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The Effect of User Control on the Cognitive and Emotional Processing of Pictures

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This paper explores psychology related to the moment that control is exercised during interactions with media. What is the difference in the thoughtful and emotional engagement of viewers with the content presented between reacting to media versus controlling its onset? Subjects viewed pictures on a computer as part of a 2 (control) × 2 (picture type) × 16 (repetitions) × 2 (order) within-subjects experiment ($N = 22$). In one condition, subjects controlled the picture onset with a computer mouse. In the other condition, the computer controlled the picture onset. Heart rate and skin conductance were collected as indicators of the automatic attention and arousal elicited by each manipulation of control. Results showed that subjects exhibited a cardiac orienting response when the computer controlled the onset of emotional pictures. Subjects failed to orient when they had control over picture onset. Physiological arousal, as measured by skin conductance, was higher when subjects had control over picture onset. Subjects gave higher subjective ratings on valence and arousal for pictures that were presented by the computer. These results are discussed in relation to current assumptions about interactive media and audience activity.

Media experiences often start with a mouse click. Interactive technology allows people to control experiences by deciding for themselves when information will be presented. Products on a website, news in a blog and pictures in a slide show all appear milliseconds after an exact moment when information is selected with an input device attached to a computer. This control, exercised several times per view-

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ing session and with certain consequences for what will follow, is the essence of the interactive promise. Passive media invite *reaction* to content, the onset of which is controlled by someone else. Active media give people *control* to start and advance displays at their discretion, creating a sense that media can be manipulated to meet a need already contemplated.

This paper explores psychology related to the moment when control is exercised during interactions with media. What is the difference, in the thoughtful and emotional engagement of viewers with the content presented, between reacting to media versus controlling its onset? Any differences that do occur have implications for how interactive media should be defined to accent their psychological significance relative to traditional one-way experiences, and the differences will have implications for how media might be designed to maximize or minimize effects attributable uniquely to interactivity.

CONTROL AS A PSYCHOLOGICAL PHENOMENON

Psychological research has demonstrated that for future events, control and certainty are more desirable than lack of control and uncertainty. Haggard (1943) found that the ability to self-administer electric shock resulted in less physiological arousal than experimenter-administered shock. Ball and Volger (1971) found that subjects reported a stronger preference for self-administered shock than for experimenter-administered shock. Staub and colleagues (Staub, Tursky, & Schwartz, 1971) found that people without control judged less intense shocks as uncomfortable and tolerated fewer shocks than subjects with control. Bjorkstarand (1973) found that self-control of electric shock resulted in reduced galvanic skin response (GSR) compared to experimenter-controlled shock. These studies show that control is subjectively positive and beyond introspection. They also show that stimulus control can modulate affective responses to stimuli. These findings serve as a foundation for the analysis of stimulus control with respect to interactive technology.

The current study differs from previous ones in two important ways. First, the stimuli used here are mediated rather than direct. Mediated information is more subtle than direct experience. There is little, if any, cognitive elaboration necessary for responding to the pain a subject might feel from an electric shock. Cognitive and emotional responses to media, on the other hand, require the viewer to encode and interpret symbolic information.

Second, this study uses both positive and negative stimuli. This is important because media content represents a wide range of emotions. Furthermore, there is conflicting evidence regarding whether automatic processing varies as a function of emotional valence. For example, Pratto and John (1991) had subjects identify the colors in which desirable and undesirable traits appeared on a screen. Subjects took longer to identify the undesirable traits, an indication that these traits attracted more attention than the desirable ones. On the other hand, Roskos-Ewoldson and Fazio (1992) found no difference between attention to positive and negative objects in a visual search task. The current study attempts to reconcile these findings by looking at the role of picture valence in eliciting attention, in conjunction with the user's ability to control media onset.

User control here is seen as a structural feature of media: that is, it can vary irrespective of the particular content that appears on the screen. Valence is a content feature: that is, it varies irrespective of the technical features of a particular medium. Previous research has looked at how interactions between structure and content affect how people process media. Such research employs a limited capacity model of human information processing. This model is relevant to questions of interactivity and is useful in generating specific predictions about the effects of user control. The following section provides an overview of this model and how it pertains to user control.

THE LIMITED CAPACITY MODEL AND THE ORIENTING RESPONSE

Lang's limited capacity model (2000) describes how the structure and content of media may engage automatic processing. This model is relevant to studying control of media because it attributes physiological responses, like those mentioned in the electric shock studies, to different message attributes. Furthermore, this model links physiological responses with underlying cognitive mechanisms that influence how we process media.

Lang's model makes several predictions about how we make sense of media content. First, the viewer allocates cognitive resources to media based on personal interests and goals. Second, processing goals influence the allocation of resources to the subprocesses of encoding, storage, and retrieval. Third, both the structure and the content of a particular message can elicit orienting behavior, attention, and emotional responses, resulting in the automatic allocation of resources to encoding and storage. To summarize, the psychological processing of media is an interaction of structure and content, and viewer.

While much of the empirical support for this model comes from television, Lang suggests four questions to consider when applying the model to non-television situations. Two of these questions (Lang, 2000, p. 63) are relevant to the study of control: What aspects of the structure of the communication situation will engage the automatic resource allocation system, and what aspects of the situation or medium will engage the controlled allocation processes?

One way in which the structure of a message engages the automatic resource allocation system is by eliciting orienting responses. The orienting response is the brain's way of mobilizing cognitive resources for potential action. The orienting literature shows that novelty is a key factor in determining whether something will elicit an orienting response (Sokolov, 1963; Graham, 1979). If the users control stimulus onset, they know that a change in the sensory environment is forthcoming. In other words, control reduces the element of surprise that contributes to orienting. If the user knows of imminent change in the sensory environment, this knowledge serves as a priming device. If cognitive resources are primed in the seconds prior to a change in stimulation, a diminished orienting response is expected in the period after stimulus presentation.

Previous research using the limited capacity model has tested the effect of stimulus control on orienting. One experiment showed a significant interaction between control and animation on recognition memory for banner advertisements. Participants recognized animated banner ads better when they actively controlled onset, but recognized still ads better when the computer controlled onset (Lang, Borse, Wise, & David, 2002). The current study builds on this research by testing the effects of control on a pictorial stimulus set, the International Affective Picture System (IAPS; Lang, Bradley, & Cuthbert, 2001). The presentation onset of these pictures has already been shown to elicit orienting (Lang, Bradley, Cuthbert, & Hamm, 1993). In this case, we are primarily interested in how the structural feature of control affects automatic processing during the first few seconds of exposure, irrespective of content. The following section indicates how control might influence the orienting response, a primary mechanism that determines how processing resources are allocated in the first several seconds of exposure to media.

CONTROL AND ORIENTING

The orienting response is an automatic call for cognitive resources to deal with change in the environment. Knowledge of imminent change in the environment should temper the orienting response because the predictability of change should lessen the value of automaticity. When cognitive resources have been used to cause a change, the need for further automatic processing should be reduced. Furthermore, because the user is controlling stimulus onset, some cognitive resources should be activated merely by the action of pointing and clicking required to initiate stimulus onset. If cognitive activation takes place on a continuum anchored at the extremes by automatic and controlled processing, the act of pointing and clicking should represent a movement on this continuum favoring controlled processing.

According to Ohman (1979), the orienting response serves as a switch from automatic to controlled processing. If controlled processing already exists, as would be the case for a user negotiating a computer screen in order to point and click on an icon, there is less need for an evaluative "switch" to be thrown at stimulus onset.

Because people would not know what's coming, automatic processing would guide how people deal with the content of the screen. Relative to the passive condition of no control, however, the need for automatic processing is reduced. This should lead to a response different from when people have no control over stimulus onset. The subject's role as an active or passive participant causes a fundamental shift in information processing.

But what does this shift have to do with interactivity? The proposition here is that the ability to actively control when something appears is fundamentally different than passively viewing something that is externally controlled. With active control, the viewer reduces the need for appraisal and shifts from a posture of focused attention to one of certain action. One way of assessing this difference is looking at heart rate. If the above expectations are correct, active control over stimulus onset should cause a reduction in cardiac orienting. In other words, the traditional U-shaped cardiac response curve usually associated with orienting should flatten. Based on this and the previous discussion of stimulus novelty, the following hypothesis is proposed:

H1: Passive viewing of pictures whose onset is controlled by a computer will elicit cardiac orienting, but active user control over picture onset will not elicit cardiac orienting.

We can test this hypothesis by comparing the cardiac responses that result from each manipulation of control. If orienting occurs, we should see (1) a significant main effect for time, (2) a U- or inverted S-shaped cardiac response curve for the 5–7 sec immediately following stimulus onset, and (3) a significant quadratic or cubic trend in the cardiac response curve. If orienting has not occurred, we should see either nonsignificant effects or a cardiac response curve that shows acceleration of the heart after stimulus onset.

CONTROL AND AROUSAL

How might control affect autonomic arousal? The previous research about control over aversive stimuli suggests that autonomic reactivity should be less when subjects have control over stimulus onset. Furthermore, arousal elicited by discrete stimuli is generally accepted as a component of the orienting response (Dawson, Schell, & Filion, 1990). In this regard, arousal should be reduced with control over stimulus onset for the same reason that cardiac orienting should be reduced. Based on this, the following hypothesis is predicted:

H2: Autonomic arousal will be higher for pictures whose onset is controlled by the computer than for pictures whose onset is controlled by the user.

CONTROL AND SUBJECTIVE EVALUATIONS

The first series of hypotheses deals with autonomic responses fundamental to the cognitive and emotional processing of media. These primitive mechanisms are important in and of themselves; however, media effects, at least to some degree, are also determined by conscious experience. Therefore, an important question is whether subconscious responses can influence someone's conscious evaluation of content. More specifically, does the simple ability to click on a mouse and make a picture appear lead to a subjective evaluation that differs from that of a picture that is presented by of the identical picture when a computer presents it?

If cardiac orienting indicates attention and input, the answer should be yes. When heart rate decreases, cognitive resources are allocated to stimulus appraisal. This appraisal is largely motivated by emotional factors: "Is this thing good?" "Can it hurt me?" "How do I feel about it?" Once this appraisal has been made, the organism can prepare an appropriate response. At the point of this shift, the focus is not on evaluation, but action. With regard to control, Lykken and Tellegen (1974) proposed that with foreknowledge of an event, people selectively tune the appropriate receptive system in anticipation of a stimulus. If the stimulus is unpleasant, the perceived impact is tuned out. Hoffman (1997) summarized a group of experiments involving expectancy by stating "when stimulus presentation is in accord with expectation, the amplitude of the elicited reflex is reduced" (p. 190). These statements suggest that the expectancy that comes with user control should mitigate the emotional responses to the pictures that follow. Based on this, the following is proposed:

H3a: Subjects will give more positive *valence* ratings to pictures when they do not have control over picture onset than when they do have control over picture onset.
H3b: Subjects will give higher *arousal* ratings to pictures when they do not have control over picture onset than when they do have control over picture onset.

METHOD

Participants

Twenty-two undergraduates (8 male, 14 female) were recruited from an intermediate communications class at a large Western university.

Design

This study used a 2 (control) × 2 (picture type) × 16 (repetition) × 2 (order) mixed design. Control, picture type, and repetition were all within-subjects factors; Order was a between-subjects factor. Control referred to how the picture presentation was initiated. Control had two levels, user-control and computer-control. In the user-control condition, subjects actively controlled picture onset by clicking on a mouse. In the computer-control condition, subjects passively viewed pictures with onset controlled by the computer.

Picture type had two levels, emotional and neutral. This factor referred to the emotional attributes of the picture and is explained in greater detail below. Repetition referred to the number of different pictures viewed in each of the combinations of user control and picture type. Order referred to the two randomly generated picture orders that each subject viewed.

Materials

For each control manipulation, subjects also reviewed and rated half of the pictures they had previously seen using SAM, the self-assessment manikin (Lang, 1980). The SAM is largely culture-free and has assessments of valence and arousal that have been shown to correlate .9 and above with semantic differential scales that measure the same dimensions (Lang, Bradley, & Cuthbert, 1997).

Stimuli

A total of sixty-four pictures were selected from the International Affective Picture System (IAPS; Center for the Study of Emotion and Attention, 2001); 16 pictures for each combination of user control and picture type. The IAPS is a set of standardized color photographs that includes content from many different categories (e.g., animals, people, scenery).

The first level of picture type, emotional pictures, referred to pictures that came from one of the four combinations of valence and arousal: high valence/high arousal, low valence/low arousal, high valence/low arousal, and low valence/high arousal. The second level of picture type, neutral, referred to pictures that had received evaluations near the midpoints of the valence and arousal dimensions. Pictures in both conditions were categorized according to their average ratings in previous studies.

Digitized pictures were copied onto Microsoft Powerpoint slides for presentation. A black screen preceded each picture for at least 5 sec, which served as a baseline period for the physiological measures. After 5 sec, a prompt resembling a “play” button appeared in the lower center of the screen. In the user-control condition, subjects clicked on this prompt to initiate the next picture. In the computer-control condition, subjects did not click on the prompt, but just waited for the next picture to appear on its own.

The duration of the prompt in the computer-control condition was randomly assigned as either 0, 1, 2, 3, or 4 sec long. This was done for two reasons. The first was to minimize subjects' ability to accurately predict when the next picture would appear. Second, the random times simulated the duration of time it took people to point and click on the prompt in the user-control condition.

In order to prevent subjects from leaving the mouse pointer on the prompt and clicking, the pointer disappeared if it remained stationary for more than a few seconds and reappeared only when the subject moved the mouse. This forced subjects to engage in pointing and clicking for each picture, mimicking actual computer use. Each picture appeared and remained on the screen for 6 sec before being replaced by the next black screen. The 6-sec period was necessary to get physiological data and is identical to previous research measuring physiological responses to the IAPS collection.

Physiological Recording

Physiological signals were measured, amplified, and recorded using Coulbourn modules linked to a PC computer. The VPM software program (Cook, Atkinson, & Lang, 1987) coordinated the sampling and storage of physiology data.

Heart Rate

Heart rate was recorded using standard Beckman Ag/AgCl electrodes placed on the forearm. The signal was amplified and filtered by a Coulbourn S75–01 bioamplifier. A Schmitt trigger interrupted the PC every time it detected the R-spike of the cardiac wave. Data were initially collected as interbeat intervals, or milliseconds between consecutive R-spikes. They were then edited and converted off-line to heart rate in beats per minute.

Skin Conductance

Skin conductance was recorded using standard Beckman Ag/AgCl electrodes placed on the palmar region of the subject's non-dominant hand. The electrodes were attached to a Coulbourn S71–23 isolated skin conductance coupler. The signal was sampled at a rate of 20 times per second and converted to conductance values in microSeimens (uS).

Analysis

For heart rate, cardiac response curves were created by computing change scores for each second from picture onset to offset. To create each change score, the baseline heart rate at the moment before picture onset was subtracted from the heart rate at each particular second after onset. For skin conductance, SCRs were coded for both magnitude and frequency during each picture presentation. Average SCR frequencies were computed by dividing the total number of SCRs elicited in a particular manipulation by the number of repetitions of that same manipulation. This means that these averages include repetitions in which no SCR was elicited. The criterion for determining an SCR was an increase in skin conductance of .10 uS from valley to peak during the viewing period of an individual picture.

Physiological data were analyzed using repeated-measures analysis of variance (ANOVA). The Huynh-Feldt correction was applied to all degrees of freedom from within-subjects factors in which the assumption of sphericity was violated. SAM and other self-report data were also analyzed using repeated-measures ANOVA.

Procedure

All subjects sat down and provided informed consent upon entering the laboratory. The experimenter prepared the subject's skin and attached the necessary physiological sensors. The experimenter told people they were going to help in the creation of a standardized pictorial test of emotional intelligence to be used in student assessment for grades 6–9. The experimenter continued by telling subjects that they were chosen for the experiment because their high level of emotional intelligence would be an asset in selecting pictures for this supposed test. Emphasis was placed on the importance of the project and the service that the participant provided.

After ensuring that the physiological equipment had been calibrated and a clear signal was coming in, the experimenter warned each subject that a few of the pictures contained graphic and perhaps disturbing content. The experimenter then presented a slide that explained the procedure. When subjects indicated that they understood the procedure, the experiment began.

Subjects viewed pictures in either the computer-controlled or the user-controlled slide presentation depending on random assignment of order. In each of the two conditions, subjects saw two slide presentations, one containing neutral pictures and one containing emotional pictures. Once this had been completed for both presentations (first manipulation of control), subjects viewed half of the pictures a second time and evaluated each picture using the SAM instrument. This procedure was used for two reasons. First, the act of filling out the SAM instrument would confound analysis of physiological responses *between* trials. Second, having people look at pictures continuously is a more externally valid simulation of interactive media use then interrupting them every 10 sec to fill out a questionnaire item. This process was repeated for the second manipulation of control. Upon completion, subjects were paid, debriefed, and dismissed.

RESULTS

Before testing the proposed hypotheses, statistical analyses were conducted to rule out any confounding effects of order and gender. There were three random assignments of order. First, it was randomly determined which of two picture orders subjects would see for each manipulation of control and picture type. Second, subjects were randomly assigned an order to experience the two manipulations of control (user control/computer control). Next, subjects were randomly assigned an order in which they would experience the two manipulations of picture type (emotional pictures/neutral pictures). All of these order assignments were counterbalanced such that an equal number of subjects were assigned to each order. There were no significant effects of order on any of the dependent measures. Likewise, there were no significant effects of gender on any of the dependent measures.

Hypothesis 1 predicted that orienting would occur when subjects passively viewed pictures whose onset was controlled by the computer, but would not occur when subjects actively controlled stimulus onset. In order to better isolate the effect of control from the effect of picture content, this hypothesis was tested separately for emotional and neutral pictures. This hypothesis was tested by looking for a significant main effect for time, visually inspecting the cardiac response curve for each condition, and looking for a significant quadratic or cubic trend in each curve.

When subjects passively viewed emotional pictures controlled by the computer, the resulting cardiac curve showed a significant main effect for Time, $F(5, 105) = 3.05, p < .05, \eta^2 = .13$. As Fig. 1 shows, heart rate decreased between onset and 3 sec, and then increased back towards prestimulus level between 3 and 5 sec. This U-shaped curve is consistent with that of an orienting response. The quadratic trend of this curve was significant (Table 1), indicating that an orienting response occurred.

When participants actively controlled the onset of emotional pictures, the resulting cardiac curve showed a significant main effect for Time, $F(5, 105) = 4.37, p$

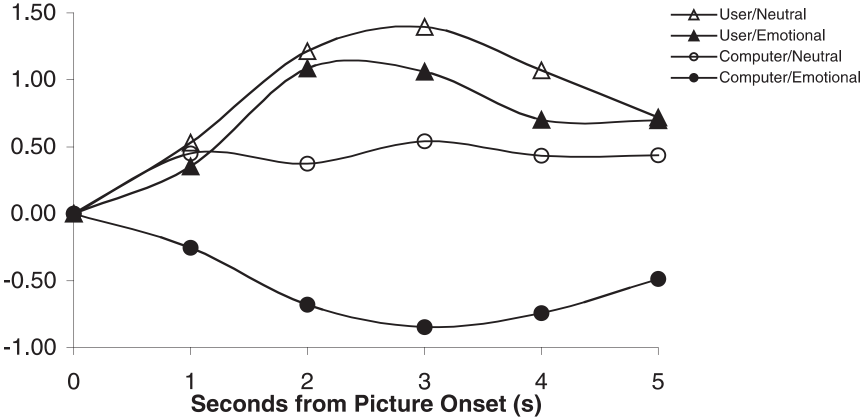

FIGURE 1 Effect of Control Over Picture Onset and Picture Type on Heart Rate Change Over Time.

TABLE 1
Results of Quadratic Trend Analyses for Cardiac Responses to Emotional Pictures

Manipulation	*F (1, 21)*	*Significance (p<)*	*Effect Size (η^2)*
User Control	5.47	.03	.20
Computer Control	6.44	.02	.24

$< .05$, $\eta^2 = .17$. However, as Fig. 1 shows, this curve resembles an inverted "U", making it nearly the exact opposite of what took place when participants did not have control over picture onset. This curve is not consistent with that of an orienting response. As Hypothesis 1 predicted, the passive viewing of emotional pictures controlled by the computer elicited an orienting response, while the active viewing of emotional pictures controlled by the participant did not elicit an orienting response. In other words, the ability of the user to control the onset of emotional pictures eliminated the orienting response.

When participants passively viewed neutral pictures controlled by the computer, the main effect for Time was non-significant. When participants actively controlled the onset of neutral pictures, the resulting cardiac curve showed a significant main effect for Time, $F(5, 105) = 7.67$, $p < .05$, $\eta^2 = .27$. However, as Fig. 1 shows, this curve resembles an inverted "U," which does not represent an orienting response. The ability of the user to control the onset of neutral pictures did not affect the orienting response. Hypothesis 1 is supported for emotional pictures but not for neutral pictures.

Hypothesis 2 predicted that autonomic arousal would be higher for pictures whose onset was controlled by the computer than for pictures whose onset was controlled by the user. We tested this hypothesis by analyzing both the frequency and amplitude of subjects' skin conductance responses with a 2 (control) × 2 (picture type) × 16 (repetition) repeated-measures MANOVA. For SCR frequency, the main effect of control was significant, $F(1, 21) = 13.19$, $p < .01$, $\eta^2 = .41$. Subjects had more skin conductance responses when they actively controlled picture onset (Mean = .21, SE =.04) than when picture onset was controlled by the computer (Mean = .11, SE = .03). As Fig. 2 below shows, this effect was consistent regardless of whether picture type was emotional or neutral, although the effect of control was more pronounced for emotional pictures.

A similar analysis yielded a significant main effect of control on SCR amplitude, $F(1, 21) = 4.96$, $p < .04$, $\eta^2 = .21$. Subjects had stronger skin conductance responses when they actively controlled picture onset (Mean = .07, SE = .01) than they had when picture onset was controlled by the computer (Mean = .04, SE =

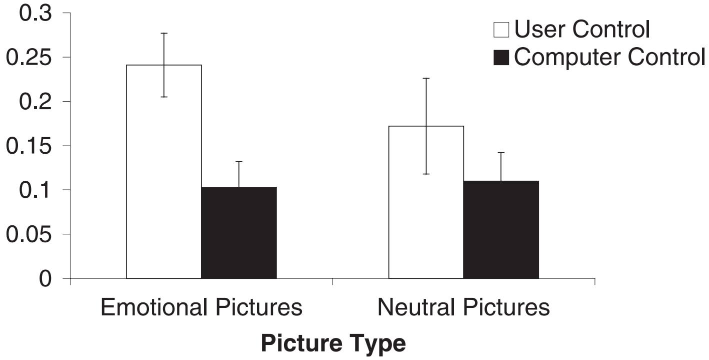

FIGURE 2 Effect of Control on Frequency of Skin Conductance Responses for Emotional and Neutral Pictures.

.01). Similar to the previous analysis, this main effect was consistent regardless of whether picture type was emotional or neutral, as shown in Fig. 3 below.

Overall, these results show that participants experienced higher physiological arousal when they actively controlled picture onset, compared with the arousal experienced when they passively viewed pictures whose onset was controlled by the computer. Hypothesis 2 is not supported. As Figs. 2 and 3 illustrate, the differences in arousal caused by stimulus control are greater when pictures have emotional, as opposed to neutral, content. This corresponds to the heart rate analyses, which showed that the effect of stimulus control was significant only when pictures were emotional.

Hypothesis 3a predicted that subjects would give more positive *valence* ratings to pictures when they did not have control over picture onset than when they did have control over picture onset. Hypothesis 3b predicted that subjects would give

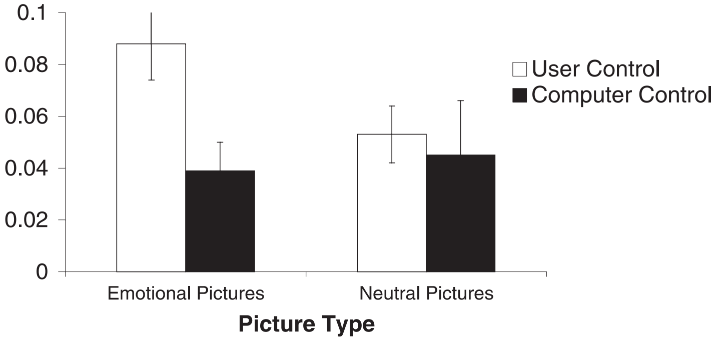

FIGURE 3 Effect of Control on Magnitude of Skin Conductance Responses for Emotional and Neutral Pictures.

higher *arousal* ratings to pictures when they did not have control over picture onset than when they do have control over picture onset. The rationale for these hypotheses was that the orienting response, which facilitates the encoding of sensory information, would lead to a more discriminating appraisal of the content of the pictures. When subjects orient to a pleasant picture, for example, they should give that picture a valence rating that is more positive than the rating they would give to a similar pleasant picture that had not elicited orienting.

The emotional pictures were analyzed according to their predetermined levels of valence (positive/negative) and arousal (high/low). The pictures were divided into four groups: high arousal, low arousal, positive valence, and negative valence. To test Hypothesis 3a (effect of control on valence ratings), a 2 (control) × 2 (valence) × 4 (repetition) repeated-measures ANOVA was run on the SAM data. The main effect of control was significant, $F(1, 21) = 10.73$, $p < .01$, $\eta^2 = .34$. Overall, pictures were given more positive valence ratings when onset was controlled by the computer (Mean = 4.91, SD = .13) than when onset was controlled by the user (Mean = 4.42, SD = .13). This effect, however, was moderated by a significant control × valence interaction, $F(1, 21) = 16.73$, $p < .01$, $\eta^2 = .43$. This analysis is shown in Fig. 4. For positive pictures, ratings were significantly higher for pictures presented by the computer (Mean = 7.35, SD = .19) than ratings for pictures whose onset was controlled by the user (Mean = 6.36, SD = .23). A paired-samples *t*-test demonstrated that this difference was significant, $t(21) = 4.32$, $p < .01$). For negative pictures, ratings were nearly identical for both computer-controlled (Mean = 2.46, SD = .15) and user-controlled (Mean =2.48, SD = .18) pictures. As Fig. 4 shows, the ability to control onset affected valence ratings for pleasant pictures, but did not affect valence ratings for unpleasant pictures. Hypothesis 3b is supported for pleasant pictures but not unpleasant pictures.

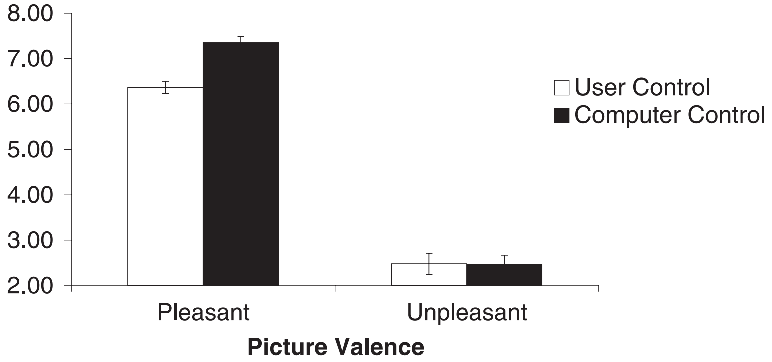

FIGURE 4 Effect of Control on Self-Reported Valence Ratings of Pleasant and Unpleasant Pictures.

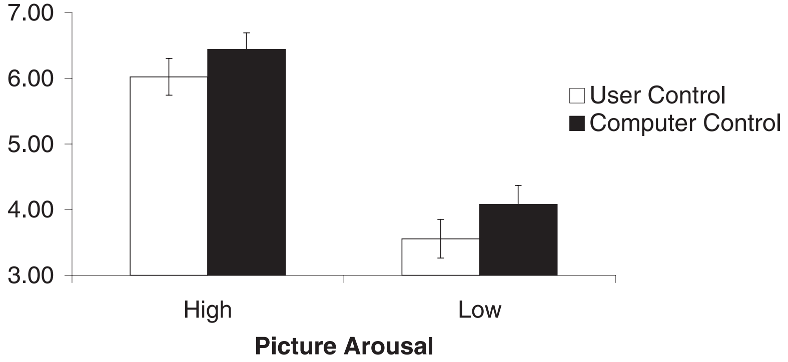

FIGURE 5 Effect of Control on Self-Reported Arousal Ratings for High and Low Arousal Pictures.

To test Hypothesis 3b (effect of control on arousal ratings), a 2 (control) × 2 (arousal) × 4 (repetition) repeated-measures ANOVA was run on the SAM data. This analysis yielded a significant main effect of control, $F(1,21) = 8.36$, $p < .01$, $\eta^2 = .29$. Subjects gave higher arousal ratings for pictures that had been seen in the computer-control condition (Mean =5.26, SD = .25) compared to ratings for pictures seen in the user-control condition (Mean = 4.79, SD = .28). The control × arousal interaction was not significant. For high-arousal pictures, ratings were higher for pictures presented by the computer (Mean = 6.44, SD = .29) than ratings for pictures whose onset was controlled by the user (Mean = 6.02, SD = .30). The same trend held for low arousal pictures. Ratings were higher for pictures presented by the computer (Mean = 4.08, SD = .29) than ratings for pictures whose onset was controlled by the user (Mean = 3.56, SD = .32). This analysis is shown in Fig. 5. Hypothesis 3b is supported.

DISCUSSION

The goal of this research was to explore differences between reacting to media versus controlling its onset. A different chain of events occurred depending on whether or not people had the ability to control picture onset with the click of a mouse. When people controlled the onset of emotional pictures, they did not orient. They showed greater physiological arousal but rated pictures as less arousing and less positive. When the computer controlled the onset of emotional pictures, people oriented yet showed less physiological arousal. They rated pictures as more arousing and more positive. Things changed when pictures were neutral. People did not orient to neutral pictures regardless of who controlled onset. They showed more physiological arousal when they could control onset with a mouse. Ratings of neutral pictures did not significantly differ based on who controlled onset.

These results indicate that the ability to control media onset affects orienting, at least in the case of emotional content, and, by extension, the allocation of cognitive resources to the sub-process of encoding. This research follows extensive previous research by Lang and colleagues that demonstrated numerous structural features can affect the processing of television (e.g., Thorson & Lang, 1992; Lang, Bolls, Potter, & Kawahara, 1999), radio (Potter, Lang, & Bolls, 1998), and computers (Lang, Borse, Wise, & David, 2002). By demonstrating the effects of control, we have added a new structural feature that previous literature has characterized as an important component of new, more interactive media.

These results also raise several interesting questions. First, if physiological arousal is a component of the orienting response, why did people show less arousal for content that had elicited orienting? One possible explanation is that, when people had control, the physical and cognitive effort of pointing and clicking elicited arousal that lingered into the picture-viewing period. The performance of any task should increase arousal. The act of pointing and clicking certainly qualifies as a task, albeit a routine one for regular computer users. Furthermore, there is a physical component to this task that should also raise arousal. Perhaps the residual arousal from pointing and clicking was stronger than the arousal component of the orienting response.

A second, related question is why, when people controlled the onset of emotional pictures, did they give lower arousal ratings to pictures that had elicited higher physiological arousal? The possibility that the higher physiological arousal was an artifact of pointing and clicking has already been mentioned. The lower arousal ratings could be a result of the diminished sense of novelty or surprise when people can make things happen with the mouse. The importance of novelty in orienting was the basis for the prediction that people would not orient to pictures that they could control with a mouse click. Perhaps novelty has similar importance in our emotional evaluations of media. People generally decry a movie with a predictable end. And sporting events are more exciting when the final result hangs in the balance. The user control that is a hallmark of interactive media may diminish peoples' surprise and wonder because they are always at least partially responsible for what comes next.

On the other hand, if pointing and clicking leads to diminished emotional evaluations of content, why did not people give more negative valence ratings to negative pictures that were controlled by the computer? The interaction of novelty and valence may play a role here. According to Bradley (2000), skin conductance changes for pleasant pictures are mediated in part by novelty. The same is not true, however, for unpleasant pictures. When IAPS pictures were presented twice in a row, skin conductance diminished from the first to the second presentation for pleasant pictures, but not for unpleasant pictures. Perhaps something similar takes place when people evaluate emotional pictures: less novelty leads to lower valence ratings for pleasant pictures but not for unpleasant pictures. If this is the case, there are significant ramifications for the design of interactive media relative to content. People can have greater control over the onset of unpleasant content without diminished subjective responses. On the other hand, pleasant content should be produced in a manner that maximizes novelty.

An important question that future research will address is how interacting with media affects memory. The orienting results permit some speculation. The role of orienting as gatekeeper for the encoding of media is well established (Lang, 2000). As Lang points out, stimuli that elicit orienting are encoded and recognized better than stimuli that do not elicit orienting. Thus, the ability to control onset might actually lead to poorer memory. If the criterion of effectiveness is the facilitation of cognitive processing, more interactivity might not always be a good thing.

Another interesting question raised by the orienting results is whether the ability to control media makes viewing less cognitive? We know that people have a limited capacity of cognitive resources. If more of those resources must be devoted to navigating interactive media, what is left in the tank when people reach the content they have been seeking? Future research should examine how the complexity of a navigational task affects responses to similar stimuli. These results lead to the expectation that complex navigation will lead to residual arousal but diminish both orienting and subjective evaluations of emotion.

What specifically do these results tell us about interactivity relative to features of traditional media? They draw attention to the increase in navigational complexity as media become more interactive. Navigating through television, for example, requires little cognitive effort relative to that required by interactive media. Direction and space on a television are significantly reduced relative to most computer interfaces. These results suggest that the cognitive and physical demands of controlling media generate responses separate from that which is elicited by content alone. In the tradition of the limited capacity model, control is demonstrated here to be an important structural feature of interactive media.

Finally, these results allow speculation about how a greater understanding of interactivity may change existing assumptions about the psychological processing of media. Interactive media differ from traditional media in the time periods at which they engage processing resources. To this point, research on the psychological processing of media is largely based on an exposure period that begins when a particular message appears and ends when that message disappears. The moments before stimulus onset are considered a baseline period of little theoretical importance. Interactive media, on the other hand, require people to do more to *get* to the period that researchers define as exposure. Distinguishing between "getting there" and "being there," where "there" is defined as exposure to a message, may be helpful. Research on the psychological processing of traditional media generally focuses on "being there." This study showed that when "getting there" required active pointing and clicking rather than passive waiting, people experienced significantly different cognitive and emotional responses. An understanding of how people process interactive media is impossible without exploring the relationship between getting there and being there. Perhaps with interactive media, as the saying goes, the journey is more important than the destination.

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REFERENCES

Ball, T. S., & Vogler, R. E. (1971). Uncertain pain and the pain of uncertainty. *Perceptual and Motor Skills*, *33*(3, Pt. 2), 1195–1203.

Bradley, M. M. (2000). Emotion and motivation. In J. T. Cacioppo, L. G. Tassinary, and G. Berntson (Eds.) *Handbook of Psychophysiology* (pp. 602–642). New York: Cambridge University Press.

Center for the Study of Emotion and Attention [CSEA-NIMH] (2001). *The international affective picture system: Digitized photographs.* Gainesville, FL: The Center for Research in Psychophysiology, University of Florida.

Cook, E. W., III, Atkinson, L. S., & Lang, K. G. (1987). Stimulus control and data acquisition for IBM PCs and compatibles. *Psychophysiology*, *2*, 726–727.

Cook, E. W., III, & Turpin, G. (1997). Differentiating orienting, startle, and defense responses: The role of affect and its implications for psychopathology. In P. J. Lang, R. F. Simons, & M. Balaban (Eds.), *Attention and orienting: Sensory and motivational processes* (pp. 137–164). Mahwah, NJ: Lawrence Erlbaum Associates.

Dawson, M. E., Schell, A. M., & Filion, D. L. (1990). The electrodermal system. In J. T. Cacioppo & L. G. Tassinary (Eds.), *Principles of psychophysiology: Physical, social, and inferential elements* (pp. 295–324). New York: Cambridge University Press.

Grabe, M. E., Lang, A., & Zhao, X. (2003). News content and form: Implications for memory and audience evaluations. *Communication Research*, *30*(4), 387–413.

Haggard, E. A. (1943). Experimental studies in affective processes: I. Some effects of cognitive structure and active participation on certain autonomic reactions during and following experimentally induced stress. *Journal of Experimental Psychology*, *33*, 257–284.

Hoffman, H. S. (1997). Attentional factors in the elicitation and modification of the startle reaction. In P. J. Lang, R. F. Simons, & M. Balaban (Eds.), *Attention and orienting: Sensory and motivational processes* (pp. 185–204). Mahwah, NJ: Lawrence Erlbaum Associates.

Lang, A. (1994). What can the heart tell us about thinking? In A. Lang (Ed.), *Measuring psychological responses to media* (pp. 99–113). Hillsdale, NJ: Lawrence Erlbaum Associates.

Lang, A. (2000). The limited capacity model of mediated message processing. *Journal of Communication*, *50*(1), 46–70.

Lang, A., Borse, J., Wise, K., & David, P. (2002). Caputured by the World Wide Web: Orienting to structural and content features of computer-presented information. *Communication Research*, *29*(3), 215–245.

Lang, P. J. (1995). The emotion probe: Studies of motivation and attention. *American Psychologist*, *50*, 372–385.

Lang, P. J., Bradley, M. M., & Cuthbert, B. N. (1997). Motivated attention: Affect, activation, and action. In P. J. Lang, R. F. Simons, & M. Balaban (Eds.), *Attention and orienting: Sensory and motivational processes* (pp. 97–135). Mahwah, NJ: Lawrence Erlbaum Associates.

Lang, P. J., Bradley, M. M., & Cuthbert, B. N. (2001). International affective picture system (IAPS): Instruction manual and affective ratings. Technical Report A-5, The Center for Research in Psychophysiology, University of Florida.

Lang, P. J., Bradley, M. M., Cuthbert, B. N., & Hamm, A. O. (1993). Looking at pictures: Affective, facial, visceral, and behavioral reactions. *Psychophysiology*, *30*, 261–273.

Liu, Y., & Shrum, L. J. (2002). What is interactivity and is it always such a good thing? Implications of definition, person, and situation for the influence of interactivity on advertising effectiveness. *Journal of Advertising*, *31(4),* 53–64.

Lykken, D. T., & Tellegen, A. (1974). On the validity of the perception hypothesis. *Psychophysiology*, *11*, 125–132.

Ohman, A. (1979). The orienting response, attention, and learning: An information-processing perspective. In H. D. Kimmel, E. H. Van Olst, & J. F. Orlebeke (Eds.), *The orienting reflex in humans* (pp. 443–471). Hillsdale, NJ: Lawrence Erlbaum Associates.

Ohman, A. (1997). As fast as the blink of an eye: Evolutionary preparedness for preattentive processing of threat. In P. J. Lang, R. F. Simons, & M. Balaban (Eds.), *Attention and orienting: Sensory and motivational processes* (pp. 165–184). Mahwah, NJ: Lawrence Erlbaum Associates.

Prattor, F., & John, O. P. (1991). Automatic vigilance: The attention-grabbing power of negative social information. *Journal of Personality and Social Psychology*, *61*, 380–391.

Roskos-Ewoldson, D. R., & Fazio, R. H. (1992). On the orienting value of attitudes: Attitude accessibility as a determinant of an object's attraction of visual attention. *Journal of Personality and Social Psychology*, *63*(2), 198–211.

Sokolov, E. N. (1963). *Perception and the conditioned reflex*. Oxford, England: Pergamon Press.

Staub, E., Tursky, B., & Schwartz, G. E. (1971). Self-control and predictability: Their effects on reactions to aversive stimulation. *Journal of Personality and Social Psychology*, *18*(2), 157–162.

Steuer, J. (1992). Defining virtual reality: Factors determining telepresence. *Journal of Communication*, *42*(4), 73–93.