The Effects of Edits on Arousal, Attention, and Memory for Television Messages: When an Edit Is an Edit Can an Edit Be Too Much?

Annie Lang, Shuhua Zhou, Nancy Schwartz, Paul D. Bolls, and Robert F. Potter

This study examines the effect of the rate of edits (camera changes in the same visual scene) on viewers' arousal and memory. The rate of edits varied from slow to very fast. Results show that as the rate of edits increases physiological arousal, self-reported arousal, and memory increase. It is suggested that edits can increase attention to and encoding of television message content without significantly increasing the cognitive load of the message.

The literature on television effects frequently finds that, although television viewers report high levels of exposure to television, memory for what they have seen is very low (Gunter, 1987). Recent research is beginning to explain these findings by demonstrating that the relationships between exposure and attention, and between attention and memory are not simple, direct, or linear.

Many researchers and research traditions have built a convincing body of evidence that exposure does not determine attention (Biocca, 1988; Chaffee & Schleider, 1986). Rather, exposure seems to be a necessary but not sufficient case for attention to occur. Viewers' needs, intentions, and goals play a large role in determining whether the viewer will pay more or less attention to a message (Gantz, 1978; Geiger &

---

Annie Lang, (Ph.D., University of Wisconsin-Madison, 1987) is an Associate Professor in the Department of Telecommunications at Indiana University. Her research focuses on the cognitive processing of mediated messages.

Shuhua Zhou, (Ph. D. candidate, Indiana University) is an Instructor in the Telecommunications & Film Department at the University of Alabama. His research interests are media content and effects.

Nancy Schwartz, (Ph.D. candidate, Indiana University) is an Adjunct Instructor in the Department of Telecommunications at Indiana University. Her research interests include children and media and learning from electronic media.

Paul D. Bolls, (Ph.D. candidate, Indiana University) is an Instructor in the Mass Communication Department at Southern Illinois University at Edwardsville. His research interests include the cognitive processing of mediated messages.

Robert F. Potter, (Ph.D., Indiana University, 1998), is an Assistant Professor in the Telecommunications & Film Department at the University of Alabama. His research interests include the cognitive processing of mediated messages.
Newhagen, 1993; Gunter, 1987; Levy & Windahl, 1984; Petty, Cacioppo, & Schumann, 1983).

Research also shows that attention levels do not remain constant during viewing of a message; attention frequently varies both between and within programs, individuals, and situations. In particular, attention levels during viewing of a single message have been shown to fluctuate predictably as a function of a television message's structure and content (Lang, 1995; Reeves, Thorson, & Schleuder, 1985; Reeves & Thorson, 1986; Reeves, et al., 1985). This research has demonstrated fairly convincingly that exposure to a message is not a guarantee of attention. Even among “attentive viewers”, attention level varies over the course of a viewing session.

Recent research suggests that a similar situation exists for the relationship between attention and memory. Early research often inferred attention by measuring memory - making the assumption that if viewers remembered something then they must have paid attention to it, and if they didn't remember something, it was because they hadn't paid attention to it (Grimes & Meadowcroft, 1995). However, it now appears that many types of television messages elicit quite high levels of “attention” and quite low levels of memory for the content of the message (Gunter, 1987; Thorson, Reeves, & Schleuder, 1985, 1986).

Using the limited capacity approach to television viewing to analyze the relationship between TV’s form and content and viewers’ attention to and memory for television messages, Lang and her colleagues have shown that many aspects of television can create states of high attention which result in poor memory for television messages (Lang, Bolls, Potter, & Kawahara, 1999; Lang, Newhagen, & Reeves, 1996).

A Limited Capacity Approach to Television Viewing

The limited capacity approach to television viewing (Lang, 1995; Lang & Basil, 1998; Lang, Bolls, Potter, & Kawahara, 1999; Lang, Newhagen, & Reeves, 1996) suggests that viewers’ information processing resources are limited. In order to process television messages, television viewers must encode the information contained in the message, retrieve already stored information from long term memory in order to make sense of the incoming message, and store the new information in long term memory. This approach argues that three sub-processes of information processing—encoding, storage, and retrieval—occur continuously, simultaneously, and to some extent automatically while viewers watch television. The viewers’ fixed capacity for limited processing resources are flexibly distributed across these three simultaneously occurring processes¹. The distribution of resources is determined both by automatic processes (triggered by content and structural features of the message) and by controlled processes (driven by viewer interests, needs, goals, and motivations).

The task of watching television is performed adequately when all three subprocesses have sufficient resources available to perform at the level desired/required
by the viewer. If there are not sufficient resources available, the overall task of watching television will be performed less effectively. When this occurs, it is often the case that one of the sub-processes will be more affected than the others.

During television viewing, viewers are not in control of the pace at which information is presented: the viewer must “keep up” with the message. As a consequence, resources to encode and make sense of a message are allocated automatically in response to the structural and content characteristics of the message. When a message is difficult—either in terms of content or in terms of structure—an increase in the number of resources allocated to encoding and on-line retrieval (the sub-processes primarily involved in sense-making) results. The viewer in this case has fewer resources available for the sub-process of message storage. When this happens, the viewer remembers less of the message. This means that a message may receive very high levels of attention (that is the viewer is working very hard to encode and make sense of the message), but still will be remembered poorly, because the viewer was unable to allocate sufficient processing resources to store the message.

Previous research testing this theory has demonstrated that one can increase viewer attention to the message while decreasing their memory for the message by increasing either the structural complexity of a message (Lang et al., 1999; Yoon, Bolts, & Lang, 1998; Yoon, Bolts, Lang, & Potter, 1997), the content difficulty of a message (Lang, Geiger, Strickwerda, & Sumner, 1993; Thorson & Lang, 1992), or both (Lang et al., 1999).

One way to increase the resources allocated to encoding a television message is by introducing structural features (such as cuts, edits, graphics, and sound effects) into television messages. Many structural features of television elicit what is called an orienting response (Lang, 1990).

The “orienting response” is an involuntary physiological and behavioral response that directs our attention toward new or relevant information in the environment. The orienting response is made up of a set of physiological and behavioral responses which include: turning sensory receptors (eyes, ears, nose) toward the stimulus, lowered heart rate, decreased blood flow to the muscles, alpha wave suppression in the electroencephalogram (EEG), increased skin temperature, increased electrical conductivity of the skin, and increased blood flow to the brain (Lynn, 1966; Lang, Simons, & Balaban, 1997). Orienting responses to television messages have been measured using eyes on screen (Anderson, 1983), EEG (Reeves, et al., 1985), and heart rate (Lang, 1990; Lang, Geiger, Strickwerda, & Sumner, 1993; Lang, Newhagen, & Reeves, 1996; Lang & Thorson, 1992).

The limited capacity approach to television viewing suggests that when a television message elicits an orienting response, this results in an increase in the allocation of processing resources to encoding the information in the message. Several studies (Lang, 1990; Lang, 1991; Reeves, et al., 1985; & Thorson & Lang, 1989) have demonstrated that the formal or structural features of television (such as cuts, movement, and sound changes) both evoke the orienting response and increase the resources allocated to processing messages. Both Lang et al. (1993) and Geiger and
Reeves, (1993) demonstrated that secondary task reaction times (often used as a measure of resources allocated to processing) are slower immediately following both cuts and edits in television messages.

At the same time, this research shows an increase in attention and resource allocation elicited by the cut or edit does not lead automatically to an increase in memory for the message. Rather, the short-term or local effect of the structural feature on memory varies as a function of the overall, global cognitive load imposed by the content of the message. The global cognitive load imposed by the message can be varied by manipulating either the structure or the content of the message.

Thorson & Lang (1992) manipulated global cognitive load by varying the difficulty of the material contained in videotaped lectures, then examining the effects of local orienting responses elicited by videographics on memory. They demonstrated that memory for the content of the lectures increased following orienting responses when the global content of the lecture was easy for the viewer (low cognitive load). However, when the global lecture content was difficult, memory for information following the orienting response decreased (high cognitive load).

Similarly, structural features can be used to manipulate both the global and the local cognitive load. Global cognitive load can be manipulated by increasing the number and rate of structural features contained in a message (Lang et al., 1999; Reeves, Thorson, & Schleuder, 1985).

Local cognitive load can be affected by the type of structural feature. Lang and Basil (1998) suggest that one can conceptualize structural features in terms of the amount of new information introduced by the structural feature. Some types of structural features typically occur in conjunction with the introduction of new information. That information may be expected or unexpected, and it may be semantically related or semantically unrelated to the information which preceded the structural feature. Lang and Basil (1998) suggest that when structural features introduce a lot of new information or unexpected or unrelated information, they require more resources to be fully processed. On the other hand, structural features which introduce little new information or expected information will require fewer resources to be fully processed. This suggestion was made based on a review of the research investigating resource allocation, attention, and memory elicited by various types of camera and scene changes in television messages.

Lang et al. (1993) varied the cognitive load of structural features by varying the "relatedness" of the message on either side of a cut. Related cuts were defined as cuts where the information following the cut was narratively and semantically related to the information preceding the cut. Unrelated cuts were defined as cuts where the information following the cut was narratively and semantically unrelated to the information preceding the cut. They hypothesized that unrelated cuts impose a greater cognitive load on the viewer and require more resources to be fully processed. Results indicated that memory for information following the cut was better for related cuts than for unrelated cuts.

A limited capacity approach predicts this phenomenon. It suggests that both the
related and the unrelated cut will elicit orienting responses which result in more
resources being allocated to encoding the message. However, the unrelated cut by
definition is associated with the introduction of new (unrelated) information. As a
result—the additional resources allocated in response to the cut are in fact needed to
encode new and unrelated information introduced by the cut. Therefore, the viewer's
processing capacity is briefly overloaded, due to the new and unrelated information,
which results in a momentary decrease in memory for information occurring at the
point of transition marked by the cut.

Related cuts, on the other hand, are associated with less new information and
information after the cut which is related to previous information. Typically, related
cuts provide either a different view of the same scene, or a new scene introduced and
therefore expected in the context of the message. Thus, at least some of the additional
resources allocated to encoding as a result of the orienting response may not be
needed. This super abundance in resources may result in more information being
encoded than is absolutely necessary to "keep up" with the meaning of the message,
resulting in an increase in memory for information occurring right at the point of
the edit.

A recent study (Lang et al., 1999) extended this work by examining the effects of the
number of cuts in a message on overall memory for the message. In this study, cuts
were defined as a shift from one visual scene to a completely new visual scene within
coherent 30 second messages. All of the cuts in this study were semantically related
(that is, they were part of a naturally occurring 30-second segment), but a cut always
introduced a completely new visual scene. Thus, a cut always added new informa-
tion in the form of a new visual scene. The number of cuts in 30-second messages was
varied, and memory for the messages was measured. The limited capacity approach
predicts an inverted U-shaped relationship between increase in cuts and memory,
since initially cuts will help viewers to process the message by increasing the
processing resources allocated to the message. However, as cuts continue to increase
in number, the viewer will be unable to keep up with the demand for processing
resources, and memory will suffer. Results showed that as the number of cuts
increased from slow (0-1 cuts in 30 seconds) to medium (5-6 cuts in 30 seconds),
viewer memory for the messages increased. However, as predicted, memory for fast
messages (those with 10 or more cuts in 30 seconds) was lower than memory for
medium messages.

Both Lang and Basil (1998) and Lang et al. (1999) suggest that a different story may
be told, if one manipulated the amount of new information introduced by the cut.
Cuts which introduce very little new information into a message should elicit
orienting responses, and therefore elicit an increase in processing resources allocated
to encoding, but all of the additional resources allocated to encoding the cut, may not
be needed, since there is little new information to be encoded. It is logical to suggest
that increasing the number of cuts which add little "new" information to a message
may not overload a viewer’s processing system as quickly as increasing the rate of
cuts which do add new information. Conceivably, cuts that introduce almost no new information might never overload the processing system.

This possibility is examined in the present study. Cuts are defined as a change from one visual scene to another within a coherent (semantically related) 30 second message (the same definition used in Lang et al., 1999). An edit, on the other hand, is defined as a change from one camera shot to another within the same visual scene. In other words, edits are camera changes within the context of a single location. For example, alternating speakers' faces during a conversation would be described as edits. Unlike a cut, which takes the viewer to a completely new environment and therefore adds a considerable amount of new information to the message, an edit should elicit orienting responses but introduce much less new information, and therefore require less effort to process. As a result, increasing the number of edits in a message should increase the number of orienting responses elicited, which, in turn, should increase viewer attention to the message. This leads to hypothesis 1:

H₁: As the number of edits in a message increases, attention to the message will increase.

At the same time, because all of these additional resources may not be needed to process new information, memory for the messages should increase. This leads to hypothesis 2:

H₂: As the number of edits in a television message increases, memory for the content of the message will increase.

Previous research on the rates of cuts and edits suggests that fast paced messages (those with many structural features) elicit, in addition to increased attention, increased arousal in viewers (Gunter, 1987; Hitchens, Thorson, & Duckler, 1994; Reeves, Thorson, & Schleuder, 1986; Watt & Krull, 1977; Yoon et al., 1997; Yoon et al., 1998). Because arousal is often associated with an increase in memory and liking for messages (Lang, Dhillon, & Dong, 1995; Lang, Greenwald, Bradley, & Hamm, 1993) arousal is an important variable to examine. Increasing the number of cuts in a message was clearly shown to increase both viewers self-reports of arousal and their autonomic arousal (measured by skin conductance) in the study reported above (Lang et al., 1999). It is expected that increasing edits will similarly increase viewers' levels of autonomic nervous system activation—or arousal. Hence:

H₃: As the level of edits in a television message increases, viewer arousal will increase.

Method

This overall experiment is a mixed 4 (Order of Presentation) X 4 (Edits) X 5 (Message) design. To construct the stimulus tapes, 20 coherent messages, each
one-minute long, were chosen from a pool of television programs, advertisements, and feature movies. The messages chosen included dramas (4), comedies (1), science fiction (1), cop shows (1), cartoons (2), sports (4), commercials (2), information shows (2), self-help shows (2), and talk shows (1). No one genre appears more than once in any level of rate of edits. Messages were chosen to create four levels of edits (slow, medium, fast and very fast). Four random experimental orders were constructed. Order of presentation was the only between subject variable.

Edits were operationalized as change from one camera shot to another within one visual scene. A visual scene was defined by an establishing shot. Cuts to anything in the establishing shot were defined as edits. Cuts to things not present in the establishing shot were defined as cuts. Thus, if the inside of a football stadium is an establishing shot, all shots taken within the stadium are then defined as edits. But a scene change to something outside the stadium is a cut. Clearly, using this operational definition, all edits do not introduce the same amount of new information, but one can be reasonably confident that the edits (as operationally defined here) introduce less new information than do cuts. The four levels of edits were defined according to the following criteria. 0-7 edits within the one-minute message is slow, 8-15 is medium, 16-23 is fast, more than 24 is very fast paced. All the messages contained fewer than 3 cuts (a level defined as “slow” in previous research)4.

Subjects

Thirty nine communication majors participated in the experiment for class credit. Visual recognition, heart-rate, and skin conductance were collected from all 39 subjects.

Dependent Variables

Memory was measured using a visual recognition task. Brief video scenes were shown to the subjects who pushed the buttons on a joystick to indicate whether they had seen the scene before. Each scene was 6 frames long. Subjects viewed 120 scenes separated by 2 seconds of black. Sixty of the scenes came from messages the subjects had seen before, while the other half, foils, came from messages they had not seen before. Both the correctness and the speed of their responses were measured. The visual recognition task took 4.2 minutes.

Recognition hypotheses were tested using a signal detection analysis of the recognition data. Signal detection theory is discussed at length and applied to communication research in Shapiro, 1994. Signal detection analysis is based on the theory that finding a memory in your memory is like detecting a weak signal in the environment. Two major components affect a person’s decision as to whether or not a signal (or memory) has been detected. One dimension of that decision is how
sensitive one's senses are to changes in the environment. This is called sensitivity or d prime. The second dimension of that decision relates to how willing a person is to guess, that is how liberal or how conservative their decision-making strategy is. This is called the criterion bias.

To perform a signal detection analysis four values are computed for each subject: (1) the percentage of hits—that is the percentage of items subjects say they have seen before which they have in fact seen before; (2) the percentage of misses—that is, the percentage of items they said they had not seen before which they had seen before; (3) the percentage of correct rejections—that is the percentage of items they said they had not seen before that, they had not seen before, and; (4) their percentage of false alarms—that is, items they said they had seen before that they had not seen before. These values are combined to compute a subject's sensitivity (called d prime) and the subject's criterion bias. The greater a subject's sensitivity - the more accurate their memory is, both in terms of hits and correct rejections. Criterion bias is determined by the number of false alarms and misses and is interpreted as how confident a subject needs to feel about having seen an item before he or she is willing to say the item was seen before. Using signal detection analysis allows one to attribute an increase in percent correct to either improved sensitivity or a shift in criterion bias.

Attention was assessed by measuring viewers' heart rate during viewing (Lang, Newhagen, & Reeves, 1996; Martin & Venables, 1983). Research demonstrates that high attention to an external stimulus (like a television message) results in significant slowing of the heart rate (Lacey & Lacey, 1974; Lacey, Kagan, Lacey, & Moss, 1963; Lang, 1990; Lang, Newhagen, & Reeves, 1997). If viewers pay more attention to messages as the number of edits increases, then they should have slower mean heart rates (indicative of greater attention) during faster paced messages than they do during slower paced messages. Heart rate is a relatively slow responding physiological measure. Because, on average, the heart beats about one time per second, and because it may take two to three beats for a response to begin, heart rate responses are generally analyzed over time and referenced to the beginning of the stimulus. In this case, not only does the heart rate response unfold over time, but so does the independent variable manipulation. The rate of edits, that is the number of edits occurring over time, is not apparent until some time has passed. For this reason, heart rate is collected as milliseconds between beats and averaged over various lengths of time. In this study, heart rate was averaged over two 30-second periods. By the second 30-second period, the effect of rate of edits should be demonstrable relative to the initial 30 seconds. The design used for the analysis is a mixed 4 (Order of Presentation) X 4 (Edits) X 5 (Message) X 2 (Time) ANOVA. Thus, the hypothesis is for an Edits X Time interaction.

Arousal was measured in two ways: 1) viewers used the SAM (Self-Assessment Mannequin; Lang, Greenwald, Bradley, & Hamm, 1993) scale to report how aroused they felt following each message, and; 2) The frequency of skin conductance responses (SCRs) was measured during viewing (Hopkins & Fletcher, 1994).
Apparatus

The experiment was controlled by a Zenith 386 computer with a Labmaster A/D D/A board. SC was measured by placing two Beckman standard Ag—AgCl electrodes on the subject’s non-dominant hand after washing the skin with distilled water to control hydration. The signal was passed to a Coulbourn SC module. SC level was sampled and recorded 10 times per second throughout message viewing. Spontaneous skin conductance responses (SCRs) greater than .10 microsiemens were scored to obtain the frequency of SCRs per message.

HR was measured by placing two Beckman mini Ag—AgCl electrodes on subjects’ forearms. A ground electrode was placed on subjects’ non-dominant forearm. HR was recorded using a Coulbourn bio-amplifier with filters. Heart beats were recorded as milliseconds between beats and converted to HR per second. Change scores were computed and then averaged over two 30-second periods.

Procedure

Participants were tested individually. An experimenter greeted the participant and explained that his or her heart rate and skin conductance data would be recorded using small sensors attached to forearms and hands. Each participant signed a consent form before the experiment. Participants were seated in a comfortable chair in a small room about five feet from the television monitor.

The experimenter instructed subjects to sit quietly during viewing and to pay close attention to the messages as his or her memory would be tested later. The experimenter then started the stimulus tape, and the subject viewed the messages. Before the recognition test the experimenter instructed the subject on how to use the joystick. The recognition tape was played and the subject indicated whether they had seen the scenes or not.

This experiment was conducted in conjunction with two others reported elsewhere. As a result, subjects performed six tasks during this experiment. First subjects either viewed television messages (this experiment) or read headlines on a computer screen; then they listened to a 6 minute radio message, and finally they performed the task they hadn’t done first (i.e. viewed television or read headlines). Following these three stimulus presentations, subjects completed recognition tests for all three experiments in the order they saw the stimuli. The whole experiment lasted about 1 1/2 hours.

Analysis

All of the analyses involved the same basic 4 (Order of Presentation) X 4 (Edits) X 5 (Message) ANOVA. For the heart rate analysis, as discussed previously, an additional Time factor with two levels was added. Order of Presentation was a factor in all the
analyses but there were no significant main effects of Order and no significant interactions of Order with the results reported here.

Results

Hypothesis 1

Hypothesis 1 predicted that, as the number of edits in a message increased, viewers would pay more attention, and as a result, have slower heart rates during the messages. Figure 1 shows the significant Time main effect ($F(1,29)=42.99$, $p<.000$, epsilon squared = .36$^5$) and the predicted Heart Rate by Time interaction ($F(3,87)=2.78$, $p<.046$, epsilon squared = .05). Heart rate was significantly slower in the second 30 seconds of each message than it was in the first 30 seconds. That decrease is greater for messages with more edits compared to messages with fewer edits. Thus, while subjects’ attention increased in the second half of the message for all messages, that increase was greater for fast and very fast paced messages compared with slow and medium messages.

Hypothesis 2

This hypothesis predicted that as the frequency of edits increased, memory would increase. To test this hypothesis a signal detection analysis of the recognition data was performed. Significant main effects in the predicted direction were found for both sensitivity (d' prime) ($F(3,84) = 13.64$, $p<.000$, epsilon squared = .30) and criterion bias ($F(3,84) = 51.73$, $p<.000$, epsilon squared = .62) and are shown in Figure 2. The means are given in Table 1. Thus, subjects were both more sensitive and more willing to guess during fast and very fast messages than during slow and medium messages.

![Figure 1](image1.png)

**Figure 1**
Heart Rate over Time as Function of Increased Number of Edits per Message.

![Figure 2](image2.png)

**Figure 2**
Sensitivity and Criterion Bias as Function of Number of Edits per Message.
Table 1
Mean Criterion Bias and Sensitivity Scores by Number of Edits

<table>
<thead>
<tr>
<th>Rate of Edits</th>
<th>Sensitivity</th>
<th>Criterion Bias</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slow</td>
<td>1.12a</td>
<td>-.31a</td>
</tr>
<tr>
<td>Medium</td>
<td>1.22a</td>
<td>-.83b</td>
</tr>
<tr>
<td>Fast</td>
<td>1.71b</td>
<td>-.23a</td>
</tr>
<tr>
<td>Very Fast</td>
<td>1.86b</td>
<td>-.14c</td>
</tr>
</tbody>
</table>

Hypothesis 3

This hypothesis predicted that viewers' arousal will increase as the frequency level of edits increased. Arousal was measured both in terms of sympathetic nervous system activity, indexed by skin conductance, and through the use of self-report measures. As predicted, both self-report and physiological arousal increased as a function of number of edits. The main effect for Edits on the self-report data was significant ($F(3,39)=27.14, p<.0000$, epsilon squared = .60) and is shown in Figure 3. The slow ($M=3.87$) and medium ($M=3.60$) paced messages were significantly less arousing than the fast ($M=6.15$) and the very fast paced ($M=7.44$) messages.

The main effect for both number of skin conductance responses ($F(3, 75)=13.80$, $p<.0001$, epsilon-squared=.33) and the size of the largest response ($F(3, 75)=6.98$, $p<.0000$, epsilon-square=.19) were significant. As predicted, the frequency of responses (shown in Figure 4) was much higher in the fast ($M=3.12$) and very fast ($M=3.01$) messages than it was for the slow ($M=2.02$) and medium paced messages ($M=2.08$). The size of response data showed a similar pattern (shown in Figure 5). Fast and very fast paced messages elicited larger responses ($M=1.16$ for fast messages; $M=.97$ for very fast messages) than slow ($M=.79$) and medium paced messages ($M=.78$). Thus, sympathetic arousal was greater for fast and very fast messages compared with slow and medium messages.

![Figure 3](#)
Self-Reported Arousal as a Function of Number of Edits per Message.

![Figure 4](#)
Frequency of SCR by Edits.
Discussion

Results of this study show that, as predicted, increasing the number of edits in a television message increases viewers’ attention and arousal during viewing of the message as well as their ability to remember the message at a later time. This provides evidence for the limited capacity approach to television viewing, which suggests that putting orienting eliciting structural features that do not increase cognitive load into a message can increase the levels of attention and arousal elicited by messages without overloading the limited capacity processing system. As a result, encoding of the message (indexed by recognition memory) is improved.

These results are particularly interesting when interpreted in light of previous research, which examined the effects of the number of unrelated scene changes (called cuts) on viewers’ attention, arousal, and memory for television messages. The limited capacity approach to television viewing suggests that unrelated scene changes introduce more new information into the message than related scene changes do. As a result, the task of processing the message is more difficult, and therefore imposes a greater cognitive load, when scene changes are unrelated than when they are related.

This study showed that like cuts (unrelated scene changes), edits (related scene changes) increase viewers’ autonomic arousal, self-reported arousal, and attention to the television messages. However, unlike cuts, which impaired recognition for messages, increasing the pacing of edits results in a continuous increase in recognition memory for the messages, suggesting that the processing system is not overloaded by rapidly paced edits.

This finding is interesting both practically and theoretically. Practically, these
results suggest that producers can use related scene changes, or edits, to elicit attention and arousal from viewers without necessarily sacrificing the viewers' ability to process the message contained in the video. Since arousal and attention affect most aspects of information processing, as well as liking for messages, it is good to know that simply using two-camera rather than one-camera production can increase attention and arousal in a way that does not result in a decrease in memory.

Theoretically, it is interesting to note that the pattern of these results suggests that the relationship between arousal and edits is not precisely linear. Slow and medium levels of edits appear to result in a lower level of arousal, while fast and very fast levels of edits result in a higher level of arousal. This suggests a step function as opposed to a linear relationship. Previous research, using cuts, showed increasing arousal levels for each level of cuts. Future research should continue to probe the shape of this relationship and test even faster rates of edits to determine whether there is a point at which memory begins to decline.

In addition, future research should examine the impact of faster rates of edits on messages which vary in terms of content difficulty. In easy messages, for example, the number of edits may never increase to a point where the processing system is overloaded. In difficult messages, however, a fast rate of edits might at some point overload the processing system.

It would also be interesting to examine the differential impact of rate of edits on visual and verbal memory. This study only investigated the impact of edits on visual memory in a recognition task. Some previous research (Lang, 1994; Lang, Potter, & Bolls, 1999) suggests that visual structural features which increase cognitive load may disproportionately impair memory for the verbal elements of the message as opposed to the visual elements of the message.

These results continue to support the usefulness of the limited capacity approach to television viewing as a framework for investigating the impact of message variables on the information processing of television messages. Future research should continue to examine the effects of edits and other structural features of television on viewer processing of messages.

References


**Notes**

1 This is a fixed capacity model. The psychology literature contains both fixed and variable capacity models (Kahneman, 1976). However, research using the limited capacity model of television viewing has consistently supported predictions made by a fixed model. Since a fixed capacity model is more parsimonious than a variable capacity model, we have continued to use a fixed capacity model.

2 The amount of information introduced by a cut is a continuous variable. The distinction being made here is an attempt to define a range of values at either end of that continuum. Some "edits" will introduce a good deal more information than others. For example, an establishing shot of a crowd, followed by a cut to a close-up of an individual in the crowd, would define as an edit in this study, but it clearly introduces a great deal of new information. Other "edits" introduce very little new information, such as the change from a camera on the left side of a set to a camera on the right side. In this study, a cut to anything that existed in a previous establishing shot was called an edit. If the cut was to something which did not appear in a previous establishing shot, it was called a cut. All of the cuts and edits occurred in coherent 30 second messages.

3 In addition, increased arousal has been theorized to increase cognitive capacity (Kahneman, 1976). This hypothesis has been tested twice in the context of television viewing using the
limited capacity model. In neither case did the data support the hypothesis that increased arousal increased capacity (Lang, Dillon, & Dong, 1995; Lang et al., 1999).

4 Other research, and our experience gathering the stimuli, suggest that these rates are within (and possibly cover comprehensively) the normal range of rate of edits in naturally occurring television. For example, Hibbs, Bolls, & Lang (1995) selected a random sample of 70 two-minute television messages. They found that the number of edits in these messages ranged from 0.57 with an average of 14.1. The average would be in our medium range, with our fast and very fast rates being well above average. The same study found the rate of scene changes or cuts to range from 0.54 within average of 8.9. Thus, holding our rate of cuts to less than 3 in two minutes does correspond to a slow rate of cuts. Another example can be found in a content analysis of the structural features of standard and tabloid news magazines shows. Grabe, Zhou, & Barnett (1998) found that the average shot length for standard TV news magazines was 5.28 seconds, and for tabloid news magazine shows it was 3.72. These numbers correspond to an average rate of combined cuts and edits of ten per minute for standard news magazine shows and sixteen per minute for the tabloid shows. This would make the standard shows medium and the tabloid shows fast in this study.

5 Epsilon squared is a standard effect size estimate which can be used with repeated measures analysis. Epsilon-squared is a more conservative estimate of effect size than the better known eta-squared (Keppel, 1982).