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Examining the Critical Moments in Information Processing of Water Conservation Videos within Young Farmers and Ranchers: A Psychophysiological Analysis

Laura M. Fischer[1], R. Glenn Cummins[2], Kyle C. Gilliam[3], Matt Baker[4], Scott Burris[5], & Erica Irlbeck[6]

Abstract

Discussions on how to conserve and provide enough water has become one of the most highly debated issues in modern society. Although many Extension efforts have engaged the public in understanding behavior and attitudes toward water conservation, limited research has focused on understanding how agriculturalists respond to water conservation messages. The goal of this study was to employ the use of a psychophysiological measure to determine what message components elicited increased information processing during exposure to two water conservation videos. When the two videos were compared in total, no significant difference in heart rate was observed. However, a more granular analysis of phasic or short-term periods of heart rate deceleration revealed five segments of increased cognitive resource allocation while viewing the scientific video and three segments during the testimonial evidence video. Finally, self-report data approached statistical significance, with the subjects reporting greater elaboration while viewing the testimonial evidence video compared to the scientific video treatment. These findings provide unique evidence suggesting that farmers and ranchers allocate greater cognitive resources to scientific evidence, on screen graphics, and narrated statistics.

Keywords: cognitive resource allocation; information processing; message frames; psychophysiology; water conservation

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Introduction and Literature Review

Globally, water is a crucial aspect of human survival impacting modern industry, recreation, and the agricultural food system (Watkins, 2009). Although water may cover more than 70% of the planet, less than three percent is freshwater that may be used for drinking (Adler, 2007).

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[1] Laura M. Fischer is an Assistant Professor of Integrated Strategic Communication at the University of Kentucky, 217 McVey Hall, Lexington, Kentucky, 40506, lmfischer@uky.edu
[2] R. Glenn Cummins is an Associate Professor in the College of Media and Communications at Texas Tech University, 2500 Broadway Lubbock, Texas, 79409, glenn.cummins@ttu.edu
[3] Kyle C. Gilliam has a new address and title. It is Instructor in the Department of Agricultural, Leadership, and Community Education at Virginia Tech, 175 West Campus Dr., Blacksburg, VA, 24061, kylecgilliam@vt.edu.
[4] Matt Baker is a Professor in the Department of Agricultural Education and Communications at Texas Tech University, 15th and Detroit, Lubbock, Texas, 79409, matt.baker@ttu.edu
[5] Scott Burris a Professor in the Department of Agricultural Education and Communications at Texas Tech University, 15th and Detroit, Lubbock, Texas, 79409, scott.burris@ttu.edu
[6] Erica Irlbeck an Associate Professor in the Department of Agricultural Education and Communications at Texas Tech University, 15th and Detroit, Lubbock, Texas, 79409, erike.irlbeck@ttu.edu

However, both non-recreational and recreational activities used to support modern society have negatively impacted the quantity of water available (Huang, Lamm, & Dukes, 2016). In an effort to preserve naturally occurring freshwater, discussions on how to conserve and provide enough water has become one of the most highly debated issues in modern society (Levy & Sidel, 2011).

Increases in water use are due to a growing population who needs more water than ever before to sustain themselves (Bartlett, 1999; Flint, 2004). According to Flint (2004), water demand in the United States has more than doubled since the 1950's and is expected to continue to increase as the world population grows to more than 9 billion by the year 2050. Although residential and industrial water demands play a key role in urban and suburban environments, water demand is primarily used for agricultural irrigation in rural areas (Huang et al., 2016).

The context of this research was in the Southern Great Plains in an arid to semi-arid environment. In 2007, Allen, Baker, Segarra, and Brown reported that irrigated landscapes in these climatic areas were often fragile and stressed due to declining water quality and quantity and that efficiencies in irrigation (often exceeding 95% for drip systems) resulted in more water usage as new cropping systems were added.

According to West, Johnson, Kellison, Brown, and Pate (2015), some of the most conservation-oriented farmers in the Southern Great Plains experienced a 25% decline in aquifer volume compared to a 2003 baseline measure. Texas High Plains farmers are also facing state-mandated pumping restrictions. As of January 1, 2015, Texas House Bill 1763 required that regional water districts adopt conservation measures. The regional underground district adopted a "Desired Future Condition" of 50% of the 2010 saturated thickness remaining in the aquifer in 50 years and placed a new rule on the amount of water that can be extracted to 18" per contiguous acre. Regional producers realize that the next drought will include these new pumping restrictions. Hence, growers and municipalities alike have a sense of urgency for interventions, which will reduce aquifer depletion where 95% of the aquifer extraction is to support the region's $5B agricultural economy (West et al., 2015).

Prior research has shown farmers and ranchers have been found to have positive attitudes toward water conservation practices and programs (Durst, Meyers, Irlbeck, & Ritz, 2016). However, these same farmers also have indicated neutrality when asked if they had intentions of participating in water conservation practices (Durst et al., 2016). Durst et al.'s (2016) study on farmer and producers' perceptions on water conservation had similar results in terms of consumer water conservation perceptions to Huang et al. (2016) and Gorham, Lamm, and Rumble (2014) studies.

Many farmers and ranchers understand the need for engaging in water conservation behaviors; however, many are unable to maximize participation in water conservation activities due to a variety of reasons. These reasons range from changing weather patterns, the need to maximize production due to increasing costs and debt service obligations, and/or land tenure issues. Because persuasion theories suggest that the higher the level of cognitive information processing, the higher the level of attitude change during a persuasive message (Petty & Cacioppo, 1986), a useful first step in crafting tailored messages that will achieve strategic communication goals is to identify specific message elements or techniques that elicit increased information processing. By identifying such passages that yield increased information processing in response to educational videos that persuade receivers to participate in conservation behaviors, agriculturalists (i.e., Extension faculty, agricultural communicators, and agricultural educators) can develop higher quality messaging.

Prior research has addressed the ideas of strategic communications (i.e., targeting audiences and tailoring messages) as an effective means to communicate about water conservation practices with the public. For example, Huang et al. (2016) recommended message tailoring, or developing communication and education programs that are relevant to the specific needs and behavioral patterns of high-water users. Gorham et al. (2014) identified how critical thinking style or the way individual's think about and seek out information had a moderate relationship with water conservation intentions. Similarly, the role of salient and tailored messages to encourage water conservation behaviors has provided evidence that such messaging can encourage individuals to participate in environmentally responsible behavior (Warner, Rumble, Martin, Lamm, & Cantrell, 2015). When making information salient for consumers to participate in behaviors, or frame a message, communicators select aspects of information "to promote a particular problem, definition, casual interpretation, moral evaluation, and/or treatment recommendation" (Entman, 1993, p. 52).

Message features or attributes refer to aspects of communication that produce a greater effect on affective, cognitive, and behavioral processes that impact persuasion (Shen & Bigsby, 2013). The goal of the persuasive messages is to have the receiver think and behave in a specific way or to find information as truthful (Petty & Cacioppo, 1986; Shen & Bigsby, 2013). Specifically, the aspects of message construction have influenced how receivers find information to be true (Shen & Bigsby, 2013; Warner et al., 2015). Within persuasion literature, researchers have found two types of message features impacting decision-making are statistical evidence, which "presents statistics such as frequencies and percentages to support the claim," or testimonial evidence, which "uses a person's personal experience, eye-witness account or personal opinion to support a claim" (Shen & Bigsby, 2013, p. 22). In Allen and Preiss' (1977) meta-analysis, statistical evidence was found to be more persuasive than testimonial evidence. However, Warner et al. (2015) discovered messages resonating with an individual's social and personal beliefs were more effective in persuading someone to participate in conservation behaviors in consumer-based research with water conservation messages.

Studies have shown how tailored message frames are crucial to achieving strategic communication goals to encourage an audience segment to engage in water conservation (Gorham et al., 2014; Huang et al., 2016; Warner et al., 2015). However, these studies only allow the researchers to understand an individual's overall or global response to communication materials after they have viewed it, and they disregard the dynamic nature of messages or how they unfold over time. Moreover, post-test assessment fails to reveal the dynamic nature of individual response to various parts of a message over time. Theories of information processing suggest higher levels of information processing lead to higher levels of change in attitude and behavioral intent (Petty & Cacioppo, 1986). Drawing upon theories of information processing during message consumption, this study employs a psychophysiological, or a biometric measurement tool (e.g., heart rate deceleration as a measure of cognitive resource allocation), to understand how specific message attributes or components of a message elicit increased levels of information processing in response to water conservation videos.

Conceptual Framework

In order for a communications message to have an effect on attitude or behavioral intention, it must be processed by an individual (Lang & Ewoldsen, 2010). Information processing has been conceptualized as the idea of how an individual attends to, makes sense of, and remembers information contained in a message (Geiger & Newhagen, 1993; Lang, 2000). In theories regarding information processing of persuasive messages to encourage behaviors, such as the Elaboration Likelihood Model, higher central-route processing refers to higher levels of information processing of a persuasive message (Petty & Cacioppo, 1986). Such central processing of a message leads to stronger memory for the message, attitude, and behavior change. As researchers look to understanding what parts of water conservation messages create more significant changes in attitude and behavior, researchers must determine what cognitive processes occurred that resulted in the desired attitude change (Lang & Ewoldsen, 2010).

During message consumption, information processing is automatic, and the individual will undergo sub-conscious cognitive and emotional processing of messages (Lang, 2000; Potter & Bolls, 2012). The use of psychophysiological measures of viewer response allows researchers to investigate the sub-conscious processing by continuously monitoring and recording "changes in the activity of physiological system caused by psychological input" (Ravaja, 2004, p. 193). This approach differs from typical measurement approaches that rely on qualitative or quantitative self-report in that such responses are subject to various biases and represent a less "pure" measurement of how viewers automatically respond during message consumption. Put another way, self-report data are viewed as "offline" responses; whereas, psychophysiological measures are "online" responses collected during the act of message consumption. Moreover, because psychophysiological responses are continuously recorded in synchrony with message viewing, researchers are able to examine specific message elements that elicit potent cognitive processing and emotional response to reveal key message components. Advances in cognitive psychology and media psychology have provided considerable evidence linking various overt physiological responses to covert psychological mechanisms, including cognitive resource allocation and emotion (Potter & Bolls, 2012; Ravaja, 2004).

Attention. Attention to an external stimulus such as a media message has been conceptualized as the "allocation of limited mental resources to a specific stimuli" (Ravaja, 2004, p. 197). Within psychophysiology, this increase in resource allocation or attention is indexed by cardiac deceleration, or a decrease in heart rate (Potter & Bolls, 2012). Furthermore, this allocation of cognitive resources may occur both in a controlled and uncontrolled fashion. For example, uncontrolled responses may be "orienting responses" to novel stimuli or the introduction of something in one's sensory environment. Such responses are considered as short-term or phasic responses to specific elements within a message, which can be contrasted with more sustained or tonic responses to a message overall. Within media messages, such phasic responses may be elicited by structural elements such as cuts, edits, or the introduction of onscreen graphics (Lang, Bolls, Potter, & Kawahara, 1999; Lang, Potter, & Grabe, 2003). In contrast, controlled attention allocation over time may result when viewers find information particularly salient or high in motivational relevance (Ravaja, 2004). Additionally, these measures may provide evidence of attention allocation that is complementary, and even sometimes, contradictory to self-report data (Ravaja, 2004). In both types of response, the individual prepares for greater information uptake, and these increases in attention allocation have been shown to relate to increased memory for elements of a message (Bolls, Muehling, & Yoon, 2003).

By continuously tracking these measures of viewers' allocation of resources to a message, researchers can empirically examine processing of information without relying on self-report (Ravaja, 2004). Furthermore, these psychophysiological measures have the unique ability to detect changes in information processing throughout the duration of media consumption and allows researchers to understand how processing changes over time in response to changes in a message as it unfolds (Potter & Bolls, 2012). Lastly, measurement of resource allocation through psychophysiological measures allows comparisons with more traditional self-report measures to reveal consistencies or discrepancies between the two. Sometimes, by adopting these tools to understand what elements of a message elicit increased attention within specific audiences, agricultural educators and communicators can develop messages targeted to increasing information processing to influence behavior intentions and attitude change.

Purpose and Research Questions

Supporting Research Priority 7: Addressing Complex Problems of the AAAE National Research Agenda (Andenoro, Baker, Stedman & Weeks, 2016), the goal of this study was to employ an innovative measurement approach—the use of psychophysiology as a transdisciplinary approach to solving the complex problem of sustainable water management—to determine what message attributes or components elicit increased information processing during exposure to two sample water conservation videos. To fulfill the purpose, the following research questions were addressed:

RQ_1: What differences, if any, existed between the participants' overall or tonic cognitive resource allocation between the two videos?

RQ_2: What message attributes created increased short-term periods of cognitive resource allocation in the scientific evidence and testimonial videos?

RQ_3: What were the differences in self-reported message elaboration between the two videos?

Method

Design

To address these research questions, an experiment was conducted where participants viewed two videos focusing on water, drought, and agriculture while the psychophysiological measure of heart rate for cognitive resource allocation was continuously recorded. A 2 (message appeal: testimonial vs. scientific evidence) X 80 (3-second time periods) within-subjects design was used to evaluate the role of information processing during stimulus exposure in a laboratory setting. Within this research approach, within-subjects designs are frequently employed to control for individual differences in resting or baseline heart rate (Potter & Bolls, 2012).

Independent Variable (Message Treatment)

The persuasive strategy employed by a message has the potential to elicit differences in message elaboration by inviting either central or peripheral processing of message content (Shen & Bigsby, 2013). Based upon prior research, two messages employing distinct message appeals while discussing water and drought impacts in the Southwestern United States were employed. A variety of video messages discussing drought and agricultural water use in the southern region of the Ogallala Aquifer were reviewed for possible use. Two videos were selected that were of identical length but varied in their treatment of the subject. The first treatment was a human-interest or testimonial video outlining farmer/rancher personal experience, or testimonial evidence, of the effect of drought in an area geographically proximal to the research location. The narration and graphics featured stories of how drought impacted the farmers and ranchers, personally and financially, present in the story. The second treatment was a scientific evidence-based video distributed by the National Science Foundation. The video contained a heavy focus on presentation of statistics and percentages related to water use and conservation. Both videos were edited to be four minutes in duration. Presentation order of the videos was counterbalanced across participants to guard against order effects (Ary, Jacobs, Sorenson, & Walker, 2013).

Dependent Variable

To understand the influence of the message on the participant, cognitive resource allocation was measured continuously throughout the videos. Additionally, elaboration was measured after viewing the video.

Cognitive Resource Allocation. Attention has been conceptualized as greater allocation of cognitive resources to encoding a message into the participant's memory. It has been operationalized through cardiac deceleration (i.e., lower heart rate) via online measurement during message consumption (Potter & Bolls, 2012). Throughout an orienting response to a specific message attribute, Ravaja (2004) explains, "increased cardiac parasympathetic activity causes the heart to slow down and is associated with information intake, attention, and approach behavior" (p. 201).

To answer research question one and two, heart rate was recorded as time between R-spikes in the QRS pattern in electrocardiogram waveform and transformed for ease of interpretation into heart rate in beats per minute. Heart rate data were resampled offline into 80 three-second time intervals. Lastly, heart rate values were transformed into change scores from a baseline or resting state to control for individual differences in physiological response. Baseline measures of heart rate were assessed for five seconds before onset of each message.

Elaboration. Cognitive elaboration of a message's features occur when individuals think critically and evaluate the content and features of a stimulus. In order to determine the level of elaboration on each message, or research question three, the researchers utilized Reynolds' (1997) self-report elaboration scale. After viewing each message, participants were asked to indicate their level of agreement with 12 items that were paired with 5-point Likert-type response scales (1 = *Strongly Disagree*, 5 = *Strongly Agree*). Sample items included "While watching I was exerting a good deal of cognitive effort" and "While watching the message, I was deep in thought about the message." Responses were internally consistent (Cronbach's $\alpha = .84$), and they were summed and averaged to create an elaboration measure in response to each message.

Participants

For the purpose of this study, twenty beginning farmers and ranchers from the Lubbock, Texas area were recruited for this study. Participants were provided a $100 gift card to Tractor Supply Company as an incentive. The beginning farmers and ranchers were selected as individuals who had recently completed, or were close to completing, a college degree program in an agricultural college at a large university. To be selected for the study, participants were required to work in a production agriculture field. The participants indicated all were male (n = 20), 65% (n = 13) were involved predominately in crop production, and 35% (n = 7) were involved in livestock production. Physiology data were deleted for three participants due to high levels of noise artifacts from participant movement, yielding a sample of 17 for analysis ($n = 17$).

Procedure and Protocol

After participants signed Texas Tech University Institutional Review Board approved consent forms, the psychophysiological measures of heart rate were collected via a bioamplifier module data acquisition system connected to a desktop computer running AcqKnowledge version 4.21. The procedure was designed based on recommendations from Potter and Bolls (2012). The AcqKnowledge software allows researchers to control the data acquisition process and extract the data offline after collection. The participants were seated in a comfortable chair locked in a reclining position and were asked to view two stimulus clips on a 40-inch flat panel television monitor approximately four feet away (Potter & Bolls, 2012). Instructions and stimuli were presented on the television monitor through MediaLab stimulus presentation software. Heart rate, the physiological indicator of cognitive resource allocation, was continuously recorded from the electrocardiogram (ECG) waveform obtained from the AcqKnowledge software during exposure to each stimulus. To record ECG, three silver/silver chloride (AG/AGCL) electrodes were placed on the participants (ground electrode placed on the wrist, positive and negative referenced recording electrodes placed on the forearms), and signals from the electrodes were transmitted to ECG100C bioamplifier module, and then to the data collection program, AcqKnoweledge (Potter & Bolls, 2012).

Data Analysis

To perform data analysis, participant data were converted into change scores for each psychophysiological measure (Potter & Bolls, 2012). Change scores were calculated by subtracting heart rate for each time interval from the mean baseline score. Baseline data were collected 5 seconds prior to each stimulus to represent the participant's resting heart rate prior to message onset (Potter & Bolls, 2012). Raw data were recorded at 1 second intervals, and the data were resampled offline into 3-second segments. A repeated-measures ANOVA was conducted in SPSS version 22.0 to answer RQ1. To determine the message attributes that created higher levels of cognitive resource allocation (RQ2), the researchers created an average for each participant response per 3-second segment. Next, z-score computations were completed in SPSS version 22.0 and were plotted on a graph in Excel. Potter and Bolls (2012) discussed cognitive resource allocation occurs when heart rate decreases. Visual inspections of peaks more than 1.0 standard deviations below the baseline identified attention allocation to message attributes over time. Afterward, the researchers conducted a repeated measures ANOVA to determine the significance of the changes in heart rate (RQ2). A paired sample *t*-tests was also used to determine differences in self-perceived elaboration between the treatment videos (RQ3).

Results

RQ1: What differences, if any, existed between participants' overall cognitive resource allocation between the two videos?

This research question sought to identify if any difference appeared in overall resource allocation between the two videos. A repeated-measures ANOVA was conducted where message type (2) and time period (80) served as within-subjects factors and heart rate change from baseline served as the repeated dependent measure. This test failed to find an overall effect of message type, $F(1, 16) = .20$, $p > .05$. Thus, no global difference was observed in terms of overall resource allocation between messages resource allocation.

RQ2: What message attributes created increased short-term periods of cognitive resource allocation?

In this research question, the researchers sought to identify specific short-term moments within the message that led to increased cognitive resource allocation. To identify these moments, mean heart rate change scores for each time segment were standardized to z-scores. These z-scores were then plotted and visually inspected to identify unique moments within each message when mean standardized heart rate change scores fell below 1.0 standard deviation from the series mean of zero. As such, these represent periods indicative of increased resource allocation (i.e., decreases in heart rate).

Scientific Evidence Video

Visual inspection of the standardized heart rate change data provided evidence of five critical moments within the scientific evidence video where heart rate deceleration suggested increased levels of cognitive resource allocation. Figure 1 depicts the standardized heart range change for the mean for all participants over the duration of the video (see Figure 1).

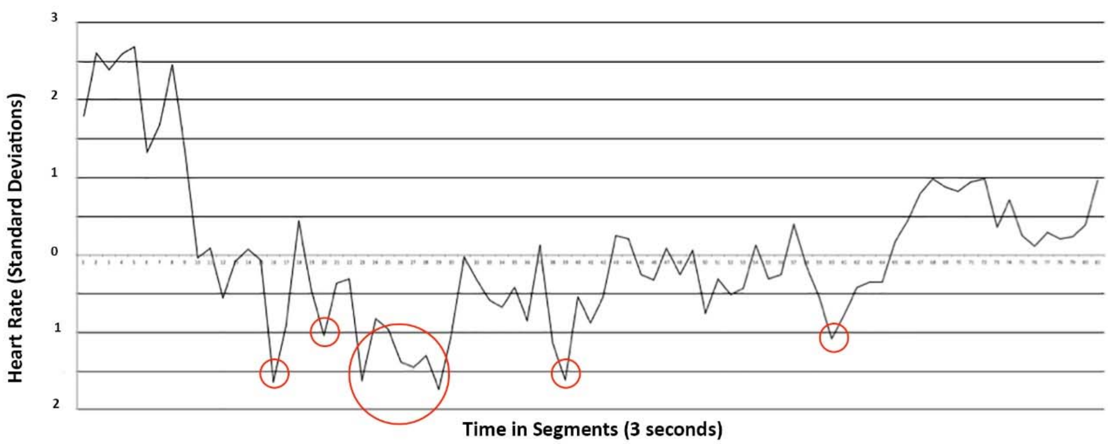

Figure 1. Standardized heart rate change over time during scientific evidence video (n = 17).

Table 1 provides a description of the video during the critical moments. To verify the decrease in heart rate change during each of these segments, data for each period were subjected to repeated-measures ANOVAs where time period served as the within-subjects variable and the change score measurements for each specified period served as the repeated dependent measure.

The first test examining heart rate deceleration during time segment 16 found a significant decrease in heart rate relative to baseline, $F\ (1, 16) = 19.99$, $p < .001$,$\eta^2_p = .56$. Similarly, a critical moment occurred at segments 23 to 30, which depicted the agricultural irrigation scene, $F\ (8, 128) = 6.67$, $p < .001$, $\eta^2_p = .29$. Third, the discussion on the period of drought for segments 38-41 also led to a statistically significant decrease in heart rate from baseline, $F\ (4, 64) = 9.87$, $p < .001$, $\eta^2_p = .38$. Lastly, the animated graphic explaining aquifer recharge at time period 60 also elicited a significant decrease in heart rate from baseline, $F\ (1, 16) = 20.18$, $p < .001$, $\eta^2_p = .56$. In sum, these passages all represent moments within the four-minute video where participants exhibited significant differences in allocation of cognitive resources to the message.

Table 1

Description of Scientific Evidence Video Critical Moments

Segment	Imagery	Narration
16		"The Ogallala Aquifer, also known as the High Plains Aquifer, is a ground water storage reservoir that stretches 174,000 mi^2 underneath parts of eight states from South Dakota to Texas."
20		"Today's irrigation technologies is able to pump out water that has been in the aquifer for hundred for thousands of years in just a matter of minutes."
23-30		"A rate that far outpaces the rate that nature can replenish it - threatening the over sustainability of the aquifer and for agriculture."
38-41		"This area as well as others, you are now in a period of exceptional drought."
60		"In Western Kansas, it can take one year to recharge the aquifer by less than an inch."

Note: Segment numbers refer to three-second segments within each video.

Testimonial Video

Figure 2 depicts a similar visual inspection of the data (standardized mean of heart rate for all participants). The graphic provides evidence of three moments within the testimonial video where heart rate deceleration suggested significant levels of cognitive resource allocation (standardized heart rate change scores more than 1.0 standard deviations away below the series mean).

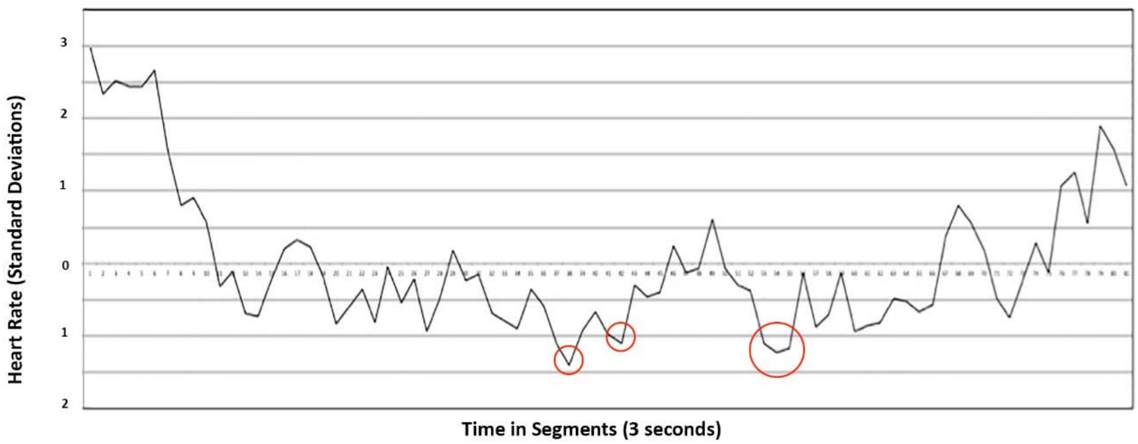

Figure 2. Standardized heart rate change over time during testimonial video (n = 17).

Table 2 provides a description of the video during the critical moments. A repeated-measures ANOVA examining heart rate change from baseline within those segments revealed that scores were significantly lower during that period, F (4, 64) = 11.64, $p < .001$, $\eta^2_p = .42$. Next, a discussion of corn not thriving in the heat within segments 41-42 likewise elicited significant decrease in heart rate from baseline, F (2, 32) = 10.31, $p < .001$, $\eta^2_p = .39$. The third and final critical moment was within segments 53-55, F (3, 48) = 10.62, $p < .001$, $\eta^2_p = .40$. In sum, the testimonial video elicited fewer passages where participants exhibited increased attention allocation.

Table 2

Description of Testimonial Video Critical Moments

Segment	Imagery	Narration
37-39		"We wear two hats. We use our farming hat to raise the feed source, and we use our cowboy or cattleman's hat to raise our cattle on our pasture land."
41-42		"Corn does not do well in the heat. So that's a problem right there."
53-55		"Cattle numbers are down. Cow Herds are going down. Thus, we are losing Cargill's, packing plants, there aren't enough cattle to keep them open."

Note: Segment Numbers refer to three-second segments of video

RQ3: What were the differences in self-reported message elaboration between the two videos?

To answer the final research question, a paired-samples *t*-test was conducted to compare responses to the self-report measure of message elaboration in response to the two videos. The test revealed that the difference in message elaboration approached statistical significance, $t(20) = 1.84$, $p = .086$, Cohen's $d = .41$. Participants reported greater elaboration in response to the testimonial message ($M = 4.28$, $SD = .41$) compared to the scientific evidence message ($M = 4.10$, $SD = .30$). Although the test statistic did not reach the level of statistical significance, the associated effect size (Cohen's $d = .41$) suggests that the observed effect was moderate (Ellis, 1988). Thus, the failure to reach significance may be a function of the small sample of beginning farmers and ranchers employed in the design (Hoyle, 1999). Laboratory studies such as this one often have small sample sizes. Wasserstein and Lazar (2012) explained scientific conclusions should be evaluated based on many contextual factors including inferences and effect size, the design of the study, the quality of the measurements, the phenomenon under study, and the validity of the assumptions. Instead of disregarding data not passing a specific threshold, researchers should evaluate the research based on many contextual factors (Thorson, Wicks, & Leshner, 2012; Sullivan & Feinn, 2012). Therefore, although the finding was non-significant, it shows a specific data trend.

Discussion and Recommendation

This study assessed the role of information processing as a function of message type. The researchers examined the influence of two message types (scientific evidence and testimonial) of water conservation videos on the physiological process of attention and the self-report measure of elaboration. The results of this study indicated the video providing greater levels of scientific evidence had a higher level of cognitive resource allocation because the scientific video had more frequent heart rate deceleration during critical moments throughout the video.

Specifically, research question two explored which facets of the two videos elicited attention. The results for the scientific evidence video indicated media features, such as cuts, edits or the introduction of on screen graphics, elicited orienting responses that result in increased attention allocation (Lang et al., 1999; Lang et al., 2003). Similarly, orienting responses were documented with message features depicting on-screen graphics in the scientific evidence video. Additionally, in segments 13 and 77, information included scientists referring to statistics depicting the impact of drought and the necessity for water conservation to elicit an attention response.

Although the scientific evidence video provided evidence of higher attention allocation during exposure to specific video features, the testimonial video caused participants to allocate attention to information related to their current occupation. For example, in the testimonial video, the participants had an orienting response, as observed by a decreased heart rate, when the narrator discussed issues regarding management practices, temperature impacting cattle efficiency, and the loss of jobs in production plants. As discussed by Warner et al. (2015), issues impacting the participants personally have elicited a higher level of persuasive effectiveness, or a higher level of information processing, due to messages with personal or social congruence. The researchers concluded visual media pertaining to life on the farm resulted in personal similarity, which caused an attentional response.

Global responses to the messages were reported through self-report elaboration scale used in research question three. Although the paired samples *t*-test was approaching significance, the moderate effect size indicated the participants had a greater elaboration during the testimonial message. This result suggested cognitive processing was higher for the testimonial; however, psychological measures provided evidence that the scientific message invited more frequent resource allocation. Perhaps this finding was a result of the scientific message that was more demanding of limited resources, while the testimonial invited more rumination with easier to process information. This finding is representative of online (i.e., physiological and biometric measurements) versus offline (i.e., self-report) measures of response. The offline response is a more contemplative response that references a more cumulative representation of how the individual provided cognitive resource allocation; whereas, the online response is raw and immediate to the specific message features in the videos.

Because message frames are crucial to strategic communication goals (Gorham et al., 2014; Huang et al., 2016; Warner et al., 2015), understanding which aspects of message construction and the message appeal that impact information processing are crucial to improving farmer and rancher water conservation practices. Not only does information processing lead to memory recall, but it also leads to higher levels of attitude formation and behavioral intention in the case of persuasive messaging (Petty & Cacioppo, 1986). The results of this study suggest communication with farmers and ranchers about water conservation may be different than strategic communication to target the general public about water conservation.

When targeting farmers and/or ranchers with messages, educators and communicators should focus on incorporating scientific evidence to promote information processing. The results of this study indicated farmers and ranchers allocate cognitive resources to scientific evidence. At the same time, inferences to personal relevance and messages congruent with aspects of farming resulted in increased cognitive resource allocation provided minimal evidence to attention allocation. Extension and communications practitioners and faculty should use this information to apply and combine scientific evidence with a small amount of discussion of testimonial content to improve information processing to partake in water conservation behaviors. Similarly, within an educational setting, this study's results show educators and communicators should include more emphasis on presenting statistics and facts related to reasons to implement water conservation tactics embedded within video graphics into curriculum. For example, the findings suggested attention allocation to on-screen graphics representing facts and statistics as well as references to the participants' current occupation and community news elicited a higher attention response. Therefore, when creating messages and educational programming, practitioners should implement these types of elements into their educational and communication materials.

Another contribution of this paper is the use of psychophysiological measures of message processing to examine specific elements that elicit potent responses. As previously noted, key advantages of this approach are that these measures capture pre-conscious responses that are free of various biases as well as the ability to identify specific elements within a message that are effective (Potter & Bolls, 2012). Much research examines the "message" as a solitary unit without consideration of the changing nature of that message as it unfolds over time. Further research should explore the impact of various content and production features in information processing and provide connections to attitude or behavioral intentions. As shown in this study, physiological measures provide agricultural social sciences with the ability to pinpoint how specific message features impact message processing. This knowledge should be used in experimental methods to explore how facets of information such as topic, message features, and number of arguments, effect how individuals perceive information, process information, and develop an attitude toward such information. The authors suggest future research in the realm of biometric or psychophysiological analysis should be continued in the agricultural education, agricultural communications, agricultural leadership, and Extension settings. Prior research within this field has explored the effects of the stimuli post exposure. However, as stated by Lang and Ewoldsen (2010), the word effect implies that only change is important. The use of these measures will allow the field to grow and to understand the dynamic nature of media consumption, and what elements of stimuli provide a specific response. This tool allows researchers to dissect the message and to understand how a specific point of stimuli relates to information processing. For example, future research should continue to explore the connections between information processing and heart rate. Additionally, biometric research may also be used to connect emotional arousal, or an emotional response, to information processing and attention. Additionally, within the traditional classroom setting, the researchers propose understanding how manipulated lesson plans and teaching strategies relate to attentional responses from students.

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