Media Delivery Method Shows No Effect On Physiological Stress Response Factors of Heart Rate, Blood Pressure and Respiration

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Running Title: Physiological Stress Response to Modern Media

Keywords: audio, blood pressure, media, respiration, stress, visual

Word Count: 3539

Abstract

Blood pressure, heart rate and respiration rate were measured to investigate the stress response induced by an emotionally stimulating video regarding the Islamic State of Iraq and Syria (ISIS). After control experiments were conducted on an initial set of subjects, test subjects were exposed to one of three treatment videos: audio only, visual only with subtitles, or both audio and visual with subtitles. The hypothesis being tested was that watching an emotionally evocative video featuring current terror tactics by ISIS with both audio and video will increase participants' heart rate, blood pressure, and respiration rates more significantly compared to either watching the video with subtitles only or listening with audio only. It was hypothesized that the audio-only stimuli would also increase heart rate, blood pressure, and respiration rates but not to the extent of the combined auditory and visual stimuli. Based on the longer processing time for visual stimuli it was predicted that the visual-only stimuli would cause the smallest increases in heart rate, blood pressure and respiration rate. Statistical data analysis revealed that no treatment was more effective than another. In summary, individuals encounter different types of media formats that could potentially differ in their mental and physical effects. However, according to this study, varying media formats do not have significantly different effects on an individual's physiological response.

INTRODUCTION

Stress often results from exposure to emotionally and physiologically challenging experiences. When the human body experiences stress, it responds by releasing catecholamine hormones such as norepinephrine or epinephrine from the adrenal glands (McEwen et al., 2007). These hormones are responsible for increasing heart rate and breathing rate, and with prolonged stress elevate blood pressure (Harvard Mental Health Letter, 2011). The physiological effects stress can have on heart rate and blood pressure, particularly over time, are relevant to both mental and physical human health and well-being (Holman et al., 2013).

In current society people are inundated with videos, articles, and trending media relating to crime and other potentially violent themes which may induce stress. A recent topic is the Islamic State of Iraq and Syria (ISIS), which has become an imminent world terrorism threat (Stanford University, 2015). According to one study, individuals can experience a stress

response to hearing about a distressing issue even if they did not personally experience it (Schuster et al., 2001). Many Americans experienced significant stress after the September 11 terrorist attacks, despite not having been in New York City at the time of the events (Schuster et al., 2001). Repeated exposure to media coverage of traumatic events, such as frequently watching footage of the Boston Marathon bombing and its aftermath, has been shown to cause high acute stress. This type of stress over time can eventually lead to serious mental and physical health concerns. Psychological problems including Post-Traumatic Stress Disorder (PTSD) or physical ailments including cardiac problems can result from untreated chronic stress (Holman et al., 2013). The body's reaction to stressful media necessitates a study of specific physiological responses, including heart rate, blood pressure, and respiration, none of which have been extensively studied. Given the prevalence of global terror issues in modern news, a study of physiological reactions to emotionally stimulating media, and in particular terrorism-related media, is crucial to the understanding of human health issues.

The researchers are interested in studying physiological responses to media in different forms, including audio-only media, visual-only media with subtitles, and combined audiovisual media. Visual and auditory processing occurs in different areas of the cerebral cortex, and auditory stimuli processing time is shorter than that for visual stimuli (Recanzone, 2009). One study showed that emotional perceptions of television and radio media are distinct, bringing about the question whether audio and visual media evoke different physiological responses (Cohen, 1976). Based on this information, it is important to consider how the differences in physiological reactions to auditory and visual stimuli.

Respiration, blood pressure, and heart rate will be measured on the individuals in this study. Biopac software and instruments will be used to collect respiration data, a blood pressure

cuff will be used to measure blood pressure, and a finger pulse oximeter will be used to obtain participants' heart rates. Three study groups will be shown different combinations of a blank screen, a "neutral" video and an "emotionally-stimulating" video while wearing headphones. Treatment Group D will be a control group that is first shown a blank screen, then is exposed to various forms of neutral stimuli. Subjects in this group will first listen to neutral audio, then watch a neutral video without audio, and finally watch a neutral video with audio. The neutral video will be nature scenery footage and neutral audio will be nature sounds. Treatment Group A will be shown a blank screen, and the audio of an emotionally stimulating video. Treatment Group B will be shown a blank screen and the same emotionally stimulating video with subtitles and no audio. Treatment Group C will be shown a blank screen and the emotionally stimulating video with both video and audio. A video pertaining to ISIS affairs will serve as the emotionally stimulating media. The initial blank screen shown to participants will serve as a control to obtain baseline data for each person on heart rate, blood pressure, and respiration. Comparing the average measured baseline data with the average measured heart rate, blood pressure, and respiration data during all scenarios will provide an answer to the hypothesis. This knowledge will provide meaningful information on the effects of stressful audio and visual media.

It is hypothesized that watching an emotionally evocative video featuring current terror tactics by ISIS with audio will increase participants' heart rate, blood pressure, and respiration rates more significantly compared to when subjects are watching either the video with subtitles-only or listening to audio-only. Based on literature, it is expected that the audio-only stimuli will also increase heart rate, blood pressure, and respiration rates but not to the extent that the combined audio and visual stimuli will. The processing time for visual stimuli is longer than the processing time for auditory-only stimuli, so it is predicted that visual-only stimuli will cause the

smallest increases in heart rate, blood pressure and respiration rate. This hypothesis was formulated based on interest in exploring how modern media-induced stress affects human physiological factors such as heart rate, respiration rate, and blood pressure. Also of interest was how the medium of the stimulus may affect the magnitude of the stress response. The topic was decided upon through collaboration among researchers.

METHODS

Participants:

Participants in this study were University of Wisconsin-Madison students aged 20-23. In total 36 students participated. Of those 36 students, 14 participants were male and 22 were female. All participants were given a consent form and had the opportunity to decline participation for any reason (Figure 1).

Materials:

Respiration rate, heart rate, and blood pressure were recorded as participants wearing in-ear headphones were introduced to varying audio and/or visual stimuli while sitting in front of a laptop computer. For respiration rate, a BSL Respiratory Effort Transducer (BIOPAC Systems, Inc. Goleta, CA, Model#SS5LB) was used to determine breaths per minute. The respiratory transducer was connected to a BIOPAC MP36 system (BIOPAC Systems, Inc. Goleta, CA, Model#MP36). The Biopac Student Lab Data Analysis includes BSL 4 software run on a Windows 7 Dell desktop computer. A Nonin finger pulse oximeter/CO_2 detector (Nonin Medical, Inc. Minneapolis, MN, Model#9843) was used to measure heart rate. For blood pressure, an Omron blood pressure cuff (Omron Corporation, Kyoto, Japan, Model#BP791IT) was used. Standard Apple iPod earbuds (Apple, Inc. Cupertino, CA, Model#MB770G/A) were used for control and audio purposes. To display video, a 2013 Apple MacBook Air (Apple, Inc.

Cupertino, CA) was used. For neutral auditory and visual stimuli, a YouTube clip of the video "Relaxing Sounds of Waves - 2 Hours - Tropical Beach Relaxation" (https://www.youtube.com/watch?v=QBa-e45o6eM) was played for three minutes and 17 seconds. For emotionally evocative auditory and visual stimuli, a three minute and 17 second CNN news clip from YouTube titled "ISIS videos show children training to kill" (https://www.youtube.com/watch?v=jQQofc-jf5Q) was used.

Experimental Design:

The experiment was conducted according to the timeline in Figures 2 and 3. Participants were seated at a desk with a laptop. They first filled out a form indicating their name, gender, age, and the date they participated in the study. Participants were then given the consent form and signed to authorize their willing participation in the study. The consent form outlined the relative time the experiment would run and warned of potential exposure to evocative images and audio. After this was completed, recording equipment was positioned on participants. First, the BSL Respiratory Transducer was fitted around the participant's chest, at axillary level. Next, the pulse oximeter was placed on the index finger of the participant's right hand. The blood pressure cuff was then fastened above the elbow of the participant's left arm. Lastly, they were given headphones to place in their ears for the duration of the trial. Equipment was cleaned using sanitary wipes between trials.

Following set up, participants were instructed to rest their arms on the table, to keep their feet flat on the floor with their legs uncrossed, to refrain from talking, and to keep their eyes on the computer screen to allow for accurate measurement of all variables. After participants received these instructions, a baseline blood pressure reading was taken. Baseline heart rate and respiration measurements were taken for one minute with the participant staring at a blank

screen. At the end of one minute, blood pressure was again recorded. A member of the research team then played the video for the participant, either using audio only, video with subtitles and no audio, or a video with both auditory and visual stimuli. To first establish a control group, five participants were exposed to all three conditions after one minute of baseline measurements: they listened to the audio of the neutral video, watched the neutral video without audio, and watched the neutral video with audio. A neutral video of waves on a beach was used for both auditory and visual stimuli. See Figure 2 for a timeline of the process for control participants. During the videos, heart rate and respiration measurements were recorded. Following each video, blood pressure measurements were taken. After one minute of baseline measurements, participants in treatment groups A-C either listened to emotionally evocative audio, watched the emotionally evocative video without audio but with closed captioning, or watched the emotionally evocative video with audio. Each stimulus was three minutes and 17 seconds. See Figure 3 for a timeline of the process for experimental participants and Table 1 for the three different treatment groups. Screen brightness and volume were kept at 50% (as per standard Apple settings) for all trials with either auditory or visual stimuli. Participants were placed into groups by running the various trial types through a randomization program provided by Alan Sayler, statistics consultant.

Data and Statistical Analysis:

Blood pressure was recorded after each scenario via an Omron blood pressure cuff and was used to calculate Mean Arterial Blood Pressure (MABP). The formula used was MABP = [(Systolic Pressure - Diastolic Pressure)/3 + Diastolic Pressure]. Heart rate was recorded every 30 seconds for the entirety of the scenario using a Nonin finger pulse oximeter/CO_2 detector, and was averaged over the entirety of each respective scenario. Breaths per minute (BPM) were

digitally calculated by measuring from peak to peak of consecutive breaths once every 30 seconds as detailed in Figure 4. Finally, average breaths per minute was calculated.

As a positive control, two of the researchers were used as participants. Participants were introduced to an emotionally evocative video with extremely violent content relating to current worldwide terror threats, during which heart rate, blood pressure and respiration were measured. A trend in the data from these pilot studies suggested that the video was able to elicit an increase in heart rate, blood pressure, and respiration rate. This positive control also established researchers' competence in using testing equipment and in collecting data.

An analysis of variance (ANOVA) statistical model was used to compare the variation between participants' heart rate, blood pressure, and respiration measurements in the control group. Based on that analysis, it was determined that the neutral audio, visual only, and auditory and visual combined stimuli did not cause statistically significant changes in the physiological variables measured. As such, it was decided that experimental participants who would be exposed to the emotionally evocative audio, visual-only stimuli or combined visual and auditory stimuli would not also need to watch neutral auditory or visual stimuli for an additional control. A Student's t-test was used to analyze data from the three experimental groups to determine if a statistically significant difference in heart rate, blood pressure, and respiration existed based on exposure to either audio only, visual only, or combined auditory and visual stimuli.

RESULTS

Data for heart rate, respiration, and blood pressure of the control group and three different treatment groups was analyzed. A Student's t-test was used to conduct statistical analysis, and a p-value < 0.05 was established as the standard of statistical significance. Based on this standard

of statistical significance, the data collected from the three different treatment groups represents a failure to reject the null hypothesis. A lack of statistical significance shows that heart rate, respiration, and blood pressure are not affected by media delivery method and demonstrates no significant relationship between various media formats and physiological responses (Table 2).

Statistical analysis of control testing exhibited no notable differences in blood pressure, heart rate, and respiration between participants who were sequentially exposed to audio-only, visual-only, and combined auditory and visual media. An analysis of variance (ANOVA) test showed no significant difference in heart rate ($p=0.95$), no significant difference in respiration rate ($p=0.902$), and a significant change in Mean Arterial Blood Pressure ($p=0.0064$) based on sequential exposure to the three treatments as defined in Group D of Table 1. T-test analysis indicated that there is no correlation between heart rate and stimulus type regardless of sex ($t=2.013$) and treatment group ($t=1.039$).

Analysis of heart rate data revealed no significant difference between treatment groups ($p=0.1094$) or between genders ($p=0.0542$). The heart rate was also found to have no correlation to stimulus type ($p=0.1094$). T-test analysis also indicated no correlation between stimulus and heart rate regardless of sex ($t=2.013$) and treatment group ($t=1.039$). According to data collected on heart rate, seven-out-of-ten participants showed an increase in heart rate in response to the audio-only treatment (Group A), ten-out-of-ten showed an increase in heart rate in response to visual-only treatment (Group B), and eight-out-of-ten showed an increase in heart rate in response to combined auditory and visual treatment (Group C).

Data analysis indicated that changing the media delivery method would have no significant impact on respiration rate measured in breaths per minute ($p=0.5324$). This assertion remained accurate regardless of sex ($p=0.561$) and treatment group ($p= 0.318$). T-test analysis

also indicated no correlation between stimulus and respiration rate regardless of sex (t=0.588) and treatment group (t=1.018). For all participants in Treatment Group B, an average increase of 3 breaths per minute was noted, while only six-out-of-ten participants in Treatment Group A experienced increased respiration as seen in Figure 6. Eight-out-of ten participants in treatment group C experienced an average increased respiration rate of 1.5 breaths per minute (Figure 7).

Data recorded from the three treatment groups indicated a decrease in mean arterial blood pressure for eight-out-of-ten participants in treatment groups A, B, and C . T-test results indicate that there is no correlation between stimulus and blood pressure change regardless of sex (t=-0.924) and treatment group (t=-0.323). P-values also indicate that there is no significant correlation due to sex (p=0.364) or treatment group (p=0.749). The mean arterial blood pressure was also found to have no correlation to stimulus type (p=0.6378).

DISCUSSION

The results of this study do not support the hypothesis that participants' heart rate, blood pressure, and respiration rate will be highest when they watch an emotionally evocative ISIS video with visual and auditory stimuli, lowest when they watch the video with visual-only stimuli, and at an intermediate value when they only receive auditory stimuli from the same video. Statistical analysis showed that there was no significant difference from baseline in the three physiological variables based on the type of media participants were exposed to. This result suggests that the type of emotionally evocative media participants are exposed to does not significantly affect their heart rate, blood pressure, and respiration rate. Therefore, short-term

effects of exposure to different forms of emotionally evocative media may not be relevant to the physiological stress response.

Various phenomena may explain why no statistical significance was found based on the type of stimuli participants were exposed to. There were many influences that this limited study could not feasibly take into account. Research has shown that many factors affect an individual's blood pressure, including but not limited to their gender, the time of day, and how much they have eaten in a particular day (Gellman et al., 1990). Furthermore, literature establishes that blood pressure decreases with the amount of time an individual is sitting due to an increase in parasympathetic activity (Widmaier et al., 2016, p. 383). During a period of twelve-minute control testing, a statistically significant difference in mean arterial blood pressure was found for participants who were sequentially exposed to neutral audio-only, visual-only, and combined auditory and visual stimuli. This finding supports the idea that blood pressure decreases as participants are sitting for extended periods of time. This is relevant to this study, as participants remained seated throughout the experiment. Their blood pressure and heart rate may have naturally decreased due to their body position independent of the stimuli they were exposed to. Importantly, participants' blood pressure readings may also have been different from normal for each individual due to so-called "white coat hypertension," (Shapiro et al., 1996) which states that a temporary increase in blood pressure results from an emotional reaction to a clinical environment (Siegel et al., 1990).

Potential sources of error may also clarify why the results of this study are statistically insignificant and do not support the initial hypothesis. One University of California study reported that continuously measuring blood pressure more accurately represents average blood pressure than does occasional measurements (Shapiro et al., 1996). The study format did not

allow for constant blood pressure monitoring as continuously taking measurements may have been distracting for participants during media exposure. Ideally, participants' blood pressures would be recorded after they were able to rest for at least five minutes and at a time when they had not eaten anything, consumed caffeine or smoked for at least 30 minutes (Shapiro et al., 1996) as those factors are known to affect blood pressure. Due to time constraints and scheduling of participants, it was not possible to control for these confounding factors. Also, due to the limited availability of study participants and the gender distribution of the Physiology 435 class that many participants were recruited from, it was not possible to maintain complete gender balance among treatment groups. The significantly higher proportion of females in this study, based on known gender differences in blood pressure, may have threatened the accuracy of the results. Findings from The Behavioral Medicine Research Center indicate that females have a considerably lower blood pressure than males (Gellman et al., 1990). Finally, due to time constraints and availability of participants, it was not feasible to recruit more than 34 participants to allow for a greater pool of data to draw conclusions from.

In future studies, it may be useful to monitor blood pressure more continuously or more often than was possible in this study. It would also be helpful to ensure that participants' activities prior to participation are consistent, such as refraining from caffeine at least 30 minutes before starting measurements. Additionally, it would be highly beneficial to recruit more participants as well as to strive for a more even gender distribution between treatment groups. Another interesting aspect worth considering for future studies is how various forms of emotionally evocative media would physiologically affect veterans or participants with PTSD. People with cultural or familial ties to the areas impacted by ISIS may also exhibit unique physiological responses. These groups of individuals might be expected to exhibit significant

increases in heart rate, respiration, and blood pressure as compared to individuals without these connections or experiences.

While statistically significant differences in physiological variables based on treatment groups were not found in this study, these results still carry relevance in relation to media exposure. As media coverage of emotionally evocative material is increasingly prevalent in current society, it is important to understand the role of such media in human health. Continued monitoring of physiological responses to emotionally evocative media could provide insight regarding the causes of chronic diseases such as hypertension and high blood pressure. Future research in this field is essential to maintaining a healthy population.

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ACKNOWLEDGEMENTS

We would like to acknowledge the guidance and support provided by Dr. Andrew Lokuta, the Physiology 435 Teaching Assistants and Peer Learning Volunteers, our statistician Alan Sayler, all participants of our study, and any editors of our paper.

TABLES

Table 1: Distinction between the three test groups A, B, C and control group D.

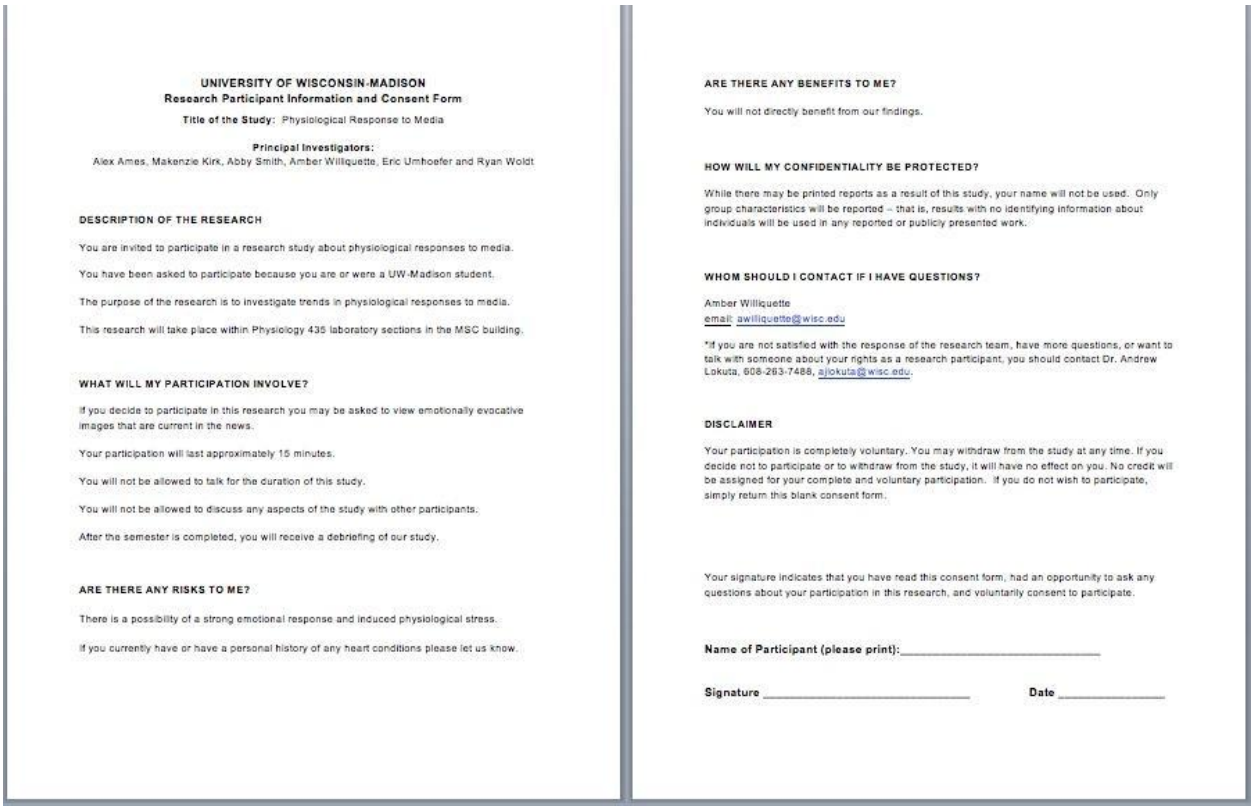
Group	Treatment
A	Blank screen, stimulus audio only
B	Blank screen, stimulus video with closed captioning
C	Blank screen, stimulus video with audio
D	Control group: blank screen, neutral audio, neutral visual stimulus, neutral audio and visual stimulus

Table 2: P-values as calculated from the Student's t-test.

Variable	Treatment p-value	Gender p-value
Heart Rate (Beats Per Minute)	0.3081	0.0542
Respiration (Breaths Per Minute)	0.318	0.561
Blood Pressure (Mean Arterial Blood Pressure)	0.749	0.364

FIGURES AND LEGENDS

Figure 1: Consent form participants received and signed prior to initiating the experiment.



UNIVERSITY OF WISCONSIN-MADISON
Research Participant Information and Consent Form

Title of the Study: Physiological Response to Media

Principal Investigators:
Alex Ames, Makenzie Kirk, Abby Smith, Amber Williquette, Eric Umhoefer and Ryan Woldt

DESCRIPTION OF THE RESEARCH

You are invited to participate in a research study about physiological responses to media.

You have been asked to participate because you are or were a UW-Madison student.

The purpose of the research is to investigate trends in physiological responses to media.

This research will take place within Physiology 435 laboratory sections in the MSC building.

WHAT WILL MY PARTICIPATION INVOLVE?

If you decide to participate in this research you may be asked to view emotionally evocative images that are current in the news.

Your participation will last approximately 15 minutes.

You will not be allowed to talk for the duration of this study.

You will not be allowed to discuss any aspects of the study with other participants.

After the semester is completed, you will receive a debriefing of our study.

ARE THERE ANY RISKS TO ME?

There is a possibility of a strong emotional response and induced physiological stress.

If you currently have or have a personal history of any heart conditions please let us know.

ARE THERE ANY BENEFITS TO ME?

You will not directly benefit from our findings.

HOW WILL MY CONFIDENTIALITY BE PROTECTED?

While there may be printed reports as a result of this study, your name will not be used. Only group characteristics will be reported – that is, results with no identifying information about individuals will be used in any reported or publicly presented work.

WHOM SHOULD I CONTACT IF I HAVE QUESTIONS?

Amber Williquette
email: awilliquette@wisc.edu

*If you are not satisfied with the response of the research team, have more questions, or want to talk with someone about your rights as a research participant, you should contact Dr. Andrew Lokuta, 608-263-7488, ajlokuta@wisc.edu.

DISCLAIMER

Your participation is completely voluntary. You may withdraw from the study at any time. If you decide not to participate or to withdraw from the study, it will have no effect on you. No credit will be assigned for your complete and voluntary participation. If you do not wish to participate, simply return this blank consent form.

Your signature indicates that you have read this consent form, had an opportunity to ask any questions about your participation in this research, and voluntarily consent to participate.

Name of Participant (please print):_____

Signature _____ Date _____

Figure 2: Experimental timeline for a control participant.

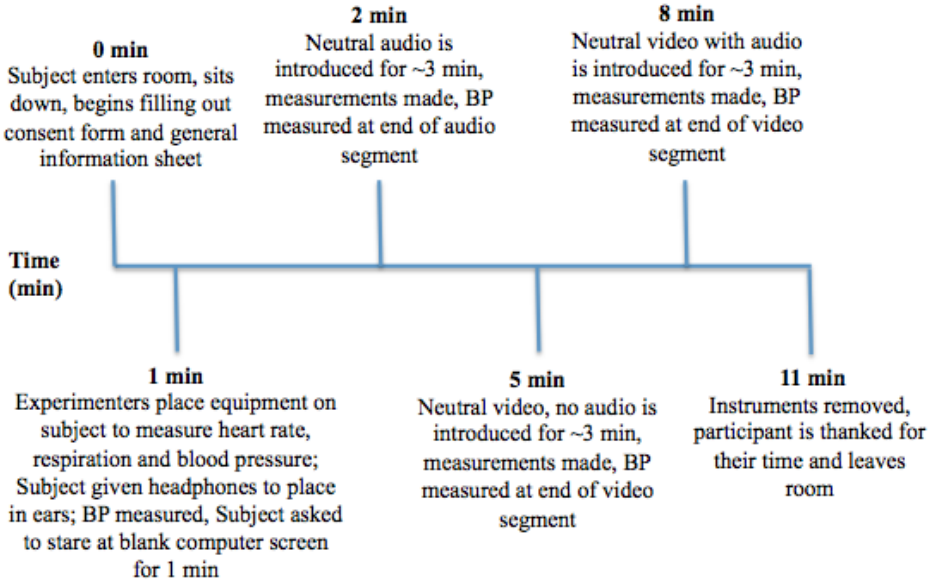


Figure 3:

Experimental timeline for a non-control participant.

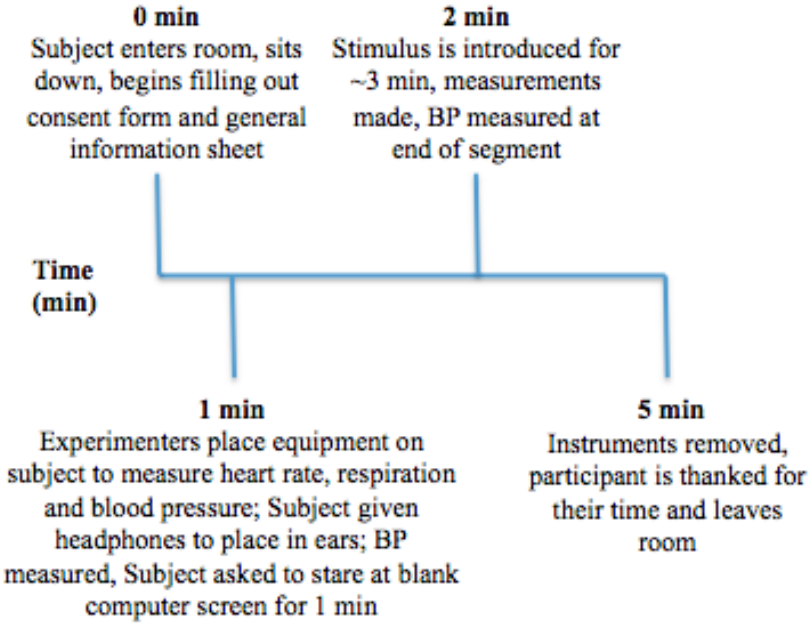


Figure 4: Screen visualization of how respiration (BPM) was measured in Biopac.

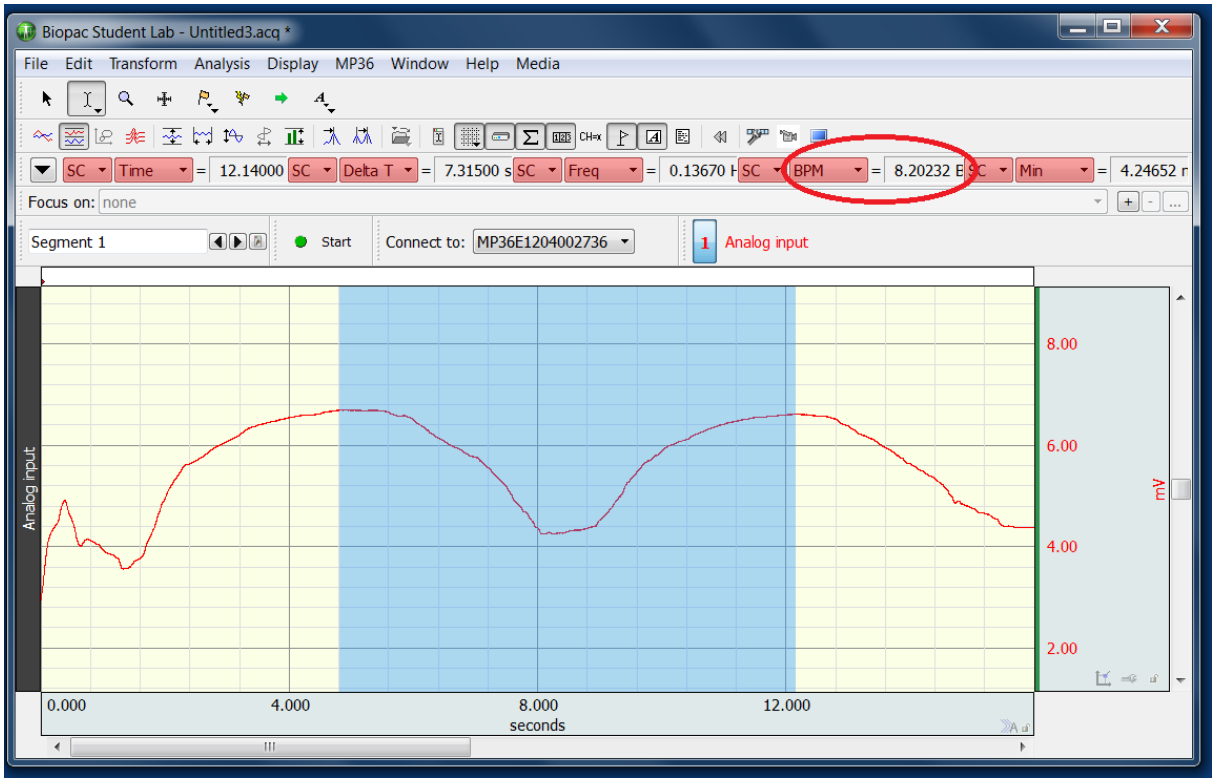


Figure 5: Chart representing the average changes in physiological variables for participants in Treatment Group A (audio only). Values are presented in each variable's respective unit.

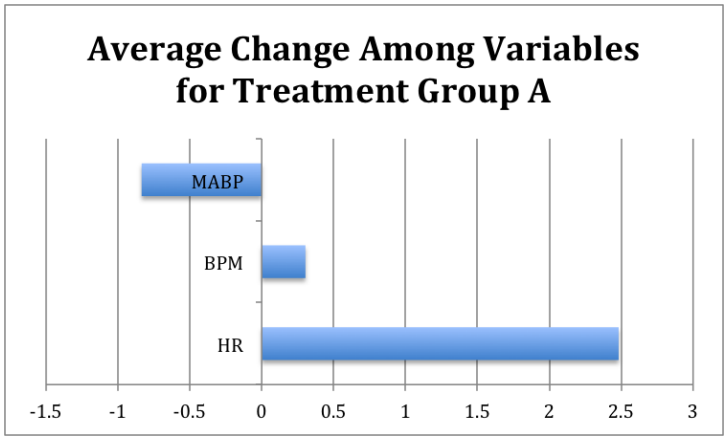


Figure 6: Chart representing the average changes in physiological variables for participants in Treatment Group B (visual only). Values are presented in each variable's respective unit.

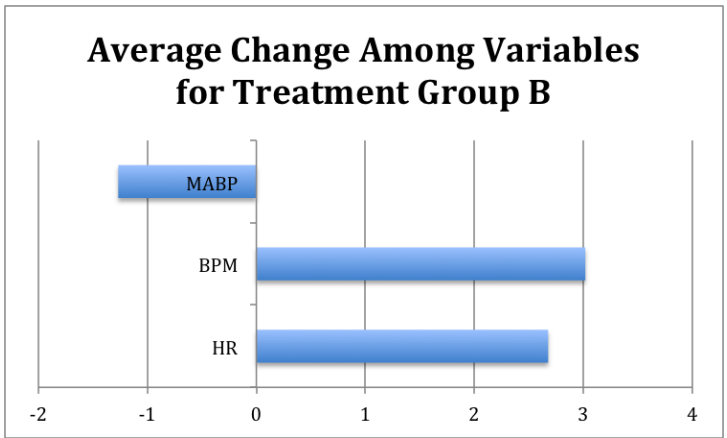


Figure 7: Chart representing the average changes in physiological variables for participants in Treatment Group C (audio and visual). Values are presented in each variable's respective unit.