real scientific inquiries into this question currently exist. However, studies of similar shifts in technological applications of educational materials can provide some insight to these questions. In particular, this study will examine whether or not there are effects on knowledge retention based on changes in graphic design (particularly type) and shot composition when producing content specifically created for viewing on handheld devices.

This will be of interest to video producers because many times alternate distribution methods of video programming are an afterthought of the finished product. This was often problematic when video was first made available for internet distribution. Only a decade ago, in the 1990s, video began to become prevalent on the internet. However, early compression technologies were not as effective at preparing video for viewing across small bandwidths. Therefore, differing production techniques were often recommended to ensure smoother playback for end users (Terran Interactive Inc., 1999). For instance, lighting requirements were more stringent. It was difficult to achieve viewable video on the web if there were low levels of lighting when capturing footage. Compression technologies did not deal well with lots of movement within video frames, so producers would often lock down shots on a tripod to minimize the amount of motion in a given shot. The use of camera moves such as zooms, pans, or tilts was also discouraged for the same reasons. Producers would try to keep details within shots to a minimum. The simpler the shot, the easier it was for end users to make out what it was that they were supposed to be viewing. In short, the process of preparing video for distribution on a website was significantly different than preparing the same or similar content for viewing on a standard television set. Even simple things could make a big difference in how effective a program compressed for playback. For instance, Terran Interactive cautioned producers when shooting subjects outdoors, stating that producers should “Beware of trees moving in a breeze – the high detail and subtle changes between frames make both temporal and spatial compression difficult” (p. 16).

The infancy of video distribution via the internet brought with it changes in the paradigms that producers used to create products for that medium. Over time, compression technologies improved and bandwidth used to move data from servers to end users increased. As a result, recommendations such as the example from Terran Interactive Inc. (1999) fell to the wayside, and producers were given more freedom in how they created video content for the web. As the industry is currently breaking ground in distributing videos via wireless handheld devices, the question becomes whether or not new shifts in paradigms are necessary in order to create effective videos for this new delivery method.

The bulk of concerns which lead to the initial shifts in production techniques when creating video for web playback were a result of compression requirements. As such, the next section focuses on what compression is, how it works, and why it is important for distributing video content to handheld, wireless devices.

Video and Compression for Handhelds

There are fundamental differences in the types of signals used to view video on standard televisions compared to the same video played back on wireless handhelds. In an ideal world a study of this nature would be able to look beyond the technical specifications of video signals and concentrate solely on the cognitive science underlying the use of handheld video as an educational tool. To an end user, the only difference in appearance is the physical size of the image. However, the sequences being viewed, though similar in shape and form, are very different from one another beneath the surface. Studies have shown that the characteristics of video compression have had

mixed effects on end user perceptions (Chen, Ghinea, & Macredie, 2006; Gulliver, Serif, & Ghinea, 2004; Ong, et al., 2006; Rimmel, Keval, Mansfield, & Hands, 2005).

Understanding how these signals are manipulated for playback is a crucial part of the production process. Therefore, it is necessary to detail the compression process and specify the signals that will be compared within this study.

The most challenging problem in trying to articulate the differences in existing video signals is that there are a lot of them. During the era of analog television the Federal Communications Commission (FCC) specified the signal that was to be used for transmitting video broadcasts. As such, all televisions and video recording devices were designed with one signal in mind. There were differences in quality among differing manufacturers, but the underlying signal that was output from cameras and then viewed by end users was the same. Decades later when a digital version of this signal emerged, companies such as Sony, Panasonic, JVC, and others began creating different proprietary digital video specifications which were often incompatible with one another. This time, the FCC refrained from forcing compliance with one specific signal, and instead let developers choose from a variety of digital signal formats. Essentially, the government let the battle for signal dominance be fought out within the marketplace. The industry responded with a wide array of formats coming from a multitude of manufacturers. Austerberry (2002) stated that “There have been about 100 formats developed over the last 50 years, but less than 20 have been successful in the marketplace” (p. 64). A discussion of these various types and kinds of video specifications that exist and compete for market dominance is impractical due to the

extensive list of varying formats. Therefore, this section touches on the most common U.S. signal and draws up comparisons to the most current handheld video specifications. The two signals specifically discussed are the two used to compare the aesthetic design factors in standard and handheld video within this study.

It is appropriate to begin by describing the one common factor between the two specifications that were examined. It is the fundamental element of an electronic image: the pixel. Digital video images derive their color by using an additive system of red, green, and blue (RGB) values. Individual images (or frames - as will be discussed shortly) are comprised of a grid of tiny electronic dots called pixels. All standard digital video formats are comprised of 72 individual pixels per inch (PPI). This is referred to as the resolution of the image. Each pixel within the image displays a single color that is derived from combinations of red, green, and blue values. On computers, the saturation of each color is represented numerically on a scale from zero to 255: zero being total absence of the color and 255 being the most saturated presence of the color. For example, a moderately dark orange color can be represented within an individual pixel as a combined red value of 220, a green value of 156, and a blue value of 15. Each individual pixel is an individual dot of color. Since the pixels are so small, when viewed from a distance, the grid of individual colored dots (the pixels) blends to create the entire image which end users view either on their handheld devices or on television sets in their homes.

It should be noted that this is a very basic description of the structure of a digital video image. The actual calculations of these individual pixels are usually derived via

mathematic ratios that take luminance into account along with raw color information. The ratios of color to luminance vary depending on format and compression schemes. Further, pixels are even shaped differently between formats: computers use square pixels to create images, while digital video often uses rectangular shapes. However, delving this deep into the engineering behind video technology can become mind-numbingly complex. Entire books exist on the topic which carry the specifics of the signal far beyond the necessary scope of this work (Austerberry, 2002; Symes, 2001). For purposes herein, the pixel will settle as the smallest building block of a digital video image. From here, it is possible to expound upon fundamental differences between handheld and digital television signals.

The standard television signal used throughout North America and Japan is the National Television Systems Committee Digital Video (NTSC DV) signal (Tollett, Rohr, & Williams, 2004). The image is 720 pixels wide by 480 pixels tall (see Figure 4).



Figure 4: The NTSC DV television image is 720 x 480 pixels (Hutchens, 2007d)

The NTSC DV signal was originally designed as an analog format. As the move toward digital technologies became apparent, the ITU-R BT.601-4 standard was developed to convert the analog signal to a broadcast quality digital signal (Austerberry,

2002; International Telecommunication Union, 1994). Upon conversion, the resulting digital video signal required a data rate of 165.89 Mbits/s (megabits per second) in order to be viewed in real time (Al-Mualla, Canagarajah, & Bull, 2002). Currently, wireless data networks are not capable of transmitting data at this rate. Table 4 compares the data rates for the NTSC DV signal and wireless distribution methods.

Table 4

Data Rate Comparisons Between Signals

Signal	Data Rate per Second
NTSC DV	165.89 Mbit/s
Wireless LAN	11Mbit/s
3G	144 Kbit/s

Two primary wireless distribution methods are 3G networks (third generation mobile networks) and wireless LANs (Local Area Networks). 3G mobile networks are two-way transmission networks used to transmit data via cellular phones. The initial development of 3G mobile networks in Asia, Europe, and the U.S. resulted in peak data transmission rates of 144 kilobits (Kb) per second (Feldmann, 2005). This is a huge discrepancy from the necessary data rate for distributing NTSC DV programming. Wireless LAN systems are typically used for wireless networks around homes or offices. This system offers markedly increased bandwidth availability at 11 Mbps, however this is still only a fraction of the size of the full NTSC signal (see Table 5 for data conversion scale). Further, consumers must deal with the additional limitations in range of use.

Feldmann (2005) stated that “A key feature of a 3G network is that it offers ubiquitous and continuous coverage. The range of a wireless LAN is restricted up to 100 meters” (p. 70).

Table 5

Bitrate Conversion

Size	Conversion
1,000 bits =	1 Kb (kilobit)
1,000,000 bits =	1Mb (megabit)
1,000,000,000 bits =	1 Gb (gigabit)

Downloading even short NTSC video clips at the current rates of wireless LANs or 3G networks would take hours. This is where compression comes into play. Wooton (2005) described compression as similar to attempting to fit “an elephant through the eye of a needle” (p. 1). It is a means of discarding visual information to make file sizes small enough to transmit across lower bandwidth connections.

The most sophisticated compression algorithm currently being used to compress video for mobile devices is H.264. Wooton (2005) described it as “The present champion of all codecs governed by the MPEG standards group. This is the most thoroughly scrutinized and carefully developed video-coding system to date” (p. 12). H.264, like all codecs, is essentially a mathematical model used to discard and average out information within an image to reduce its file size while (ideally) maintaining an accurate representation of the original image that can be transmitted more quickly across

lower-bandwidth networks. The standard was designed to be both flexible and robust, supporting different types of uses. It defines a set of three profiles relevant to the function for how the encoded signals will be transmitted and viewed (Richardson, 2003). The Main profile has applications with broadcast video, DVD compression, and other lossless or near-lossless high resolution video transmission standards. The Extended profile is used primarily for streaming applications. The Baseline profile is designed for efficient encoding and transmission of video conferencing and mobile video. This is the profile which will be utilized to encode video for this study.

Interlaced Images, Progressive Images, and Frame Rates

“Television pictures are composed of a series of horizontal lines arranged in a sequence that scans down the entire screen from top to bottom” (Wooton, 2005, p. 77). The NTSC DV signal operates at 29.97 frames per second (FPS). This means that every second, 29.97 individual images are sequentially presented to the viewer. When the National Television Systems Committee originally wrote the specifications for the signal, it was not possible for the communications infrastructure to push full frames (also called progressive frames, as will be discussed shortly) through to consumer television sets. To cheat this, they split the horizontal arrangement of lines into odd and even “fields”. Therefore, the 480 horizontal lines, each one pixel tall, are displayed in odd and even patterns to give the illusion of full frame motion. So what viewers watching TV at home actually see are 59.94 fields of even and odd lines of the screen image every second (see Figure 5).



Figure 5: A close up look at an NTSC image (left) reveals odd (middle) and even (right) interlaced frames (Hutchens, 2007e)

Computers, on the other hand, display images via ‘progressive’ scanning. They do not break images up into odd and even fields. They are capable of displaying all horizontal lines in an image at the same time. As PDAs are essentially small computers, their display technology is based on progressive scanning as well. When compressing NTSC DV digital video for playback on mobile devices the interlaced images are converted to progressive images.

Further, compression also offers producers and editors the option of controlling how many frames per second the end user actually views. Unlike television sets, computers have a wide array of options for how many frames pass a users eye in a given second. Usually, producers will reduce the FPS for playback on computer or web-based applications. This reduces the overall file size of a given program, and allows programs to reach users with limited bandwidth more quickly. There is no hard rule for how much (or whether or not) one should reduce frame rate for displaying video on handheld or computer screens. This decision is usually made based on the need to reduce overall file size in order to transmit materials to end users. Basically, it is the act of balancing

quality or speed of delivery: one can reduce quality and achieve faster delivery speeds, or one can increase quality and, potentially, slow delivery speeds.

This offers a basic overview of the underlying differences between NTSC DV television and handheld portable video files. While compression is not a factor in this particular study, there has been some research exploring differences in compression rates for web-based applications (Benierbah & Khamadja, 2005; Nyström & Holmqvist; 2007; Ong et. al; 2004). The documentation of the signals used in this study will be provided for future research which may be interested in comparing compression rates for optimal delivery of handheld video. More important for the present study, the type of compression used to create video files which can be viewed on handheld devices can have detrimental effects on the legibility of graphic designs and the general imagery within a given video production. The section on graphic design within this chapter will expound upon that. Having a general understanding of the process will help readers understand the concepts being examined herein.

Learning with Video

“The theoretical foundation of instructional television is rooted in behaviorist psychology” (Clark, 1998, p. 291). From the period of around 1920 until 1970, the dominating theories underlying education in American classrooms were centered on educational frameworks which held that learning occurred when learner behaviors were successfully altered by some form of educational stimulus (Dellarosa, 1988; Hofstetter, 1997). As time went on and more and more research exploring behaviorist psychology was conducted, it began to lose favor among many theorists in the field. While it did

fairly well in developing an understanding of how to predict animal behavior, it seemed to have only limited applications for explaining how humans learn (Bruning, Schraw, & Ronnig, 1999; Hofstetter). The human mind is capable of a number of mental processes such as thinking, creating ideas, interpreting information, storing memory, solving problems, and so on. Researchers attempting to explain these mental functions within the behaviorists' stimulus-response framework increasingly discovered that their outcomes "seemed neither to satisfy nor to contribute greatly to our understanding of human cognition" (Bruning et al., p. 5).

As behaviorism drew increasing scrutiny from experts, the idea of 'cognitive psychology' began to emerge as a more comprehensive and robust theory which held better explications for many of the shortcomings of its predecessor. The theory offered a broader view of the learning experience by factoring the interaction between the knowledge which learners possess, the information which they must process, and their available processing capabilities at the moment that information is encountered. Eventually, the cognitive model became the dominant theory for how people intake, process, and store information: it essentially explains *how we learn*.

Cognitive psychology emphasizes that learning is a constructive process rather than a receptive one. A large portion of the theory attempts to structurally explain how people intake information, separate and store it, and consequently, derive new ideas and meaning. It has had a profound influence on modern education; especially relating to research on educational video and multimedia (Mayer, 2001; Mayer & Moreno, 1998; Mayer & Sims, 1994; Metallinos, 1996; Roe, 1998). Mayer has used it throughout his

research to develop a theory for how people learn in multimedia-based environments. His ultimate goal has been to establish practical models which help to define best practices for achieving transfer of learning to end users of multimedia educational products. Mayer's Cognitive Theory of Multimedia Learning consists of three primary assumptions for how humans process, interpret, and assimilate information into working memory. The first assumption is that people process information through two primary channels: visual and aural. These channels of information are constantly managing data within working memory. The visual channel processes images, motion, animation, and written text and symbols. The aural channel processes sounds, voices, and narratives. These two conduits of incoming information are not mutually exclusive; there is a relationship between the two. For instance, the aural channel can process and derive meaning from a voice speaking the word "penguin," even in the absence of a physical image. Simultaneously, however, the mind conjures up an image of a black and white, flightless, aquatic bird waddling around on a white horizon. Conversely, one might look at a photo or video of a penguin being attacked by a polar bear. In order to describe this event to another person, one must mentally convert the information from the visual channel into words that can then be verbally transmitted.

The second assumption of the theory holds that each channel has a limited capacity for receiving and storing information. A person looking through a magazine with a large number of photographs, such as GQ or Cosmopolitan, for example, will not be able to remember every picture that was viewed in the magazine once it has been set aside. Similarly, most of the information presented on a video screen consisting of

images and multiple sets of text (such as a news ticker moving across the bottom of the screen and stock prices being updated across the top) is likely to be lost because it will simply be too much for one's working memory to hold and process (Mayer, Heiser, & Lonn, 2001). Our aural channel suffers from a similar limited capacity as well. Narration and long strands of verbal information cannot be held intact for long in working memory (Mayer, 2001). People tend to discriminate and retain the important concepts within the presented information to develop a general understanding of what was spoken. Consider, for example, that most are not able to recite even the most recent conversation with a peer or colleague verbatim: they are only able to convey the general ideas expressed during the dialogue.

The third assumption in the cognitive theory of multimedia learning is that people actively process the information they receive. That is, they attempt to apply meaning to the information obtained from the outside world. An audio tape recorder or VCR merely records information for retrieval at a further date. Humans record the information they receive but assimilate new and old information to derive meaning and knowledge. Further, people actively seek to construct knowledge structures to facilitate coherent mental representations of new information (Cook & Mayer, 1998).

Accordingly, Mayer (2001) stated, "This assumption suggests two important implications for multimedia design: (1) the presented material should have a coherent structure and (2) the message should provide guidance to the learner for how to build the structure" (p. 51). This is important to the idea that formal features are learned representations for how people process information. Consider that using a clock-wipe or

a slow dissolve between two scenes is commonly used to represent elapsed time in a video. Prior to the existence of film and video, there was no such representation for people to create this association. It is a concept that viewers have learned to interpret and understand automatically. Thus, it demonstrates how formal features can shape instructional video content through applied cognitive models.

The rules of cognitive engagement differ between forms of educational media (Kimber, Pillay, & Richards, 2007; Wise & Reeves, 2007; Yaros, 2006). This is due to several factors. The first relates to the symbol systems which different forms of media use. Symbol systems are the varying sets of elements which a given mode of media has the ability to employ for any message (Goodman & Cundick, 1976). They are especially important for the storage of mental representations of ideas. For instance, books can employ words, pictures, graphs, and tables to represent known conventions that readers can easily retain. Video, while possessing the ability to utilize the same symbol systems as books, is generally regarded as employing representational symbol systems to convey meaning (Kozma, 1991). That is, it utilizes combinations of motion pictures with aural information to allow viewers to retrieve meaning from its content. However, in order to achieve the cognition of a given idea or set of ideas, one must be able to process these symbol systems. Kozma (1991) stated that “media can also be described and distinguished by characteristic capabilities that can be used to process or operate on the available symbol systems” (p.181). Consider that, while VHS and DVD technologies both employ the same set of symbol systems, there is a distinct difference in their process and retrieval abilities. VHS machines allow a user to fast-forward or rewind the

tape in order to access a certain piece of information. DVDs have the ability to set up bookmarks or to use menu-driven designs for easier, faster information retrieval. Conversely, traditional broadcast television utilizes the same symbol systems, but does not offer any form of the retrieval of information. Of course, recording broadcast programming onto the VHS medium, or utilizing newer services such as TiVo to record and retrieve information introduces those capabilities, but in the absence of those technologies viewers are not able to retrieve information for reexamination once it has been processed. Therefore many scholars postulate that symbol systems and processes capabilities both exert heavy influence on a technology's ability to deliver meaningful educational content (DeLoach, 2004; Garrod, Fay, Lee, Oberlander, & MacLeod, 2007; Goodman & Cundick, 1976; Kozma, 1991).

It is the symbol system component of this theory of media cognition that most heavily relates to the study at hand. For it is within this realm that the relevance of formal features comes into play. It is thought that certain formal features can be used and manipulated to influence the amount of visual attention that viewers give to a program (Huston et al., 1983). The frequency and duration of visual attention has been the subject of much study by researchers investigating the effectiveness of educational video (Anderson & Field, 1983; Anderson, Lorch, Field, Collins, & Nathan, 1986; O'Bryan & Silverman, 1974). The amount of attention which viewers give to video content is thought to influence the comprehension of the information being presented (Calvert, Huston, Watkins, & Wright, 1982). Once attention is captured, viewers can then process the contiguous information being presented for the duration of time that

their attention is maintained. If their attention is lost, the subsequent programming information is less likely to be processed for comprehension. Bruning, Schraw, and Ronnig (1999) stated that:

people cannot do more than one or two things at the same time; even the most able person can perform only a limited number of tasks simultaneously. This limitation makes what students attend to a significant part of instructional effectiveness. (p.30)

Television viewing is often a supplemental activity (Anderson et al., 1986). That is, people, especially children, are often doing other things while the television is on and playing. Children might look at and away from a given television program several hundred times within an hour, with glances from several seconds up to around a minute if they are engaged in other simultaneous activities. It has been suggested that the amount of attention given to a particular program has a direct affect on one's ability to learn from it (Kozma, 1991).

According to Kozma (1986) "attention is influenced by two factors: (a) understandability of the content, and (b) the formal features of the production" (p. 15). Huston et al. (1983) identified certain specific formal features which seemed to have a greater ability to capture viewer attention: sound effects, music, animation, fast-paced edits, camera motion and movement, and narration. However, they discovered that viewer age had an effect on the impact certain formal features had in terms of capturing attention. This is thought to be largely due to an individual's level of cognitive development as well as viewing habits. For instance, children seemed to at least lightly monitor programming most of the time, even if there were other things happening around them which commanded the majority of their attention. Their interests seemed to

be recaptured more frequently, though in limited duration, by formal features such as visual movement, laughter, women's, children's, and cartoon-like voices, laughter, and sound effects (Kozma, 1991). Other formal features such as special effects and high-energy motion and physical activity were more likely to sustain attention for longer periods of time. Consequently, the use of men's voices in narration, long periods of inactivity, and slow, elongated camera movements were more likely to result in losing children's visual attention.

Anderson et al. (1986) hypothesized that these reactions may, in fact, be learned from the associations that children make as a result of repeated exposure to given formal features. They suggest that programming which uses the types of formal features which seem to more frequently lose children's interest, such as slow camera movement or male voices, are more frequently components of adult-oriented programming requiring higher orders of comprehensive skills. Their frequent inability to understand the content being presented to them may result in a more immediate 'tuning out' of similar types of formal features, even when used in the context of lower-level comprehensive programming such as children's video shows.

Huston et al. (1983) proposed that attention is related to the comprehensibility of programming. They suggested that the ease or complexity with which a program can be comprehended has an inverted U relationship with attention. That is, extremely simple content and extremely difficult content both achieve lower levels of attention with children. Conversely, video content that falls more in a moderate range of comprehensive complexity generally achieves higher levels of attention.

It should be noted that attention alone does not necessarily lead to comprehension (Anderson, Lorch, & Field, 1981; Anderson et al., 1986). In cases where viewers are not developmentally able to comprehend content, such as instances where children are viewing adult-level material, low levels of comprehension have been shown even when high levels of attention were achieved. Further, the younger the viewer, the more difficulty the audience has in selecting and processing the central messages of an educational program. Young viewers sometimes focus instead on subsidiary information which may not be part of the instructional designer's desired learning outcomes (Collins, Wellman, & Keniston, 1978). However, Calvert et al. (1982) argue that this latter problem, where viewers have difficulty determining the appropriate information to be processed, can be overcome when producers strategize the use of formal features to grab attention and subsequently focus them to underscore information relevant to the desired instructional outcomes and goals.

So, to summarize thus far, the cognitive theory of multimedia learning provides a theoretical basis for how people intake and process video information. This process of mentally absorbing and organizing information leads to the creation of symbol systems for how humans interpret the meanings behind the formal features used to construct video programming. The next section will begin to summarize research in the first of two formal features being researched within this study: shot composition.

Studies Relating to Shot Composition and Sequencing

The composition and subsequent sequencing of shots can have a critical impact on how a story or concept is told by video producers and, conversely, interpreted by

audiences. A number of studies have been conducted relating to the impact that types of shots and sequencing can have on viewers. McCain and Repensky (1972) developed a study on the effects that different shot compositions have on interpersonal attraction. They hypothesized that “varying camera shots will result in differences in interpersonal attraction ratings for comedy performers previously unknown to receivers” (McCain & Repensky, p. 5). To test this theory, they videotaped two comedians performing two short (approximately two minute) comedy routines. Each performance was taped with three side-by-side cameras at a distance of nearly 20 feet from the performers. Each camera framed a different shot of the performance. One taped each scene framed to a long shot, another taped the scene framed to a medium shot, and the last, to a close up.

Unable to find a measurement instrument previously used to assess levels of interpersonal attraction, McCain and Repensky (1972) developed a 30 item evaluation comprised of Likert-type scaled measurements. They showed videos of each comedian to randomly assigned classes of elementary school students in either long, medium, or close up format. A factor analysis of the test instrument led them to isolate three main factors for comparison which they labeled *physical attraction*, *social attraction*, and *task attraction*. ANOVAs found no significance in their social attraction category, however they did find significant differences in physical attraction ratings based on the type of shot used to frame each comic. Participants rated one comedian (Curly) as more physically attractive than the other (Edmonds) in all shot compositions; however, levels of physical attraction differed significantly when each comedian was analyzed against himself in other shot compositions (e.g. comparing a long shot of Edmonds to his

medium shot and close up shot). They also found a significant interaction effect in the *task attraction* factor between the close up conditions of the two comedians. McCain and Repensky did not specifically define what this factor was, however from analyzing items on their test instrument, it appears that this factor is based on ratings of how confident participants would be working with each comedian in task-oriented situations such as problem solving and group work situations. The authors suggest that this interaction was a result of the comedians' straight-man/funny-man routine, and therefore produced differing results on the close up comparisons than on the medium and long shot comparisons for that particular factor.

While McCain and Repensky's (1972) study is interesting in that it demonstrates that there can be significant differences in viewer attitudes based on shot composition, there are some issues with the study. For one, while they explain the population as being elementary schoolchildren, they never document the actual number of participants. They allude to the random assignment of groups, but they never state how many groups participated, making it impossible to even guess at the actual number of children who viewed the treatments and filled out the test instrument. Additionally, as they created their own test instrument to measure levels of viewer attraction to comedians, they do not appear to have tested the reliability of the instrument prior to or even during the data collection for this study. While results of their factor analysis were somewhat documented, they do not provide details of a reliability analysis for the instrument. To their credit, they did indicate that limitations within their study did not allow for generalization about the effects that differences in camera shot composition have on

viewer attraction. They went on to recommend that further studies be conducted to provide deeper insight into the effects of shot composition.

McCain, Chillberg, and Wakshlag (1977) conducted a more robust study which examined the effects of camera angles on viewers' attitudes toward television presenters. The study utilized two male and two female speakers to deliver individual speeches on the topic of whether or not school grading systems should be revised. Each speech was videotaped by five cameras arranged on a vertical plane twelve feet from the speaker to simultaneously capture multiple camera angles of each speech. The resulting five versions of each speech were: 1) an extremely high angle looking down on the subject, 2) a slightly high angle looking down on the subject, 3) a straight-on camera angle at eye level with the subject, 4) a subtly low angle looking up at the subject, and 5) an extremely low angle looking up at the subject. These five angle treatments for each of the four speakers resulted in twenty total conditions for comparison.

Participants in the study consisted predominantly of college sophomores taking introductory communications courses. Twenty classes of approximately 18 students each took part in the study. Each individual class viewed one of the aforementioned treatments and then took a survey to measure their perceptions of the speaker's credibility. The test instrument utilized "24 differential scales designed for assessing credibility of peers and mass media figures" (McCain, Chillberg, & Wakshlag, 1977, p. 37). Using a factor analysis with varimax rotation, they narrowed the factors to measures of competence, composure, sociability, and dynamism, which became the dependent variables for the study.

They analyzed the resulting data with a two-way ANOVA and found significant differences between angle treatments for all of the dependent variables except for measures of dynamism. Ultimately, they discovered “A near perfect linear relationship between camera angle and perceived composure, sociability, and competence” (McCain, Chillberg, & Wakshlag, 1977, p. 39). They found that the higher the camera angle became for each presenter, the higher viewers rated their perceived credibility for each of these three dimensions.

McCain, Chillberg, and Wakshlag (1977) also conducted a follow up to this experiment where sequences of the previously captured high, low, and straight-on (eye level) angles were edited together and shown to a group of similar size and demographic make-up. What they found was that audience judgments on the same three previously tested factors differed depending on whether or not the second shot, in a sequence of two shots, was higher or lower than the preceding shot. Their findings for the second test were more in line with conventional ideas about the psychological impact of such angled shot compositions: whereby the lower angle shots often make subjects appear more dominating, imposing, and in control. (Burrows et al., 1992; Hickman, 1991; Zettl, 1976). Conversely, higher angle shots which look down on subjects are typically thought to “diminish stature... an effective way of suggesting vulnerability or isolation” (Watson, 1990, p. 26).

While some have examined potential cognitive effects of camera angle (McCain, Chillberg, & Wakshlag, 1977; McCain & Repensky, 1972) others have delved even deeper to see if the angle of lights used to illuminate subjects in a particular screen

composition can have effects on viewer perception (Jackman, 2002; Zettl, 1976).

Lighting is often used to establish mood. Metallinos (1996) stated:

A single lighting source such as a key light placed above a person, although it might create some strong and harsh shadows, still looks normal and creates a natural mood because we are experiencing the sun lighting the objects from above and the lights, at night, also above us. However, when the same light source is placed below eye level, a different scene is created, altering atmosphere and creating mysterious, unusual, and uneasy feelings. (p. 241)

To examine the potential effects of lighting angles, Tannenbaum and Fosdick (1960) took still photographs of four individual models (an older man, an older woman, a young man, and a young woman) using four different lighting angles to illuminate them. They lit the models from a low angle, an angle level to the model's eyesight, a high angle, and an extreme high angle. The four models, illuminated by four different lighting angles, resulted in 16 treatments. Tannenbaum and Fosdick stated that "Black and white prints were made from the negatives, with great care taken to insure uniformity in contrast and tone" (p. 256). The sample consisted of four groups of 15 students enrolled in undergraduate sociology courses. Participants were presented all 16 treatments via a slide projector in a darkened classroom setting. They were instructed to rate each model on a set of 12 bi-polar scales which were designed to measure three factors: evaluation, activity, and potency. Questions intended to rate the model on the *evaluation factor* were designed with scales such as good-bad, honest-dishonest, kind-cruel, etc. *Activity factor* questions were designed to measure whether or not the model was perceived as active or passive, slow or fast, or warm or cool. Warmness or coolness is not specifically explained in the text of their paper, however based on their descriptions, this researcher is assuming that this referred to perceptions of the actual

temperature of the models. The *potency factor* is given little in the way of explanation within the document other than describing that participants were instructed to evaluate the models as either heavy or light, and soft or hard.

They utilized a Latin Square ANOVA to measure the collected data. Results relating to the *evaluation factor* were the most interesting within their study. Tannenbaum and Fosdick (1960) stated “Here we find significant differences between models, between lighting angles, and also in the model-by-lighting angle interaction” (p. 258). Participants in their study overwhelmingly favored the older woman model over the other models. The significant difference between lighting angles showed that the high angle of lighting (not the extreme high angle) was the preferred look for each of the models. None of the other lighting conditions showed any significant differences. Tannenbaum and Fosdick were expecting to find that the low angle lighting treatment would produce unfavorable ratings among participants, but this was not the case. What they did discover is that while the differing lighting conditions affected viewer interpretations of the model, the actual interpretations differed depending on the individual model being evaluated.

Calvert et al. (1982) examined a variety of different formal features in an attempt to identify which ones more effectively captured attention among grade school aged children. The attention rates and comprehension of a sample of 128 kindergarten, third, and fourth grade students were collected and analyzed to answer their research questions. Students were brought into a mobile lab in randomized, same-sex pairs and seated at a table with toys, paper and crayons, comic books, and other potential

distractions. They were told that they could read, play, talk, or watch television as they preferred over the duration of their time in the lab. The researchers then left the room and started the television remotely. They played a 15 minute black and white edited version of an episode of the popular Fat Albert cartoon. The researchers had previously analyzed the edited program to specifically identify the types of formal features which existed within the program and the precise moments when they occurred.

Visual attention was measured and scored based on the times and durations that each child looked at the television set. Independent observers seated behind one-way mirrors scored the viewing attention for the children. Two observers per child were used to compare reliability of the measurements. Documentation of the onset or offset of a child's attention was considered valid as long as each respective observer's notation of the child's action occurred within four to eight seconds of the other observer's notation. Invalid documentations of child viewing attention were not computed. Overall the observers agreement rate was 97%.

Upon completion of the cartoon the children were given a 60 item test to measure the information which they could recall from the program. The questions were developed using input and feedback from undergraduate college students. An initial survey was presented to the group of college students after they viewed the edited program. They were asked to rate whether or not information on the measurement instrument was directly presented or inferentially presented. Questions had to achieve at least a 70% agreement rate among the survey sample to remain on the test.

Calvet et al. (1982) found that the children paid attention to the screen 37% of the total length of the program. Their results supported the notion that certain formal features were better at capturing children's attention than others. "Overall, the most striking aspect of the comparisons was the similarity rather than the differences in attention patterns to formal features" (Calvet, et al, p. 608). Character action (both rapid and moderate), vocalizations, sound effects, pans, child voice narration, and visual special effects captured and held attention at significantly higher rates than other features such as music, zooms, or adult voice narration. Younger children did not comprehend the content as well as older children. This effect was magnified when information was presented within the program in an inferred way rather than an overt way. The younger age groups in this study seemed to have a more difficult time interpreting subtle messages than their older counterparts. Outcomes of their measures of comprehension support claims that there is more to comprehension than just attention (Anderson, et al., 1981; Anderson et al., 1986).

However, research into formal features has not always produced significant results for knowledge retention. Roe (1998) examined whether or not camera angles and onscreen movement could be manipulated to affect viewers' ability to process information aurally and/or visually. Specifically, he looked at retention of information, as well as attitudinal responses to the presented information. To test for any possible effects on the dependent variable, Roe created a video which consisted of a single shot of an automobile on screen. His independent variables were camera angles and movement toward the camera by on-screen objects. The study consisted of nine

treatment groups which ranged from standard to extremely low angle camera shots of a vehicle. He also tested movement by having the car either remain static onscreen, or by having it move toward the camera either moderately fast, or extremely fast. An identical audio narration track describing ignition timing was used for each of the treatments. The sample size for the experiment consisted of 198 college students equally divided into groups of 22 students per one of the nine groups. A two-way ANOVA analysis found no significant differences between any of the treatment groups.

Silbergleid (1992) investigated whether or not varying the levels of intensity or frequency of certain formal features would increase viewer attention. To do this, he created three different versions of an educational video about the workings of the Wall Street Stock Exchange. The 'basic' version of the program consisted of cuts-only edits and simple on-screen graphics to display the informational content. A more sophisticated intermediate version of the same video used dissolves, fades, and more sophisticated graphic designs to convey the visual information being presented. An advanced version of the same video consisted of extensive use of transition effects and motion graphics to create a visually richer adaptation of the financial educational video product.

A total of 119 college level communications students participated in the study. To test whether or not these variations produced increases in learning comprehension or general likeability of the program, he broke the sample into four groups. One group viewed the basic version of his video. Another viewed the intermediate version. A third viewed the advanced version, and a fourth viewed a different video with similar formal

features as those used in the advanced version of the program. Almost no specifics are offered about the video which the fourth group viewed in Silbergleid's (1992) documentation of the study: only that the last group was used as the control group.

To collect data, he used a posttest only methodology. A forty question, multiple choice test was developed and pilot tested for use in the study. Likert-type questions were used to measure the degree to which individuals liked the programming. Questions were also included to determine if the amount of prior knowledge which students had about the subject matter had any influence on their test performance. Sixteen of the forty questions within the test were specifically pinpointed for separate analysis, as the information which presented these concepts occurred within four seconds of a change in formal features. The operating theory being tested was that if changes in certain formal features contribute to increased attention, then content presented immediately after these types of attention-grabbing changes should result in increases in comprehension of the specified information.

Silbergleid (1992) found no significant differences of any kind among the variations tested in his study.

The results of this study indicate that different levels of complexity of visual production techniques in ITV [instructional television] programs have no significant effect on the amount of learning comprehension of the viewer or on the degree of likeliness expressed by the viewer for the ITV program. These results do not support the theory that complex visual production techniques will lead to an increase in learning. (Silbergleid, p.20)

While Silbergleid's (1992) study found no evidence supporting current theories for how viewer attention can affect cognitive engagement and thus result in learning, there are some elements of his study which should be scrutinized. First, the introduction

of a control group which viewed an entirely different video than the three experimental groups seems questionable. According to the documentation, all of the groups were given the same test instrument, which covers the topic of monetary finances and the workings of the stock market. Yet Silbergleid states that the control group's video was "of the same length and style but dealing with a different subject matter" (p.15). This would seem to introduce an extreme number of variables, making it difficult to interpret the results of any statistical analysis. This also leads one to question how reliable results from a test instrument on money and finance can be if one of the groups taking the instrument viewed a video of entirely different subject matter.

Lastly, Sieberglied specifically examined sixteen questions designed to test retention of knowledge presented within four seconds of changes in unspecified formal features. This portion of the analysis is examining a phenomenon known as *attentional inertia* (Hawkins et al., 2002). This is the idea that sufficient levels of attention conducive to cognitive processing may not occur until after around eight seconds of active attention, "perhaps reflecting a point at which enough content has been processed so that attention can be called "engaged" with the... message rather than merely "oriented" or captured by some stimulus" (Hawkins et al., p. 25). So, while formal features within Silbergleid's videos may have captured attention, it does not necessarily mean that cognition was occurring at the point that information expected to be recalled on the test instrument was introduced. Similarly, other research suggests that certain formal features are more conducive to capturing the attention of particular demographics (Calvert et al., 1982; Schmitt, Anderson, & Collins, 1999; Singer, 1980). While

Silbergleid identifies general differences in the formal features compared in his treatments, he does not offer great detail on what they specifically are or how they are utilized within the context of the individual programs. Perhaps the formal features used to assemble the treatment programs were not the most appropriate for the college-aged students which participated in the study. As details on the use of formal features are not offered within the documentation of the research, it is impossible to make educated interpretations of the results of the study.

Of course, the relationship between formal features and ultimate cognition of content on the part of the viewer is complex and remains a theoretical basis from which to conduct research. Schmitt, Anderson, and Collins (1999) stated that, “attention to television moves from predominant control by salient formal features to more complex relationships with formal features and content” (p. 1166). While shot composition and editing techniques comprise a portion of studies conducted on the effects of formal features in educational television, there are certainly other formal features which have enjoyed less presence in the limelight of research. In the following section, focus shall shift to graphic design as a formal feature within video production. An overview of the research on this topic demonstrates that there is reason to believe that graphic design factors do have an influence on the cognitive effects of learning with video and multimedia products.

Graphic Design

Cognitive models of learning are also applicable to graphic design within educational video productions. Shedroff (2001) stated that “The most important aspect

of any design is how it is understood in the minds of the audience” (p. 60). In conjunction with cognitive load theory, poor graphic and visual design can negatively impact viewers’ ability to learn (Vekiri, 2002). While it is generally understood that strong and suitable graphic design is necessary for transfer of learning to occur by means of educational media, it has also been suggested that most of the literature offering guidelines for design is based largely on opinion rather than empirical research: further, that most of the empirical research that exists is older and may not be especially relevant in today’s vastly complicated media environments (Williams & Stimatz, 2005). This suggestion seems valid when digging for literature to support a study which examines graphic design in the context of modern day video applications. There is a large body of research concerning the legibility and readability of fonts within printed materials (Goudy, 1946; Tinker, 1963; Williams & Stimatz). However research on textual type, size, and/or legibility within video monitor environments has been far less robust (Geske, 2000). In recent years the advent of multimedia-based instruction has led to increased research in the uses of text and design features to support theories of cognitive learning (Arditi & Cho, 2005; Ardit & Cho, 2007; Chen, Ghinea, & Macredie, 2006; Mayer, 2001; Mayer, Heiser & Lonn, 2001; Mayer & Moreno, 1998; Mayer & Sims, 1994). While research of this nature is useful to achieving an overall understanding of design techniques which support cognition, the inherent differences in screen technology (Larson, 2007) force researchers to acknowledge multiple caveats in the application of research findings across differing mediums. If one supports the idea that underlying differences in how technology is used to construct visual information for end users can

affect learning outcomes, the problem then becomes compounded exponentially due to the vast differences in video signals that exist. NTSC signals alone have considerable differences when examining the traditional analog signal in comparison to the digital version. However when one factors in the multitude of high definition (HD) formats that are currently competing for market dominance, the task of deriving relative meaning across formats becomes nearly insurmountable: likely a reason for why studies of this nature are difficult to procure. Nonetheless, given the relatively small amount of research on type and design within video contexts, one is forced to look beyond research on conventional video and cross into the boundaries of research findings of text and design within multimedia learning environments in order to hypothesize how these same features within small format video will affect cognition and knowledge retention among viewers.

While there is no clear answer to whether or not cross-referencing these formats is a sound method for deriving valid research theories, some authors embrace this methodology under the argument that the varying platforms of technology which exist today are due to an ongoing convergence of media formats that has been playing out since print typographic techniques were first used to display graphic information in the early days of television (Cooke, 2005; Williams & Stimatz, 2005).

Though graphic design encompasses a large number of concepts (symbols, logos, lettermarks, form, Gestalt psychology, layout, etc.) there are a few which are of primary concern to the present study. They shall be encountered frequently in the remainder of

this review of literature, thus they require a bit of explanation before proceeding to the empirical research.

The Language of Type

In general, there are two families of fonts: serif and sans serif (Berryman, 1990; Chandler, 2001; Lenze, 1990). Serifs are strokes that appear at the end of letters. Serif fonts possess serifs at the end of their respective letter strokes. Conversely, sans serif fonts do not possess these strokes (see Figure 6).



Figure 6: Serif vs Sans Serif Font Styles (Hutchens, 2007f)

The studies examined in the following section often compare sans serif and serif fonts to measure influences on performance, preference, and legibility. Researchers have compared the effectiveness of the two families for quite some time (Lenze, 1990). For video production, two factors often preclude the decision to use sans serif fonts over serif fonts. First, when using serif fonts at small sizes in video, the interlaced nature of standard video can cause the small points at the end of serifs to visually ‘flicker’, creating a distracting effect for the viewer. The second reason is due to an effect used to improve legibility which is called anti-aliasing. When using this technique in computer and video applications, some suggest that it reduces the readability of serif fonts because of the physical size of pixels on a video or computer screen (Bernard & Mills, 2000; Felici, 1996). This can be detailed with further clarification by first taking a moment to describe differences between orthochromatic and anti aliased type.

High resolution print materials use what is called an ‘orthochromatic’ process to render type that is printed onto books, magazines, brochures, and so on. The printed area where the font appears is made up of tiny little dots (the same as pixels, described earlier in this chapter). The smaller the size of the dots which make up the image, the higher the resolution is. In an orthochromatic process, each dot is assigned one of two values: solid black or solid white. High resolution books and magazines can have resolutions up to 2,400 pixels per inch (PPI) or more (Chandler, 2001). This extremely high resolution works well in creating high quality text. As such, small details (such as serifs on fonts) are easily legible. Even lower-end printers used in office settings usually offer around 300ppi resolution, creating elegant, easy to read printed material.

For multimedia and video applications, screen resolutions are capped at a mere 72ppi . This resolution allows the transmission of nearly 30 images per second to reach viewers without losing data or overloading the capacity to transmit the amount of visual information to the viewer. Video can be created at higher resolutions than 72ppi, however, it is virtually impossible to transmit such high resolution imagery based on the transmission specifications of standard definition television. As such, when creating an image using 72ppi rather than a higher resolution, such as 2,400ppi, the lower resolution pixels are larger, as they still must occupy the same amount of physical space (an inch) to create the overall image. These larger pixels do not create text as easily legible as what can be produced in printed material. To compensate for the roughness of orthochromatic rendering technologies on computer and video screens, a process called ‘anti-aliasing’ was created to smooth out letters displayed via these mediums (see Figure

7). Since pixels on computer and video monitors can have varying tones, anti aliasing uses grayscale techniques to create a softer outline for a given font to make it appear less jagged onscreen. While this smoothing process is generally more pleasing to the eye, some argue that serif fonts are not particularly well suited to anti-aliasing, as the serifs themselves create an additional fuzziness to individual letters which is thought to negatively impact legibility (Chandler, 2001).



Figure 7: Orthochromatic vs. Anti-aliased Type (Chandler, 2001)

Video: Text and Design Research

Grotticelli (2006b) stated that for video content designed for small screens, “traditional on-screen graphics, titles, and lower-thirds... need reconsidering on a smaller scale” (p. 34). While on the surface this sounds like a logical strategy, research reveals that this is not necessarily true. Mills and Weldon (1987) conducted an empirical review of research over the last few decades into the effects of font size on readability and legibility. They concluded that while legibility measures often increase in correlation with increases in font display, they also detected a pattern in research results which indicates that there may be a threshold where increasing size no longer achieves significant differences in results. They state that “for computer screens as for printed text, there may be an optimum size from which any variations in either direction will reduce reading performance” (Mills & Weldon, p. 338).

Rather than recommending specific font sizes, some suggest using ratios for minimal letter height based on the distance of the viewer from the medium (Smith, 1979; Tinker, 1963; Wogalter, 2006). Smith (1979) conducted a multi-year study to test whether or not there was any scientific validity to the idea that ratio-based formulas could serve as a reliable gauge for designers. Over the course of several years, engineering college students in human factors courses were given research assignments requiring them to collect legibility measurements with various subjects and compare their findings with recommended standards. Students were free to choose the type of text-based content for analysis. The procedure to carry out the testing was simple. They were required to position viewers at a distance far enough away from a given text-based display that they could not read it. Viewers were then asked to slowly move toward the display until they could read the text. The distance from the display was measured and recorded along with a description of the font size and type used. A multitude of treatments were tested. “Some tested single letters or random mixtures of letters and numerals. Most tested single words or running text” (Smith, 1979, p. 665). In total, 88 student researchers collected data from over 500 viewers resulting in a total of 2007 measures of legibility. Smith compared his overall data to the recommendations specified in U.S. Military Standard 1472B which specifies a distance/font size ratio for developing physical user equipment interfaces (Smith; Wogalter). From the total number of measures taken, only eight instances of the individual measures fell within the ratio specified in 1472B. The remaining 2001 measures all showed that visual acuity was actually much greater than what the standard presumes. In other words, the

recommended standard appeared to be very conservative, as the data shows that humans can legibly read text at much higher distance to letter size ratios than the standard allows for. Smith's study did support the idea, however, that the standard generally appears to be safe in guaranteeing legibility.

One interesting angle to the idea of utilizing a ratio of font size to distance for obtaining practical, ideal designs is the notion that users will always have a fixed distance. While there are recommendations (Beldie, Pastoor, & Schwarz, 1983; Pastoor, Schwarz, & Beldie, 1983) for optimum viewing distances from a standard television set, it is unknown how close or far the average person sits away from their televisions when viewing them. The same could be said for printed text, as it is merely the act of moving one's hand closer or further away to adjust the distance of a page of print. And, of course, handheld video devices offer up the same variability in viewing. So, while the notion of ideal ratios is interesting, its practicality in just about any design medium, electronic, print or otherwise, is somewhat questionable.

One of the few studies looking at differences in text specifically on color television sets was conducted by Pastoor, Schwarz, and Beldie (1983). Measuring font sizes with the height by width ratio of a given font, they measured the legibility of four different sized fonts. Since the fonts they measured were fixed-size dot-matrix fonts, all characters in a given set, both upper and lower case, occupied the same number of horizontal pixels on the screen. To test for legibility, they measured five performance tasks and one rating task for each of twenty total participants in the study. The various conditions and layouts of font information were displayed on a 51 cm color television

monitor. Curiously, and they do not specify why they chose to do this, they set up the television so that there would be no interlacing interference – in other words, they used progressive frames to display the images. This is somewhat puzzling, as this is one of the fundamental differences between computer displays and television displays. In altering the nature of the signal, it would seem that they would have been just as well served to have shown the varying treatments on computer monitors rather than televisions. Regardless, four different quantitative measures were used to test legibility. Participants were asked to read the textual content aloud as quickly as possible. This task was timed for comparison among subjects. They were each given a problem where they were presented with a screen of lower case letters as well as a corresponding sheet of paper with similar letters in a similar layout. They were each given two minutes to find as many discrepancies between the paper and electronic screen as possible. A third measure was taken for what the researchers dubbed an *information service* task. Subjects were shown a screen of text listing products, prices, and names of stores where the items could be purchased. They were repeatedly asked, in each different font treatment, to pick the cheapest store which carried a given item. For the final quantitative measure, participants were given a list of words which they were required to place in alphabetical order. With the exception of the last mentioned task, where participants created lists of on-screen words in alphabetical order, the researchers found that differences in font sizes yielded significant differences in all of the task-based measures.

The four treatments across all of the participants' tasks consisted of the following four font sizes (in width by height-based pixel ratios): 5 x 7, 7 x 9, 9 x 13, and 11 x 15.

What Pastoor, Schwartz, and Beldie (1983) found was that increases from 5 x 7 to 7 x 9 sized fonts, and increases from 7 x 9 to 9 x 13 sized fonts yielded significant differences in overall scores. While the increase from 9 x 13 sized fonts to 11 x 15 sized fonts did yield a slightly higher mean score, it was not a significant mean difference when tested at the $p = .05$ level. For two of the four described tasks, “the quantitatively best performances were achieved not with the largest character size (11 x 15), but rather with the 9 x 13 character size” (Pastoor, Schwartz, & Beldie, p. 271). This is consistent with other research which has suggested that while increasing font sizes can improve task-oriented viewing, there may be a threshold at which increasing size no longer achieves much benefit (Beldie, Pastoor, & Schwarz, 1983; Sheedy, Subbaram, Zimmerman, & Hayes, 2005).

Beldie, Pastoor, and Schwarz (1983) looked at the impact on task efficiency that fixed matrix size fonts have, compared to variable matrix size fonts. They tested reading speed, error identification, and word identification to see if either font style yielded better results in these tasks. Viewing conditions were the same as those conducted by Pastoor, Schwartz, and Beldie (1983) in that viewers sat six screen heights from the monitor when viewing. Also like the prior study, the information was viewed in progressive frames, rather than with interlaced frames. A total of nine subjects took multiple task-oriented tests with both of the two font treatments. The arrangement of the test sequences varied from subject to subject.

Repeated measures one-tailed T tests were calculated for each of the variables. Their findings showed a significant difference in reading times between the two

treatments. Variable matrix fonts yielded faster reading times than type composed with fixed matrix fonts. Only one of the error-identification based tasks showed a significant difference: error identification appeared to be more accurate with variable matrix fonts than with fixed matrix fonts. Their findings support the idea that variable matrix fonts are more flexible for designers to work with than fixed matrix fonts. One suggested reason for this is that, since variable matrix fonts are overwhelmingly used in print materials, perhaps viewers are used to reading this style of layout and therefore are more accustomed to perusing it for information.

Geske (2000) studied font size and type face effects on readability and user preference. Seventy-eight participants viewed randomly assigned paragraphs of text on web pages with treatments that varied the font style and size. Speed of reading was measured to the nearest second for each treatment. A multiple choice test on the material was presented upon completion of each treatment to measure for comprehension and short-term recall. Participants were also asked questions relating to their preference among the various treatments.

Geske's (2000) conclusions generally support the idea that a threshold exists for reading text on computer monitors. Among the range of ten to fourteen point sizes which he tested, he found that twelve point fonts achieved the best results in terms of speed of reading. Statistical significance for this finding was only found in serif type faces, however. Interestingly, the largest size font in his study, fourteen point, was subjectively the most preferred of the sizes, even though it did not achieve the best performance among the varying treatments. This finding is consistent with other research that points

to the idea that viewers prefer larger sized font treatments, even though they may not necessarily offer the strongest performance (Chen et al, 1996; Pancheo et al., 1999). Geske did find statistically significant differences between font treatments in measures of comprehension based on short term recall. Viewers reading twelve point fonts achieved significantly higher comprehension scores than all the other font sizes, even between serif and sans serif fonts. Geske stated that, “this research shows that some of the common sense typographic “rules” and traditions are not supported by the evidence. Larger type, while preferred by the reader, is not better for speed of reading or comprehension” (¶ 60).

Of course, there are studies with opposing results that suggest that larger font sizes correlate to improvements in reading and comprehension. Chandler (2001) examined the effects of sans-serif vs. serif type, font sizes in eight, ten, and twelve point type, and orthochromatic compared to anti-aliased type on reading speed and comprehension in computer-mediated environments. While his analysis was not concerned with television or handheld viewing all of his subjects viewed the various treatments on computer monitors, so his results were of relevance to this study.

Chandler (2001) conducted a study with 110 college students from Virginia Polytechnic Institute and State University. Small groups (approximately 5 students at a time) were brought into a lab setting and instructed to read through multiple paragraphs of text on a computer monitor. While the selected passages were the same, they either read the passage in Helvetica (a sans-serif style font) or Palatino (a serif style). Participants viewed randomized styles and sizes across all of the treatment groups.

Results from the study indicated that there was statistical significance in viewer legibility based on font size. Ultimately, those reading from twelve point fonts scored significantly higher at the $p < .05$ level than those reading from eight or ten point sizes across all variables. Chandler (2001) also found that choices in anti-aliased and orthochromatic type yielded statistically significant differences in legibility based on whether or not a sans-serif or serif font was used. Sans-serif fonts achieved better legibility results when rendered by orthochromatic means than with anti-aliasing technology. Conversely, serif fonts achieved better legibility results with anti-aliased on-screen rendering than when presented as orthochromatic.

While Chandler's (2001) study yielded some significant differences and interaction effects based on measures of legibility, it produced no significant differences in terms of viewer comprehension of the presented materials. This is certainly worth note, as the measure of legibility used was a speed-of-reading test. While often used as a measure of the effectiveness of font variables in varying circumstances (Beldie, Pastoor, & Schwarz, 1983; Pastoor, Schwarz, & Beldie, 1983), speed of reading is not terribly relevant within video applications. For one, the temporality of the text that a viewer is exposed to is controlled entirely by the producer. The decision is made by the producer or editor to keep a certain body of text, be it a lower-third or full screen graphic, on screen for a given amount of time. Viewers can usually choose to pause a screen if they need more time to process the information, but this is rarely necessary. Seasoned producers and editors will usually keep text on screen at minimal lengths, and will account for the amount of time that one needs to read a given block of text. Therefore,

while Chandler denotes that larger font sizes yield increased legibility, his results on comprehension, which showed no statistical significance, are probably more applicable to the current study. These results support the ideas within this study, which counter arguments made by Groticelli (2006a; 2006b) that a proper approach to graphic design for small screen viewing is to simply increase the overall size of text and its framework to encompass half or all of the total real-estate of the viewing screen.

Sheedy et al. (2005) measured the impact of font size on legibility among a number of additional factors. For their study, they recruited 30 students from Ohio State University. Their inclusion criteria required that all participants had at least 20/20 vision. Four different font sizes (eight, ten, twelve, and fourteen) were tested across six different fonts (Verdana, Georgia, Times New Roman, Arial, Franklin, and Plantin) to obtain measures of legibility. They compared anti-aliasing styles, kerning adjustments, and italic and bold font treatments across all of the test conditions. They also looked at the effects of different display types: Liquid Crystal Display (LCD), Cathode Ray Tube (CRT), and printed hard copies of text. Each of the participants viewed all of the three display conditions from an even distance, and measures of acuity were collected for all forms of treatments (font size, font style, anti-aliasing, etc.).

Their findings were consistent with the idea that there is a threshold on font sizes in visual displays. “No further increase in legibility was obtained at pixel heights greater than 9. The 9-pixel setting (10-point font) provided enough detail for optimal recognition, and hence additional pixels did not significantly improve threshold legibility” (Sheedy et al., 2005, p. 806). In general, sans-serif fonts performed better in

measurements of legibility than serif fonts. Of the six fonts that were compared, Veranda and Arial showed significant differences in measures of legibility than the other fonts in the study. While their research showed that certain sans-serif fonts outperformed other serif fonts, they caution on generalizing too much from their results. Sheedy et al. stated that “It is not possible to generalize that one category of fonts is more legible than the other. It appears that the legibility of each font would need to be determined separately” (p. 813).

The works of the various researchers and authors cited whom have contributed to the present understanding of type and design offer an overview of the factors which come into play given the recent convergence of print and electronic media which continues to saturate the everyday experience. The application of these research findings shall be detailed in the following chapter on the methodology of this study. The ultimate goal is to implement these findings within the newer context of handheld video and, hopefully, gain a better understanding of how (or even if) these principles apply to creating educational video products for handheld video applications.

Leadership Considerations

As the study of leadership has evolved, so have the theories for leadership styles and competencies. While it is generally held that certain aspects of leadership cross all spectrums of management, some hold that leading highly skilled, technical professionals – an adequate description for those involved in professional video production – requires alternative, specified skills and talents outside of the scope of traditional management (Glen, 2003; McCall, 1983; Rosenbaum, 1991). Knowledge workers have a nature and

style that differs from other workforce sectors. They are driven by the strong desire for both personal and professional achievement. “As such, they are most productive when they can achieve their professional goals in the process of pursuing organizational goals” (Morse & Babcock, 2007, p. 164). They also require a great deal of independence. Generally, the greater their ability to control the conditions and tempo of their tasks and environment, the better their ability to function in a work setting.

To a large extent, this necessitates a degree of technical competence from the leader or manager of a team of skilled professionals. On one hand, the leader of knowledge workers needs to be able to act as a liaison between clients and technical professionals. Communication structures of this nature can reduce the effects of sluggish bureaucracy that can occur from clients who do not understand how the trade works, but need to feel directly involved in a project due to their personal nature. In this role, the leader must have enough competence of the product being created to intercept requests from clients that may potentially bog down the process and disrupt the ability for team members to stay focused and on track for a given project.

Beyond the ability of running interference, leadership competence is crucial to managing knowledge workers due to the expectations that most knowledge workers have for their leaders. Glen (2003) stated that technical professionals “... generally don’t suffer fools gladly” (p. 36). Those with highly technical backgrounds are quick to judge whether leadership is worthy of respect. If project managers demonstrate that they are not competent in the tasks which they are supposed to be overseeing, workers in these environments will quickly build barriers to communication and collaboration as a means

of protecting themselves from the influence of unwise managerial decisions which may affect their work.

So why then do leaders in educational multimedia and video production care about the minutia of whether or not long shots or close-ups are important when transferring video to handheld specifications? How does a study of graphic legibility and its effects on knowledge transfer in handheld mobile video contribute to the body of research on educational leadership? Though small in scope compared with many 'big picture' studies in the educational leadership arena, this study is of primary interest to leaders overseeing knowledge workers in educational multimedia and video production environments. Primarily, it offers a morsel of insight into production standards that will help build competence for leadership in these settings. Studies of this nature will add to the theoretical constructs that shape the educational communications of the future. Leaders armed with the knowledge acquired from these experiments will have better insight on how to strategize educational media production and distribution.

For any organization, leaders are faced with issues that affect the organization both internally and externally (Bolman & Deal, 2003). Externally, leaders in educational media must possess awareness of the trends in new media that surround them. McLaughlin (2001) stated that "The information consumer has continually demanded easier and better access to information" (p. 38). Commercial and private enterprises are scrambling to meet the demands that consumers have for instant gratification of their products. Leaders in educational media environments must also strategize in a similar manner in order to ensure that their curricula are as prolific and accessible as possible to

learners. When budgets are tight, as they often are in educational environments, not having the foresight to see mobile transmission as an option for a video and multimedia production can easily translate to ineffective distribution of expensive and resource-intensive content. Poor strategic modeling of production and distribution schemes can have a dramatic impact on the effectiveness of educational media. Vekiri (2002) stated that “learning difficulty may sometimes result from the design of instruction and not from the nature of the material to be learned” (p.276). Short-sightedness on the part of educational media leaders can easily lead to the dissemination of media which falls short of end-user knowledge retention. When this occurs, the leader has failed to properly perform his or her responsibilities.

These issues are important to the internal functions of multimedia and mobile video production as well. Given the necessity of competence for leaders in these environments, it is important for them to be able to design and articulate media strategies to his or her team. These strategies must be formulated by experienced, knowledgeable leaders. Not only is it important for gaining the trust and respect of technical professionals, but sound decisions supported by theoretical constructs of research are more likely to achieve the ‘buy-in’ which is necessary for employees to carry out their tasks with the independence and motivation that they require for job satisfaction.

A review of the literature suggests that both of the formal features discussed within this paper – composition and graphic design – can weigh heavily on the success or failure of educational videos. The ultimate question being asked herein is; does the delivery medium of video content (NTSC video or handheld video) alter the style in

which shot composition and graphic design should be utilized to achieve maximum viewer retention of knowledge being presented? The following chapter contains a summary of the methodology used to answer this question through this mixed-mode analysis: the ultimate goal being to gain insight to the effects that these formal features have on knowledge retention with end users of mobile educational video. It will contain a summation of the development of a measurement instrument, as well as details on the data collection process and analyses for this dissertation. Results of the study will be detailed in Chapter Four, followed by discussion and implications of the findings in Chapter Five.

CHAPTER THREE: METHODOLOGY

Introduction

This study was designed to ascertain a better understanding for production methods which improve knowledge retention for learners using handheld educational video. Two formal features were manipulated within the context of an educational video on wine evaluation. The two variables specifically altered were shot composition and graphic design styles. The goal of the study was to determine if manipulation of these variables had any affect on a user's knowledge retention. The study also examined user preferences for viewing educational content on regular television sets compared to handheld devices.

Problem Statement

Viewing video on handheld devices is a new phenomenon: the result of a convergence of communications technologies which cater to our increasingly mobile lifestyles (Koblentz, 2005; Orgad, 2006; Wagner 2005). Despite a deficiency of scientific inquiry, industry practitioners are already publishing opinions about the proper usage of shots and graphics when developing content for small screens. A school of thought is developing which suggests that video content produced for mobile devices should avoid the use of long shots and increase the overall size of graphics used in mobile handheld video (Grotticelli, 2006a, 2006b; Orgad; Wang, Houqiang, & Fan, 2006). If these assumptions are true, then content creators for mobile devices should follow these guidelines in order to ensure the adequate communication of messages to

viewing audiences. If, however, they are based on false conjecture, then producers are more likely to place unnecessary limitations on the symbol systems available to convey meaning and instruction via the medium of handheld video. This could ultimately result in the creation and distribution of inferior message designs due to production practices based on false assumptions.

This study was designed to test whether or not these prescribed stylistic formulas are necessary. The remainder of this chapter will describe the overall methodology used for this study, and detail the processes used to develop and refine the instrumentation used to collect data.

The Educational Video

The test instrument used for this study was designed to measure viewers' knowledge retention of content from a ten minute educational video on the subject of wine evaluation. The video was produced specifically for this study. The subject of wine evaluation was chosen in hopes of maximizing interest in a topic that is somewhat elusive to the general public. Initial drafts of scripts for an educational topic concerned video production and motion design tutorials, but they were abandoned for fear that those types of topics would only be of interest to certain populations. Further, the learning outcomes for educational products delving into those types of topics tend to be skill-based. The researcher was looking for something which would hopefully be of interest to a broader audience. Attention and attentional inertia are thought to contribute heavily on learning outcomes from video programming (Anderson, Lorch, & Field, 1981; Anderson et al., 1986; Huston et al., 1983). Learning outcomes for this study were

based on the statistical analysis of test scores on the video's subject matter. The desire was to design video content that would sufficiently capture and maintain the interest of general audiences so as to reduce any influence on learning outcomes resulting from general boredom of the topic being presented.

The subject matter content for the script on wine evaluation was validated by a Master Sommelier, who also acted as the on-camera host for the program. The content matter was broken into three sections: a brief segment about the origins of wine tasting, a general comparison of different types of wine evaluation, and the general steps used by tasters to evaluate wines.

The program was formatted for two viewing scenarios. One version was created as a standard NTSC formatted programming. A second version was created following the recommendations of Groticelli (2006a; 2006b), who emphasized limited use of LS compositions and larger design of graphic elements.

Text elements of lower third graphics for the NTSC DV version of the video were designed with 36 point sized Arial fonts that were either italic or regular formatted. Text elements for lower third graphics for the handheld (HH) version of the video were designed in 45 point Arial Black, a notably larger and thicker font (see Figure 8). The bar used to frame the lower third information in the HH version was vertically 44% taller than the one used to frame content for the NTSC version. In terms of width, both graphics were the same size, filling the horizontal axis of the screen.

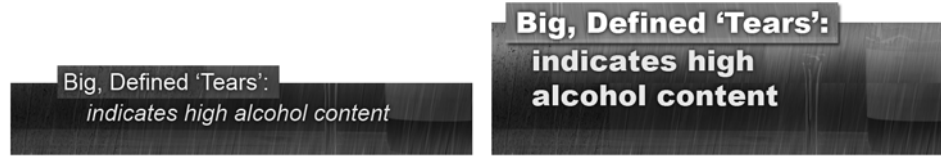


Figure 8: NTSC DV (left) and HH (right) Lower 3rd Treatments

Full Screen (FS) graphics for the NTSC DV version of the video were designed using the Arial font in 42 point size. Text in the HH version was, again, larger and fatter, using the Arial Black font in either 45 or 50 point size. Proportionally, there were no differences in the amount of the screen that was filled. In both instances, the graphics entirely filled the contents of the screen. See Figure 9.



Figure 9: NTSC DV (left) and HH (right) Full Screen Treatments

The FS version of the program utilized wide shots, medium shots, and close ups to present the subject matter. For the HH version, only close ups and medium shots were used to present the subject matter. It is important to note that medium shots were used sparingly, and only to help enhance the pacing of the program so as to minimize the effects of a slow, disengaging pace on viewer attention.

The two formatted versions of the program were shown on one of two devices: 24 inch iMacs, or iPods with screens of 3.5 inches or smaller. Those viewing the iPod

treatments either viewed iPod classics with 2.5 inch monitors, or iPod Touches featuring 3.5 inch monitors. Since the research goal of this study is to generalize the results across the multitude of formats of handheld devices, the two devices were clustered together and analyzed as 3.5 inch or smaller monitors.

For additional comparison, the formatting treatments were also flip-flopped across both delivery mediums. Therefore, the NTSC formatted program was also shown on iPods while the HH version was shown on 24 inch iMac monitors (see Table 6).

Table 6

Four Treatments for this Study

Treatment Number	Shot Composition & Graphic Formatting	Delivery Medium
1	Standard Television shots & graphics	24" iMac
2	Handheld shots & graphics	3.5" or smaller iPod
3	Standard Television shots & graphics	3.5" or smaller iPod
4	Handheld shots & graphics	24" iMac

The Test Instrument

The initial design of the test instrument consisted of two sections. The first part was an 18 question test designed to quantitatively measure learning outcomes. The second section consisted of demographic data collection as well as open-ended qualitative data collection questions to examine learner preferences about learning from different forms of media. Together, these sections were developed to collect data for use

in answering the four primary research questions in this study. A pilot study was conducted to test the instrument. The pilot study was designed to measure the reliability of the instrument. Forty-eight employees from the corporate offices of a Fortune 500 company voluntarily participated in the study. Ages ranged from 21 to 67 years, and all had either normal vision or vision that was properly corrected with either glasses or contacts during viewing. Participants viewed their respective video treatment individually. Those randomly selected to view one of the two standard NTSC versions did so on a 27 inch television monitor. Those randomly selected to view the content on a handheld device were presented one of the two video treatments on a Samsung Blackjack smartphone with a 2.4 inch screen. Since all participants in the pilot study viewed their treatments individually with no extraneous noise or interruptions, no headphones were used during either viewing condition.

The goal of the pilot study was to measure and improve upon, if necessary, the reliability of the instrument. Using Chronbach's Alpha, eight questions were removed resulting in an improved reliability alpha of .643 (see Table 1 and Table 2). Since the sample size for the dissertation study was expected to be nearly three times larger, the decision was made to retain the improved 10 question version of the test in anticipation of increased power of the instrument.

The ten question test was then presented to a panel of experts in educational research. Their feedback, along with suggestions from members of the dissertation committee for this study, led to the final test instrument used for the study (see Appendix).

Research Questions

- 1) What differences, if any, exist between self-perceptions of learning with video training materials formatted for handheld devices compared to large screen delivery mediums?
- 2) Is there a difference in learning outcomes based on shot composition and graphic design formatting for educational videos being viewed on 3.5 inch screens (or smaller) compared to 24 inch monitors? (See Table 3 for grouping.)
- 3) Is there a relationship between user learning preferences for viewers watching educational video content on handheld devices or televisions and viewer frequency of watching educational videos on handheld devices?
- 4) What are the relationships, if any, between the user frequency of viewing videos on handheld devices and learning outcomes?

Thus, the following hypotheses are generated for examination in this study:

- 1) H_0 = There is no difference in self perceptions of learning between the four treatment groups.
- 2) H_0 = There is no difference in learning outcomes between the four treatment groups.
- 3) H_0 = There is no difference in learning outcomes between users viewing content on iPods and those viewing content on 24 inch monitors.
- 4) H_0 = There is no difference in ranked video quality between the four treatment groups.
- 5) H_0 = There is no relationship between the preferred learning methods of users and the frequency in which they report viewing handheld video content.
- 6) H_0 = There is no relationship between reported frequency of viewing video on handheld devices and learning outcomes.

Data Analysis

Learning outcomes were measured based on an individual's performance on the ten item test. Self perceptions of learning were measured with four items on the test

which ask users the extent to which they agree or disagree with statements relating to how easy they found the contents of the video. The variety of hypotheses presented required several different approaches for testing. Hypothesis one was tested with an Analysis of Variance. The second hypothesis was tested using an Independent T-test. Hypothesis three used an ANOVA. The fourth hypothesis was tested using an Independent T-test. Hypothesis five utilized a Kruskal-Wallis nonparametric test. Hypothesis six was measured with Chi-square Test of Independence. The seventh hypothesis was tested with a Pearson Correlation.

Several qualitative questions were also asked within the test instrument (see Appendix) to gain deeper insight beyond the quantitative measures being conducted. This data was analyzed by the researcher to expound upon the findings herein.

Sample

The sample for this study consisted of 132 undergraduate college students at the University of Central Florida. Participants were enrolled in one of two curricula: Visual Language or Digital Media. General ages ranged from 18 to 26 years of age. Six groups of 20 to 30 students each were tested. The treatments for each group were randomly assigned based on a generated set of numbers from Research Randomizer (Urbaniak & Plous, 2008). Since the students were grouped together in clusters of 20 or 30 at a time, all students were provided headphones so that they could view their respective treatment without interruption or interference from others viewing the video on nearby devices. Upon completion of viewing, each student was provided the paper test instrument for completion.

Limitations

This study was intended to expand upon previous research into the cognitive effects that formal features have on viewers. Specifically, the research goal was to determine if alterations in shot composition and graphic design result in changes in knowledge retention and viewer preference. This work expanded on previous examinations on the effects of formal features by making comparisons within the newer realm of viewing video in the context of small, handheld devices. As this medium is relatively new, no prior studies or test instruments exist to directly measure the research questions and hypotheses that were tested herein. To compensate for this, an extensive review of literature was conducted to compile best practices used in the past to study similar effects within similar mediums. These practices were borrowed from to devise the current methodology discussed in this chapter.

A proprietary test instrument was developed to collect and measure data for use within this study. A pilot study utilizing several statistical analyses as well as several rounds of peer review was conducted to modify and improve the reliability of the instrument.

Data were collected using a sample of undergraduate college students studying visual language and digital media. The subject matter of the instructional material was chosen to maximize interest levels across a broad spectrum of audiences. The desire was to avoid polluting the collected data by introducing viewer disinterest or lack of attention to the topic. Still, while it was believed that, in general, the subject matter would appeal to a broad spectrum of viewers, it was understood that not everyone, including college

students, would find interest in the topic of wine evaluation. As such, disinterest in the instructional materials could have led to a lack of attention, in turn corrupting the collected data. There may also have also been members of the selected sample whom already possessed a great deal of knowledge on the topic. To minimize their effects, randomization was employed to increase the likelihood that these folks would be randomly distributed across the sample.

Additionally, though most instructional designers make the best efforts to craft engaging training materials, not all instruction has the levity to be generalized for mass audiences. Some instructional needs may simply be about topics that are, in general, not interesting. For instance, instructional videos on tax preparation, or even industrial training such as proper sanitation of poultry processing equipment, while not compelling content, may be necessary training for a given population. As such, results from this study will not likely be able to be generalized to these types of applications.

Lastly, as this chapter has described, participants in this study took the test immediately after viewing their respective video treatment. As such, this study was not designed to measure any long-term gains or losses in knowledge retention. The data collected represent a snapshot of knowledge immediately retained by viewers through the methodical use of formal features to highlight and accentuate key instructional goals. Long-term effects on learning and/or application of the skills presented within the video were beyond the scope of this study.

Summary

The methodology used to develop instrumentation and collect and analyze data for this study has been detailed within this chapter. Research questions were presented as well as a set of hypotheses for examination. A set of 132 undergraduate college students were sampled with the methodologies outlined herein. Chapter Four will present the raw data collected and the results of the statistical analyses designed to answer the research questions and address the hypotheses. Chapter Five will conclude with a discussion of the results as well as implications and recommendations for further research into this area of inquiry.

CHAPTER FOUR: ANALYSIS OF DATA

Introduction

This investigation was designed to offer insight on a topic that has recently emerged within the video production profession: should videos produced for playback on handheld devices be produced with more limited sets of formal features than videos produced for playback on standard size monitors? The variety of formal features available for manipulation for a study of this nature made it impossible to test all of them. To keep the results manageable, two formal features were chosen as variables for this study. The first was *shot composition* and the second was *graphic design*. Some authors suggest that when producing videos for handheld devices, the use of long shots should be minimized and avoided if possible (Orgad, 2006; Wang, Houqing, & Fan, 2006). Grotticelli (2006b) recommended that graphics such as lower third identifiers should utilize up to half of the screen size in order to ensure legibility for viewers. These assumptions were tested in a conjoined fashion: that is, shot composition and graphic design were manipulated together across the four treatment groups. Participants watching a video formatted according to the specifications for handheld video viewed shot composition *and* graphic design treatments manipulated in accordance with the aforementioned recommendations. Those watching video formatted for large screens viewed a shot composition *and* graphic design treatment recommended for that specified format. The treatments were then flip-flopped so that one group watched videos formatted for handheld viewing specifications on large monitors and another group

watched the video formatted for large monitors on a handheld device. Table 7 shows the formatting treatments across the four groups which were compared in this study.

Table 7

Four Study Treatments

Treatment Number	Shot Composition & Graphic Formatting	Delivery Medium
1	Standard Television shots & graphics	24" iMac
2	Handheld shots & graphics	3.5" or smaller iPod
3	Standard Television shots & graphics	3.5" or smaller iPod
4	Handheld shots & graphics	24" iMac

One hundred thirty-two undergraduate students at the University of Central Florida took part in the study. Ninety of the students were enrolled in the Digital Media curriculum, while the remaining 42 were enrolled in Visual Language courses. As such, all participants had at least some degree of exposure to the production values under examination. While the purpose of the examination was explained, none of the participants were told which specific formal features were manipulated, or which version of the treatment they were viewing. Subjects ranged between 18 and 31 years of age. Twenty-six percent of the participants were female, with the remaining 74% being male. Sixty-seven percent of the sample were Caucasian. Twelve percent were Hispanic. Eleven percent were Asian. Five percent were African American. The remaining five percent defined themselves as other. See Figure 10.

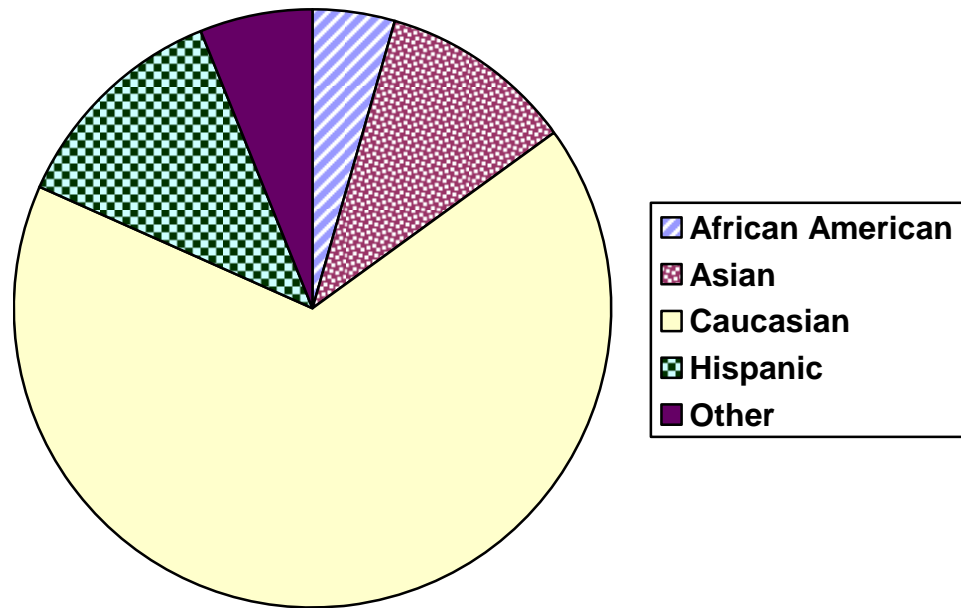


Figure 10: Sample Ethnicity

Reliability

As detailed in Chapter One, the test instrument underwent multiple revisions through both a pilot study and an expert review panel in an attempt to establish a reliable measure for learning outcomes. The scores obtained on these learning outcomes were to be used in various quantitative analyses within this study. Upon the conclusion of the pilot study, the Chronbach's Alpha score of the learning outcomes portion of the test instrument was at .64 (see Table 2). The feeling was that with modifications made during the panel review, as well as the increased sample an acceptable Chronbach's Alpha of .7 or higher would likely be achieved. Unfortunately this was not the case.

When the Chronbach's Alpha test was repeated with the sample of 132 students, the outcome plummeted to .18 (see Table 8).

Table 8

Reliability of Learning Outcomes Measures (n = 132)

Chronbach's Alpha	N of Items
.177	10

This, of course, had an impact on the statistics used to measure differences among learning outcomes based on media and modifications to the educational program. For now the reliability of the test is simply detailed. The implications of this on the overall findings within the study are detailed in Chapter Five.

Research Question One

The first research question asked was: what differences, if any, exist between self-perceptions of learning with video training materials formatted for handheld devices compared to large screen delivery mediums? The desired outcome was to gain insight as to whether or not formatting or delivery methods could contribute to any significant differences among the perceived ability to learn from a given medium. Participants were asked the degree to which they agreed or disagreed with statements concerning their ability to visually comprehend content as well as their increased understanding of the materials presented within the video (see Figure 11).


 <p>Indicate the extent to which you agree or disagree with each statement below by circling the corresponding number.</p>	Strongly Disagree ▼	Somewhat Disagree ▼	Neither Agree nor Disagree ▼	Somewhat Agree ▼	Strongly Agree ▼
I found the contents of this video easy to understand.	1	2	3	4	5
I found the graphics in this video easy to read.	1	2	3	4	5
The visual elements in this video were easy to see.	1	2	3	4	5
I know more about wine tasting than I did prior to watching this.	1	2	3	4	5

Figure 11: Self-Perceptions of Learning Questions

Hypothesis One

The first hypothesis tested for this question was: there is no difference between self perceptions of learning between the four treatment groups. An analysis of variance (ANOVA) was used to test this hypothesis. The test instrument included a series of four questions which measured the extent to which participants strongly agreed or strongly disagreed that they had learned from their respective treatment. Each question had five Likert-type choices for the answer (see Figure 11). Participant rankings were summed across the four questions. Therefore those who strongly agreed for all questions that they were able to learn from the video had a score of twenty. Conversely, anyone strongly disagreeing that they were able to learn from the video and its elements would have scored four points.

Levene's Test showed significance, so the error variance was assumed to be unequal across the different groups (see Table 9). Since the ANOVA test is robust enough to handle departures from normality and unequal variances, it was used to test group differences.

Table 9

Levene's Test for Hypothesis One ANOVA

<i>F</i>	<i>df1</i>	<i>df2</i>	<i>p</i>
8.82	3	124	.000

* $p < .05$

Table 10

Analysis of Variance for Hypothesis One

Source	<i>df</i>	<i>F</i>	η	<i>p</i>
Between subjects				
Perceptions of Learning	3	2.53	.058	.060
Error	127	-	-	-

Note. R Squared = .058 (Adjusted R Squared = .035)

An analysis of variance revealed no significant difference ($F_{3, 127} = 2.53, p = .06$) between perceptions of learning among treatment groups, however it was marginal (see Table 10). The null hypothesis was not rejected. No differences in perceptions of learning were observed regardless of the media used to present the content, or the manipulation of formal features within a given treatment. Over 75% of participants

scored 18 points or higher (from the 20 total possible) in the assessment of their ability to learn from the video.

To gain a deeper insight into participants' feelings toward viewing educational content on handheld devices, the following open-ended question was asked on the instrument: do you think that you can effectively learn from viewing educational videos on handheld devices? Why or why not?

Nearly 86% of respondents responded yes to the question. A number of different reasons were offered. Accessibility to educational materials appeared numerous times as an advantage of the handheld devices. Participants pointed out that they were more likely to have accessibility to their handheld device than a computer or television, and therefore saw that as a benefit to having the materials available in this format. Many who answered 'yes' to the question included the caveat that the content needed to be produced well enough for viewers to see and comprehend the subject matter. One participant stated "as long as I can see it, I can learn it, no matter what the source is." Some even felt that the small format screen had advantages over larger format screens. The small screen on the iPod "forces you to focus on a small area of viewing, so your attention is more focused." Another participant highlighted the kinetic properties of being able to hold the device while watching the educational content. "I like to hold and touch things, so as a kinetic learner, it works."

While some felt that the handheld devices aided their ability to focus, others expressed concerns about potential distractions. One participant who liked the content

stated that "... it just takes more effort to pay attention." "I think it's the same as any other display, although I could see it being easier to get distracted," stated another.

Seventeen from the sample responded that they did not feel that effective learning could take place with content delivered on handheld devices. The distraction factor appeared multiple times within this group. One respondent stated, "I feel that you can easily get distracted by learning something on such a small screen." "It's easy to be distracted with such a small screen," responded another. And another participant added that, "it's hard to stay focused on a handheld device."

Among respondents who answered 'no' to the question, concerns about the ability to easily see the content also appeared multiple times. One person stated, "I have poor eyesight and glasses are not always readily accessible for me." Another stated that, "It's too small to see. If there are notes, I can't read them."

Others who responded *no* to this question simply did not like the idea of learning from video, regardless of the size of the screen. "I can only learn so much from watching TV," stated one participant. Another explained that they did not prefer any video instruction because of the lack of opportunity for feedback or explanations if concepts are being interpreted incorrectly by the learner.

Research Question Two

The second research question was; is there a difference in learning outcomes based on shot composition and graphic design formatting for educational videos being viewed on 3.5 inch screens (or smaller) compared to 24 inch monitors? This question was meant to answer whether or not recommended formatting differences for video

content produced for standard size monitors compared to handheld screens could have any effect on learning outcomes for viewers of educational videos.

Hypothesis Two

The following hypothesis was created to test research question number two: there is no difference in learning outcomes between the four treatment groups. An analysis of variance was conducted to test this hypothesis. Levene's test revealed no significant difference in error variance, therefore the homogeneity of variance was assumed for the ANOVA test (see Table 11).

Table 11

Levene's Test for Hypothesis Two ANOVA

<i>F</i>	<i>df1</i>	<i>df2</i>	<i>p</i>
1.474	3	128	.225

* $p < .05$

Table 12

Descriptives for Hypothesis Two ANOVA

Treatment	Mean	Std. Deviation	N
NTSC	9.17	.954	35
HH	9.24	.786	29
NTSC (HH format)	8.92	1.124	38
HH (NTSC format)	9.2	.85	30
Total	9.12	.941	132

Table 13

Analysis of Variance for Hypothesis Two

Source	<i>df</i>	<i>F</i>	η	<i>p</i>
Between subjects				
Learning Outcomes	3	.830	.019	.479
Error	131	-		-

Note. R Squared = .019 (Adjusted R Squared = -.004)

The ANOVA test revealed no significant difference ($F_{3,131} = .83, p = .479$) between learning outcomes across the four treatment variables (see Table 13). Scores on the test instrument appear to be similar across all four treatments.

Hypothesis Three

To further test for any effects that may be a result of the media format, the following hypothesis was created in relation to research question number two: there is no difference in learning outcomes between users viewing content on iPods and those viewing content on 24 inch computer monitors. An Independent T-Test was used to test the hypothesis (see Table 14).

Table 14

Independent T-test: Learning Outcomes between Two Groups

	Levene's Test		T-test for equality of means				95% Confidence Interval		
	<i>F</i>	<i>p</i>	<i>t</i>	<i>df</i>	<i>p</i>	Mean Difference	Std. Error Difference	lower	upper
Score	1.568	.213	-1.09	130	.278	-.179	.165	-.505	.147

Levene's Test revealed that there was no significant difference in variance between users viewing content on iPods and those viewing content on 24 inch computer monitors ($p = .213$), therefore equal variances were assumed. T-test results showed no statistically significant differences in scores between the two groups ($t = 1.09$, $df = 130$, $p = .278$) were revealed.

Hypothesis Four

The fourth hypothesis tested was: there is no difference in ranked video quality between the four treatment groups. A Kruskal-Wallis test was used to measure for any differences in perceived quality between the four treatment groups. No significant difference in quality was found ($\chi^2 = 1.449$, $df = 3$, $p = .694$), regardless of the size of the video screen. Therefore the null hypothesis was not rejected (see Table 15). Perceptions of quality of the educational video did not appear to negatively impact the overall results of the study.

Table 15

Kruskall-Wallis Test for Hypothesis Four

χ^2	<i>df</i>	<i>p</i>
1.449	3	.694

Research Question Three

The third research question for this study was: is there a relationship between user learning preferences for viewers watching educational video content on handheld devices or televisions, and viewer frequency of watching educational videos on handheld devices? The purpose of this question was to see if prior usage of the medium itself had any influence on user preferences of a medium.

Hypothesis Five

The fifth hypothesis of this study was: there is no relationship between the preferred learning methods of users and the frequency in which they report viewing handheld video content. To measure viewer learning preferences, participants were asked to choose their preferred method of learning from a list of six options (see Table 16). Their viewing frequency was measured by asking participants to rank the frequency in which they viewed handheld video content (see Table 17). A χ^2 Test of Independence was conducted to measure for any relationships between the variables (see Table 18).

Table 16

Preferred Method of Learning Question

What is your most preferred method of learning? (please check one)

<input type="checkbox"/> Books and/or journals	<input type="checkbox"/> Video instruction
<input type="checkbox"/> Audio instruction	<input type="checkbox"/> Online instruction
<input type="checkbox"/> Face-to-face instruction	<input type="checkbox"/> Other types of instruction (please specify) _____

Please describe why you prefer this method of learning over the other options.

Table 17

Frequency of Handheld Viewing Question

How frequently do you view video on portable, handheld devices (such as cell phones, etc.)?

<input type="checkbox"/> Daily
<input type="checkbox"/> Several times per week
<input type="checkbox"/> Several times per month
<input type="checkbox"/> Never

Table 18

χ^2 Test of Independence for Hypothesis Five

χ^2	<i>df</i>	<i>p</i>
13.671 ^a	12	.322

Note. 13 cells (65%) have expected count less than 5. The minimum expected count is .61.

There was no statistically significant relationship between viewer preferences of learning and their frequency of viewing video on handheld devices ($\chi^2 = 13.671$, $df = 12$, $p > .05$).

Qualitative data was also gathered to examine why participants preferred one method of learning over others offered. Over half of the sample chose face-to-face instruction as their preferred method. The most common reason provided related to the instant accessibility to feedback when learners had questions about content. One respondent stated that, “it allows me to ask questions and receive answers immediately.” Another reason that appeared quite frequently in the responses of those choosing face-to-face instruction was that participants could more easily engage in content presented by a live instructor than by video. Many felt that face-to-face instruction held their attention better than taped content. As one participant noted, “I seem to pay attention more when a real person is talking to me.”

Video came in as the second most preferred form of learning. Nearly 20% of participants chose this as their preferred method. Many in this group described themselves as ‘visual learners’ and added that video was particularly suited to their instructional needs. “I am more of a visual learner and videos typically get to the more important details. Videos also have the capability to be replayed,” stated one participant. Another participant gave a similar response, but also cited their interest in technology as adding to their partiality toward the medium. One person described how the subject matter of the educational video presented to the sample influenced the preference of the media, stating that, “I knew nothing about wine or sampling it for that matter, and I

don't think I would have learned as much if I hadn't watched a video on it as opposed to reading about it.”

Online instruction received the third highest ranking among the choices with just under ten percent of the sample favoring this method of learning. The reasons offered for this preference were almost entirely related to preferences of self-paced instruction as well as the ability to access online training at any time. Books followed closely behind online instruction with almost eight percent of the sample choosing them as their preferred method of learning. Ironically many of the same reasons offered for online training preferences appeared throughout this group as well. “I can go at my own pace...” and “easy to pick up and can be done almost anywhere” are some examples of respondent preferences for books and journals over other forms of educational delivery.

Seven respondents chose ‘other’ as their preferred method of learning, accounting for just over five percent of the sample. These participants favored ‘hands-on’ learning which allowed them to experiment and do things on their own. No one from the sample chose ‘audio instruction’ as their preferred method.

Research Question Four

The fourth and final research question examined for this study was: what are the relationships, if any, between the frequency of viewing videos on handheld devices and their effect on learning outcomes? The purpose of this question was to attempt to see if frequency of use of the technology could be, in any way, related to performance in an educational context.

Hypothesis Six

The following hypothesis was created to test research question four: there is no relationship between reported frequency of viewing video on handheld devices and learning outcomes. To test the hypothesis, a Pearson Correlation was conducted (see Table 19).

Table 19

Pearson Correlation for Hypothesis Six

	Viewing Frequency	Score
Pearson Correlation	1	.008
<i>p.</i> (2-tailed)	-	.925

The Pearson Correlation revealed no significant difference ($p = .925$) between the viewing frequency of handheld devices and test scores. The null hypothesis was not rejected.

Sample Viewer Trends and Knowledge

To further understand the viewing habits and preferences of the sample, additional tests were conducted with the data. The instrument contained a rank-ordered question relating to subject viewing frequency of handheld video (see Table 17). A Mann-Whitney U test was conducted to measure for any significant differences in viewing habits between males and females within the sample. No statistically significant difference was found ($z = -.845, p > .05$) between male and female viewing frequency of handheld video (see Table 20).

Table 20

Mann-Whitney *U* Test Viewing Frequency between Gender

<i>Mann-Whitney U</i>	<i>Z</i>	<i>p</i> (2-tailed)
1518	-.845	.398

A Kruskal-Wallis test was conducted to measure for any differences in viewing frequency among the ethnic makeup of the sample. No significant differences ($\chi^2 = 1.25$, $df = 4$, $p = .87$) were found among the groups (see Table 21).

Table 21

Kruskal-Wallis Test for Viewing Frequency between Race

χ^2	<i>df</i>	<i>p</i>
1.25	4	.87

In total, over half of the sample reported never viewing video on handheld devices. Nearly one third stated that they viewed handheld video several times per month. Less than ten percent reported viewing handheld video several times per week. The same percentage reported viewing handheld video daily. See Figure 12.

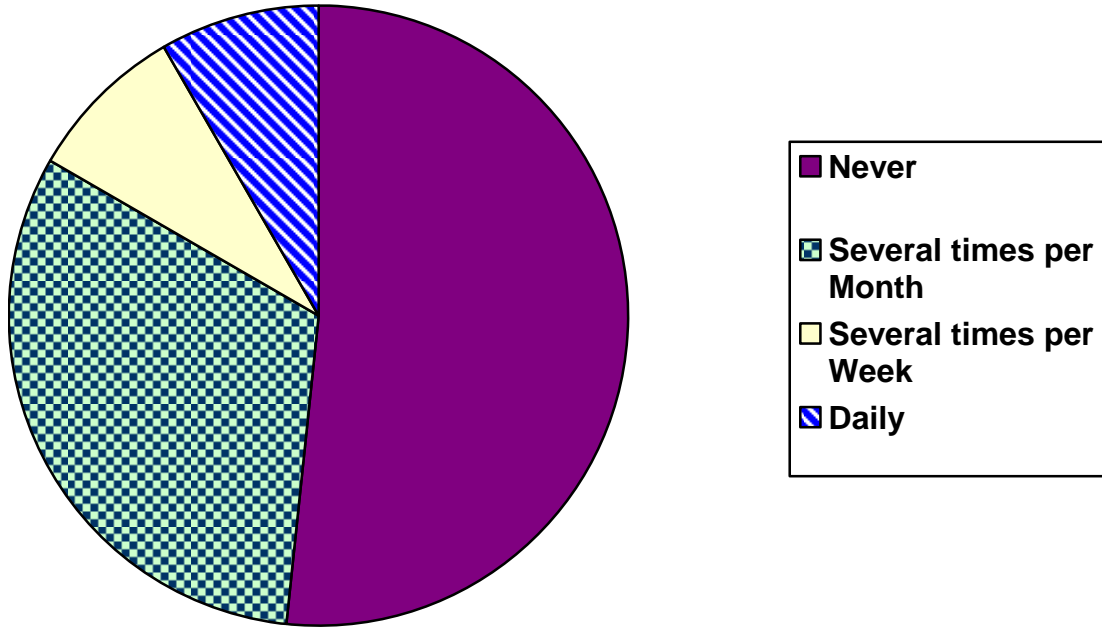


Figure 12: Reported Frequency of Viewing Handheld Video

Prior knowledge of the subject matter across groups was also of interest to the researcher, as this could have influenced learning outcomes. Participants were asked to rate their knowledge of wine tasting prior to watching the video (see Table 22). To measure whether or not there were any differences among the groups, a Kruskal-Wallis Test was conducted. Results indicated that there was no significant difference ($\chi^2 = .669, df = 3, p = .88$) in prior knowledge of the topic among the four treatment groups. As such, it can be assumed that prior topic knowledge did not impact the outcomes of the study.

Table 22

Prior Knowledge of Wine Question

I would rate my knowledge of wine prior to watching this video as:

- Excellent
 - Above average
 - Average
 - Below average
 - Poor
-

Handheld Viewing Motivations

To further understand what does (or would) motivate users to spend more time using handheld devices for viewing video content, the following open-ended question was asked: what reasons do you (or would you, if you don't currently) watch video content on portable handheld devices? Portability and travel were frequently referred to as reasons for utilizing such devices. "It can give me something to do while I ride the shuttle or walk to class" stated one respondent. Another person reported enjoying viewing handheld videos "when bored or on planes or a long trip." Yet another stated that they would use the devices to watch video "during long trips when access to more standard things isn't available."

Convenience was another reason that was frequently cited. One person responded "Convenience in situations where I find myself bored; such as in airports or doctor's offices." Another respondent stated, "Mine has a large wide screen and is very watchable. I prefer not being chained to my computer or TV." Others reported utilizing

the convenience of the devices for more practical purposes: “I save some of my [video] projects on my iPod so that I can show my friends and family.”

Ease of use also appeared multiple times as an important factor. Though no one specifically wrote that they found the devices difficult to use, it appears that being able to easily access the desired video programs is something that many in the sample believe important to their utilizations of handheld video devices.

A portion of the sample indicated that they had no interest in viewing handheld video. “I honestly would rather watch it on a computer if I had to watch it at all,” was one such response. Some stated that they just did not like watching video on small screens, and therefore were less likely to do so. Still a few others did not prefer viewing handheld video because of the power consumption issues on their playback devices. “It kills my battery!” wrote one participant.

Summary

The analyses of the data obtained for this study were presented in this chapter. Chapter Five contains summaries, thoughts, and interpretations of these findings. Conclusions and implications for future research in the area of formal features for handheld video will also be discussed.

CHAPTER FIVE: DISCUSSION AND RECOMMENDATIONS

Purpose

This study was designed to test whether or not manipulation of formal features is necessary when producing educational video content that will be viewed on handheld devices. In many cases, video programming content is produced for standard sized screens found in most households, then down-converted for distribution on handheld devices. There is a school of thought, however, which suggests that additional measures should be taken during the production phase of a video to ensure that video content is clearly communicated. Some suggest that formal features such as shot composition and graphic design styles should be manipulated to better utilize the small amount of screen real estate available on handheld monitors (Grotticelli, 2006b; Orgad, 2006; Wang, Houqing, & Fan, 2006). Taking this approach can be more costly and time consuming. Certainly for this researcher, it extended the amount of time spent on the set while taping the video produced for this study. To manipulate the shot compositions across treatments, every long shot (LS) in the script had to be taped twice as both long and medium shots (MS) in order to have all of the necessary footage to produce the final product that would be shown across all treatments. The amount of graphics produced for the final video was also doubled. Two sets of the same graphics had to be created with differing specifications for each delivery medium. If the need for altering formal features across the two delivery mediums turned out to be legitimate, then these same measures would have to be taken for any video project being produced for handheld viewing

devices. The only alternative would be to produce strictly for handheld devices. This would mean creating content within the constraints of the limited sets of formal features proposed for that medium, then distributing the video across standard and handheld video mediums. For most, this would not be an acceptable solution, as the constraints on design styles and shot compositions would likely result in less than pleasing end products for those viewing on standard devices: based on the sample taken herein, this would be an overwhelming majority of the population. For organizations with deep pockets, producing with dual shot and graphic design treatments may simply result in minor inconveniences. However, for others with less than robust financial resources, the amount of time and energy expended to undertake these recommendations can have far larger consequences on the success or failure of an educational program. Thus, the purpose of the study was to expand the current research on formal features by venturing into the world of handheld video and providing insight as to whether or not these assumptions actually yield improved viewing experiences.

As with any endeavor of this size and scope, many new things were learned: some through the outcomes of successful research and others through failures which will guide future investigators seeking to increase our understanding of the cognitive science underlying video programming. The details of those successes and failures follow.

The Instrument

By far, the greatest disappointment in terms of developing this study was the low reliability score that resulted on the learning outcomes portion of the test instrument when applied to the sample. Despite pilot study results which looked as though validity

would be achieved when applied to a larger sample with less variables, the reliability plummeted on the ten answer, multiple choice section of the instrument which was used to measure learning outcomes for the study sample. While, in general, there were no significant differences found on these portions of the study, it must be noted that the reliability of the ten question test used to measure learning outcomes for content presented in the video is questionable.

While reviewing the literature for this research, no record was found of any general test instrument which could be used for a study of this nature. Most similar prior research utilized proprietary instruments for their respective research questions. Seeing no viable alternative, the decision was made to create a test instrument which mirrored real-world applications of video education in industry and corporate training environments.

When looking at the overall scores, it is likely that a portion of this failure was due to the ease of the test instrument. The lowest score on the test was six (out of ten possible correct) and only two out of 132 participants scored that low. The highest and most frequently occurring score was a perfect ten. Nearly 42% of the sample achieved this score.

It is possible that the high test scores may have been a result of the video successfully teaching the content across all treatments. In hindsight, a pretest/posttest methodology would likely have been a better indicator for differences in learning before and after each subject viewed the video. However even with that alteration in methodology, the validity of the test would likely still be called to question, so a better

quantitative data collection tool will be needed for future research. Recommendations for this are summarized at the end of this chapter.

Having been forewarned by colleagues of the dangers in taking the path of developing one's own test instrument, the decision was made to also incorporate more qualitative input for the study to offset any snags which may have resulted from a proprietary instrument. So while the reliability tests of the learning outcomes portion were poor, there is still much to be gained from the study as a whole.

Research Question One

What differences, if any, exist between self-perceptions of learning with video training materials formatted for handheld devices compared to large screen delivery mediums?

The hypothesis created to test this research question was: there is no difference in self-perceptions of learning between the four treatment groups. No significant differences were found. The sample indicated that their impressions of the ability to learn from any of the treatments of the video were overwhelmingly positive.

Four Likert-type questions were asked which had users rank their perceptions of quality and their ability to learn from their respective video treatment. The totals were summed and analyzed across differing treatment groups to test the hypotheses generated for this question. Possible score ranges would have been between four (for someone who *strongly disagreed* with all four statements) and 20 (for those who *strongly agreed* with all four statements). Results suggest that the sample felt that they understood the content and could learn from the video, regardless of their treatment. No one in the entire sample scored less than 12 total points, indicating that the lowest self-perceptions of the ability

to learn from a video treatment generally held no opinion on the topic. One person from the entire sample scored a 12, and another scored 13. Nearly 75% of the sample scored 18 points or higher, indicating that they had a positive self-perception of their ability to learn from the presented video content.

One of the four statements was: I know more about wine tasting than I did prior to watching this. Nearly 95% of the sample either *agreed* or *strongly agreed* with this statement. It appears that neither the delivery medium nor the manipulation of formal features had any influence on viewer perceptions of whether or not they learned from the video. Overall, viewers felt as though they had acquired new knowledge on the subject matter, regardless of the treatment to which they were exposed.

Another statement within the self-perceptions category was: the visual elements in this video were easy to see. Over 95% of the sample either *agreed* or *strongly agreed* with this statement. Screen size and formal features did not contribute to viewers' ability to easily perceive the video images presented to them. No one in the sample strongly disagreed with this statement.

Participants were asked the degree to which they agreed or disagreed with the statement: I found the graphics in this video easy to read. Again, nearly 95% of the sample either *agreed* or *strongly agreed* with the statement. This statement was specifically pointed toward the differences in graphic design between the treatments. As no observed differences were found from the statistical analysis, it can be assumed that the two design treatments for this study were equally effective. This supports the idea that creating differing design treatments for handheld and large screen viewing is

probably unnecessary unless there are obvious problems with legibility when down-converting a video for viewing on a handheld device.

The final ranked statement used to measure self-perceptions of learning was: I found the contents of this video easy to understand. Of the 132 total participants, 128 (97%) either *agreed* or *strongly agreed* with this statement. The remainder of the sample chose *neither agree nor disagree* as their response to this. No one in the sample chose *disagree* or *strongly disagree* as a response to this statement. Clearly, regardless of the screen size or manipulation of formal features, the sample participants felt that they were able to visually and aurally take-in and understand the content being communicated to them.

An additional open-ended question was asked on the instrument to gain insight into the findings from this research question. The question asked, *do you think that you can effectively learn from viewing educational videos on handheld devices? Why or why not?* Regardless of the delivery medium, respondents overwhelmingly indicated that they felt they could effectively learn from educational videos presented on handheld devices. Nearly 86% (113) responded yes to the question and offered a variety of reasons for their opinion. Participants felt that easy access to content was a substantial plus for using handhelds as learning tools. The ease and convenience of keeping these devices on one's person was mentioned multiple times as a benefit to storing educational videos on them. The potential for having this content readily available appeared to fit well into students' 'on-the-go' lifestyles. Many indicated that they look for ways to entertain themselves and pass time when undertaking such tasks as riding a bus,

waiting in a doctor's office, or simply walking across campus between classes. Some reported already using similar devices to listen to music in similar circumstances, and expressed interest in viewing video content in place of audio files if given the option.

Several participants felt that the size of the device might actually *increase* viewer focus, since all of the content is presented within a small display area. However, the topic of focus appeared more frequently as a concern among those who *did not* feel that handheld devices were effective presentation tools for educational videos. Around 13% (17 total participants) of the sample felt that educational videos on handheld devices could not provide effective instruction. Seven respondents from this group felt that it was too easy to be distracted. Small screens take up a very small portion of our total vision. Over time, home theater screens as well as movie screens have grown to provide viewers with more 'immersive' experiences. Certainly, viewing content on small handheld devices is a step in the opposite direction from this trend. Perhaps exposure to these larger, more immersive experiences has negative impacts for those asked to focus on small handheld devices when viewing video content. It is impossible to tell causal implications from the data collected herein, as the issue of viewer focus was not an initial consideration for this study. However, it certainly raises an interesting topic for further research.

Ultimately there were no differences in self-perceptions of learning between the treatment groups. At least in this instance, viewers felt that they were able to comprehend and learn from the content being presented to them. Learners were just as comfortable watching and learning from educational video content that was simply

down-converted from the original 'produced for large screen' version as they were with any of the other treatments. This lends credence to the idea that reproducing portions of content for handheld distribution may not be necessary to still produce effective educational videos.

Research Question Two

Is there a difference in learning outcomes based on shot composition and graphic design formatting for educational videos being viewed on 3.5 inch screens (or smaller) compared to 24 inch monitors?

Three null hypotheses were generated to test this research question

- 1) H_0 = There is no difference in learning outcomes between the four treatment groups.
- 2) H_0 = There is no difference in learning outcomes between users viewing content on iPods and those viewing content on 24 inch monitors.
- 3) H_0 = There is no difference in ranked video quality between the four treatment groups.

The first two hypotheses for this research question were aimed at directly testing the question between all four groups, as well as breaking the sample into two groups (those viewing with iPods, and those viewing with 24 inch monitors). The third hypothesis was intended to be supplemental, as it was meant to determine if the overall quality of the video could have accounted for any influence between the two-group and four-group testing scenarios. Since this research question and its corresponding hypotheses were based on scores obtained from the learning outcomes measure on the instrument, the findings here are questionable. An ANOVA was used to test the first hypothesis, and a χ^2 Test of Independence was used to test the second. The findings

between the two tests are consistent with those found in the first research question: there were no significant differences in learning outcomes between the two groups. The average score across all four groups was nine correct out of a total ten questions. When the groups were combined to look specifically at those who viewed either video format on an iPod compared to those who viewed either video format on a 24 inch monitor, the average score still came out to be nine out of ten correct.

When analyzed with a Kruskal-Wallis test, the four treatment groups showed no significant differences in ranked quality of the educational video. Viewers had the option to rank the video as poor, below average, average, above average, or excellent. One third of the sample ranked the video as excellent. Nearly half of the sample ranked the video as above average, and the remainder of the sample ranked the video as average. No one in the sample ranked the video as poor or below average. Therefore, negative perceptions of video quality do not appear to have been a factor of influence. This ended up having little meaning for research question number two due to the problems encountered with reliable learning outcomes. This does have important overall implications for the study because it demonstrated that, in terms of viewer ranking, it is possible to produce videos for handheld devices which are considered at least acceptable without the need for manipulation of shot composition and graphic design.

Research Question Three

Is there a relationship between user learning preferences for viewers watching educational video content on handheld devices or televisions and frequency of watching educational videos on handheld devices?

The underlying purpose of this question was to examine whether or not prior exposure and/or usage of the medium had any relationship with learning preferences. The null hypothesis created to examine this research question was: there is no relationship between the preferred learning methods of users and the frequency in which they report viewing handheld video content.

A χ^2 Test of Independence revealed no relationships between frequency of viewing and learning preferences. Over half of the entire sample (68) reported never viewing handheld video content. Just over 31% (42) reported viewing videos on handheld devices up to several times per month. Around eight percent (11) reported viewing several times per week. The remainder of the sample (11) reported viewing videos on handheld devices daily. Around 80% (110) of the sample indicated that they either never or rarely watched handheld videos. With such a small number of people reporting regular exposure to the media, it is possible that there just wasn't enough saturation of usage within the sample to obtain a clear picture of whether or not repetitive viewing can alter media preferences.

Upon choosing a preferred method of learning, participants were prompted to explain their preference. Over half of the sample (72) chose face to face instruction as their preferred method of learning. There were two primary reasons for this which appeared numerous times in these responses. The first was the opportunity for instant feedback and correction. Participants preferred having a live instructor present concepts to them over other learning methods. In general, most felt that there was less opportunity

to interpret knowledge incorrectly if an expert was present to take questions and correct any misinterpreted ideas on the spot.

The second common reason offered for this preference was that participants felt that a live presenter was able to hold their attention better than any of the other forms of media listed. While attentional inertia has been explored in other studies by varying formal features such as editing, transition styles, and pace, this was not a focal point examined within this study (Calvert et al., 1982; Schmitt, Anderson, & Collins, 1999; Silbergleid, 1982; Singer, 1980). However, the need to use these formal features to maintain attention was taken into consideration during the production of the educational video used in this study. In fact, concerns about keeping audience attention were the impetus for choosing the subject matter of the educational video. As discussed in Chapter Three, the strategy was to use best practices to produce a dynamic video which would hopefully maximize viewer attention. So given that there were no measures for attention built into the study, even though participants gave the video high scores on quality across all treatments, it is impossible to know if comments received concerning difficulty maintaining attention were related to inappropriate usage of attention holding formal features, individual disinterest in the subject matter, or ingrained cognitive processes developed from a lifetime of exposure to video as a medium. Regardless of the cause, the sample clearly felt that face-to-face instruction was better able to capture and maintain learner focus than educational video products.

Video was the second most preferred method of learning among the sample. However the gap between video and face-to-face instruction as a preference was wide.

Barely 20% of the sample (26) chose video, with over 50% choosing face-to-face. This might also help to explain why only a small number of the sample reported frequently using handheld video. With the vast majority of them not preferring it as a learning method, it is possible that this may be the reason that they have not sought out the new technology to take advantage of it. Of course, it could also be that with a technology so new, there simply may not be enough offerings on the market yet for potential viewers to take advantage of. The video category was not subdivided to separate standard video from other forms such as handheld video or video used in the context of other multimedia tools. However, given that such a low portion of the sample reported ever using video on handheld devices, it is likely that alternate forms of video viewing would have scored far lower on the scale if they had been subdivided.

Those who did chose video as their preferred method of learning often cited their penchant toward 'visual learning.' They liked the instant accessibility of content as well as the ability to skip around within a program to repeat important information. Others were partial to video because of its ability to focus in on content and drill down learning objectives with precision.

The remainder of options for learning preferences (book/journals, audio, online, and other) combined to form a total of less than 20% of sample preferences. Nearly equal numbers of the sample chose Books/journals and online learning as their preferred method. Both groups seemed to value self-pacing and instant accessibility as advantages for either method. No one among the sample chose audio as a preferred method of learning.

Ultimately, these results suggest that the frequency of use of handheld video does not sway user preferences in terms of methods of learning. However, since the portion of the sample reporting frequent usage was very low, this question may need to be explored again if usage increases in coming years with the intensity that Blum (2006) and the Telecommunications Industry Association (2007) predict.

Research Question Four

What are the relationships, if any, between the user frequency of viewing videos on handheld devices and learning outcomes?

The following hypothesis was created to test this question: there is no relationship between reported frequency of viewing video on handheld devices and learning outcomes. No significant relationships were revealed in the Pearson Correlation conducted to analyze the data.

There were several problems with this overall analysis. As mentioned with reference to research question number three, the number of those reportedly viewing videos on handheld devices on a frequent basis was small relative to those who either rarely or never used the medium. Beyond that, this analysis utilized learning outcomes as the basis for comparison among the treatment groups. So the failure of the reliability test for that portion of the instrument also calls to question the results for this research question.

Conclusions

Implications

While the findings herein were not without limitations, they still offer guidance down the continued path of examination on the impact of formal features within video production. As production budgets continue to be stretched in an ever darkening economic setting, the ability to utilize video products across multiple delivery applications will continue to be a burden for producers to bear. Having to alter shooting and post production methodologies to placate the supposed needs for distributing video via handheld devices can certainly impose time and budget constraints on a project.

The findings herein suggest that alterations in these formal features may not be necessary. There were no significant differences in participant self-perceptions of learning from any of the treatments. Users responded positively that they were able to learn from the videos regardless of whether or not shot composition and graphic design had been altered to ‘maximize’ their effectiveness for small screen playback. Further, quality rankings from all of the participants were high. No one in the sample ranked any of the treatments below an ‘average’ rating. The overwhelming majority felt that the video, regardless of treatment, was either above average or excellent in terms of quality. So, at least in this instance, perceptual quality was not affected by any need to manipulate formal features to match a given treatment. It stands to reason that if this can be done once, then it can be done again.

The information collected from open-ended questions within the instrument also offers valuable insight into the factors which motivate viewers to embrace one form of

learning media over another. Despite the myriad technological methods for presenting educational materials, learners in this sample still overwhelmingly prefer the instantaneous interaction available with face-to-face instruction. The ability to ask questions and receive feedback still makes instructor-led educational settings the preferred method. Unless new technologies are developed which allow video programming the ability to provide instantaneous feedback, other forms of instruction will likely continue to act as supplements to the educational process. The closest leap toward that type of interactive ability would be distance learning courses with live lecturers streaming classroom presentations via handheld devices. It is possible to envision such usage sometime in the not-so-distant future, however currently there is little buzz within the industry concerning any such efforts.

Despite the technological lag which might prompt more users to embrace handheld video as a primary source for education, participants did indicate a number of reasons for which they would embrace the technology in its current form. Mobility and travel seemed to be the most common themes for embracing the medium. Users could easily envision using the technology when in transit or for passing time when away from computers or televisions. As such, producers should continue to keep these user trends in mind as they develop education and training content. Programs should continue to be disseminated mostly in short-format. Of course, technical limitations will continue to drive this trend also. Playing video on these devices is a processor-intensive function and places substantial strain on batteries. However, even if battery life increases enough

to offer long-format programming, producers should rely more heavily on viewing trends to make such decisions.

Recommendations for Future Research

The failure of the validity of the learning outcomes portion of the test instrument was perhaps the most difficult among the problems encountered for this study. Looking at past research, there appeared to be no standardized tool capable of measuring the impact of formal features on such measures as learning outcomes. While setting to the task of creating an instrument, the researcher tried to come up with a subject topic that would, hopefully, maximize viewer interest. Thus a video which offered training and instruction on the nuances of wine tasting was developed to supplement the test instrument. However, after the datum was collected and the numbers were being crunched, it occurred to the researcher that a different approach might yield better results for inquiries such as this. There are programs that exist which offer training on strategies used to raise scores on standardized tests such as the Graduate Record Exams (GREs), Scholastic Achievement Tests (SATs), and so forth. If a short video could be created to instruct subjects on strategies for improving scores on the mathematic portions of the GRE, one should be able to manipulate formal features within the video to measure if they have any effect on learning outcomes. By teaching strategies for overcoming sections of standardized tests, one should be able to bypass the difficulties involved in creating a valid test instrument capable of measuring learning outcomes. This approach might also allow one to explore an even wider range of formal features, as it should free the researcher from the task of trying to validate a proprietary instrument. Similar ideas

occurred to this researcher during the literature review process of this endeavor, however during that phase the idea being explored was to take a subject, such as math, and attempt to create a small modular instructional video which would literally teach a mathematic concept: for instance, geometry. The problem became twofold: first, how does one create a *short* instructional video which accurately covers such a broad, complex topic? Second, and of more concern to the researcher was; how does one keep that *interesting* so that the problem of attentional inertia does not creep in as a factor which corrupts the data? However, if one took an approach of *strategies* for passing these subjects, rather than trying to teach the subject from beginning to end, it could be possible to keep the appropriate pacing for the medium. Beyond that, editing and pace could also become one of the variables manipulated, possibly adding to the overall value of the study. A tool of this nature would also require a dynamic on-camera talent to keep viewers engaged. Looking at the problems encountered herein, it seems like this could result in a viable product to provide deeper insight into the research questions posed for this study. Showing viewers shortcuts which improve their success on an instrument of this sort has more potential for engaging general populations than the rather dry nature of direct instruction of high mathematical concepts. If a pretest and posttest were employed, one should be able to measure differences between to two and determine if differing video treatments or differences in the media demonstrate significant differences in achievement.

One interesting finding in this study was the difference in opinion as to whether or not small handheld devices offered more or less focus than viewing on large monitors.

Some participants suggested that they were easily distracted by things happening around them as they viewed the video content on handheld devices. Others stated the exact opposite, suggesting that having to focus their attention on such a small area actually *increased* their focus. Is it possible to predict this? Could there be relationships between types of learners and the degree of attention that one can maintain for handheld playback devices? Such research may provide valuable insight for educators needing to produce educational video content for audiences with pre-identified behavioral traits or learning disabilities.

For this study, students were shown the video in classroom settings of 20 to 30 students at a time. Each student was provided headphones to view their respective treatment. However, in real-world settings participants have indicated that they would be more likely to view handheld educational videos in a variety of settings. It would be interesting to determine the level of distractions which could lead to the success or failure of knowledge transfer. Certainly if headphones were not provided the participants' experiences (and likely ratings and outcomes alike) when viewing the video would have been markedly different. With 20 to 30 videos playing in a room all at the same time, comments on the ability to focus would likely have been very different. Future research investigating potential thresholds for acceptable interference levels when viewing video on handhelds could provide educators with a better understanding of proper uses and applications of the technology.

Another area which will be of concern to developers is whether or not repeated exposure to viewing handheld video could increase its acceptance as a preferable

learning method. Measures for this were calculated within the sample. However, such a small number of participants reported having exposure to viewing handheld video, that there was likely not enough saturation to gain a clear understanding of any potential impact. Certainly, the infrastructure is being built to make viewing videos on handheld devices an everyday occurrence (Blum, 2006; Orgad, 2006). As usage of the medium becomes more widespread, it will be interesting to see if trends differ, or if face-to-face instruction will remain a preference for learners. Similarly, another worthwhile question for future investigations would be whether or not repeated use of educational handheld video has any impact on learning outcome performance.

This study in no way accounted for potential gains or losses in long-term memory. Certainly, one advantage to the short-format types of educational videos being studied herein is the ability to view it repeated times to refresh forgotten information. However, one question that arises is whether or not presenting information in such short ‘bursts’ of content might have any impact on long term knowledge retention. Future research should look to develop a repeated measures study to see if the knowledge presented has any staying power with participants.

Summary

The purpose of this study was primarily to examine what appeared to be anecdotal statements concerning the proper development of educational videos prepared for distribution via handheld devices. By developing some formalized scientific inquiry, it was hoped that the study would shed some light on whether or not these statements held any truth, or if they were simply assumptions being stated as fact. Though further

research is needed for clarification, it appears that these recommendations may not be necessary. If anything, these measures might only be detrimental to educational video productions by placing unnecessary burdens budgets and resources. Ultimately, a definitive answer to this topic will require more sound measures of learning outcomes, however this study takes a step in the right direction.

Perhaps the more significant aspect of this study is the transition from looking at formal features in the context of traditional video to examining it as a mobile, handheld learning tool. Those filling leadership roles in educational video production environments will certainly find value in continued studies of this nature. As digital video will continue to offer new and expanded features, researchers must continue to study how or if new delivery mediums will change the ways in which videos must be produced in order to effectively communicate and transfer knowledge. The findings herein will hopefully lay a brick in the path toward a complete understanding of best practices for producing video content in this new, digital age of video. Katz (2007) stated that, “Almost every household in American has a television set” (p. 49). The time is fast approaching when every *hand* in America will have a television set. Only continued research can prepare leaders and practitioners of educational video production on how to ready themselves for the cultural changes which will result from this new, evolving technology.

APPENDIX A: PILOT STUDY IRB APPROVAL



University of Central Florida Institutional Review Board
Office of Research & Commercialization
12201 Research Parkway, Suite 501
Orlando, Florida 32826-3246
Telephone: 407-823-2901, 407-882-2901 or 407-882-2276
www.research.ucf.edu/compliance/irb.html

Notice of Expedited Initial Review and Approval

From : UCF Institutional Review Board
FWA00000351, Exp. 5/07/10, IRB00001138

To : Jason Hutchens

Date : June 25, 2007

IRB Number: SBE-07-05063

Study Title: Educational Handheld Video: Testing an Instrument

Dear Researcher:

Your research protocol noted above was approved by **expedited** review by the UCF IRB Vice-chair on 6/21/2007. **The expiration date is 6/20/2008.** Your study was determined to be minimal risk for human subjects and expeditable per federal regulations, 45 CFR 46.110. The category for which this study qualifies as expeditable research is as follows:

7. Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

The IRB has approved a **consent procedure which requires participants to sign consent forms.** Use of the approved, stamped consent document(s) is required. Only approved investigators (or other approved key study personnel) may solicit consent for research participation. Subjects or their representatives must receive a copy of the consent form(s).

All data, which may include signed consent form documents, must be retained in a locked file cabinet for a minimum of three years past the completion of this research. Any links to the identification of participants should be maintained on a password-protected computer if electronic information is used. Additional requirements may be imposed by your funding agency, your department, or other entities. Access to data is limited to authorized individuals listed as key study personnel.

To continue this research beyond the expiration date, a Continuing Review Form must be submitted 2 – 4 weeks prior to the expiration date. Advise the IRB if you receive a subpoena for the release of this information, or if a breach of confidentiality occurs. Also report any unanticipated problems or serious adverse events (within 5 working days). Do not make changes to the protocol methodology or consent form before obtaining IRB approval. Changes can be submitted for IRB review using the Addendum/Modification Request Form. An Addendum/Modification Request Form **cannot** be used to extend the approval period of a study. All forms may be completed and submitted online at <http://iris.research.ucf.edu>.

Failure to provide a continuing review report could lead to study suspension, a loss of funding and/or publication possibilities, or reporting of noncompliance to sponsors or funding agencies. The IRB maintains the authority under 45 CFR 46.110(e) to observe or have a third party observe the consent process and the research.

On behalf of Tracy Dietz, Ph.D., UCF IRB Chair, this letter is signed by:

Signature applied by Joanne Muratori on 06/25/2007 10:12:38 AM EDT

APPENDIX B: DISSERTATION IRB APPROVAL



University of Central Florida Institutional Review Board
Office of Research & Commercialization
12201 Research Parkway, Suite 501
Orlando, Florida 32826-3246
Telephone: 407-823-2901, 407-882-2901 or 407-882-2276
www.research.ucf.edu/compliance/irb.html

Notice of Expedited Initial Review and Approval

From : UCF Institutional Review Board
FWA00000351, Exp. 5/07/10, IRB00001138

To : Jason Hutchens

Date : January 08, 2008

IRB Number: SBE-07-05364

Study Title: Educational Handheld Video: Examining Shot Composition, Graphic Design, and their Impact on Learning

Dear Researcher:

Your research protocol noted above was approved by expedited review by the UCF IRB Chair on 1/8/2008. The expiration date is 1/7/2009. Your study was determined to be minimal risk for human subjects and expeditable per federal regulations, 45 CFR 46.110. The category for which this study qualifies as expeditable research is as follows:

7. Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

The IRB has approved a consent procedure which requires participants to sign consent forms. Use of the approved, stamped consent document(s) is required. Only approved investigators (or other approved key study personnel) may solicit consent for research participation. Subjects or their representatives must receive a copy of the consent form(s).

All data, which may include signed consent form documents, must be retained in a locked file cabinet for a minimum of three years (six if HIPAA applies) past the completion of this research. Any links to the identification of participants should be maintained on a password-protected computer if electronic information is used. Additional requirements may be imposed by your funding agency, your department, or other entities. Access to data is limited to authorized individuals listed as key study personnel.

To continue this research beyond the expiration date, a Continuing Review Form must be submitted 2 – 4 weeks prior to the expiration date. Advise the IRB if you receive a subpoena for the release of this information, or if a breach of confidentiality occurs. Also report any unanticipated problems or serious adverse events (within 5 working days). Do not make changes to the protocol methodology or consent form before obtaining IRB approval. Changes can be submitted for IRB review using the Addendum/Modification Request Form. An Addendum/Modification Request Form **cannot** be used to extend the approval period of a study. All forms may be completed and submitted online at <http://iris.research.ucf.edu>.

Failure to provide a continuing review report could lead to study suspension, a loss of funding and/or publication possibilities, or reporting of noncompliance to sponsors or funding agencies. The IRB maintains the authority under 45 CFR 46.110(e) to observe or have a third party observe the consent process and the research.

On behalf of Tracy Dietz, Ph.D., UCF IRB Chair, this letter is signed by:

Signature applied by Janice Turchin on 01/08/2008 01:42:38 PM EST

IRB Coordinator

APPENDIX C: PERMISSION FOR USE OF COPYRIGHTED
MATERIAL

Jason Hutchens
813 Mt. Vernon St.
Orlando, FL 32803

May 3, 2008

Scott Chandler
401 Willard Dr.
Blacksburg, VA 24060-5257

Dear Scott:

As you are well aware, I am completing a doctoral dissertation at the University of Central Florida entitled Educational Handheld Video: Examining Shot Composition, Graphic Design, and Their Impact on Learning. I would like your permission to reprint in my dissertation excerpts from the following:

Comparing the Legibility and Comprehension of Type Size, Font Selection and Rendering Technology of Onscreen Type

The excerpts to be reproduced are: Figure 7: Orthochromatic rendering of type, 216 ppi.

The requested permission extends to any future revisions and editions of my dissertation, including non-exclusive world rights in all languages, and to the publication of my dissertation by UMI. These rights will in no way restrict republication of the material in any other form by you or by others authorized by you. Your signing of this letter will also confirm that you own [or your company owns] the copyright to the above-described material.

If these arrangements meet with your approval, please sign this letter where indicated below and return it to me in the enclosed return envelope. Thank you for your attention in this matter.

Sincerely,
Jason Hutchens

PERMISSION GRANTED FOR THE USE REQUESTED ABOVE:

By: 

Scott B. Chandler

Date: 03 May 2008

APPENDIX D: TEST INSTRUMENT

Principles of Wine Tasting: Test



Please print clearly:

Course: _____ Date of Birth: _____
mm / dd / yyyy

Circle the appropriate answer. Please make only one selection per question.

1. The earliest description of professional wine tasting dates back to
 - a. 6th century B.C.
 - b. 3rd century B.C.
 - c. The middle ages
 - d. The Industrial Revolution
 - e. The American Civil War
2. What does *vintage* refer to?
 - a. The style of wine
 - b. The type of grape
 - c. The age of the vine that the grape is picked from
 - d. The year the bottle was corked
3. What is a *comparative* tasting?
 - a. Comparing a hodgepodge of different types of wines
 - b. Comparing a single vintage of wine
 - c. Comparing a single type of wine bottled in different years
 - d. Comparing the same vintage and type of wine among different producers
4. Which choice demonstrates the best order for tasting wine?
 - a. Oaky reds, followed by oaky whites
 - b. Least oaky whites to most oaky whites, followed by least powerful reds to most powerful reds
 - c. Oakiest whites to oakiest reds, followed by lightest whites to lightest reds
 - d. The order in which you taste wines is not important to the process



↓ Please continue on the back of this page. ↓

5. Which of the following is unrelated to evaluating a wine's aroma?
- Fruitiness
 - Earthiness
 - Tannins
 - Wood or Oak
6. What setting is best for evaluating the appearance of wines?
- A dimly lit area
 - A brightly lit area with a light blue background
 - A brightly lit area with a white background
 - Near a burning flame
7. What does the presence of heavy *tears* or *legs* indicate?
- A high alcohol content
 - A low alcohol content
 - Subtle acidity
 - Heavy acidity
8. After swishing a taste of wine around in your mouth, the next recommended action is:
- To gargle it to coat the back of the throat
 - To spit it out before the palate is overwhelmed
 - To slurp in some air to help the nose detect flavors
 - To swallow it and immediately drink water to avoid contaminating the flavor
9. What are tannins?
- Substances which create tar-like odors in wine
 - Components of grape skins which help wines age
 - The gassy characteristics found in sparkling wines
 - A style of barrel used to age prized wines
10. What is a wine's *finish*?
- The amount of time that the flavors linger
 - The amount of earthiness in its taste
 - The amount of gas in the wine
 - How long the *legs* or *tears* last



→ Please continue to the next page. →

Indicate your answers to these questions by marking an 'x' in the appropriate box.

Ethnicity:

- African American
- American Indian
- Asian
- Caucasian
- Hispanic
- Other

I would rate my knowledge of wine prior to watching this video as:

- Excellent
- Above average
- Average
- Below average
- Poor

How would you rate the quality of this educational video?

- Excellent
- Above average
- Average
- Below average
- Poor

Gender:

- Male
- Female



My vision while viewing this was:

- Normal
- Impaired but corrected with glasses or contacts
- Impaired and not corrected

How frequently do you view video on portable, handheld devices (such as cell phones, etc.)?

- Daily
- Several times per week
- Several times per month
- Never


What is your most preferred method of learning? (please check one)

- | | |
|---|---|
| <input type="checkbox"/> Books and/or journals | <input type="checkbox"/> Video instruction |
| <input type="checkbox"/> Audio instruction | <input type="checkbox"/> Online instruction |
| <input type="checkbox"/> Face-to-face instruction | <input type="checkbox"/> Other types of instruction
(please specify) _____ |

Please describe why you prefer this method of learning over the other options.



↓ Please continue on the back of this page. ↓

 <p>Indicate the extent to which you agree or disagree with each statement below by circling the corresponding number.</p>	Strongly Disagree	Somewhat Disagree	Neither Agree nor Disagree	Somewhat Agree	Strongly Agree
	▼	▼	▼	▼	▼
I found the contents of this video easy to understand.	1	2	3	4	5
I found the graphics in this video easy to read.	1	2	3	4	5
The visual elements in this video were easy to see.	1	2	3	4	5
I know more about wine tasting than I did prior to watching this.	1	2	3	4	5
I prefer learning from videos on portable handheld devices (such as cell phones, PDAs, iPods, etc.).	1	2	3	4	5
I prefer learning from videos on standard television sets.	1	2	3	4	5

Do you think that you can effectively learn from viewing educational videos on handheld devices? _____ Why or why not? _____

What reasons do you (or would you, if you don't currently) watch video content on portable handheld devices? _____

What other educational video topics would you enjoy learning about on portable handheld devices? _____

Thank you again for taking time to complete this research. Your participation is greatly appreciated! We hope you've learned a lot from this video. Cheers!

Researcher use only:	
<input type="checkbox"/> NTSC	<input type="checkbox"/> HH
<input type="checkbox"/> NTSC – HH gfx	<input type="checkbox"/> HH – NTSC gfx

APPENDIX E: VIDEO SCRIPT

VIDEO SCRIPT

TITLE: **"Principles of Tasting Wine"**

WRITER: **Jason Hutchens**

PRODUCER: **Jason Hutchens**

DRAFT : **Final**

DATE: **6/7/07**

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VISUAL

FADE IN:

1. **LS** GEORGE MILIOTES • **CU V2**

LOW 3RD: "George Miliotes – Master Sommelier"

2. MONTAGE OF ECUs. PEOPLE TASTING WINES

3. CU GEORGE

FS GRAPHIC: "The oldest known description of wine tasting dates back to the 3rd century BC."

DISSOLVE

4. **OTS CU** MAN WRITING IN LATIN ON OLD SCRIBE. ZOOMS OUT.

5. **CU** MAN W/CANDLE IN FOREGROUND BEING BLOWN LEFT.

6. **CU** MAN REACHES OVER TO

AUDIO

GEORGE: "Hi. I'm George Miliotes, and I'm here to talk to you about the art of tasting wine. We've all seen the peculiar manner that professional wine tasters exhibit when sampling wines. All that swirling, sipping, slurping and spitting... the process appears humorous to most of us, and often comes across as kind of snooty. But there is a reason for it – and that's what we're going to learn about today. We'll start by delving into the origins of wine tasting and some different types of tastings. However most of our time will be spent discussing and demonstrating how to get the most out of your tasting experience.

When we finish, we'll have a short test for you to take to see what you've learned. So pay attention, and let's get started!

Wine tasting as a profession has existed for centuries. The oldest known reference which describes the process dates back to the third century B-C by a gentleman named flor-ehn-TIHN-ee-us."

NARRATOR (OLD VOICE): "Some people taste wines when the wind is in the north, because then the wines remain unchanged and undisturbed. Experienced drinkers prefer to taste when the wind is from the south, because this has the most effect on the wine and reveals its

VISUAL

- POUR WINE FROM
PORCELAIN JUG INTO
STEEL CUP
7. CU REACHES OVER AND
PLUCKS BREAD FROM
LOAF
8. CU EATS BREAD WHILE
WRITING. PAUSES TO SIP
WINE FROM WOOD CUP.
9. CU PLACES CUP ON TABLE.
RETRIEVES WRITING
QUILL.
10. CU MAN'S FACE. BELCHES.

DISSOLVE

11. CU GEORGE

12. **MS** GEORGE • **DELETE V2**

13. CU DOLLY DOWN FRONT OF
BOTTLES FROM SAME
VINTAGE. ENDS WITH
GLASS BEING POURED IN
FRONT OF BOTTLE

LOW 3RD: "Horizontal Tasting: Same
wines, same vintage, different
producers"

DISSOLVE

FS GRAPHIC: "Vintage = year
bottled and corked"

DISSOLVE

14. CU DOLLY PULL BACK
ACROSS LABELS OF
CABERNET SAUVS

LOW 3RD: "Vertical Tasting: different

AUDIO

nature. One should not taste when hungry,
because the sense of taste is blunted, nor after
heavy drinking or a large meal. The person
tasting should not do so after consumption of
food with a sharp or very salty taste, or anything
which affects the sense of taste strongly, but
should have eaten as lightly as possible, and be
free of indigestion." –BELCHES-

GEORGE: "Mannerisms aside, this does go to
show that people have been thinking about the
process for centuries. The good news is that it
won't take you hundreds of years to learn how to
do it, or what it's all about. In fact, we'll knock the
basics out right here over the next couple of
minutes. First, let's talk about the four types of
tastings that you're likely to encounter. The first
is called a *horizontal tasting*. This is a
comparison of the same types of wine, for
instance, chardonnay, by different producers
from the same vintage.

By vintage, I'm referring to the year that the wine
was bottled and corked.

The second type is called a *vertical tasting*. This
is a comparison of different vintages of the same
wine. So, for instance, if a winery is setting up a
tasting for their Cabernet that consists of six

VISUAL

vintages, same wine"

DISSOLVE

15. MS GEORGE

LOW 3RD: "Blind Tasting: glass of wine with no information. Taster must guess"

DISSOLVE

16. CU POURING WINE WITH "X"ed
OUT LABEL INFORMATION

DISSOLVE

17. CU GEORGE

LOW 3RD: "Comparative Tasting: a hodgepodge of selections"

DISSOLVE

18. CU PAN ACROSS MISC WINE
BOTTLES

DISSOLVE

19. CU GEORGE

20. ECU POURING 3oz WINE INTO
GLASS. ZOOM OUT TO
REVEAL 6oz POUR

21. CU GEORGE

AUDIO

different examples – one from 1992, another from 1993, 1994 and so on, then you've got a vertical tasting.

The third type is called a *blind tasting*. You won't see these too often unless you're testing to become a sommelier.

Essentially you're presented with a glass of wine that you know nothing about, and must attempt to identify it based on its characteristics.

And lastly, there's what's called *comparative tasting* – which is what you'll likely find at your local wine merchant on select days. It's basically when there is no rhyme or reason to the selection, other than it's simply a hodgepodge of selections that the person setting up the tasting felt like showcasing for that particular event.

So, we've talked a little about its history, and examined some different types of tastings – now let's get to the actual process, and talk about how to taste a wine and what to look for while you're doing it. Begin by pouring about 2 to 3 ounces of wine into a glass. When you order a glass of wine in a restaurant, servers will typically fill the wine glass about half way up, which is a 6 ounce pour: the industry standard. To taste, you really only need a small amount of the juice. And actually, when you go to taste, you'll only have maybe an ounce of liquid in your mouth – so 2 to

VISUAL

DISSOLVE

FS GRAPHIC: "Tasting Order: Begin with whites before reds. Least powerful to most powerful. Least oak to most oak."

22. **LS** GEORGE IN FRONT OF TASTING SETUP WITH WHITES AND REDS. GEORGE POINTS TO GLASS OF RED WINE. POINTS TO GLASS OF WHITE. • **CU OF POINTING TO RED. CU OF POINTING TO WHITE – V2.**

23. **CU** GEORGE

DISSOLVE

FS GRAPHIC: "Tasting Steps: 1) sight 2) aroma 3) taste"

DISSOLVE

24. **LS** GEORGE IN FRONT OF TASTING SETUP. HOLDS WHITE WINE OVER PAPER • **CU GEORGE V2**

25. **ECU** WINE OVER WHITE CLOTH

DISSOLVE

26. **MCU** ZOOM IN WINES WITH DIFFERENT VISUAL LOOKS.

27. **CU** GEORGE

AUDIO

3 ounces in the glass is plenty.

Its also important to begin with white wines before reds, and in each case, you should start with the lightest and work your way up to the heaviest. Otherwise, if you start with a deep red like a Merlot or Cabernet and then switch to something light like a Riesling, your taste buds are going to be so blown out by that big red wine that you won't be able to get much out of the Riesling. With that in mind, lets look at the actual process.

Evaluating a wine consists of three sequential steps. The first is sight. Second is aroma. And third is taste. We'll begin with sight. When visually examining wine you'll want to be in a brightly lit area with a white sheet of paper. Hold the wine over the paper to assess its clarity and color. Is the liquid clear enough to see through, or is it muddy with bits of sediment floating around in it?

Wines can take on lots of visual characteristics, and professional wine tasters can determine a lot from the appearance of a wine.

Look for bubbles to see if there is any gas present in the wine. Swirl it around a bit and see if there are any "legs" or "tears".

VISUAL

28. CU SWIRLING RED WINE
AROUND. STOPS TO
EXAMINE TEARS

29. ECU TEARS RUNNING DOWN
GLASS

LOW 3RD: "When tears are 'big' and
'defined', that indicates a high
alcohol content in the wine"

DISSOLVE

30. CU FEMALE SWIRLING AND
SNIFFING WINE IN GLASS

31. CU GEORGE

FS GRAPHIC: "Scent Criteria: Fruit?
Earthiness? Wood or Oak?"

32. CU GEORGE

33. CU GEORGE'S WINE GLASS

34. MS GEORGE • CU V2

LOW 3RD: "Most of taste is actually
smell"

AUDIO

These are the big, thick drips that run down the glass when you swirl it. If the tears are big and defined, that means there's a high alcohol content within the wine.

The second step is examining the aroma of the wine. Swirl the liquid around so that the wine's flavors are stirred up. Tilt the glass at an angle and put your nose all the way into the glass like this. Gently inhale for 3 or 4 seconds – this is important because the scents may change over the course of the time you inhale. Think about the variety of aromas that you get from the scent. I typically think about three criteria. What fruit flavors are there? Any fruit that you can think of can show up in the flavor profile of a wine. Are there any earthy flavors or tones happening – such as tar or soil? And are there any wood or oak flavors? If there are, then the wine has probably been barrel-aged. This can contribute a whole variety of rich flavors such as butter or spice to a wine, so think about that as you take in the aromas.

The last step is to taste the wine. Here's an interesting fact that most people don't know: the biggest part of taste is actually smell. When you eat food, chewing liquefies portions of what you eat. This produces a smellable vapor and that's

VISUAL

35. CU GEORGE

DISSOLVE

GRAPHIC: TONGUE
ILLUSTRATING TASTEBUDS

DISSOLVE

36. CU PERSON SWISHING WINE

DISSOLVE

37. MS GEORGE • CU GEORGE V2

38. ECU GEORGE TASTING WINE

39. MS GEORGE • CU V2

AUDIO

where most of "taste" comes from. If you don't believe me, the next time you sit down for a meal try eating with you nose pinched and see how it affects the flavor of your food. Also, consider how having a stuffy head from a cold affects your appetite... it's all related to scent and the role it plays in our ability to taste.

The tongue has four primary areas where taste-buds detect different flavors. The tip of the tongue detects sweetness. Saltiness is registered just behind the tip. Acidity or sourness is registered on the sides of the tongue. And bitterness is detected closer to the back of the tongue. So when you see someone making squishy faces to taste their wine, its because they're swishing the wine around so that all the tastebuds will be able to detect these different flavor characteristics.

To taste the wine, get about an ounce of the liquid in your mouth and swish it around to cover the inside of your mouth. You'll also want to slurp in a tiny amount of air – again helping those nose receptors pick up the flavors – then spit out the wine, or simply swallow it. Here comes the best part, I'll demonstrate...

TASTES WINE AND SPITS OUT

Now all you have to do is concentrate on all the different flavors that come to you. As I said

VISUAL

40. CU WINE IN GEORGE'S HAND

41. MS GEORGE • CU GEORGE V2

LOW 3RD: "Finish: how long flavors linger"

FS GRAPHIC: "Tannins: components of grape skins that help wines age and contribute to powerful flavors"

42. LS GEORGE. ZOOM OUT • CU V2

AUDIO

before, it will often mirror what you've smelled. The difference is that tasting will be more intense because you've added the senses that your tastebuds provide along with your sense of smell. For instance, this wine has some apple and pear flavors going on in there. There is also some chalky minerality and earthiness in there, and maybe just a hint of oak. It also has what I would call a medium finish. By that, I mean that the flavor lingers, but it isn't powerful. Many light white wines will have a quick finish – in other words the taste is there when you sip it, but quickly fades away after its swallowed. On the flip side of that, you have some big reds like Cabernet that often have a long finish that can linger for minutes after you've tasted them.

The last thing you'll notice is whether or not there are tannins in the wine. Tannins are components of the skin that are extracted into the wine to help them age. They give a more powerful taste to wines, and give you that dry feeling, like little sweaters on your teeth. They're an essential component to many reds and can often be found in whites too. If you've got a big, thick, fuzzy feeling in your mouth after tasting the wine, you've just tasted a highly tannic wine.

So that's it! We talked about the history of tasting, the different types of tastings that can be set up, and went through the process of tasting

VISUAL

AUDIO

and evaluating wine. Now you know everything you need and then some to begin exploring the world of wine and the endless combinations of flavors that are out there.

FADE OUT

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