The Relationship Between Physiological Responses and Emotion Regulation Behavior During Situation Modification

Taylor Vonk

Northeastern University
Abstract

As we navigate the world around us, emotion regulation plays an essential role in how we manage our emotional and physiological responses to the things, people, and situations that we encounter every day. One important way people can regulate their emotions is by changing or modifying the emotional situations they encounter. Previous research has shown that people use information about their physiological responses to make decisions about emotional material (Birk & Bonnano, 2016), so the current study sought to better understand what motivates people to modify emotional situations by examining the relationship between physiology and situation modification. The current study monitored participants’ heart rate and skin conductance while they watched emotional video clips and decided whether to skip or watch segments of the videos. Emotion levels of each video and self-reported mood were measured in terms of both valence (positive, negative, or neutral) and arousal (physical activation). The study found that participants skipped segments of neutral videos and low arousal videos most frequently. Skipping more negative video clips was correlated with more negative mood. This suggests that participants preferred emotional and arousing material, regardless of whether it was positive or negative.
Introduction

Emotion regulation, or how we manage our emotions and physiological responses, is essential to how we navigate the world around us. In every experience, these emotional and physiological responses go hand in hand. For example, when we experience strong emotions, physiological responses like our heart rate, skin temperature, or energy level may change. Emotion regulation involves finding allostasis, or balance, that satisfies our needs for both emotion and physiology. For example, in stressful situations, it is important for us to be activated enough to able to react with fight or flight responses but also not be so activated that we are frozen with fear. On the other hand, if we are too happy and physically relaxed, we may not be prepared enough for sudden dangers that may arise. Not only is an emotional and physical allostasis important in specific situations, but it is also important throughout our lifetimes. For example, positive emotions have been theorized to contribute to long-term physiological well-being such as improved immune system function, decreased risks of heart disease, and greater longevity (Tugade, Fredrickson, & Barrett, 2004). Because of this need for balance, emotion regulation is a dynamic and fluid process that allows us to manage our responses to different kinds of situations in our lives.

Emotion Regulation

The emotion regulation strategies that people use to respond to, and process emotional situations, also play an important role in emotional experiences. The Process Model of Emotion Regulation suggests that there are five major categories of emotion regulation strategies (Gross, 1998). These categories include situation selection (choosing what situation to put yourself in), situation modification (changing the situation that you are already in), attentional deployment (what you pay attention to),
cognitive change (changing the meaning of the situation in your mind), and response modulation (directly changing your response to the situation).

These different strategies can be grouped into preemptive and responsive categories. In the preemptive category, situation selection and situation modification are used to regulate emotion either before a situation occurs or during the beginning of a situation unfolding. On the other hand, responsive strategies, like attentional deployment, cognitive change, and response modulation, are used once the situation has already begun unfolding or after the situation has already occurred. Researchers suggest that, at least in short term situations, the more preemptive emotion regulation strategies are more effective than the responsive strategies for regulating emotion (Vujovic, Opitz, Birk, & Urry, 2014).

However, there is significantly less research on situation selection and situation modification than the other strategies and little is understood about what motivates people to use these strategies.

Since previous research suggests that emotion regulation is guided by physiological responses (Birk & Bonnano, 2016), it is important to examine physiology during emotional situations in order to better understand the mechanisms behind the use of these preemptive strategies. However, not only is there an insufficient number of studies on preemptive strategies (Vujovic, Opitz, Birk, & Urry, 2014), but there is also a need to examine this essential relationship between emotions and physiology (Charles, 2010). Thus, it is important to study the role of physiology in emotion regulation to better understand what motivates our behaviors in response to the world around us.

Situation modification is a particularly interesting strategy to examine, in terms of physiology, because of the time at which it occurs during the experience of emotion. In situation modification, it is much easier to empirically examine the role of physiological responses because situation modification is usually employed in reaction to the experience of unwanted emotions once a situation has already begun unfolding. Thus, there are concrete physiological responses to measure during situation modification.
A previous study, that examined situation modification, found no age differences in the effectiveness of a particular situation modification strategy. During a task, in which participants were shown video clips and allowed to skip as many segments of the video as they wanted, the researchers found no relationship between skipping segments and participants’ reported moods (Livingstone & Isaacowitz, 2015). This finding raises the question of why participants continued to use the strategy, by continuing to skip video segments, even though it did not seem to lead to more positive emotional experiences.

Current Study

To address the questions raised by this experiment and to better understand the mechanisms underlying situation modification, the present study was designed to examine the use and effectiveness of the situation modification strategy in conjunction with physiological responses. To do so, the present study monitored participants’ heart rate, impedance, and skin conductance while they watched video clips and decided whether to watch or to skip segments of the videos. Thus, this study can help us begin to understand how physiological reactivity may motivate peoples’ emotion regulation behavior.

Hypotheses

Situation Modification Use

1. In the Livingstone & Isaacowitz (2015) study, the researchers found that valence was not significantly related to skipping behavior. In concurrence with this finding, I hypothesized that participants would skip a similar number of positive and negative video clips.

2. Additionally, I hypothesized that participants would choose to skip viewing more low arousal video segments. I hypothesized these results because previous studies on the role of arousal in
emotion regulation have shown that younger adults may choose higher arousal material more than lower arousal material (Sands & Isaacowitz, 2016; Sands, Garbacz, & Isaacowitz, 2016). Existing theories in emotion regulation suggest that, because younger adults see themselves as having plenty of time left in life, they are more interested in experiencing emotional situations, regardless of whether they are arousing, in order to gain more life experiences (Carstensen et. al., 1999).

**Situation Modification Effectiveness**

3. Also in accord with the results of the Livingstone & Isaacowitz (2015) study, I hypothesized that skipping negative material would not be related to emotional experience, indexed by self-reported valence ratings, but that skipping positive material would be related to more negative emotional experiences.

4. I hypothesized that increased arousal responses would not lead to increased skipping behavior because younger adults seem to find arousing material more interesting.

5. In the same vein as Hypothesis 4, I further hypothesized that skipping high arousal material would be related to decreased arousal responses (i.e., decreased heart rate and skin conductance levels).

**Method**

**Participants**

31 younger adults, aged 18-23 years, (M_{age} = 19.06, SD_{age} = 1.23) were recruited from Northeastern University’s student participant database, Psylink, for credit in the Introduction to Psychology course. There were 18 females and 13 males. Participants had a variety of ethnic (3.2% Hispanic) and racial backgrounds (51.6% Caucasian, 35.4% Asian, 12.9% African American).
Participants were screened for health issues and medications influencing the function of the autonomic nervous system prior to participation.

**Materials**

*Physiological Measures*

The physiological measures were selected to be a representative sample across different autonomic nervous system measures. A Mindware 8-slot Bionex chassis (Mindware Technologies Ltd., Gahana, OH) recorded an electrocardiogram (ECG), cardiac thoracic impedance measures, and electrodermal activity. Cardiovascular measures were recorded using standard disposable ECG electrodes applied after the skin was prepared at each site with abrasive gauze and an alcohol pad. The ECG was recorded at a rate of 500 Hz using a modified Lead II configuration (Berntson et al., 1997). Impedance cardiography was recorded using a four-spot electrode configuration (see Sherwood et al., 1990). Skin conductance was recorded with Ag/AgCl electrodes, containing EDA paste, placed 2 cm apart on the palm of the non-dominant hand. Impedance and skin conductance measures were not included in the analyses for the purposes of this paper.

*Pre-experimental Health and Cognitive Screen*

To ensure that I used a healthy subject pool, and that I can attribute changes in physiology to our experimental manipulations, participants were screened for chronic health problems and recent substance use. These criteria also excluded any psychologically or physically vulnerable subjects. Participants were assessed for, and excluded based on having:

1. Asthma
2. Cardiovascular illness or stroke
3. Chronic medical problems
4. Skin allergies to adhesives
5. Self-reported (past or present) psychiatric illness
6. Use of prescription drugs, alcohol, tobacco and caffeine within 12 hours of participation
7. Implantable cardioverter defibrillators (ICDs) or pacemakers

**Cognitive Tests and Personality Questionnaires**

Participants completed measures of fluid intelligence, including the digit span and digit symbol tasks from the Wechsler Adult Intelligence Scale-Revised (WAIS-R; Wechsler, 1981). Participants also completed a set of questionnaires that included a basic demographics inventory (age, ethnicity, level of education, religious affiliation, and current health status) and measures of current mood using the Positive and Negative Affect Scale (PANAS; Watson et al., 1988). Participants then completed a series of questionnaires that assessed personality, typical affective experience, and emotion regulation styles. These included the Midlife Development Inventory (MIDI) Personality scales (Lachman & Weaver, 1997), the Center for Epidemiological Studies-Depression (CES-D) Scale (Radloff, 1977), the Life Orientation Test (LOT; Scheier & Carver, 1985), the Emotion Regulation Questionnaire (ERQ; Gross & John, 2003), the Emotional Self-Efficacy Scale (ESES; Kirk et al., 2008), and the Emotional Mindset Scale (EMS; unpublished). These measures were collected as standard lab protocol but are not central to the hypotheses and thus will not be discussed further in this manuscript.

**Video Stimuli**

The emotional stimuli for this study consisted of a series of 3 to 5 minute long video clips that have been used by previous researchers and have been shown to elicit negative, positive, or neutral emotions. There were two low-arousal positive, two low-arousal negative, two high-arousal positive,
two high-arousal negative, and two neutral videos. These videos were tested in an online survey with a different set of participants to ensure that there are no age differences in perceived arousal and valence of the videos before use in the study and so that participants’ peripheral physiological arousal could be measured. Each video was divided into roughly 20-30 second segments at the end of each of which participants were asked if they wanted to watch the next segment. The segments were chosen based on both logical points of transition in the video clips as well as sections that would potentially elicit different arousal responses. For example, if a video clip was a news report about a stunt driver jumping a car over a canyon, the first segment would be the reporters describing and discussing the stunt, the second segment would be the driver preparing to make the jump, the third segment would be the driver making the jump, and the fourth segment would be the driver safely completing the jump. With this method of dividing the videos into segments, I was able to track specific time points in participants’ arousal responses. The videos were programmed in the experiment using EPrime 2.0 software (Schneider, Eschman, & Zuccolotto, 2001) in order to coordinate participants’ behavioral choices and physiological responses with the stimuli.

Procedure

Participants completed a shorter version of the health questionnaire in an online survey format and were instructed to email the researchers stating whether they were eligible to participate in the study or not (participants were instructed not to indicate why they were excluded from the study). Once participants’ eligibilities were determined, they were scheduled for the experiment.

At the laboratory session, participants provided informed consent. Then the researcher attached the physiological sensors and the participants completed demographic and additional health questionnaires while the physiological signals stabilized. Participants then sat quietly during a 5-minute
resting period to obtain their baseline physiology when in a presumed neutral state. Next, the researchers provided written and verbal instructions to the subject. After this baseline period of data collection, participants watched a series of 10 video clips that ranged in emotional content. Periodically, throughout each video, the video paused and the participant was prompted to indicate if they wanted to continue watching the video or skip to the next segment. If they chose to continue watching, the video continued playing from where it paused. If they chose to skip to the next segment, the video skipped to the next segment that was predetermined by the researchers. To ensure that participants did not choose to skip segments just to finish the experiment faster, participants were told that if they finished the video portion early, they would be given another task until the full two hours were finished. During the video, participants were also instructed to rate their valence continuously using a dial. Next, the researcher went through a practice run with the participant. After the practice run, and once the participant acknowledged that he or she understood the instructions, the researcher started the experiment and then left the testing room. The researcher then monitored the experiment from the control room. After the participant completed all the experimental tasks, he or she was debriefed and granted credit toward their psychology course (2 credits for a two-hour session).

Results

Scoring

Skipping. Participants’ skipping behavior during the experiment was measured as the percentage of the possible total number of skips.
Physiology. Physiological signals were aggregated into bins for each video. Physiological reactivity was then computed by subtracting the average for the last two minutes of the resting baseline from the video average for heart-rate and RSA.

Analysis

Manipulation Check

To examine if the video valence predicted self-reported valence at the end of each video, I conducted a repeated-measures ANOVA. I found that people felt best after positive videos and worst after negative videos ($F(2, 64) = 44.876, p < .001, \eta^2_p = .548$). I also found that people reported higher levels of arousal after watching high arousal videos ($F(2, 64) = 23.519, p < .001, \eta^2_p = .424$) compared to low arousal and moderate arousal videos.

Situation Modification Use

I conducted a repeated-measures ANOVA to examine if video valence predicted the percentage of video clips skipped. I found a main effect of valence with participants skipping more neutral segments ($F(2, 64) = 5.971, p = .004, \eta^2_p = .157$) than positive ($p = .045$) or negative ($p = .050$) video segments. Consistent with my Hypothesis 1, participants skipped the same number of positive and negative video segments (see Figure 1). Additionally, I conducted a repeated-measures ANOVA to examine if video arousal predicted the percentage of video clips skipped. Consistent with my Hypothesis 2, I found that participants skipped low arousal videos significantly more than high arousal videos ($F(1,32) = 3.89, p = .057, \eta^2_p = .144$; see Figure 2).
Physiological Responses

I also conducted repeated-measures ANOVAs to examine if there is a relationship between video valence and heart rate or RSA. I found a main effect of video valence on heart-rate reactivity ($F(2,38) = 4.41, p = .019$), with the lowest heart-rate reactivity during negative videos and highest heart-rate reactivity during positive videos. However, I found no effect of video valence on RSA reactivity, ($F(2,32) = 0.76, p = .477$). Additionally, there was no difference in heart-rate reactivity ($F(1,19) = 1.35, p = .259$) or RSA reactivity ($F(1, 16) = 1.08, p = .310$) between the low and high arousal videos.

Situation Modification Effectiveness

To determine whether skipping behavior is related to mood, I aggregated the skipping and reactivity data by the affective content of the video (e.g. positive low, negative high, etc.) There were no outliers that required removal. I correlated the percentage of clips skipped with valence ratings for each of the video types. Inconsistent with my Hypothesis 3, skipping negative videos was negatively related to valence ($r = -.401, p = .02$), where increased skipping was related to decreased valence. For neutral videos, there was a marginally significant relationship with more skipping being linked to more negative valence ratings ($r = -.331, p = .06$). Also, inconsistent with my Hypothesis 3, there was no significant relationship between skipping positive videos ($r = -.256, p = .150$). Additionally, there was no significant relationship between skipping either high arousal videos ($r = .231, p = .914$) or low arousal videos ($r = .176, p = .327$) and reported valence.

To determine whether skipping behavior is related to physiological responses, I also correlated the percentage of clips skipped with heart rate and RSA reactivity. Inconsistent with my Hypothesis 4 and Hypothesis 5, there was a significant relationship between heart-rate and skipping behaviors for the
neutral videos ($r = -0.199$, $p = .04$) and low arousal videos ($r = -0.122$, $p = .018$) where more skipping was linked to a smaller change in heart rate. For RSA, there was no relationship to skipping behavior.

**Discussion**

The purpose of this study was to examine whether there was an effect of video valence or arousal on the use of situation modification and whether physiological responses were related to situation modification, indexed by skipping behavior. The study found that participants skipped significantly more neutral videos than emotional videos. This finding supports my Hypothesis 1, that participants would skip a similar amount of positive and negative videos. While valence did influence skipping behavior, skipping was only increased for neutral videos, which essentially lack emotional content, whereas participants watched more of the positive and negative videos. The findings of the study also support my Hypothesis 2, that participants would choose to skip viewing more of the low arousal video segments, suggesting that they preferred more arousing content. Because the study used a younger adult participant sample, this finding aligns with previous research that also suggests that younger adults prefer higher arousal material over lower arousal material (Sands & Isaacowitz, 2016; Sands, Garbacz, & Isaacowitz, 2016).

I also found that skipping more negative videos was related to more negative valence and that skipping positive videos was not related to valence, which contradicts my Hypothesis 3 that skipping negative material would not be related to emotional experience and that skipping positive material would be related to more negative emotional experiences. While this correlation suggests that there is a relationship between reported valence and skipping behavior, the correlation does not determine the directionality of this relationship (i.e. whether skipping predicts mood or mood predicts skipping). It is
possible that people that felt worse chose to skip more negative materials, or alternatively, it is possible that skipping the negative content led to worse moods. If people chose to skip more negative material because they felt worse, it suggests that participants were attempting to regulate their emotions by using the situation modification strategy. This supports the idea posited by the Process Model that one way in which people can attempt to regulate their emotions is by using the situation modification strategy (Gross, 1998). If skipping the negative content led to worse moods, a possible explanation is that situation modification was an ineffective strategy for regulating mood; if situation modification was effective, participants should theoretically experience better moods after skipping negative content. However, because the directionality of the relationship between skipping material and mood is still unclear, more complex analyses will need to be performed to better understand whether skipping negative material led to worse mood or if worse mood led to skipping negative material.

Additionally, I found that there was a correlation between skipping behavior and heart rate for low arousal videos but not for high arousal videos, which contradicts my Hypothesis 4 that increased arousal would not lead to increased skipping behavior. Specifically, there was a relationship between increased skipping during neutral and low arousal videos and decreased heart rate. This finding suggests that neutral and low arousal content, while not reported to be unpleasant, may not align well with individuals’ ideal affective states (Roberti, 2004). Furthermore, I found that there was no relationship between skipping high arousal video clips and heart rate, which contradicts my Hypothesis 5 that skipping high arousal material would predict decreased arousal responses. It may be that young individuals actually prefer more arousing, affective situations regardless of their valence. A possible explanation for the lack of correlation between skipping high arousal video clips and heart rate is that there are individual differences in whether people prefer to engage in high arousal material and how they are affected by it (Roberti, 2004). As with the correlations between skipping and mood, these
correlations between skipping and physiological responses do not determine the directionality of the relationship (i.e. whether skipping predicts arousal or arousal predicts skipping). Therefore, more complex analyses will also need to be performed to better understand whether skipping neutral or low arousal material leads to decreased heart rate or if decreased heart rate leads to skipping more neutral or low arousal material.

Some of these findings seem to align with existing theories and research that suggest that people use situation modification to attempt to regulate their emotions (Gross, 1998), that valence is not significantly related to the use of situation modification (Livingstone & Isaacowitz, 2015), and that younger adults prefer higher arousal material over lower arousal material (Sands & Isaacowitz, 2016; Sands, Garbacz, & Isaacowitz, 2016). While situation selection is often conceptualized as a strategy that allows people to change the environment before or after emotions become too intense, this study suggests that situation modification may play an important role for regulation in low arousal and neutral situations, which may not align with younger individuals’ ideal affective states.

However, there are some limitations to this study. For example, in the design of the study, there were only two videos for each valence-arousal pairing (positive and negative, high and low arousal) in addition to two neutral arousal and valence videos. The small number of videos in each category meant that there was not a very wide range of variability in valence and arousal. Additionally, the current study only examined arousal during one emotion regulation strategy. To get a better picture of how arousal affects emotion regulation, more strategies should be examined.

This study provides initial evidence that arousal may play an important role in situation modification. Previous research suggests that age-related differences in motivation and resources may change the effectiveness of some forms of emotion regulation (Charles & Luong, 2013). So, future
research should examine older adults under the same paradigm as this study in order to better understand these age differences in the role of physiology in emotion regulation.

Since the exact mechanisms that underlie emotion regulation, specifically how physiology plays a role, are still not fully understood, it is important to continue exploring different possible regulators of emotion in addition to age, such as arousal, attention, trauma history, etc. Once these mechanisms are better understood on their own, it will be useful to integrate them and see how they interact with each other. Furthermore, it will be necessary to try to improve these studies so that they represent real life as well as possible. Gaining these understandings is important because it allows us to better understand the human emotional experience and how to modify, improve, and utilize it for various applications such as treatment of disorders, conflict resolution, and interpersonal relationships.
References


Figures and Tables

Figure 1. Average percentage of positive, negative, and neutral video clips skipped

Figure 2. Average percentage of high and low arousal video clips skipped