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„Psychophysiological measures of boredom:
How does boredom affect the willingness to exert effort?"

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Abstract

The often negatively connotated phenomenon of boredom has been found to fulfill the function of causing attentional shifts towards explorative and engaging cues helping to escape the current situation. Thus, experiencing a lack of stimulation might cause attentional shifts towards more effortful situations and activities. This study investigated if individuals bored due to understimulation are motivated to exert more effort compared to non-bored individuals when given the opportunity to perform a subsequent task. It was hypothesized that boredom due to understimulation enhances the motivation to exert effort, and that this effect is reflected by the cardiovascular system, specifically in the form of a shortened pre-ejection period (PEP). The difficulty of the task was unknown to participants. Effort was measured via cardiovascular reactivity. A total of 111 participants were randomly assigned into two independent groups (boredom/experimental vs. neutral/control). Change scores on PEP, heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP) as well as self-reported questionnaire data were compared. The main results revealed a significant effect, albeit opposite to what was hypothesized. This indicates an existing connection between boredom and effort mobilization, providing new insights upon which future research will benefit from.

Keywords: motivation, boredom, effort, cardiovascular reactivity, pre-ejection period

Contents

Introduction

Boredom appears to be pervasive. Affecting individuals of all genders, ages, and cultures, the experience of being bored is often described as an aversive state of wanting, but not being able, to engage in satisfying activity (Eastwood et al., 2012). Due to its commonness and affective experience, most of us have little trouble both recognizing and distinguishing it from other related emotions and affective states (Goldberg et al., 2011; van Tilburg & Igou, 2012). Yet despite its prevalence and our familiarity with it, the precise nature of boredom remains elusive (Danckert, 2013). This elusive nature is illustrated nicely by the lack of consensus on how to define boredom (Belton & Priyadharshini, 2007; Kanevsky & Keighley, 2003; Vodanovich & Watt, 2015).

While an agreed upon definition of boredom has not been formulated, most researchers agree that understanding the phenomenon of boredom is paramount due to its many real world consequences. Specifically, boredom has been associated with low academic performance, high dropout rates, mistakes on the job, depression, and anxiety (van Hooft & van Hooft, 2018), as well as impulsive and reward-seeking behavior such as gambling, overeating, and drug abuse (Blaszczynski et al., 1990; Crockett et al., 2015; Iso-Ahola & Crowley, 1991), but a view gaining favor among researchers proposes that boredom has an important function for humans (Bench & Lench, 2013). Recent studies that look at boredom as a state define it as a discrete emotion that steers our cognition and actions by conveying information about our environment and psychological state (Westgate & Steidle, 2020). When we are bored, our attention shifts, and we seek out novel stimuli or activities that are different from the ones that caused the bored state (Elpidorou, 2018). These stimuli and activities can even be negative, as long as they differ from the boring stimuli and activities (Bench & Lench, 2019). Consequently, the state of boredom might affect people's motivation to exert effort when facing the possibility of escaping the current situation.

Given the behavioral, medical, as well as social impact of boredom, detailed research on the underlying mechanisms of boredom seems necessary. One way of learning more about the underlying mechanisms of boredom is through a better understanding of its psychophysiological consequences. Still, relatively little is known about the distinct character of boredom, in particular its psychophysiological nature. As one of four experiential character components proposed by Elpidorou (2018), the physiological consequences of boredom play a major part in the process of holistically understanding its construct.

The central objective of this thesis is to contribute to our understanding of the construct of boredom by determining the psychophysiological consequences of boredom due to understimulation and applying it to the context of volition, a second character component proposed by Elpidorou (2018). In particular, the thesis focuses on how boredom affects the willingness to exert effort.

It is important to mention that the data collection was conducted in cooperation with Simon Gander, as his master's thesis was written in the same area of research. For this reason, the sample and the manipulation, as well as parts of the study procedure and the survey instruments used, are identical.

Theoretical Background and Hypotheses

Boredom

Westgate and Wilson (2018) mention three groups of theories of boredom focusing on different aspects of boredom. *Environmental* theories focus on the environmental inputs that cause boredom, such as constrained choice (Chin et al., 2017), non-optimal arousal (Berlyne, 1960), and insufficient stimulation (e.g., Posner, Russell, & Peterson, 2005), while *attentional* theories focus on the cognitive processes underlying boredom, specifically the regulation of attention (Eastwood et al., 2012). In contrast to environmental or attentional theories of boredom, *functional* theories focus on its underlying purpose and view boredom as a discrete emotion with an adaptive function (Westgate & Steidle, 2020) that serves as a bearer of information. This was not always the case. Before boredom was defined as an emotion, it was often seen as a neutral state, not fitting the definition of an emotion as a situated affective state (Clore & Ortony, 2013). In the meantime, this view has changed (Westgate & Steidle, 2020). For instance, research has found people would rather choose negative stimuli such as the admission of mild electric shocks (Wilson et al., 2014) or looking at disturbing imagery (Bench & Lench, 2019) than being bored. Merrifield and Danckert (2014) showed that the psychophysiological signature of boredom is distinct from other emotional states as well. These findings indicate that boredom should indeed be treated as a discrete emotion (Elpidorou, 2018).

Traditionally, theories of state boredom argue that it arises from a lack of arousal (Fiske & Maddi, 1961; Hebb, 1966). However, research has illustrated that low arousal (Mercer & Eastwood, 2010; Thackray et al., 1977; van Tilburg & Igou, 2017), high arousal (Abramson & Stinson, 1977; London et al., 1972), and even a combination of both low and high arousal (Chin et al., 2017; Eastwood et al., 2012; Fahlman et al., 2013) can be associated with boredom. Thus, accounts solely focusing on arousal have been deemed insufficient for explaining the complex phenomenon of boredom. Subsequently, researchers argued for two different factors to produce boredom: either (1) a lack of attention or (2) a lack of meaning. Researchers focusing on the attentional roots of boredom argue that the affective state of boredom occurs when people are aware that they cannot engage their attention in an activity and attribute this lack of engagement to the activity (Eastwood et al., 2012). Researchers focusing on the meaning roots of boredom argue that the affective state of boredom signals to the individual that the current activity lacks meaning and motivates them to find meaning in an alternative activity (Schmeitzky & Freund, 2013; van Tilburg & Igou, 2012).

Meaning and Attention Components Model of Boredom

Following the understanding produced by these newer theories, Westgate and Wilson developed the *Meaning and Attention Components* (MAC) *Model of Boredom* (2018), proposing that boredom is a functional emotion with both attentional and meaning components and suggesting that this distinction can be applied to better understand boredom. The attentional component alludes to the information that boredom provides on whether successful cognitive engagement in the current task is present (Westgate & Wilson, 2018). The meaning component informs whether the current task, regardless of engagement, is important to the individual and thus worth seeking (Westgate & Wilson, 2018). In other words, the attention component can be described as a (mis)match between requirements and resources, while the meaning component is composed of a (mis)match between activities and valued goals. According to this model, the two components can cause boredom independently and give rise to different profiles of boredom, each with different effects on cognition and behavior (Westgate & Wilson, 2018).

Another central proposition of the MAC model is that different profiles of boredom have different motivational and behavioral consequences, depending on the constellation of the components and their specific nature. The one profile central to this research, Profile A, emerging from understimulation (attention component) and low meaning (when the task is incongruent with valued goals; meaning component), is that of meaningless and attentional boredom, which as a function predicts the outcome of seeking an interesting activity (Westgate & Wilson, 2018). This is in line with *optimal arousal theory*, which posits the existence of person- and situation-relative optimal levels of arousal or challenge and claims that a certain behavior is exhibited that enables this optimal level to be reached (Csikszentmihalyi, 1975, 1988).

To substantiate these propositions, Westgate and Wilson (2018) conducted four studies, the first of which was a meta-analysis compiling 14 experimental studies, propounding evidence for the alleged connection of both components with boredom. The second study found significant main effects for both components in predicting boredom, with no significant interaction between the components themselves. The third study examined the relationship between cognitive demand and boredom on a correlational level. In accordance with the propositions of the MAC-model, results provided evidence for a curvilinear relationship, meaning both low and high demand were correlated to boredom, while moderate demand was not. In the fourth and final study, which was an analysis of a prior experiment (Westgate et al., 2017), the cognitive demand of a given task was manipulated, and it was found that making demanding tasks easier to perform also lowered boredom as a result. Thus, strong evidence exists illustrating the functional components and antecedents of boredom. In contrast, evidence illustrating its downstream influence on subsequent motivation is limited.

Motivational Consequences of Boredom

Many have assumed that boredom should directly influence motivation due to its classification as an aversive effect and its ability to motivate behavioral and cognitive changes (Elpidorou, 2014, 2017). This has led many researchers to conclude that boredom's function is to prompt individuals to seek out new and rewarding experiences in order to find meaning and stimulation that may be lacking in their current environment (Geana et al., 2016; Inzlicht & Friese, 2019; Westgate & Wilson, 2018). However, the evidence for the direct motivational consequences of boredom on subsequent activities in the same situational setting is limited.

It has been suggested that boredom, indirectly, contributes to motivational consequences for subsequent activities in the same situation setting, as evidenced by researchers who claim that the classic ego-depletion effect is the result of inducing boredom during initial self-control depletion (Wolff & Martarelli, 2020). Only recently has direct evidence for this assumption been provided by research that revealed increased brain-related reward activation to reward cues (Milyavskaya et al., 2019) and increased exploration-type behavior even at the cost of monetary reward (Geana et al., 2016) following the induction of boredom. Although these findings support the notion that boredom can prompt individuals to seek out new experiences, further research is needed to directly test this assumption.

Effort Mobilization and Cardiovascular Response

Building upon the work of Obrist's active coping hypothesis (1981) — beta adrenergic influences on the heart and vasculature vary with effort in response to a performance challenge, which he called "active coping" — Wright (1996, 1998) proposed applying motivational intensity theory (MIT) to predict myocardial sympathetic activity. Since then, a plethora of studies (see Gendolla & Richter, 2005, 2009; Gendolla & Wright, 2005; Wright & Kirby, 2001) have altered the parameters of active coping tasks, while utilizing myocardial sympathetic activity as a measure of effort mobilization, as outlined in Wright's (1996) approach. While most research has focused on tasks with known difficulty (see Richter et al., 2012 & 2016), this thesis examines active coping during tasks with unknown difficulty. According to MIT, importance predicts effort directly for tasks of unknown difficulty. To adequately assess effort mobilization, it is necessary to measure cardiovascular indicators since effort mobilization is reflected in sympathetic activity on the heart and vascular system. For over four decades, cardiovascular (CV) indicators have been utilized as a reliable measure of engagement and effort mobilization (Richter et al., 2016). The majority of studies have used measures that reflect the force of myocardial contraction in the peripheral vasculature. Systolic blood pressure (SBP) represents the maximum force the heart exerts on the arteries between two heartbeats, while diastolic blood pressure (DBP) represents the minimum force on the arteries between two heartbeats. The number of heartbeats in a given time period, typically a minute, is known as the heart rate (HR). Recently, the pre-ejection period (PEP) has become the primary measure of myocardial contraction since it is measured directly on the heart rather than the vasculature. PEP represents the time between the initial ventricular depolarization and the opening of the aortic valve, and it is considered the most reliable and noninvasive indicator of sympathetic impact on the heart currently available. This is because PEP directly reflects changes in the force of myocardial contraction and is less dependent on parasympathetic impact or peripheral resistance compared to conventional measures such as blood pressure (Newlin & Levenson, 1979; Sherwood et al., 1990). For more information on the details and limitations of cardiovascular measurements, see Richter and colleagues (2016).

Current Study

Based on the work of Westgate and Wilson (2018), the current study aims to illustrate the psychophysiological signature of state boredom and what downstream motivational consequences it has on motivation to engage in subsequent activities in the current setting. First, participants completed a task designed to induce either high or low levels of attentional boredom through understimulation. Following this, participants completed a clicking task that has previously demonstrated the ability to capture minute changes in motivational states (Mlynski et al., 2020). To precisely measure differences in motivation between the two groups, CV indicators of effort mobilization were assessed, specifically PEP. In the current design, CV indicators provide a unique insight into the psychophysiological nature of boredom as well as participants' willingness to engage and mobilize resources in our subsequent task. In doing so, it can illustrate how state boredom increases effort mobilization in subsequent activities.

Additionally, this study aims to demonstrate the effect of boredom on increasing performance in subsequent activities. Ultimately, this will provide researchers and practitioners with a new level of nuance and understanding of how to manage the real-world consequences of state boredom.

Hypotheses

The main hypotheses derived from the presented theoretical background and central to this research are:

H1: Bored participants show greater effort-related CV response in subsequent activities.
H2: Bored participants show increased effort-related CV responses during the boredom manipulation.
H3: Bored participants perform better on subsequent activities.

Method

Data for this study was collected via a laboratory experiment. In addition to this thesis, the experiment also collected data for another thesis (Gander, 2023), which explored how boredom due to understimulation affects the evaluation of effort using implicit association tests (IAT) and the German version of the Brief Sensation Seeking Scale (BSSS; Hoyle et al., 2002).

Sample

The study aimed for a sample of at least 102 participants to find the hypothesized main effect that boredom would increase motivation on a subsequent task in the current situational setting, operationalized as an increase in effort mobilization and performance, as calculated by G*Power 3.1 (Faul et al., 2007) using a medium effect size of d =.5, an alpha of .05, and aiming to reach a power of 80%. The study concluded with a final sample of 111 students, of whom 57 were randomly placed in the boredom group and 54 were placed in the control group. Of those, 74 were women, 35 were men, one was non-binary, and one chose not to disclose their gender. Participants were young on average, with 78 indicating an age range of 18 to 24 years old, 28 indicating an age range of 25 to 34 years old, 3 indicating an age range of 35 to 44 years old, one indicating an age range of 45 to 54 years old, and one choosing not to disclose their age. Participants were recruited through the University of Vienna's LABS recruitment system, since the research was conducted in the context of the master's program in psychology. Incentives were cash or LABS credit points. At the end of the experiment, participants had the option to choose between receiving either 12 euros in cash or, if they were psychology students, 5 LABS credit points as compensation for their participation.

Cardiovascular Measurement

Impedance cardiogram (ICG) and electrocardiogram (ECG) signals were noninvasively measured with a Cardioscreen 1000 system (medis, Ilmenau, Germany) to assess heart rate (HR) and PEP. B-point location was estimated based on the RZ interval of valid heartbeat cycles (Lozano et al., 2007). PEP (in ms) was determined as the interval between R-onset and B-point (Berntson et al., 2004). This is generally accepted as the gold standard for measuring effort-related CV activation due to the lack of influence from changes in parasympathetic activity or vascular resistance, as is the case in other common effort-related CV activation measures (e.g., systolic blood pressure and heart rate).

HR was determined on the basis of IBIs assessed with the Cardioscreen system. Additionally, systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), and HR were oscillometrically assessed with a Dinamap Carescape V100 monitor (GE Healthcare, Milwaukee, WI).

Manipulation of Boredom

In the experiment, a video manipulation of boredom specifically developed for this study was utilized. Video manipulations of boredom have been widely used in boredom induction research (Leary et al., 1986; Merrifield & Danckert, 2014). However, past video inductions of boredom have commonly utilized videos that differed in both their level of boredom induction and the informational content presented. This difference in content leads to an additional confounding variable that was intended to be avoided in the current study design. Thus, two versions of a publicly available academic video presentation were utilized. The two versions contained the same informational content but differed in the tone of the presenter and the visual aids used to increase participants' engagement in the video. By doing so, the aim was to vary boredom between the two groups through engagement while leaving the informational content identical. The video shown to the control group was a German TEDx talk (Hör! Mir! Zu! Warum wir gute Kommunikation lieben: Bert Helbig at TEDxStuttgart, 2013) about effective communication. The boredom group was shown the same literal content from the TEDx talk, but read by a man sitting in front of a white background and significantly slowed down by approximately 10% using video editing software.

Participants were randomly assigned to watch the high-engagement version of the video (the control condition) or the low-engagement version (the boredom condition) and informed that they would be later tested on the content of the video with a multiple-choice test that came at the end of the experiment. Each video lasted approximately 420 seconds and was split into two 210-second segments.

Prior to the process of data collection for the main study, a pilot study with n = 38 participants was conducted online to ensure the targeted impact of the videos, with expectations towards a higher boring effect for the experimental group compared to the control group. The pilot study showed significant group differences in self-reported questions regarding feelings of boredom during the videos.

Clicking Task

A modified version of a clicking task was used that has previously illustrated the ability to capture effort mobilization changes due to changes in motivation (Mlynski et al., 2020). The clicking task instructs participants to click the left mouse button as often as possible during the presentation of a 5-second-long mildly unpleasant tone. The tone sounds every 10 seconds, and participants were informed to click only during the tone. The instructions further elaborate that to succeed on the task, participants would need to meet or exceed a certain number of clicks, which was unknown to them. Participants were presented with 24 tones throughout the task period; effort mobilization was measured during the entirety of the task; and performance was operationalized as the average number of clicks made during each tone presentation.

Measures

Attention Check Questions

A multiple-choice attention check questionnaire was created to ensure that informational content was not affected by the boredom manipulation. This questionnaire consisted of four items designed to gauge the participant's understanding of the content presented in the video. Each item asked about content that was directly stated in each video and provided four answer choices. For a closer look at the attention check questionnaire, please see Appendix A.

Manipulation Check Questions

To assess the quality of the manipulation, a version of the Multidimensional State Boredom Scale (MSBS; Oxtoby et al., 2018) that was adapted to fit the specific nature of the video boredom manipulation was administered. Participants were asked to rate their experience while watching the videos with eight items (e.g., "I felt bored."; "My mind has wandered."), on a 5-point Likert scale (1 = *not correct at all* to 5 = this is *completely right*). For a closer look at the manipulation check questionnaire, please see Appendix B.

Post-task Questions

To assess perceived importance and ability on the clicking task, participants were asked to indicate on a 10-point Likert scale how important it was for them to succeed on the clicking task (1 = *not important at all* to 10 = *very important*) and how good they believed they were at the clicking task (1 = *very bad* to 10 = *very good*).

The Multidimensional Mood Questionnaire

Current fatigue levels were measured using the multidimensional mood questionnaire (MDBF) developed by Steyer and colleagues (1994). The questionnaire contains 24 items, 12 of which form Version A of the questionnaire, and 12 additional items that form Version B. Participants rated their current mood on each item (e.g., "satisfied"; "rested"; "restless") at the present moment on a 5-point Likert scale ranging from 1 = *not at all* to 5 = *very*. Each version measures three distinct mood continuums: (1) *good mood* to *bad mood*; (2) *wakefulness* to *fatigue*; and (3) *calm* to *restlessness*. Both versions of the scale were utilized, with version A capturing baseline fatigue levels and version B capturing post-experiment fatigue levels. This way, changes in the measured emotional states during the experiments were evaluated. The two versions use polar opposite items for the same emotion (e.g., "calm" on one version and "restlessness" on the other) in order to avoid repetitional biases.

Procedure

The study was conducted in the Motivational Sciences Lab of the University of Vienna. Upon arrival, participants were met by an experimenter and seated in front of a computer screen, where they received three informed consent forms. Participants read and signed the consent forms if they were willing to participate in the study and signaled the experimenter upon completion. Following this, the experimenter collected the forms and provided them with a copy of the MDBF Version A. Participants were instructed to complete the form and signal the experimenter when finished. Following completion of the MDBF version A, the experimenter collected the form and introduced the participants to the CV measures and arm cuff before applying the arm cuff and electrodes to the participants. The electrodes were placed on each side of the participant's neck and torso. Participants were then asked what arm they would prefer using the computer mouse with and the blood pressure arm cuff was applied on the opposite arm. Following the application of the arm cuff and electrodes, participants were informed about the study protocol, starting with a description of the initial baseline period.

During the baseline period, participants were instructed to sit and listen to a predetermined playlist on YouTube, selected for its affectively neutral content. After delivering baseline instructions, the experimenter returned to the control room, started a stopwatch, and made baseline CV assessments. CV responses were recorded continuously during a ten minute period, using the mean values obtained in the final two minutes as the baseline for each CV parameter.

Following the completion of the baseline period, the experimenter loaded a program containing the boredom manipulation videos, the clicking task, and implicit measures of effort. They then returned to the laboratory chamber and instructed the participant to follow the instructions provided by the program and inform the experimenter when they completed it. The program began with the boredom induction video or control video, depending on their random group assignment. Before the start of the videos, all participants were instructed to pay attention during their display. Each video lasted approximately 210 seconds.

Following the video, participants performed the clicking task, in which they were instructed to click the left mouse button as often as possible during the sounding of a tone. The exact number of clicks was undisclosed, making this task of unknown difficulty. Once the tone ended, participants had to omit clicking the button until the tone reappeared. This was repeated 24 times. Once finished, participants completed the post-task questionnaire.

Following the post-task questionnaire, participants watched the second half of the boredom manipulation video assigned to them. Instructions and protocol were identical to those of the initial boredom induction phase. Each video lasted approximately 210 seconds. During both parts of the video as well as the clicking task, cardiovascular data was being monitored and measurements taken every 15 seconds.

Next, in random order, participants completed two IATs, one of which measured psychological liking (L-IAT), while the other test measured psychological wanting (W-IAT).

Following the implicit measure, participants completed a series of questionnaires. First, they completed the attention check items designed to measure their understanding of the video's content. Then, a manipulation check was conducted, designed to measure the boredom levels of our two groups. Beside content-related questions about the videos, participants additionally had to answer questions about how they felt during the videos. Afterwards, they completed the MDBF version B as well as the Brief Sensation Seeking Scale (BSSS; Hoyle et al., 2002), which was part of a different publication (see Gander, 2023), before demographic data about their age group and gender was collected. Following the demographic questionnaire, the program ended, and participants informed the experimenter of their completion. The experimenter then returned to the experimental chamber and removed the arm cuff and electrodes before completing a verbal debriefing. After the debriefing, the experimenter awarded participants with either 12 euros in cash or 5 LABS credits for psychology students. In total, the experiment lasted approximately 70 minutes on average.

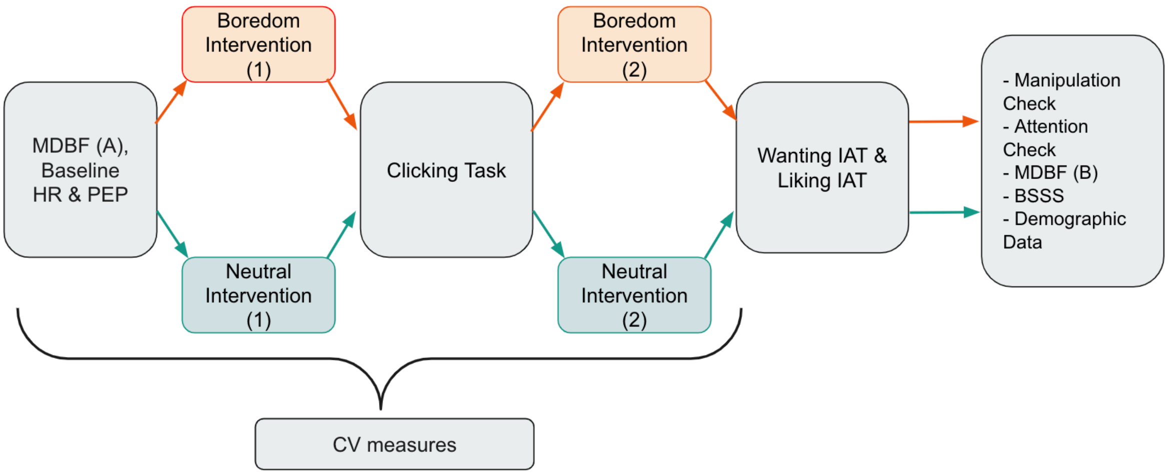

Figure 1. Study procedure.

Data Analysis

T-tests were utilized to compare the two independent groups. Prior to the main analysis, all cardiovascular data (HR, PEP, SBP, DBP, MAP) across all phases of the experiment (boredom induction and clicking task) were averaged, enabling the creation of change scores (Δ) to measure the effort put forth (Llabre et al., 1991). This resulted in a single change score for each cardiovascular measure, obtained by subtracting the average data from the boredom induction and clicking task phases from the baseline of each CV measure. The number of clicks made during tone presentations was used to evaluate clicking task performance. To ensure data accuracy, cardiovascular data was split by group, and 13 single data points (>2 *SD*, as 99% of the data should be inside this range) were excluded. Due to missing data for one subject because of a disruption during data collection, the n for the CV measures of SBP, DBP, and MAP in the control group was 53, compared to the 54 participants included in the control group baseline data for PEP and HR. After checking for outliers for the boredom induction phase data, 5 data points were removed, resulting in a sample size of at least $n = 108$. For the analysis of the performance phase data, 13 data points were removed, resulting in a sample size of at least $n = 106$. The main analysis focused on the differences in PEP change scores, while the other cardiovascular measures were used to examine the psychophysiological nature of boredom. The analysis was centered on the difference between the baseline and the clicking task, as the hypothesis pertained to the amount of effort and performance on this task. IBM SPSS was utilized for data analysis.

Results

Effort-related Cardiovascular Response

Baseline

Table 1 illustrates baseline data for cardiovascular measures. Levene's test for equality of variance did not yield significant results for any of the scores (p >.391), whereby equal variance was assumed. An independent-samples t-test revealed no difference between the boredom group and the control group in any of the five CV measures at baseline (p >.434, d < 0.15).

Table 1

Baseline data for cardiovascular measures

	Boredom			Control		
	n	*M*	*SD*	*n*	*M*	*SD*
PEP (ms)	57	124.62	16.49	54	124.44	15.21
HR (bpm)	57	81.97	11.63	54	70.22	11.75
SBP (mmHg)	57	113.50	11.39	53	112.37	9.98
DBP (mmHg)	57	64.95	6.89	53	65.35	6.12
MAP (mmHg)	57	83.22	7.15	53	82.71	6.74

Note. Abbreviations: PEP, pre-ejection period; ms, milliseconds; HR, heart rate; bpm, beats per minute; SBP, systolic blood pressure; DBP, diastolic blood pressure; MAP, mean arterial pressure; mmHg, millimeters of mercury; M, mean; SD, standard deviation.

Boredom Induction Phase

The CV Δ scores for the boredom induction phase are presented in Table 2. Again, Levene's test for equality of variance did not yield significant results for any of the scores (p >.108), whereby equal variance was assumed. Independent-samples t-tests on all five CV measures indicated no difference in effort mobilization between the two groups during the boredom induction phase (p >.158, d < 0.27).

Table 2

Change scores data for cardiovascular measures (boredom induction phase)

	Boredom			Control		
	n	*M*	*SD*	*n*	*M*	*SD*
Δ PEP	56	–1.51	4.21	54	–2.53	4.21
Δ HR	56	–0.72	2.96	53	–1.50	2.73
Δ SBP	57	0.16	5.25	51	0.12	3.86
Δ DBP	57	–0.31	3.10	53	0.09	2.96
Δ MAP	57	–0.19	3.57	53	0.30	2.96

Note. Abbreviations: Δ PEP, change score pre-ejection period; Δ HR, change score heart rate; Δ SBP, change score systolic blood pressure; Δ DBP, change score diastolic blood pressure; Δ MAP, change score mean arterial pressure; M, mean; SD, standard deviation.

Performance Phase

Table 3 presents CV Δ scores for the clicking task in the subsequent performance phase. Analysis of the pre-ejection period data revealed a significant group difference, $t(109) = 2.16$, $p = .033$, and $d = 0.41$ (Figure 2). The effort-related CV response, operationalized as a reduction of ms in PEP, was significantly greater in the control condition ($M = –7.82$, $SD = 8.19$) than the boredom condition ($M = –4.82$, $SD = 6.35$), illustrating that the boredom group had a lower motivation to engage in the subsequent activities. Analysis of the remaining CV Δ scores revealed no additional significant group differences ($p >.397$, $d < 0.16$). As PEP is the most precise of all CV measures recorded, it is common to see it capture motivational changes that fall outside the precision of blood pressure and heart rate variables (Chatelain & Gendolla, 2015; Richter et al., 2008). Levene's test for equality of variance did not yield significant differences for any of the scores ($p >.170$), whereby equal variance was assumed.

Table 3

Cardiovascular change scores for clicking task (performance phase)

	Boredom			Control		
	n	*M*	*SD*	*n*	*M*	*SD*
Δ PEP	57	–4.82	6.35	54	–7.82	8.19
Δ HR	55	1.08	3.76	52	1.11	4.08
Δ SBP	55	2.69	5.37	51	3.27	5.55
Δ DBP	56	–0.49	3.64	52	–1.12	4.09
Δ MAP	56	1.03	3.84	52	1.14	3.55

Note. Abbreviations: Δ PEP, change score pre-ejection period; Δ HR, change score heart rate; Δ SBP, change score systolic blood pressure; Δ DBP, change score diastolic blood pressure; Δ MAP, change score mean arterial pressure; M, mean; SD, standard deviation.

Figure 2

Effort-related CV response for pre-ejection period

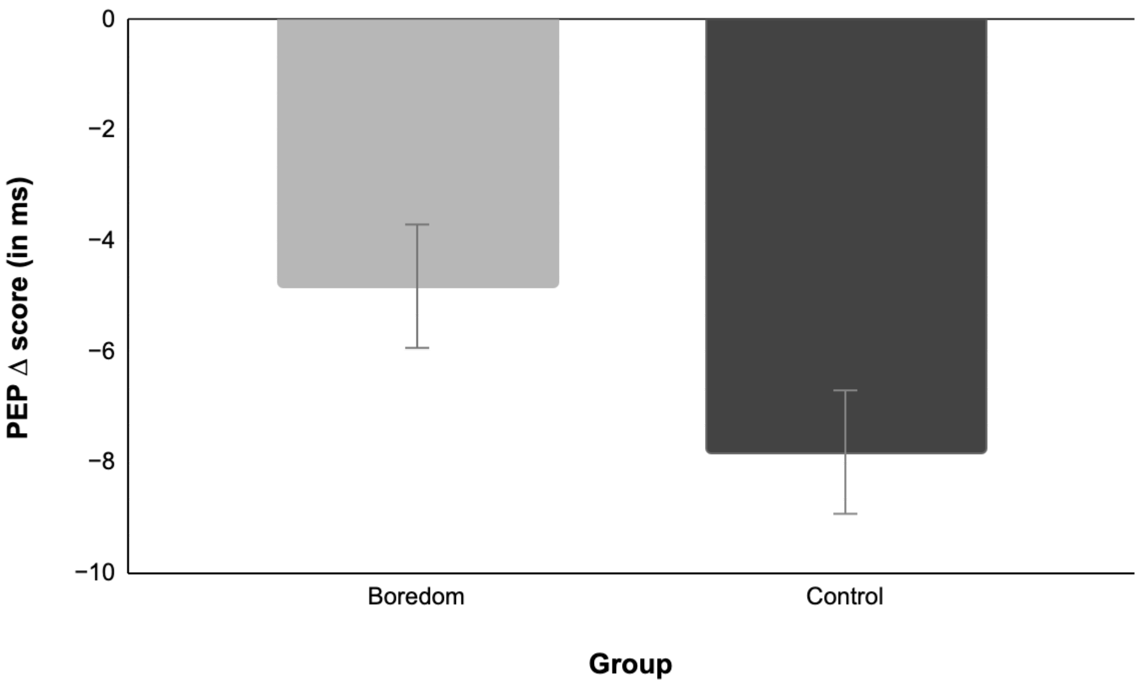

Figure 2. Comparison of PEP change scores between baseline mean data and clicking task mean data. Based on estimated marginal means for Δ pre-ejection period. Abbreviation: ms, milliseconds.

Performance

To see if the grouping variable could directly predict a significant difference in the average number of clicks, an independent-samples *t*-test was conducted, but no effect was found ($t(109) = 0.94$, $p = .349$, $d = 0.18$). This illustrates that boredom does not influence performance directly. Levene's test for equality of variances did not yield significant results for any of the scores ($p = .724$).

Subjective Data

MDBF

Additional *t*-tests revealed no significant difference between the two groups on any of the three subscales of the MDBF at baseline ($p > .404$, $d < 0.16$) or when comparing them for version B at the end of the experiment ($p > .154$, $d < 0.27$).

Another *t*-test was carried out for all three subscales in order to compare score differences that had occurred over the course of the study. This revealed no significant differences between the two groups for any of the three subscales ($p > .145$, $d < 0.28$).

Post-task Questionnaire

Between the two groups, no significant differences in self-reported importance of succeeding on the clicking task or perceived ability on the clicking task were found ($p > .185$, $d < 0.26$).

Manipulation Check Questionnaire

The manipulation check questionnaire created to quantify the effects of the intervention videos revealed significant differences between the two groups in seven out of the eight items, demonstrating that the manipulation was successful. Independent-samples *t*-tests yielded that participants in the experimental group felt more bored ($p < .001$), less interested in the content ($p < .001$), more frustrated ($p = .016$), struggled more to stay serious ($p < .001$), cared less about what happened next ($p = .007$), had their thoughts wander more ($p = .003$), and struggled more to concentrate ($p < .001$) during the videos.

Attention Check Questionnaire

Finally, an independent-samples *t*-test revealed no difference regarding performance on the attention check items between the boredom and control groups ($p > .084$, $d < 0.33$).

Discussion

Main Findings

Hypothesis 1 assumed bored participants would show greater effort mobilization in a subsequent activity. This hypothesis could not be confirmed. Conversely, data analysis did yield evidence for a statistically significant group difference between bored and non-bored participants, albeit in the opposite direction. While change scores for Δ HR, Δ SBP, Δ DBP and Δ MAP showed no statistical difference, PEP data indicated that bored participants exerted significantly less effort in the subsequent activity. Even though values for HR, DBP, SBP, and MAP were assessed for this hypothesis, these values were not part of the main prediction since they reflect a poorer indicator for myocardial sympathetic activity in comparison to PEP (Richter et al., 2016).

As for the second hypothesis, it was predicted that bored participants would show increased effort-related CV responses during the video. None of the cardiovascular measures indicated a group difference, thus resulting in rejecting the hypothesis. Moreover, the results repeatedly pointed in the opposite direction. Although, as previously stated, PEP in particular can be utilized as an indicator for myocardial sympathetic activity, data from all five CV measures were used for this hypothesis, since the primary aim was to map the psychophysiological nature of boredom.

Hypothesis 3 suggested that bored participants would perform better on the subsequent clicking task. This was not the case, since no group difference in performance between the two groups could be detected.

There are a few possible explanations for these results. First and foremost, recent work detailing how boredom can increase brain-related reward activation to reward cues (Milyavskaya et al., 2019) and increase exploration-type behavior even at the cost of monetary reward (Geana et al., 2016) provides initial support for the arguments that boredom will shift one's motivation toward exploration and reward-seeking behaviors. This would result in increased motivation to mobilize effort when faced with a subsequent activity. Thus, the current study protocol might not have confronted participants with an explorative situation. Rather, participants were kept within the same situational setting, thus leading to a reduction in motivation. A second possible explanation goes beyond the construct of boredom. As the results for the manipulation check questions show, bored individuals cared less about what would happen next and felt more frustrated than did individuals in the control group. Although the manipulation seemed to work regarding the goal of inducing boredom, it may simultaneously have triggered adjacent constructs. It is possible that these constructs interfered with the assessment of boredom. As a third explanation, the larger shortening of PEP among controls indicates an enhanced sympathetic activation during the performance phase. Sympathetic activation reflects stress which in medical circumstances is seen as adverse unless caused by physical exercise or other physiological triggers. Along these lines, controls who did not have the benefit of being bored prior to performance exposure, were more "stressed" at the same level of performance which may be seen as a negative phenomenon. It could be speculated that boredom participants have a larger psychophysiological performance reserve if stress activation would happen at higher performance levels.

Despite yielding results mainly opposite to what was hypothesized—or precisely because of this—these findings provide meaningful insights into the phenomenon. The results indicate a connection between bored individuals and the motivation to mobilize effort. Due to a lack of motivation, bored individuals could be unable to mobilize enough effort to resist certain urges in their current situation. This could lead them to withhold the cognitive resources necessary for control. When placed in the correct situation, they might be able to mobilize the cognitive resources required to fight off those urges. Real life examples would be the ones earlier touched upon, like gambling, overeating, or abusing substances. To test this approach, further research on the motivational shift produced by boredom is needed. Further, the current study provides insights into the psychophysiological nature of state boredom. These findings can help to clarify the fogged picture around the phenomenon of boredom piece by piece, to separate it from other emotions on a psychophysiological level, and thus to learn more about its effect on real-life consequences, such as depression and anxiety.

Limitations

As previously mentioned, it cannot be ruled out that participants experienced other affective states that are related to but separate from boredom. Because these affective states were not assessed in the study, it cannot be ruled out that there is a possibility of them arising as a result of the intervention or subsequent task and further distorting the evaluation of effort-related measures.

Another limitation is, that it cannot be stated with certainty that the effect of the boredom manipulation persisted through the subsequent clicking task. This might have resulted in a regression towards the mean during the task as time went on. The boredom effect in participants in the boredom group might have subsided, while participants in the control group might have gotten bored by the clicking task. It therefore remains open to what extent the prolonged induction of boredom would affect the participants.

Further, the duration of the boredom induction phase was relatively short. Even though the length of the video was based on prior research by Merrifield and Danckert (2014), there is limited scientific evidence concerning the manipulation of boredom in general and even less on how long the boredom effect lasts following these interventions. If the length of the induction of boredom should have an effect on its intensity, this raises the question of the ecological validity of the short manipulation performed in the experiment, since situations leading to boredom in everyday life presumably last a longer period of time. Since knowledge around this is scarce, further research regarding the manipulation of boredom and its optimization is needed.

In keeping with this, it is important to mention the fact that this study deliberately aims at inducing state boredom due to understimulation, which is merely a specific type of boredom. This is a central prerequisite for the deduction of the main hypotheses, since the deprivation of stimuli is believed to cause subjects to exert more effort in the subsequent task. Hence, results cannot be attributed to boredom as a whole but rather to one aspect, or profile, of boredom alone.

Future Research

Following on from this, a number of points arise that should be further explored in the future. As previously touched upon, the theoretical construct of boredom has yet to be distinguished from other constructs. This study does not attempt to explore the demarcations of boredom. Subsequent research will be needed to unravel potential constructs related to boredom. Utilization of cardiovascular measures will help to further illustrate the psychophysiological signature of boredom.

Further research is also needed on the manipulation of boredom. To better understand the effects of the construct on motivation and mobilization of effort, a broader body of knowledge on how optimal levels of boredom can be induced with certainty needs to be established. This would allow more precise comparisons to real-life boredom and its behavioral, medical, and social consequences.

Additionally, future research could dive into decoding the effects of boredom on the exertion of effort in subsequent tasks by manipulating various situations in which participants execute those tasks. More explorative tasks and new situations could give rise to the effect that was expected in this study. Closely linked with this is the previously suggested indirect influence of boredom on actual performance through its ability to shift motivation. Teh author of this thesis is convinced that future research on this will contribute significantly to a better understanding of boredom.

Conclusion

This study was not able to find evidence illustrating that individuals bored by understimulation exerted more effort on a subsequent task than did non-bore individuals. Although the main hypothesis cannot be accepted, interesting results have emerged. The results indicate a significant difference in the effort mobilized between the two groups. PEP values show that non-bored individuals put more effort into a subsequent task than bored individuals do; these results reveal a contrary effect to what was initially assumed. CV measures did not yield any notable differences between the two groups when comparing effort mobilization whilst being in a state of boredom. Further, no group differences were discovered in the performance of the subsequent clicking task.

While this study is not without limitations, the results suggest a link between boredom and the motivation to exert effort. This paves the way for further research to successfully explore how boredom affects motivation and to eventually understand what role boredom plays when it comes to mental health as well as self-destructive behavior. Beyond this, the study creates a foundation for further research on the psychophysiological nature of state boredom.

References

Abramson, E. E., & Stinson, S. G. (1977). Boredom and eating in obese and non-obese individuals. *Addictive Behaviors*, *2*(4), 181–185. https://doi.org/10.1016/0306-4603(77)90015-6

Belton, T., & Priyadharshini, E. (2007). Boredom and schooling: a cross‐disciplinary exploration. *Cambridge Journal of Education*, *37*(4), 579–595. https://doi.org/10.1080/03057640701706227

Bench, S. W., & Lench, H. C. (2013). On the Function of Boredom. *Behavioral Sciences*, *3*(3), 459–472. https://doi.org/10.3390/bs3030459

Bench, S. W., & Lench, H. C. (2019). Boredom as a seeking state: Boredom prompts the pursuit of novel (even negative) experiences. *Emotion*, *19*(2), 242–254. https://doi.org/10.1037/emo0000433

Berlyne, D. E. (1960). *Conflict, arousal, and curiosity.* McGraw-Hill Book Company. https://doi.org/10.1037/11164-000

Berntson, G. G., Lozano, D. L., Chen, Y. J., & Cacioppo, J. T. (2004). Where to Q in PEP. *Psychophysiology*, *41*(2), 333–337. https://doi.org/10.1111/j.1469-8986.2004.00156.x

Blaszczynski, A., McConaghy, N., & Frankova, A. (1990). Boredom proneness in pathological gambling. *Psychological Reports*, *67*(1), 35–42. https://doi.org/10.2466/pr0.1990.67.1.35

Chatelain, M., & Gendolla, G. H. E. (2015). Implicit fear and effort-related cardiac response. *Biological Psychology*, *111*, 73–82. https://doi.org/10.1016/j.biopsycho.2015.08.009

Chin, A., Markey, A., Bhargava, S., Kassam, K. S., & Loewenstein, G. (2017). Bored in the USA: Experience sampling and boredom in everyday life. *Emotion*, *17*(2), 359–368. https://doi.org/10.1037/emo0000232

Clore, G. L., & Ortony, A. (2013). Psychological Construction in the OCC Model of Emotion. *Emotion review : journal of the International Society for Research on Emotion*, *5*(4), 335–343. https://doi.org/10.1177/1754073913489751

Crockett, A. C., Myhre, S. K., & Rokke, P. D. (2015). Boredom proneness and emotion regulation predict emotional eating. *Journal of Health Psychology*, *20*(5), 670–680. https://doi.org/10.1177/1359105315573439

Csikszentmihalyi, M. (1975). *Beyond Boredom and Anxiety* (1st ed.). Jossey-Bass Inc Pub.

Csikszentmihalyi, M. (1988). The flow experience and its significance for human psychology. In M. Csikszentmihalyi & I. S. Csikszentmihalyi (Eds.), *Optimal experience: Psychological studies of flow in consciousness* (pp. 15–35). Cambridge University Press. https://doi.org/10.1017/cbo9780511621956.002

Danckert, J. (2013). Descent of the Doldrums. *Scientific American Mind*, *24*(3), 54–59. http://www.jstor.org/stable/24942434

Eastwood, J. D., Frischen, A., Fenske, M. J., & Smilek, D. (2012). The Unengaged Mind. *Perspectives on Psychological Science*, *7*(5), 482–495. https://doi.org/10.1177/1745691612456044

Elpidorou, A. (2014). The bright side of boredom. *Frontiers in Psychology*, *5*. https://doi.org/10.3389/fpsyg.2014.01245

Elpidorou, A. (2017). The good of boredom. *Philosophical Psychology*, *31*(3), 323–351. https://doi.org/10.1080/09515089.2017.1346240

Elpidorou, A. (2018). The bored mind is a guiding mind: Toward a regulatory theory of boredom. *Phenomenology and the Cognitive Sciences*, *17*(3), 455–484. https://doi.org/10.1007/s11097-017-9515-1

Fahlman, S. A., Mercer-Lynn, K. B., Flora, D. B., & Eastwood, J. D. (2013). Development and Validation of the Multidimensional State Boredom Scale. *Assessment*, *20*(1), 68–85. https://doi.org/10.1177/1073191111421303

Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods*, *39*(2), 175–191. https://doi.org/10.3758/bf03193146

Fiske, D. W., & Maddi, S. R. (1961). *Functions of varied experience*. Dorsey.

Gander, S. (2023). *Bored to action? The effect of boredom on the evaluation of effort* [Unpublished master's thesis]. University of Vienna.

Geana, A., Wilson, R., Daw, N., & Cohen, J. D. (2016). Boredom, information-seeking and exploration. In A. Papafragou, D. Mirman, D. Grodner, & J. Trueswell (Eds.), *Proceedings of the 38th Annual Meeting of the Cognitive Science Society* (Vol. 1, pp. 1751–1756). Austin, TX: Cognitive Science Society.

Gendolla, G. H. E., & Richter, M. (2005). Ego involvement and effort: Cardiovascular, electrodermal, and performance effects. *Psychophysiology*, *42*(5), 595–603. https://doi.org/10.1111/j.1469-8986.2005.00314.x

Gendolla, G. H. E., & Wright, R. A. (2005). Motivation in social settings: studies of effortrelated cardiovascular arousal. In J. P. Forgas, K. Williams, & W. von Hippel (Eds.), *Social Motivation* (pp. 71–90). New York, NY: Cambridge University Press. https://doi.org/10.1017/CBO9780511735066.007

Gendolla, G. H. E., Wright, R. A., & Richter, M. (2012). Effort intensity: Some insights from the cardiovascular system. In R. M. Ryan (Ed.), *The Oxford Handbook of Human Motivation* (pp. 420–438). Oxford University Press.

Goldberg, Y. K., Eastwood, J. D., LaGuardia, J., & Danckert, J. (2011). Boredom: An Emotional Experience Distinct from Apathy, Anhedonia, or Depression. *Journal of Social and Clinical Psychology*, *30*(6), 647–666. https://doi.org/10.1521/jscp.2011.30.6.647

Hebb, D. O. (1966). *A textbook of psychology* (2nd ed.). W. B. Saunders.

Hoyle, R. H., Stephenson, M. T., Palmgreen, P., Pugzles Lorch, E., & Donohew, R. L. (2002). Reliability and validity of a brief measure of sensation seeking. *Personality and Individual Differences*, *32*(3), 401–414. https://doi.org/10.1016/S0191-8869(01)00032-0

Hör! Mir! Zu! Warum wir gute Kommunikation lieben: Bert Helbig at TEDxStuttgart. (2013, December). [Video]. YouTube. https://www.youtube.com/watch?v=VNZPM1qvce0&ab_channel=TEDxTalks

Inzlicht, M., & Friese, M. (2019). The past, present, and future of ego depletion. *Social Psychology*, *50*(5-6), 370–378. https://doi.org/10.1027/1864-9335/a000398

Iso-Ahola, S. E., & Crowley, E. D. (1991). Adolescent substance abuse and leisure boredom. *Journal of Leisure Research*, *23*(3), 260–271. https://doi.org/10.1080/00222216.1991.11969857

Kanevsky, L., & Keighley, T. (2003). To produce or not to produce? Understanding boredom and the honor in underachievement. *Roeper Review*, *26*(1), 20–28. https://doi.org/10.1080/02783190309554235

Lanfranchi, P. A., Pépin, J. L., & Somers, V. K. (2017). Cardiovascular Physiology. *Principles and Practice of Sleep Medicine*, 142–154.e4. https://doi.org/10.1016/b978-0-323-24288-2.00014-3

Leary, M. R., Rogers, P. A., Canfield, R. W., & Coe, C. (1986). Boredom in interpersonal encounters: Antecedents and social implications. *Journal of Personality and Social Psychology*, *51*(5), 968–975. https://doi.org/10.1037/0022-3514.51.5.968

Llabre, M. M., Spitzer, S. B., Saab, P. G., Ironson, G. H., & Schneiderman, N. (1991). The reliability and specificity of delta versus residualized change as measures of cardiovascular reactivity to behavioral challenges. *Psychophysiology*, *28*(6), 701–711. https://doi.org/10.1111/j.1469-8986.1991.tb01017.x

London, H., Schubert, D. S., & Washburn, D. (1972). Increase of autonomic arousal by boredom. *Journal of Abnormal Psychology* (1965), *80*(1), 29–36. https://doi.org/10.1037/h0033311

Lozano, D. L., Norman, G., Knox, D., Wood, B. L., Miller, B. D., Emery, C. F., & Berntson, G. G. (2007). Where to B in dZ/dt. *Psychophysiology*, *44*(1), 113–119. https://doi.org/10.1111/j.1469-8986.2006.00468.x

Martarelli, C. S., & Wolff, W. (2020). Too bored to bother? Boredom as a potential threat to the efficacy of pandemic containment measures. *Humanities & Social Sciences Communications*, *7*(1), 1–5. https://doi.org/10.1057/s41599-020-0512-6

Mercer, K. B., & Eastwood, J. D. (2010). Is boredom associated with problem gambling behaviour? It depends on what you mean by 'boredom.' *International Gambling Studies*, *10*(1), 91–104. https://doi.org/10.1080/14459791003754414

Merrifield, C., & Danckert, J. (2014). Characterizing the psychophysiological signature of boredom. *Experimental Brain Research*, *232*(2), 481–491. https://doi.org/10.1007/s00221-013-3755-2

Milyavskaya, M., Inzlicht, M., Johnson, T., & Larson, M. J. (2019). Reward sensitivity following boredom and cognitive effort: A high-powered neurophysiological investigation. *Neuropsychologia*, *123*, 159–168. https://doi.org/10.1016/j.neuropsychologia.2018.03.033

Mlynski, C., Reza, A., Whitted, M., & Wright, R. A. (2020). Mortality salience, effort, and cardiovascular response to a bar‐press challenge: Remarkably nuanced effects of a death prime on heart performance. *Psychophysiology*, *57*(11). https://doi.org/10.1111/psyp.13649

Newlin, D. B., & Levenson, R. W. (1979). Pre-ejection period: Measuring beta-adrenergic influences upon the heart. *Psychophysiology*, *16*(6), 546–553. https://doi.org/10.1111/j.1469-8986.1979.tb01519.x

Obrist, P. A. (1981). *Cardiovascular Psychophysiology: A Perspective*. New York: Plenum Press.

Oxtoby, J., King, R., Sheridan, J., & Obst, P. (2018). Psychometric Analysis of the Multidimensional State Boredom Scale and Its Condensed Versions. *Assessment*, *25*(7), 826–840. https://doi.org/10.1177/1073191116662910

Posner, J., Russell, J. A., & Peterson, B. S. (2005). The circumplex model of affect: An integrative approach to affective neuroscience, cognitive development, and psychopathology. *Development and Psychopathology*, *17*(3). https://doi.org/10.1017/s0954579405050340

Richter, M., Friedrich, A., & Gendolla, G. H. E. (2008). Task difficulty effects on cardiac activity. *Psychophysiology*, *45*(5), 869–875. https://doi.org/10.1111/j.1469-8986.2008.00688.x

Richter, M., & Gendolla, G. H. E. (2009). The heart contracts to reward: monetary incentives and preejection period. *Psychophysiology*, *46*(3), 451–457. https://doi.org/10.1111/j.1469-8986.2009.00795.x

Richter, M., Gendolla, G. H. E., & Wright, R. A. (2016). Three decades of research on motivational intensity theory: What we have learned about effort and what we still don't know. In A. J. Elliot (Ed.), *Advances in Motivation Science* (pp. 149–186). Elsevier Academic Press. https://doi.org/10.1016/bs.adms.2016.02.001

Schmeitzky, J. R., & Freund, A. M. (2013). Goal Focus and the Experience of Boredom. Poster presented at the Max Planck Institute on the LIFE Course, Ann Arbor, Michigan.

Sherwood, A., Allen, M. T., Fahrenberg, J., Kelsey, R. M., Lovallo, W. R., & van Doornen, L. J. (1990). Methodological guidelines for impedance cardiography. *Psychophysiology*, *27*(1), 1–23. https://doi.org/10.1111/j.1469-8986.1990.tb02171.x

Steyer, R., Schwenkmezger, P., Notz, P., & Eid, M. (1994). Testtheoretische Analysen des Mehrdimensionalen Befindlichkeitsfragebogen (MDBF) [Theoretical analysis of a multidimensional mood questionnaire (MDBF)]. *Diagnostica*, *40*(4), 320–328.

Thackray, R. I., Bailey, J. P., & Touchstone, R. M. (1977). *Physiological, subjective, and performance correlates of reported boredom and monotony while performing a simulated radar control task* (pp. 203–215). Springer US. https://doi.org/10.1007/978-1-4684-2529-1_12

van Hooft, E. A. J., & van Hooff, M. L. M. (2018). The state of boredom: Frustrating or depressing? *Motivation and Emotion*, *42*(6), 931–946. https://doi.org/10.1007/s11031-018-9710-6

van Tilburg, W. A. P., & Igou, E. R. (2011). On boredom: Lack of challenge and meaning as distinct boredom experiences. *Motivation and Emotion*, *36*(2), 181–194. https://doi.org/10.1007/s11031-011-9234-9

van Tilburg, W. A. P., & Igou, E. R. (2017). Boredom begs to differ: Differentiation from other negative emotions. *Emotion*, *17*(2), 309–322. https://doi.org/10.1037/emo0000233

Vodanovich, S. J., & Watt, J. D. (2015). Self-Report Measures of Boredom: An Updated Review of the Literature. *The Journal of Psychology*, *150*(2), 196–228. https://doi.org/10.1080/00223980.2015.1074531

Westgate, E. C., & Steidle, B. (2020). Lost by definition: Why boredom matters for psychology and society. *Social and Personality Psychology Compass*, *14*(11). https://doi.org/10.1111/spc3.12562

Westgate, E. C., & Wilson, T. D. (2018). Boring thoughts and bored minds: The MAC model of boredom and cognitive engagement. *Psychological Review*, *125*(5), 689–713. https://doi.org/10.1037/rev0000097

Westgate, E. C., Wilson, T. D., & Gilbert, D. T. (2017). With a little help for our thoughts: Making it easier to think for pleasure. *Emotion* (Washington, D.C.), *17*(5), 828–839. https://doi.org/10.1037/emo0000278

Wilson, T. D., Gilbert, D. T., Reinhard, D. A., Westgate, E. C., & Brown, C. L. (2014). Would you fund this movie? A reply to Fox et al. (2014). *Frontiers in Psychology*, *5*, 1428–1428. https://doi.org/10.3389/fpsyg.2014.01428

Wright, R. A. (1996). Brehm's theory of motivation as a model of effort and cardiovascular response. In P. M. Gollwitzer, & J. A. Bargh (Eds.), *The psychology of action: Linking cogni- tion and motivation to behavior* (pp. 424–453). New York, NY: Guilford.

Wright, R. A. (1998). Ability perception and cardiovascular response to behavioral challenge. In M. Kofta, G. Weary, & G. Sedek (Eds.), *Personal control in action: Cognitive and motivational mechanisms* (pp. 197–232). Plenum Press. https://doi.org/10.1007/978-1-4757-2901-6_8

Wright, R. A., & Kirby, L. D. (2001). Effort determination of cardiovascular response: an integrative analysis with applications in social psychology. In M. P. Zanna (Ed.), *Advances in experimental social psychology* (Vol. 33, pp. 255–307). San Diego, CA: Academic Press.

Appendix

Appendix A

Attention Check Questions

1. Was schaffen Superkommunikatoren?
    a. Sie setzen Ideen durch.*
    b. Sie gewinnen Verhandlungen.
    c. Sie können sehr gut zuhören.
    d. Sie diskutieren ohne Streit.
2. Was ist die ideale Antwort bei der Vorstellung einer Idee?
    a. Ja, aber
    b. Ja, gut
    c. Ja, wann*
    d. Ja, klar
3. Was setzen Superkommunikatoren in den Mittelpunkt der Kommunikation?
    a. Den Mensch*
    b. Die Message
    c. Die Idee
    d. Das Ideal
4. Welches Produkt wird im Video als Beispiel verwendet, um die Vorgehensweise von Superkommunikatoren zu veranschaulichen?
    a. Müllverarbeitungsanlage
    b. Klimaneutrales Baumaterial
    c. Regenwasserwiederaufbereitungsanlage*
    d. Geothermisches Heizsystem

*denotes the correct answer.

Appendix B

Manipulation Check Questionnaire

Please think about the videos you just watched.

I felt bored. (Ich fühlte mich gelangweilt).
I found the content interesting. (Ich fand die Inhalte interessant).
I felt amused. (Ich fühlte mich belustigt).
I felt frustrated. (Ich fühlte mich frustriert.)
I struggled to stay serious. (Es fiel mir schwer, ernst zu bleiben).
I wanted to know what happens next. (Ich wollte wissen, wie es weiter geht).
My thoughts wandered. (Meine Gedanken sind abgeschweift).
I struggled to concentrate. (Es fiel mir schwer, mich zu konzentrieren).

Answers on a 1-5 (1 = not true at all; 5 = completely true) Likert scale.

Zusammenfassung

Das oft negativ konnotierte Phänomen der Langeweile erfüllt die Funktion, Aufmerksamkeit auf explorative und engagierende Reize zu lenken, die dabei helfen, aus der aktuellen Situation zu entkommen. Daher kann ein Mangel an Stimulation zu Aufmerksamkeitsverschiebungen in Richtung anspruchsvollerer Situationen und Aktivitäten führen. In dieser Studie wurde untersucht, ob Personen, die aufgrund von Unterstimulation gelangweilt sind, im Vergleich zu nicht gelangweilten Personen motiviert sind, mehr Aufwand zu betreiben, wenn sie die Gelegenheit haben, eine nachfolgende Aufgabe auszuführen. Es wurde vermutet, dass Langeweile aufgrund von Unterstimulation die Motivation zum Aufwand erhöht und dass sich dieser Effekt am kardiovaskulären System, speziell in Form einer verkürzten Präejektionsperiode (PEP), widerspiegelt. Die Schwierigkeit der Aufgabe war den Teilnehmer*innen unbekannt. Der Aufwand wurde über die kardiovaskuläre Reaktivität gemessen. Insgesamt wurden 111 Teilnehmer*innen zufällig in zwei unabhängige Gruppen (Langeweile-/Experimentalbedingung vs. Neutral-/Kontrollbedingung) eingeteilt. Veränderungen der PEP, der Herzfrequenz (HF), des systolischen Blutdrucks (SBP), des diastolischen Blutdrucks (DBP), des mittleren arteriellen Drucks (MAP) sowie Fragebogendaten zur Selbstauskunft wurden verglichen. Die Hauptergebnisse zeigten einen signifikanten Effekt, der jedoch entgegen der Hypothese war. Dies deutet auf einen Zusammenhang zwischen Langeweile und dem Aufbringen von Aufwand hin und bietet neue Einblicke, von denen zukünftige Forschung profitieren wird.

Schlagwörter: Motivation, Langeweile, Aufwand, kardiovaskuläre Reaktivität, Präejektionsperiode