Title: The Physiological Impact of ASMR and Distraction on Heart Rate and Blood Pressure

Course Code: MIE237

Instructor: Maurice Masliah

Submission Date: April 7, 2025

Group Members:

Raiyan Ali (1008757490)

Ayesha Karim (1010671925)

Shreya Perumal (1010207107)

1.0 Introduction

The impact of visual and auditory stimulation on physiological responses has been a key area of focus in neuroscience. This project aims to study the relationship between two factors of visual and auditory stimuli on specific physiological changes. Autonomous sensory meridian response (ASMR), commonly known as a tingling sensation by visual and auditory stimuli, has been reported to induce relaxation and reduce stress levels [1]. The use of ASMR following varying levels of adverse stimuli could overcome the stressor and provide a calming effect. This motivates the research question: *"To what extent do ASMR and the severity of external stimuli alter heart rate and blood pressure?"*. Furthermore, we aim to test whether longer ASMR exposure buffers the physiological impact of high-severity distractions. The change in physiological effects post-exposure to stress and ASMR would further uncover the information beneficial for stress relief, therapy, and general intellectual performance.

2.0 Background

Autonomous Sensory Meridian Response (ASMR) is a sensory phenomenon where tingling sensations are present that typically start at the scalp and move down to the spine. The sensations are caused by some sounds or visuals such as whispering, tapping, or intentional action. ASMR has become so widespread on the internet in recent years that millions use it for relaxation, stress relief, and sleep. While the experience is subjective, recent scientific research has begun to analyze its potential physiological and psychological effect—on autonomic nervous system measurements like heart rate (HR) and blood pressure (BP), the objective indices of relaxation and stress.

Research suggests that ASMR may activate the parasympathetic nervous system, producing effects that are similar to those experienced while in a state of meditation. Poerio et al. found that deeply regular ASMR experiencers had lower HR during stimulation than non-responders, offering evidence for a measurable physiological change [2]. Fredborg et al. found also decreases in arousal and increases in self-reported calmness when exposed to ASMR [3]. These findings have created more interest in ASMR as a potential non-pharmacological intervention for stress management in clinical, occupational, and therapeutic settings.

In contrast, distraction has been widely demonstrated to engage sympathetic nervous system activity. Environmental disturbances—especially if they are novel or cognitively demanding—can increase physiological indicators of stress like HR and BP. Seli et al. discovered that such distractions enhance cognitive load and impair attention, resulting in heightened arousal [4]. Multitasking studies have also

demonstrated the same way that introducing secondary tasks during relaxation time increases autonomic activity and disrupts relaxation responses [5].

Whereas there is a vast body of literature on ASMR and distraction separately, relatively little has explored their interaction. Of particular interest is whether repeated exposure to ASMR can protect against distraction. Previous ASMR research tends to be based on self-report measures instead of objective physiological responses, and few consider the actual presence of distractions in everyday life. This shortcoming prevents us from understanding how ASMR works under real-world conditions of distraction.

Our research attempts to redress this by investigating how varying lengths of ASMR exposure interact with distraction presence to affect heart rate and blood pressure. By systemically manipulating both exposure time and distraction within a controlled environment, we propose to test whether increased exposure to ASMR provides enhanced physiological resilience or if even prolonged relaxation states are susceptible to perturbation.

These findings have implications for clinical and daily applications of ASMR. Distraction during therapy may diminish ASMR's effectiveness, suggesting that therapy requires carefully controlled settings. Background ASMR in schools or offices may promote well-being—but only in situations where interruptions are minimal. As sensory contexts become increasingly mediated by digital media, how relaxing and interrupting stimuli interact is worth knowing to maximize stress regulation tools.

In short, while previous studies have separately documented the effect of ASMR and distraction, this study examines their intersection. In doing so, it contributes to a richer understanding of how audiovisual stimulation and contextual variables combine to yield physiological regulation—extending efforts to design better instruments and environments for relaxation and resilience.

3.0 Proposed Methods

The experiment aims to study the impact of ASMR on **heart rate** and **blood pressure**. The heart rate and blood pressure data of participants will be recorded while experiencing a stimulus and tracked using a dual heart rate and blood pressure monitor. The two main stimuli presented to participants will be a relaxing ASMR video and a random event that occurs while watching the video.

Table 1: Variables

Type	Variable	Description

Independent	Time Spent Watching ASMR	Measured in seconds. Participants view a compilation of relaxing ASMR clips intended to reduce heart rate and blood pressure.
	Random Distraction	One of three stimuli introduced during the ASMR video: • Level 1 – Ball rolls across floor • Level 2 – Phone alarm • Level 3 – Jumpscare image
Dependent	Heart Rate (HR)	Beats per minute. Normal range: 60–100 bpm. Measured via smartwatch. Sensitive to both physical and mental stress. [6]
	Blood Pressure (BP)	Systolic/Diastolic values. Normal BP: <120/80. Measured using a BP monitor. Stress can elevate readings due to adrenaline release. [7][8]

Study Participants:

The study will focus on post-secondary students at the University of Toronto. Participants will be recruited through an interest form and selected at random. Post-secondary students often face high academic stress during the midterm examination period and are in close proximity, thus, this study may provide insight into stress reduction techniques.

Hypotheses:

Let $\mu_{control}$ and μ_{ASMR} be the mean heart rate/blood pressure under control and experimental conditions, respectively.

Null Hypothesis (H_0):

Neither ASMR duration nor distraction severity affects heart rate/blood pressure.

$$\mu_{control} = \mu_{ASMR}$$

Alternative Hypothesis (H_A):

ASMR duration, distraction severity, or their interaction affects heart rate/blood pressure

$$\mu_{control} \neq \mu_{ASMR}$$

Experimental Design:

Participants will be selected at random and kept anonymous. Each participant's data will be linked to a participant number, and their name will be excluded. Before participating, participants will give informed consent and inform experimenters of any related medical conditions. Distractions will be explained explicitly upon completion to ensure participants are not expecting events to occur. Participants will wear a dual heart rate and blood pressure monitor to check heart rate and blood pressure at desired intervals. Participants will sit in a closed room in front of a screen beside two experimenters, one responsible for operating the equipment and the other responsible for photographing the reading to be later recorded.

Experimental Procedure:

1. Three readings were taken over 2 minutes (roughly 1 every 40 seconds) before exposure to the stimulus to establish a baseline.
2. The ASMR video played for 1 minute and 30 seconds, and 2 readings were taken (roughly 1 every 45 seconds).
3. At 1 minute and 35 seconds, a Level 1 Distraction occurred, and a reading was taken the moment the distraction occurred.
4. Over the next 1 minute and 30 seconds, 2 more readings were taken to observe the effects of the ASMR post-stressor.
5. If a participant was exhibiting signs of distress as a result of the experiment, the participant was led through a debriefing and breathing exercise if required.
6. Steps 1-4 were repeated for 9 more participants
7. Steps 1-5 were repeated for Distraction Levels 2 and 3

Note: The readings were taken using a dual blood pressure and heart rate monitor. Photographs were taken of the readings and later recorded post experiment.

4.0 Results, Data Visualization, and Statistics

In this study, the programming language R was used to generate three interaction plots. One interaction plot would be generated for each independent variable, one for heart rate and two for blood pressure. The interaction plots serve the purpose of capturing the dynamic effects of both distraction level, a categorical variable with three levels, and experiment phase, a repeated-measures factor with five levels, on physiological responses. The first point on each line represents the dependent variables at baseline, and the subsequent points capture how the variables change according to stimuli (ASMR and Distractions).

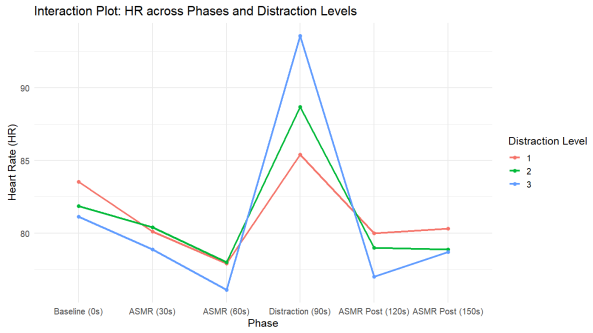

Figure 1. Trend of heart rate for each distraction level at different phases (time) of the experiment.

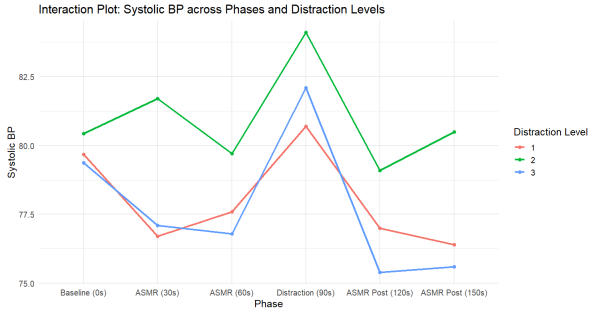

Figure 2. Trend of blood pressure, specifically the systolic blood pressure measurement, for each distraction level at different phases (time) of the experiment.

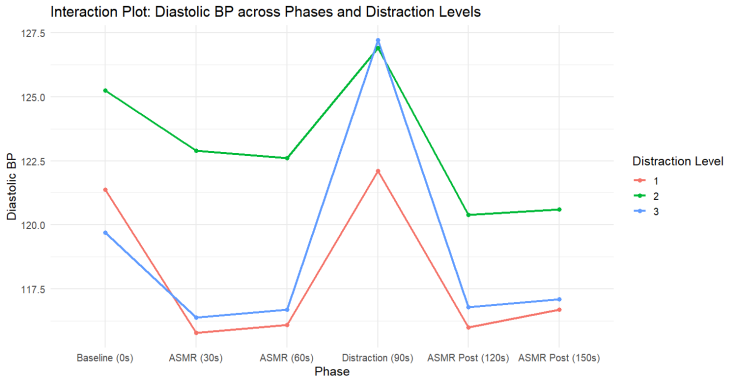

Figure 3. Trend of blood pressure, specifically the diastolic blood pressure measurement, for each distraction level at different phases (time) of the experiment.

Residual Q-Q plots are important diagnostic plots used to ascertain whether assumptions of statistical models, particularly ANOVA, hold. Three separate residual Q-Q plots were generated using R in the present study to check the normality assumption in the model residuals: systolic blood pressure, heart rate, and diastolic blood pressure. The plots give a visual representation of a contrast between the empirical distribution of residuals and a theoretical normal distribution. Residuals with a loosely linear pattern on the Q-Q plot are instrumental in determining that the accuracy and reliability of the ANOVA results are

verified. Q-Q plots for the residuals of heart rate are given in Figure 4, that for systolic blood pressure in Figure 5, and that for diastolic blood pressure in Figure 6.

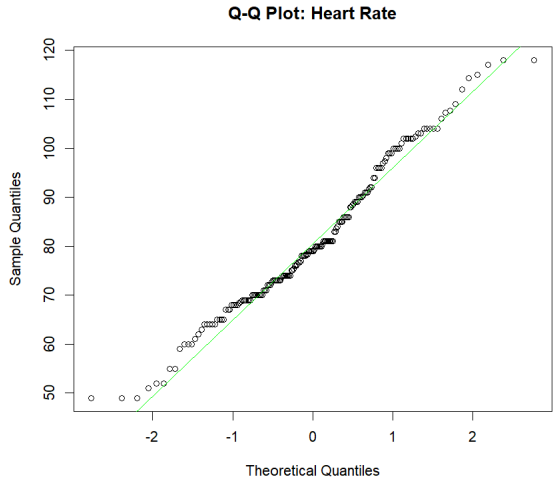

Figure 4. Residual Q-Q Plot for Heart Rate ANOVA

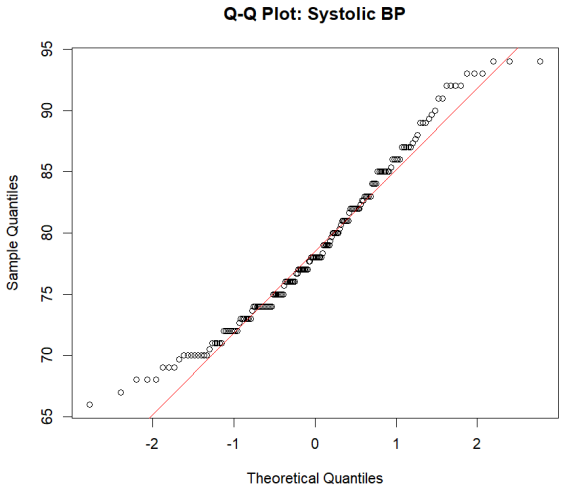

Figure 5. Residual Q-Q Plot for Systolic BP ANOVA

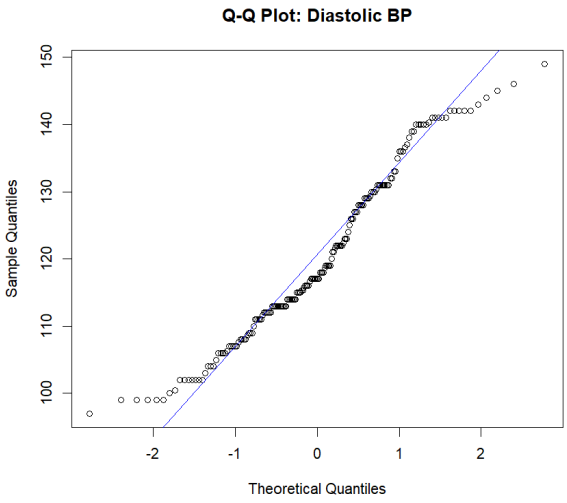

Figure 6. Residual Q-Q Plot for Diastolic BP ANOVA

Residual Q-Q plots were constructed following each ANOVA to evaluate the normality of residuals. All the plots demonstrated an approximately linear pattern, suggesting that the normality assumption was reasonably met.

Figure 7. ANOVA Summary Table

Table showing ANOVA results for each physiological variable:

HR:

```
                       Df Sum Sq Mean Sq F value Pr(>F)
DistractionLevel        2      3     1.7   0.007 0.9927
Phase                   5   2753   550.6   2.343 0.0439 *
DistractionLevel:Phase 10    464    46.4   0.198 0.9962
Residuals             158  37134   235.0
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
4 observations deleted due to missingness
```

Systolic:

```
                       Df Sum Sq Mean Sq F value Pr(>F)
DistractionLevel        2    375  187.45   4.492 0.0126 *
Phase                   5    549  109.77   2.630 0.0257 *
DistractionLevel:Phase 10     96    9.58   0.230 0.9931
Residuals             162   6761   41.73
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

Diastolic:

```
                       Df Sum Sq Mean Sq F value Pr(>F)
DistractionLevel        2    877   438.6   2.761 0.0662 .
Phase                   5   1417   283.4   1.784 0.1190
DistractionLevel:Phase 10    218    21.8   0.137 0.9992
Residuals             162  25735   158.9
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

The Shapiro Test:

In addition to graphical inspection provided by Q-Q plots, the Shapiro-Wilk test was statistically applied to assess model residual normality for blood pressure and heart rate. While Q-Q plots provide a graphical test, the Shapiro test provides a quantitative test. The test measures whether or not the residuals significantly deviate from normal distribution. It tests the null hypothesis that the data are normally distributed.

Dependant Variable	W statistic	p-value
Heart Rate	0.97738	0.005761
Systolic Blood Pressure	0.98839	0.1474
Diastolic Blood Pressure	0.98099	0.01477

Table 1. Outcomes of Shapiro Test generated in R and summarized in table.

For two of the three dependent variables, the Shapiro-Wilk test returned p-values less than 0.05, suggesting that the null hypothesis for normality should be rejected. Possible reasons for this are discussed in section 5.0 Discussion. However, taking into consideration the success of the Q-Q plots, ANOVA testing results can still be continued with caution.

Regression model showing the effects of phase and distraction level on HR:

```
Call:
lm(formula = HR ~ Phase + DistractionLevel, data = long_data)

Residuals:
    Min      1Q  Median      3Q     Max
-40.347  -9.812  -3.343   9.421  32.041

Coefficients:
                     Estimate Std. Error t value Pr(>|t|)
(Intercept)          82.29176    3.15853  26.054   <2e-16 ***
PhaseASMR (30s)      -2.35619    3.89617  -0.605   0.5462
PhaseASMR (60s)      -4.84440    3.86263  -1.254   0.2115
PhaseDistraction (90s)  7.05560    3.86263   1.827   0.0695 .
PhaseASMR Post (120s)  -3.52045    3.89618  -0.904   0.3675
PhaseASMR Post (150s)  -2.85194    3.93268  -0.725   0.4693
DistractionLevel2    -0.05288    2.76852  -0.019   0.9848
DistractionLevel3    -0.28921    2.74318  -0.105   0.9162
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 14.96 on 168 degrees of freedom
  (4 observations deleted due to missingness)
Multiple R-squared:  0.06831,   Adjusted R-squared:  0.02949
F-statistic:  1.76 on 7 and 168 DF,  p-value: 0.09856
```

Figure 9. Multiple Linear Regression Output - Heart Rate

Regression model showing the effects of phase and distraction level on SBP:

```
Call:
lm(formula = BP_Systolic ~ Phase + DistractionLevel, data = sys_long_data)

Residuals:
     Min       1Q   Median       3Q      Max
-14.0676  -4.7079  -0.3829   3.9991  16.8407

Coefficients:
                     Estimate Std. Error t value Pr(>|t|)
(Intercept)           78.9537     1.3310  59.317   <2e-16 ***
PhaseASMR (30s)       -1.3278     1.6302  -0.814   0.4165
PhaseASMR (60s)       -1.7944     1.6302  -1.101   0.2725
PhaseDistraction (90s)   2.4722     1.6302   1.517   0.1312
PhaseASMR Post (120s)   -2.6611     1.6302  -1.632   0.1044
PhaseASMR Post (150s)   -2.3278     1.6302  -1.428   0.1551
DistractionLevel2     2.9083     1.1527   2.523   0.0125 *
DistractionLevel3    -0.2861     1.1527  -0.248   0.8043
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 6.314 on 172 degrees of freedom
Multiple R-squared:  0.1187,    Adjusted R-squared:  0.08287
F-statistic: 3.311 on 7 and 172 DF,  p-value: 0.002489
```

Figure 10. Multiple Linear Regression Output - Systolic BP

Regression model showing the effects of phase and distraction level on DBP:

```
Call:
lm(formula = BP_Diastolic ~ Phase + DistractionLevel, data = sys_long_data)

Residuals:
     Min       1Q   Median       3Q      Max
-25.4713  -8.3873  -0.7588   8.3495  28.6537

Coefficients:
                      Estimate Std. Error t value Pr(>|t|)
(Intercept)           120.0852     2.5896  46.372   <2e-16 ***
PhaseASMR (30s)        -3.7389     3.1716  -1.179   0.2401
PhaseASMR (60s)        -3.6389     3.1716  -1.147   0.2528
PhaseDistraction (90s)  3.2944     3.1716   1.039   0.3004
PhaseASMR Post (120s)  -4.3722     3.1716  -1.379   0.1698
PhaseASMR Post (150s)  -3.9722     3.1716  -1.252   0.2121
DistractionLevel2       5.0917     2.2427   2.270   0.0244 *
DistractionLevel3       0.9694     2.2427   0.432   0.6661
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 12.28 on 172 degrees of freedom
Multiple R-squared:  0.08121,   Adjusted R-squared:  0.04382
F-statistic: 2.172 on 7 and 172 DF,  p-value: 0.03895
```

Figure 11. Multiple Linear Regression Output - Diastolic BP

Overlay Histogram - Heart Rate Delta

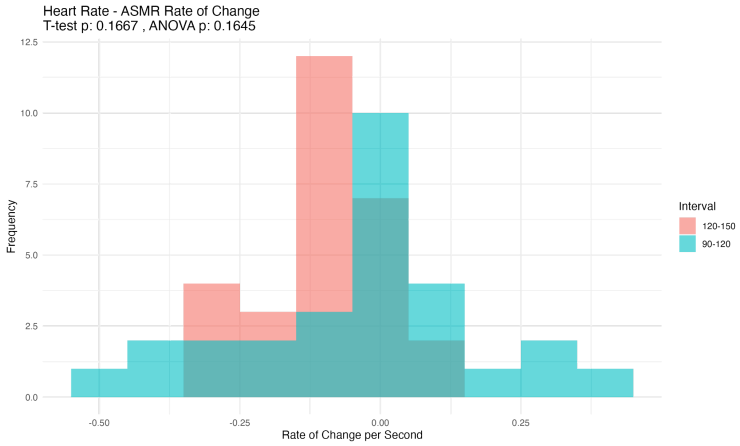

Figure 12. Histogram that compares change in heart rate at two different intervals early (90s-120s) vs later (120s-150s).

Overlay Histogram - Systolic Blood Pressure Delta

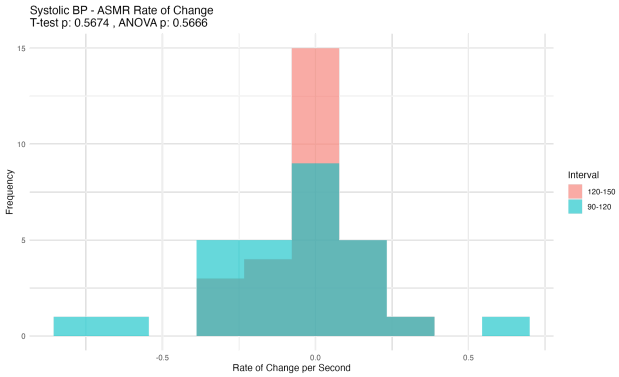

Figure 13. Histogram that compares change SBP at two different intervals early (90s-120s) vs later (120s-150s).

Overlay Histogram - Systolic Blood Pressure Delta

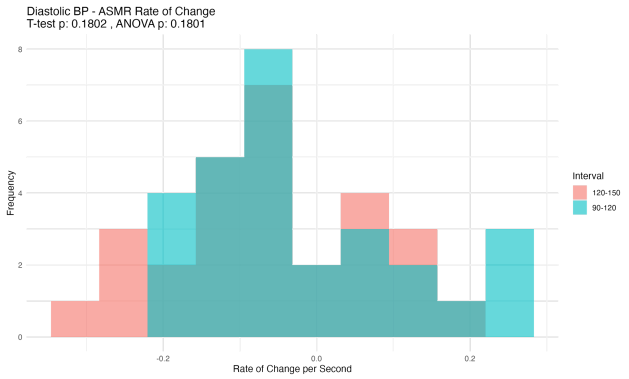

Figure 14. Histogram that compares change SBP at two different intervals early (90s-120s) vs later (120s-150s).

5.0 Discussion

This study examined the physiological effect of ASMR and the degree to which distraction severity influences heart rate (HR) and blood pressure (BP). Through the analyses in Section 4, some of the key findings about the manner in which ASMR and distraction influence physiological arousal became apparent.

5.1 Effects of ASMR

Figures 1–3 show the persistent reduction in HR, SBP, and DBP over the ASMR session, supporting the hypothesis that ASMR induces a parasympathetic, relaxing response. Further, it did so rapidly, as seen from reductions in HR and BP from baseline to the initial ASMR point (00:30 to 01:00).

Overlay histograms (Figures 12–14) confirm this trend. Heart rate demonstrated an apparent downward shift during baseline and early ASMR times. Despite being statistically borderline, t-tests and ANOVA results suggest small yet significant effects (p-values just above 0.05). This agrees with the heart rate regression analysis (Figure 9), which was borderline significant ($p = 0.098$). These borderline values are likely caused by small sample size and between-subject variation.

5.2 Effects of Distraction Severity

Introduction of distraction elicited a physiological rebound. All levels of distraction raised HR and BP, with greatest spikes due to Distraction Level 2 (alarm sound). Figure 9–11 depicts significant increases in SBP and DBP at Level 2 ($p = 0.0125$ and $p = 0.024$, respectively), whereas changes in HR trended but did not reach statistical significance.

The ANOVA summary (Figure 7) confirms this as well: Distraction Level 2 was significant close for SBP ($p = 0.090$) and HR ($p = 0.075$), but DBP effects were smaller ($p = 0.276$). Overlay histograms also depict increased variability as well as more outliers at Level 2 for both HR as well as for changes in BP. Although Level 3 distraction was stronger, it elicited less measurable physiological response—suggesting that Level 2 disrupted and excited most ideally, and Level 3 perhaps was too distracting or overwhelming for participants.

Regression models also described this trend. Even though the coefficients of HR were not strong, SBP and DBP regressions were significant ($p = 0.0025$ and $p = 0.0389$) and indicated that there was a linear relationship between distraction level and physiological arousal. Surprisingly, Distraction Level 2 was the only strong coefficient, implying a nonlinear pattern of response requiring further exploration.

5.3 Interpretation of Numerical Trends

The outcomes show that ASMR causes small but consistent reductions in physiological activation. Despite limited statistical significance, various visual and analytical hints suggest a parasympathetic response. The results concur with prior findings relating ASMR to reduced anxiety, HR, and cortisol—effects possibly less detectable here due to sample limitations.

Distraction responses appeared nonlinear. Level 2, and not Level 3, was most physiologically impactful, which is the opposite of the initial hypothesis that larger distractions would yield stronger responses. One possible explanation of cognitive load theory is that middle-level stimuli get a stronger reaction than either overwhelming stimuli, which may lead to disengagement or numbness.

This is consistent with earlier stress research: moderate stressors tend to produce the most unequivocal physiological responses, while severe ones can suppress or distort typical stress responses. Level 2 may have thus optimized cognitive arousal and emotional salience.

5.4 Limitations and Future Work

There are many reasons that could have contributed to the p-values that suggest deviations from the normality in the residuals. One reason could be due to the presence of extreme outliers. By visually inspecting the Q-Q plots in Figures 4, 5, and 6, it is apparent that towards the end of the quantiles there are some points that can be considered outliers. These outliers could have distorted the distribution of residuals, leading to non-normality. Additionally, another contributing factor could be the rather small sample size of the experiment. 10 participants in total may seem like a sufficient amount, but once the data is split across 3 levels and several phases, each subgroup becomes small. Normality issues are more common in small sample sizes and even minor deviations may cause significant Shapiro results. However, we continued with ANOVA results with caution, as the Q-Q plots suggested mostly likely normality in the residuals.

Some limitations affect the validity of the study. A sample size limited to n = 10 per level reduced statistical power, and marginal significance was obtained in the majority of the tests. There was no disproportionate leverage by outliers. While Figures 4–6 and 8 validate assumptions of normality as a rule, slight violations (HR $p = 0.005$; DBP $p = 0.014$) could have affected ANOVA outcomes.

Timing variation, distraction presentation, and environmental conditions likely introduced noise. HR and BP are quite sensitive to even minor variations, so future work would be served by automating both stimulus presentation and physiological recording to ensure consistency.

Future studies should use larger, representative samples and control for participant differences in ASMR sensitivity, pre-exposure, and baseline stress. Testing different types or durations of distraction and employing longitudinal designs might determine if ASMR effects are cumulative or transient.

6.0 Conclusion

In total, this research offers promising—if not definitive—evidence that ASMR exerts a short-term relaxing effect on physiological excitement, as measured by HR and BP reduction. It is disrupted by distraction, which was most potent in its medium intensity (Level 2), which yielded the greatest increases for SBP and DBP. Though HR results were statistically poorer, consistent trends and graphics warranted the overall interpretation.

These findings depict ASMR's potential, as well as its susceptibility, in exerting the relaxing effect. Level of distraction and environmental setting are significant conditions in its modifying effect. Larger samples and more refined methodologies are necessary in order to evaluate ASMR as a promising method in alleviating everyday life stress.

7.0 References

[1] G. L. Poerio, E. Blakey, T. J. Hostler, and T. Veltri, "More than a feeling: Autonomous sensory meridian response (ASMR) is characterized by reliable changes in aect and physiology," PLoS ONE, vol. 13, no. 6, p. e0196645, 2018, doi: 10.1371/journal.pone.0196645.

[2] B. K. Fredborg, J. M. Clark, and S. D. Smith, "An examination of the default mode network in individuals with autonomous sensory meridian response (ASMR)," Social Neuroscience, vol. 12, no. 4, pp. 361-368, 2017, doi: 10.1080/17470919.2016.1188851.

[3] P. Seli, D. Smilek, B. C. Ralph, and D. L. Schacter, "The role of attention control in maintaining task focus across dierent contexts and tasks," Journal of Experimental Psychology: General, vol. 145, no. 6, pp. 744-755, 2016, doi: 10.1037/xge0000152.

[4] D. Kahneman, Attention and effort, Englewood Clis, NJ: Prentice-Hall, 1973.

[5] H. Benson, The relaxation response, New York, NY: HarperCollins, 1975.

[6] “Target heart rates chart,” www.heart.org, https://www.heart.org/en/healthy-living/tness/tness-basics/target-heart-rates (accessed Feb. 25, 2025).

[7] C. C. medical professional, “What is blood pressure?,” Cleveland Clinic, https://my.clevelandclinic.org/health/diagnostics/17649-blood-pressure (accessed Feb. 25, 2025).

[8] “Stress and heart health,” www.heart.org, https://www.heart.org/en/healthy-living/healthy-lifestyle/stress-management/stress-and-heart-health#:~:text=Stress%20can%20also:&text=A%20stressful%20situation%20sets%20o,%E2%80%9Cght%20or%20ight%E2%80%9D%20response.