We Interrupt This Program . . .
Attention for Television Sequences

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This experiment assesses the variable amounts of attention that are required for a viewer to process two kinds of interruptions common to television: the shift from one message to a different, unexpected message and the reference to previously presented material that follows an interruption. Respondents viewed 24 television sequences composed of three segments: an initial segment drawn from one program, an interrupt segment drawn from a second program, and a reorient segment that continued the presentation from the first program. Initial and interrupt segment lengths were either 10 seconds or 30 seconds in length to produce a factorial combination of four message sequences. Attention to these interruptions was measured using reaction times to audio tones located 1 and 6 seconds after a shift. More attention was required to view the interrupt segments following 30-second initial sequences, especially at the 6-second tone location. For the reorient segments, sequences containing 30-second initial segments required more attention, as did 30-second interrupt segments. These results are interpreted in terms of limited capacity and attentional inertia models of attention.

When individuals watch television they rarely view a program that unfolds without some type of interruption. Interruptions can occur within a program, such as when the action shifts between scenes from one time and place to another, or they can occur between messages, such as when a commercial break is inserted during a program. These two kinds of interruptions are often combined, following an advertisement, when the previously presented program is resumed. Finally, interruptions can also occur over longer time periods that extend beyond a single viewing session, such as when episodes are continued over the course of a number of evenings or even weeks.

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The inclusion of interruptions in television sequences is a common problem for television producers. The incidence of commercial breaks, as well as the trend toward the presentation of a short succession of parallel scenes within television dramas, requires some understanding of how viewers make sense of and maintain interest in programs containing these attributes. This experiment takes a cognitive approach to television viewing to determine how viewers respond to interruptions. Specifically, it is designed to assess the variable amounts of attention that are required for a viewer to process two kinds of interruptions that commonly occur in television: the shift from one message to a different, unexpected message and the reference to previously presented material that follows an interruption.

Two research questions are addressed in this design:

RQ1: Is attention to new interrupt information independent of the previously presented information?
RQ2: What makes referring back to a previously presented portion of a television program easy or difficult?

The first research question is concerned with how viewers first recognize and then shift their attention when an unexpected message interrupts a previous message. The second research question is concerned with the amount of attention required to reorient back to a message that was introduced prior to an interruption. There are two factors that are likely to influence attention during this reorientation process. First, attention to the new reorient information following an interruption should be influenced by the amount of information initially presented prior to the interruption. Second, attention to the new information should also be affected by the length of the interruption separating the initial and new information. These factors are addressed by measuring attention to television sequences composed of three segments: an initial segment from one program, an interrupt segment taken from a second program, and a reorient segment that refers back to the first program presented in the initial segment.

ORIENTATION TO NEW INFORMATION

Research Question 1 is addressed in this section. This question assesses how the length of time spent viewing an initial message influences attention to a second message that unexpectedly interrupts the first. Attending to any segment containing new, unexpected information requires first recognizing this information as new and then determining its relationship with the previously presented information. When related segments are connected, the viewer's task involves the integration of the new information with the old, a relatively automatic task (Geiger & Reeves, in press). Responding to an interruption where the two conjoining segments are taken from different programs is a more demanding task. In this case, the viewer is required to recognize the two segments as independent and shift attention and memory processes from one program to the next.

The actual shift that occurs between segments also plays a role in how viewers attend to sequences of television. Any shift between related and unrelated segments involves some type of structural convention. These structural shifts are an important mechanism in the processing of interruptions because they serve as visual markers, segmenting television sequences into cognitive units. The amount of mental effort required to respond to a shift, such as a cut, varies with the degree of semantic relatedness between the connected segments as well as with the amount of time a viewer has had to attend to a particular scene. Geiger and Reeves (in press) found that more attention was required when a structural shift occurred between semantically unrelated segments of television than occurred between semantically related segments. The greatest differences between attention to the related and unrelated cuts were found 1 second after their onset. In the current experiment, attention to shifts between unrelated interrupt segments and segments that refer to previously presented information were assessed relative to the shift itself. This involves measuring attention 1 second after the occurrence of the shift. In addition, attention was measured 6 seconds after the shift to assess processing load independent of the structural shift.

Even though the interrupt and initial segments are semantically independent, what takes place prior to the shift during the initial segment should have some influence on attention after the shift to the interrupt segment. Research characterizing television viewing as a process of selective orientation to the television based on interest and comprehensibility is relevant in this case (Anderson & Lorch, 1983; Anderson, Lorch, Field, & Sanders, 1981). As the viewer becomes more cognitively engaged with the message, attention increases over the course of viewing. The increase in cognitive engagement reflects an attentional inertia, where the probability that a viewer will continue to look at the television increases with viewing length (Anderson, Alwitt, Lorch, & Levin, 1979; Anderson & Smith, 1984).

Attentional inertia plays an important role in the maintenance of attention across message boundaries. The longer that children view a particular message segment, the more likely they are to continue looking at new message segments (D. Anderson, 1985). This provides strong evidence for the role of attentional inertia in maintaining attention between unrelated message segments. In one other study, children's reaction times to an environmental distractor were measured (Anderson, Choi, & Lorch, 1987). Consistent with earlier attentional inertia research, there was a significant reduction in distractibility 15 seconds after a look was maintained. Of even greater relevance was the increase in reaction times of the head turns from the television set to the distractor stimulus. In a more recent study on reaction time and attentional inertia, children's attention was compared for coherent sequences, for randomly edited sequences, and for sequences with language distortions (Lorch & Castle, in press). Longer reaction times occurred during longer looks at the television screen, and reaction times increased over the course of viewing, especially for the coherent sequences. This pattern of results indicates that a child viewer's attention to television increases as he or she becomes more cognitively engaged with the message, a finding replicated by Meadowcroft and Watt (1990) with reaction time measures.

The present study defines attention in terms of mental effort, focusing on the variable amounts of attention required to respond to discrete structural and content shifts between messages. Attentional inertia has important implications for how much attention is required for viewers to make this shift, especially given the incidence of attentional inertia across message boundaries. Since viewers become more engaged over time, attentional inertia would predict higher levels of attention when the initial message is relatively long than when the initial presentation is short and the viewer is not as cognitively engaged. In the current research design, respondents were presented with initial message segments of either 10 or 30 seconds, followed by an interrupt segment. The selection of these levels was based on results demonstrating a significant reduction in attention to related sequences after about 22 seconds (Geiger & Reeves, in press). Based on these results and on the results for attentional inertia, attention following an interruption should be greater when the initial program segment is 30 second long than when it is 10 second long. Hence the following hypothesis was posed:

H1: Attention to a new segment that interrupts an initial segment will be greater when a long initial segment is presented than when a short initial segment is presented.

INTEGRATION OF NEW AND PREVIOUSLY PRESENTED INFORMATION

It is common in television for characters and themes to be introduced that refer to prior events. How easy or difficult it is to refer back to these previous events (Research Question 2) is discussed in this section. Comprehending information that refers to previously presented information involves a process of connecting the new with the old. The amount of attention required to do this should be influenced by two factors: how well formed the representation of the prior information is and the amount of information intervening between the original presentation and the later reference (Bower & Cirilo, 1985). When the new information refers to previously presented information that is still active in working memory, then it can be *integrated* into the currently active representation. A more demanding task involves *reinstatement*, where new information refers to prior information that must be activated into working memory. Finally, *reorientation* occurs when new information does not refer to previous information, thus requiring a completely new pattern of activation to represent the concepts, characters, and plot presented (J. Anderson, 1983).

Research in text processing indicates that integration is the least demanding and reorientation the most demanding of these tasks (Clark & Haviland, 1977; Dell, McKoon, & Ratcliff, 1983; Kintsch, Kozminsky, Streby, McKoon, & Keenan, 1975). In one study focusing on the differences between integration and reinstatement, Haviland and Clark (1974) presented respondents with sentence pairs, with the first sentence providing a context for the second sentence. Target sentences were comprehended faster when they were preceded by context sentences containing explicit antecedents than when context sentences referred to antecedents indirectly. The distinction between integration and reinstatement is often based on the amount of time and information that has intervened between the new and old information (Carpenter & Just, 1977). McKoon and Ratcliff (1980) looked at how the previous occurrence of a concept is referenced in a text. This process involves three stages: locating the referent, activating it into working memory, and connecting it to the earlier occurrence of the concept. Recognition times for words presented in the first sentence of a paragraph were faster when the last sentence in the paragraph contained a reference to the same concept.

Models of the text processing and associative memory are in many ways applicable to the processing of television sequences. Both television and text present complex messages over time. The basic cognitive processes of pattern recognition, activation of codes, and assignment of meaning are comparable between the two tasks. Lichtenstein and Brewer (1980) demonstrated how comprehension and memory for videotaped events behave similarly to stories presented in text. When a character or theme in a television message is well-developed it contains an extensive associative network, whereas poorly developed and briefer presentations reflect less developed representations. Therefore, it should be easier to recognize new information that refers to previously presented information when the previous, initial segment is presented for a longer duration, allowing for the more extensive representation to be formed. This is formally stated in the following hypothesis:

H2: More attention will be required to process information presented in the reorient segment when the initial segment it refers to is short than when the initial segment is long.

The second factor influencing attention during a reorient segment is the amount of time that intervenes between the reorient segment and the previous segment that it refers to. In instances where the current information refers to old information that is presently active, performance on the integration task will be relatively easy. When the given information is not active, then the reinstatement and connection of this information to current information will require more effort and attention. This was addressed by manipulating the length of the interruption intervening between two message segments from the same program. Integrating new information should therefore be faster when the interrupt is short than when the interrupt is relatively long. This prompted the following hypothesis:

H3: Attention to information presented in the reorient segment that refers to the initial segment will be greater when the interval between the new information and the referenced information is long than when it is short.

Attention was assessed using a secondary task, specifically the latency response to an audio tone. The secondary task paradigm is based on an assumption of limited cognitive capacity. As the demand for limited resources is allocated to a primary task, the performance on a secondary task will reflect this allocation. Longer response times indicate greater demands on attention to the primary task, in this case, watching television. This measure of attention has been applied successfully in a number of studies involving attention to television (Geiger & Reeves, in press; Thorson, Reeves, & Schleuder, 1985).

METHOD

Respondents

A sample of 28 respondents (10 men, 18 women) was recruited from an upper division course in communication research methods. Each person was paid $5 and received class credit for participating. Two persons' records were deleted from the analysis: one because of technical failure of the apparatus and the other randomly deleted to balance the number of persons in the two presentation conditions.

Stimulus Materials

Respondents viewed a 30-minute videotape composed of 24 different sequences of programs. Each sequence consisted of an initial segment that introduced one program (Segment A1), an interrupt segment that presented a second program (Segment B), and a reorienting segment that presented material from the first program (Segment A2). The sequences were edited so that the last frame of the initial segment was the first frame in the reorient segment. The breaks between the A1 and A2 segments were chosen so that they would reflect a natural shift, such as the end of a sentence. The A2 segments were selected so there would be no structural shifts during the first few seconds of this segment.

The constructed sequences differed on two dimensions: the length of the initial segment (A1) and the length of the interrupt segment (B). Each of these segments lasted for either 10 or 30 seconds, producing a four-level factorial combination of different sequences. The total presentation time for the initial (A1) and the reorient (A2) segments

TABLE 1
Sequence Type and Presentation Order, by Condition

Condition: Order 1	Condition: Order 2
Sequence 1-R1	Sequence 2-R6
Sequence 2-R1	Sequence 1-R6
Sequence 4-R1	Sequence 4-R6
Sequence 3-R1	Sequence 3-R6
Sequence 2-R2	Sequence 3-R5
Sequence 3-R2	Sequence 2-R5
Sequence 4-R2	Sequence 1-R5
Sequence 1-R2	Sequence 4-R5
Sequence 3-R3	Sequence 4-R4
Sequence 1-R3	Sequence 1-R4
Sequence 4-R3	Sequence 3-R4
Sequence 2-R3	Sequence 2-R4
Sequence 2-R4	Sequence 1-R3
Sequence 4-R4	Sequence 4-R3
Sequence 1-R4	Sequence 2-R3
Sequence 3-R4	Sequence 3-R3
Sequence 4-R5	Sequence 3-R2
Sequence 3-R5	Sequence 4-R2
Sequence 2-R5	Sequence 1-R2
Sequence 1-R5	Sequence 2-R2
Sequence 3-R6	Sequence 2-R1
Sequence 4-R6	Sequence 4-R1
Sequence 1-R6	Sequence 3-R1
Sequence 2-R6	Sequence 1-R1

NOTES: Sequence 1: 10-sec initial/10-sec interrupt/30-sec reorient; Sequence 2: 30-sec initial/10-sec interrupt/10-sec reorient; Sequence 3: 10-sec initial/30-sec interrupt/30-sec reorient; Sequence 4: 30-sec initial/30-sec interrupt/10-sec reorient.
R1: Replication 1 (of 6); R2: Replication 2; R3: Replication 3; R4: Replication 4; R5: Replication 5; R6: Replication 6.

was always 40 seconds to ensure a constant overall presentation time of the A program. Total sequence length was either 50 seconds (when the interrupt segment duration was 10 seconds) or 70 seconds (when the interrupt segment duration was 30 seconds). The four sequence types and their order of presentation are listed in Table 1.

Every respondent viewed six examples of each of the four different types of sequences, for a total of 24 different sequences. A total of 48 different messages was represented in the stimulus materials, with each sequence composed of segments taken from two different messages that were not repeated in any other segment. The particular segments were selected using the following criteria: (a) The segments were part of a narrative and were presented in a logical order; (b) each segment began at the start of some conversation, action, or event so that it was comprehensible as an isolated unit; and (c) all conversation and action occurred in a single location.

All of the program segments were drawn from television programming broadcast during fall 1989 over the three networks, PBS, and one independent station in San Francisco. The segments were selected to represent the full variation of different types of television programming. These included news broadcasts, situation comedies, dramas, and action adventures. Each segment presented at least two different characters involved in a conversation, with the exception of the news segments, which were composed of clips that included a reporter's voice-over narration and on-camera interviews. Segments that focused on a conversation were chosen so that the level of activity and the information presented over the audio channel would be roughly equivalent. Each segment contained a number of structural shifts, such as cuts, zooms, and other camera motion. In all instances, cuts were used to present a different camera angle or emphasis on objects or characters within a single setting and did not shift between settings.

The particular segments selected were not altered in any way. The only editing that occurred was in the construction of the sequences, which required tagging each segment onto the previous segment. The rationale behind the use of 24 different sequences, with a replication of six sequences for each of the four sequence types, was twofold. First, by using six different sequences to represent each of the four factorial combinations, the many spurious variables specific to particular messages, such as program genre, production styles, and complexity of audio information, would be factored out as random noise. Second, the inclusion of a number of different messages permits greater generalizability to other television messages (Reeves & Geiger, in press).

Two different versions of the 24 sequences were constructed, each with a different presentation order. Each of the four different sequence types was presented within a block before the next replication of that sequence type was presented. This was done to minimize the effects of the placement of a sequence within the overall presentation order and to control for a confound of sequence type and location within the global order. The sequences for the first presentation order were selected randomly. The second presentation order was a mirror image of the first, with the first block of sequences for Order 1 serving as the sixth block for Order 2, the second block from Order 1 as the fifth block for Order 2, and so on. The two orders served as the only between-respondents factors in this design. In each tape, the 24 sequences were separated by 10 seconds of video black to minimize order effects within the presentation. The presentation lasted 30 minutes, 48 seconds.

Design and Dependent Measures

Three within-subject factors were used in the design: (a) the length of the initial (A1) segment (10 or 30 seconds), (b) the length of the interrupt (B) segment (10 or 30 seconds), and (c) the location of the audio tone within each of the segments (1 second and 6 seconds after the onset of a segment). One between-subjects factor was used: the presentation order of the sequences. There were six replications in each of the cells within the design.

The dependent measure was the latency of response to audio tones. All tones were 1000 Hz with a duration of 100 msec. To assess attention immediately following a structural shift and independently from a shift, tones were placed in the same two locations in the interrupt and reorient segments. These tones were located 1 second after the onset of the segment (+1) and 6 seconds after the onset of the segment (+6). Therefore the critical tones for measuring attention to the interrupt segment were fired 1 second after the start of the interrupt segment (measured from the first frame of this segment) and at 6 seconds after the start of that segment. The 1-second tone position was selected to assess attention following a structural shift, whereas the 6-second tone position was designed to be a measure of attention independent from structure. The same critical tone locations were used to assess attention to the reorient segments. Tones were placed 5 seconds apart so that the primary activity of watching television would not be dominated by the requirements of constantly responding to tones and so that the reaction time to a particular tone would not be influenced by the responses to the previous tones. In all, four critical tones were located in each of the 24 sequences, for a total of 96 tones across the entire experiment. A number of other distractor tones were also inserted into the video sequences so that respondents would not become accustomed to responding to tones in specific locations and so that the critical tones could not be anticipated (see Table 2).

TABLE 2
Tone Location and Segment Length, by Type of Sequence

	Type of Segment			
	Initial	*Interrupt*	*Reorient*	*Overall*
Sequence 1	10 sec	10 sec	30 sec	50 sec
Tone location	+6	+1, +6	+1, +6, X	
Sequence 2	30 sec	10 sec	10 sec	50 sec
Tone location	+6, X	+1, +6	+1, +6	
Sequence 3	10 sec	30 sec	30 sec	70 sec
Tone location	+6	+1, +6, X	+1, +6, X	
Sequence 4	30 sec	30 sec	10 sec	70 sec
Tone location	+6, X	+1, +6, X	+1, +6	

NOTE: Tone positions are relative to the onset of the segment in which they occur: "+1" indicates a tone was fired 1 second after the onset of the segment, "+6" indicates a tone was fired 6 seconds after the onset of the segment, and "X" indicates a distractor tone was fired in a random location at least 5 seconds after the previous tone was fired and 5 seconds before a subsequent tone.

Procedure

Respondents were assigned randomly to one of two conditions reflecting the two presentation orders. The procedure was identical for both groups. Each respondent participated in the experiment individually. Individuals were escorted into a viewing room and seated in a chair located 6 feet from a television monitor. Respondents were then told by the experimenter that they were participating in a study about how people watch television and that they would see 24 different sequences of program excerpts. While they watched, they were instructed to do two things: first, to pay close attention to the sequences because they would be asked a number of questions about them later, and second, to press a button on a game paddle as quickly as they could whenever they heard an audio tone emitted from the speaker on the television monitor. After answering any questions, respondents were told that the instructions would be repeated over the monitor and that a practice session would precede the actual experiment. The experimenter then started the videotape and left the room.

The stimulus tape began with 10 seconds of black, followed by a series of instructions lasting for 50 seconds displayed in text on the television monitor. These instructions were followed by 10 seconds of black. A practice session was then presented to allow respondents to acclimate to the tone and to the secondary task. The practice session was a 1-minute segment from a single program with no interruptions or edits, followed by final text instructions encouraging the participants to watch carefully and to respond to the tone as quickly as they could. After 10 seconds of video black, the 24 sequences were presented.

At the completion of the viewing session, the experimenter returned and debriefed the respondents on the intent and design of the experiment. They were queried to see if they could discern or anticipate where the tones were located. No respondents reported any awareness of a systematic tone location. The experimenter then responded to any questions, and individuals were paid for their participation.

Apparatus

Stimuli were presented in the ½-inch VHS format over a 19-inch Sony PVM-1910 color monitor. The stimulus sequence was interfaced with an IBM AT computer via a longitudinal time code output recorded on the second audio channel of the videotape and read by a digital time code reader board installed in the computer. Secondary task tones generated by the computer were triggered by a target time code number routed through a Tascam 106 6X4 mixer and mixed with the program audio directly into the monitor speaker. The target time code also started the clock in the computer. Responses to the tone ($t \pm 1$ msec) were made on a CH game paddle and stored in the computer with the corresponding time code number.

RESULTS

Attention to Interrupt Segments

To test attention to television during the orientation to new interrupt information, a 2 (10-sec, 20-sec Initial Segment Length) × 2 (1-sec, 6-sec Tone Location) repeated measures multivariate analysis of variance (MANOVA) was computed. The dependent measure is the latency response to the audio tone.

No significant differences were found for the between-subjects variable of different message orders. There was a main effect for Initial

TABLE 3
Mean Reaction Time to an Audio Tone, by Initial Segment Length and Tone Location

	Location of Tone	
	1 Second	*6 Seconds*
10-sec initial segment length	312.9 (75.4)	306.3 (62.2)
30-sec initial segment length	308.8 (65.4)	320.3 (65.8)

NOTES: Reaction times are in msec. Numbers in parentheses are standard deviations.

Segment Length, $F(1, 24) = 6.60, p < .02$. As predicted in Hypothesis 1, responses were longer when the initial segment was 30 seconds. There was no main effect for the Tone Location relative to the shift between the initial and the interrupt segments, $F(1, 24) = .23$, n.s. But a significant interaction was found between Initial Segment Length and Tone Location, $F(1, 24) = 15.58, p < .001$. Attention increases between 1 second and 6 seconds following a 30-second initial segment but decreases when the interrupt is preceded by a 10-second initial segment (see Table 3).

In general, Hypothesis 1 was supported; it required more attention to watch television when the interrupt segment followed a 30-second initial segment than when the initial segment length was 10 seconds. An examination of the interaction reveals that the differences in attention produced by the different initial segment lengths are attributable to latencies at the 6-second tone location. The length of the initial segment had no influence on reaction times to tones located 1 second following the onset of the interruption, $F(1, 24) = 2.11$, n.s. This result can be attributed to a number of factors. The first explanation is based on how structure dominates attention during the first second following a cut. Previous research demonstrated that cuts that tie together unrelated segments automatically elicit an increase in attention, with attention peaking 1 second following the cut (Geiger & Reeves, in press). In this case, the demands of the structural shift might override the influence of long and short initial segments on attention.

The second alternative explanation is a methodological one: Because tones were always fired 1 second after the onset of a shift between segments, respondents had begun to anticipate the 1-second tone over the course of the experiment, thereby decreasing the variance of this measure. To determine this, an additional MANOVA was conducted comparing reaction times to tones located 1 second after the shift to an interrupt segment. If respondents were anticipating these tones, they would become faster over the course of the experiment. A comparison of reaction times between the two presentation orders should reveal a positive interaction if this is the case. However, there was no two-way interaction between presentation order and responses to 1-second tones over the six replications, $F(5, 20) = .52$, n.s., indicating that respondents' reaction times did not significantly decrease over the course of the experiment.

Integration of New With Previously Presented Information

This section covers the attention required to reorient to segments that follow an interrupt segment and refer to previously presented information. To test this, a 2 (10-sec, 30-sec Initial Segment Length) × 2 (10-sec, 30-sec Interrupt Segment Length) × 2 (1-sec, 6-sec Tone Location) repeated measures multivariate analysis of variance was computed. Again, reaction time to an audio tone was the dependent measure.

The between-subjects message order factor was not significant. There were also no significant interactions between message order and the other factors in the experiment. The results did not support Hypothesis 2 because attention was no greater during a reorient segment when the initial segment was 10 seconds. In fact, the result proved to be opposite to the prediction: Respondents were faster and used less attention to reorient when the initial segment length was 10 seconds than when it was 30 seconds, $F(1, 24) = 4.53, p < .05$.

Hypothesis 3 was confirmed; there was a significant main effect for Interrupt Segment Length, $F(1, 24) = 12.43, p < .01$. As predicted, reaction times were faster when the interrupt segment was 10 seconds than when it was 30 seconds (see Table 4).

No main effect was found for Tone Location, $F(1, 24) = 1.12$, n.s. There was no significant interaction between Initial Segment Length and Tone Location, $F(1, 24) = 2.91, p = .10$. There was a significant interaction, however, between Interrupt Segment Length and Tone Location, $F(1, 24) = 4.07, p < .06$. Sequences that contained a 30-second initial and a 30-second interrupt segment were especially difficult to reorient to when measured at the 6-second tone placement. This trend also produced a significant three-way interaction between Initial

TABLE 4
Mean Reaction Time to an Audio Tone, by Initial Segment Length, Interrupt Segment Length, and Tone Location

	Location of Tone	
	1 Second	*6 Seconds*
10-sec initial and 10-sec interrupt	303.9 (64.4)	306.4 (61.1)
10-sec initial and 30-sec interrupt	316.6 (74.9)	314.4 (57.8)
30-sec initial and 10-sec interrupt	311.3 (70.1)	309.3 (63.4)
30-sec initial and 30-sec interrupt	310.0 (69.7)	333.4 (69.2)

NOTE: Reaction times are in msec. Numbers in parentheses are standard deviations.

Segment Length, Interrupt Segment Length, and Tone Location, $F(1, 24) = 12.07, p < .01$. This result is not the product of some outlier within this experimental cell. Of the six sequences that contained 30-second initial and 30-second interrupt segments, five of the six messages demonstrated this trend between the 1-second and the 6-second tone placements. Once again, there is no evidence to indicate that persons responded to the 1-second tones faster over the course of the experiment. The results for the two-way interaction between presentation condition and the responses to 1-second tones over the six reorient segment replications were not significant, $F(5, 20) = .85$, n.s.

DISCUSSION

The results for attention to an interrupt segment confirmed Hypothesis 1. More attention was allocated to the interrupt segment when the initial segment was 30 seconds long than when the initial segment was 10 seconds long. This difference was dependent on the juncture where attention was measured, as indicated by the interaction of Tone Location and Initial Segment Length. One second after the start of the interrupt segment, there were no differences in attention as a function of the length of the initial segments. This result is attributable to the dominance of structure the first 1 second after the onset of a cut. This phenomenon is especially true for cuts that connect unrelated segments, such as when the sequence shifts from the initial to the interrupt segment. When this shift occurs, viewers automatically allocate attention, with the greatest demand in orienting to the new information occurring 1 second after the cut. Therefore, the 1-second time measure after the shift to the interrupt segment measures the response to the shift itself, independently from the length of the initial segment.

The significant differences in attention to interrupt segments following 10- and 30-second initial segments occur 6 seconds after the start of the interrupt segment. Attention to the interrupt segments increased between the 1-second and the 6-second tone location when the initial segment was 30 seconds in length. Attention to interrupt segments decreased over time when the initial segment was 10 seconds long. The way in which persons treated the information presented in the interrupt segment may account for this interaction. When an interrupt followed a long initial segment, it would have been relatively difficult to dismiss the prior information and focus on the current segment. Because of the greater investment applied to the longer initial segments, viewers attempted to make sense of the two segments as one unit, therefore expending effort in trying to integrate them into a meaningful sequence. In the case of the 10-second initial segment, viewers quickly shifted from the initial segment to the interrupt segment, with little or no effort in making sense of the two segments together. Therefore, the longer the cognitive investment in an initial sequence, the more difficult it was to switch to a new sequence.

These results are consistent with the findings for attentional inertia, although there is one important difference: In this case, viewers are not selecting whether to orient to the television or to some other stimulus in the viewing environment. Instead, the criterion is viewing time as dictated by the length of the segment *presented*, not by the length of the look maintained by the viewer. The pattern of results obtained with presentation length does conform to the results for look length; longer segments produced more attention across program boundaries.

Hypothesis 2 predicted more attention to reorient segments when they were preceded by 10-second initial segments when compared with 30-second initial segments. The results proved to be the opposite. Overall, viewers responded more quickly and required less attention when the length of the initial segment in the sequence was 10 seconds than when the initial segment length was 30 seconds. Attention to segments that reference previously presented information is not facilitated by having more information to refer back to. In fact, when longer initial sequences are presented, *more* attention is required.

There are two explanations for this result. First, the more information a viewer has to refer back to, the more time and attention will be required to activate it. Because a greater number of thoughts are generated during the 30-second initial segment, more time and mental effort are required to reference these than when the initial exposure involves less information. This is characterized in cognitive psychology as a "fan" effect, where the larger number of facts compete for activation. When more information is presented it will take longer for activation to spread to all the relevant items, as is the case with recognition of sentences containing a large number of facts (J. Anderson, 1974). The second explanation focuses on the expectations that viewers have while they watch television, expectations that might be determined in part by a gestaltlike notion of closure and completeness (Garner, 1973). When a short segment is presented, viewers might perceive this as an incomplete presentation. At the conclusion of the 10-second initial segment, viewers might have a greater expectation that more information will be presented to complete the interrupted presentation. As a result, they would adopt a strategy of maintaining some aspects of the initial segment active in working memory. When a longer initial segment is presented, a different strategy is adopted that treats each segment as an independent and complete message. When an interrupt segment follows a 30-second initial segment, viewers are consequently more likely to completely shift their activation to represent the new information.

The results confirmed Hypothesis 3; less attention was required during the reorient segment when the interrupt segment length was 10 seconds than when the interrupt segment length was 30 seconds. When a 10-second interrupt intervenes between the initial and reorient segments, it is easier to refer to previously presented information from the initial segment because the information retains some level of activation in working memory. Previously presented information must be completely reactivated following a 30-second interrupt segment, a more demanding task. This effect is especially pronounced 6 seconds into the reorient segment when both the initial and the interrupt segments are 30 seconds in length. Based on this outcome, the complete activation of previously presented information not only requires more attention but takes longer to reach an asymptote for activation once the reorient segment has been presented.

This pattern of results is generally supportive of the attentional inertia hypothesis. Viewers require more attention to respond to a new message when the previously presented message is relatively long. This phenomenon holds for attention to interrupt segments and for attention to reorient segments. One result is not as easily interpreted by the process of attentional inertia, however: the greater demands during the reorient segment when the initial segment was 30 seconds in length. In this case, viewers are attending to program segments that are influenced by both the immediately preceding segment and a prior segment. The main effect of initial program length on attention to the reorient segments is more effectively explained by the analogy of the "fan" effect.

Attentional inertia is supported when the focus is on the overall sequence length, that is, the influence of the initial *and* interrupt segments on attention during the reorient segment. The sequence requiring the largest amount of attention during the reorient segments contained the 30-second initial and 30-second interrupt segments. Attention in these sequences was measured after 61 and 66 seconds of viewing time. All of the other segments contained at least one segment of 10 seconds' duration, with attention measured at either 21 and 26 seconds or 41 and 46 seconds into the sequence. So, the longest sequences produced the highest levels of attention. This result is consistent with attentional inertia as longer viewing was associated with more attention. What is unique here is the existence of attentional inertia across two message boundaries, with a greater influence for the first message when viewed for a longer period of time on attention to a third message.

According to the attentional inertia paradigm, attention to television sequences increases as viewers become more cognitively engaged. This perspective is contradicted by some reaction time studies that have shown attention to decrease over time as viewers become more familiar with characters, settings, and plots (Geiger & Reeves, in press). There is evidence for both of the perspectives within this study. The length of the preceding segments was a strong predictor of attention to subsequent segments, providing support for attentional inertia. An analysis of reaction times over the course of all the sequences does reveal a trend toward decreasing reaction times, with the longest reaction times occurring during the initial segments, $F(4, 96) = 2.88, p < .05$. Future research should focus on a conceptual and methodological reconciliation between these two approaches to attention.

CONCLUSIONS

How viewers attend to sequences of television raises a number of practical issues that television producers deal with every day. A typical television program presents multiple scenes, introduces new characters, and refers to previous action. Many shows also include multiple plots, where the action shifts from one scene to another and back. What kinds of shots are used to orient the viewer to the new material, how long each of the scenes should be, and whether establishing shots should be used are just a few of the many decisions that must be made when shifts across scenes take place. These issues are especially important in the case of television news where the newscast is composed of short news segments. How these are connected, where the program shifts fall, and the length of each segment are all critical factors in maintaining the interest of an audience and promoting comprehension of the newscast.

This study contributes to an increasing body of work on how attention to television varies over time in response to message attributes. What makes this study unique (and what, in part, defines its contribution) are the message factors that are manipulated: the duration of a segment and the relationship between segments within a sequence. The manipulation of segment duration provided an opportunity to look at how the time spent viewing one thing influences the processing of something else. By looking at segments within sequences of television it is possible to describe more natural television viewing behavior. Future research should focus on integrating natural aspects of the television stimulus with research that treats television viewing as a cognitive process.

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