

Effect of Day to Day Activities on Stress by Measuring Heart Rate, GSR/EDA and Blood Pressure

BE 5382 Laboratory Principles Final Project

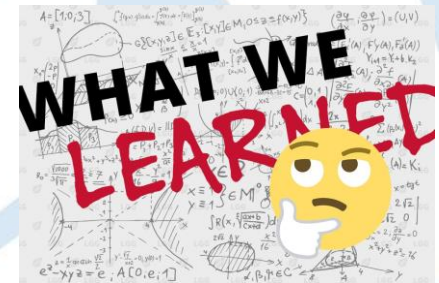
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Introduction

Experiment Goal

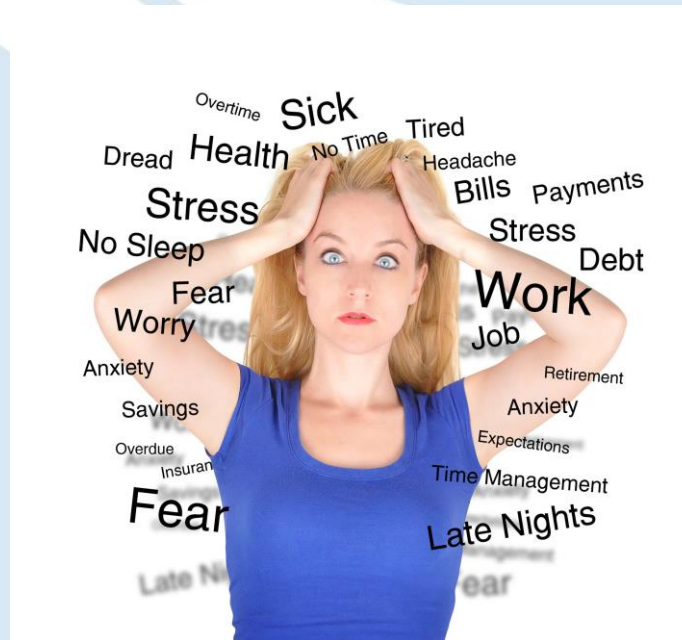
Apply what we learned through our course in how to...

- Design an experiment for a study case
 - define number of subject
 - define different factors effects on the results
 - Deciding best statistical test for data analysis
 - Define the required tools and equipment to use
- Using permanently data from previous and similar studies
- Concluding results from data analysis



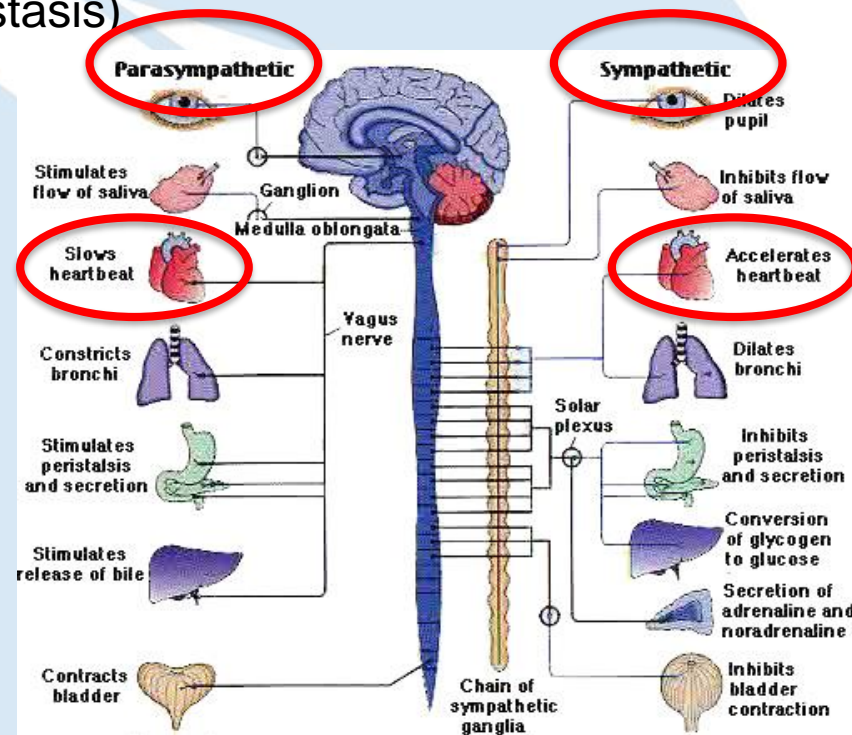
Introduction

- Stress can be defined as a body reaction to to a series of apparent physical or psychological threats
- In chronic cases stress can cause serious health problems
- We will study the effect of stress by studying the changes in 3 different physiological signals (Heart Rate, GSR and Blood Pressure)



Why Measuring Heart Rate?

- **Autonomic Nervous System (ANS)** is part of the peripheral nervous system that serves as a control mechanism to maintain the body under stable conditions (homeostasis)



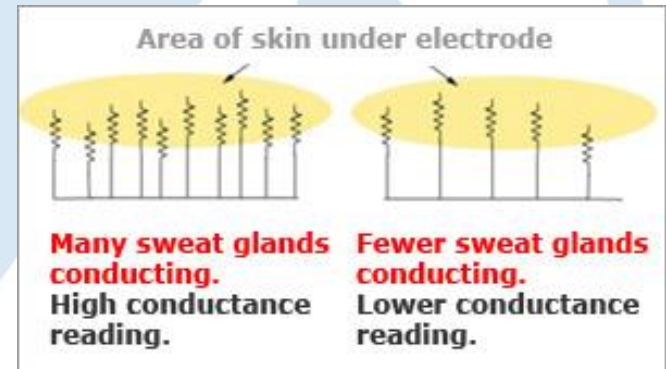
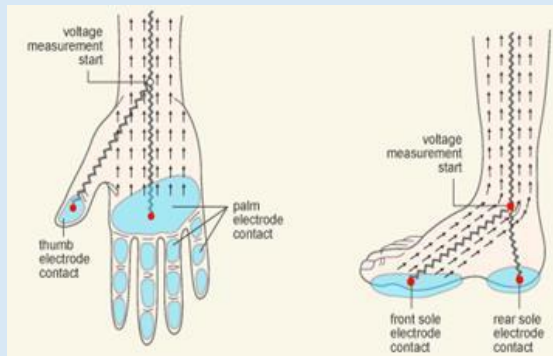
Why Measuring Heart Rate?

- ANS contain two main branches :
 - 1- Sympathetic Nervous System (SNS)
 - 2- Parasympathetic Nervous System(PNS)
- SNS branch help prepare the body action in response to potential threats
"fight or flight" response (Heart Rate increase)
- PNS branch is active under unchallenging situation, it works in opposite direction to bring the body back towards a rest states. (Heart Rate decrease)



Why Measuring Electrodermal Response/ Galvanic Skin Response?

- EDR/GSR allowed us to measure sweat gland activity, that is controlled by Sympathetic Nervous System branch of the Autonomic Nervous System
- Higher stress level causing increasing in sweat activities that cause high conductance reading due to many sweat glands conducting electric current
- Two places reliable to measure EDR, palms and feet due to high density of eccrine sweat glands



How about Blood Pressure?

- So as SNS branch of ANS prepare body action in response to potential physical or psychological threats, the body heart rate increase
- As the body heart rate increases the blood vessel narrow that increase the blood pressure.
- No proof that stress by it self causes high blood pressure, however other activities related to stress such as overeating, drinking alcohol and poor sleeping habits can cause high blood pressure
- Systolic and diastolic pressures reading were considered in our study



Tools and Equipment Used

- BIOPAC disposable Electrodes (EL 503), 3 electrodes/ subject
- BIOPAC Electrode lead set(SS2L)
- BIOPAC EDA setup
 - Disposable setup: EDA Lead (SS57L) and EDA Electrodes (EL507 x2)
 - Reusable setup: EDA Transducers (SS3LA/L) and Electrode gel (GEL 101)
- BIOPAC Student Lab System: BSL 4 software
- Computer System (windows)
- Omron 3 Series Upper Arm Digital Blood Pressure Monitor with Cuff

Experiment Design

- **Sample Size**

- Defining number of subject limited by different factors such as the available studying group (class mates) and amount of time available to test subject (class time)
- We could defined our sample size by standard deviation and effect size!
- If we had more resources, we could assume that we want at any of the activity that a subject perform reduce stress by reducing heart rate 5 bpm and between subjects standard deviation 10 bpm then by using $(n = 16\sigma^2/d^2)$ we will need 64 subjects!!
- Idea was to test as much subject as possible to increase accuracy of the experiment results

- **Duration**

- Estimated time was 15 min/subject

- **Subjects Condition**

- All subjects chosen were healthy non-smoker

Experiment Design

- **Variable of interest**

- stress

- **Factors**

3 factors included for studying heart rate and GSR:

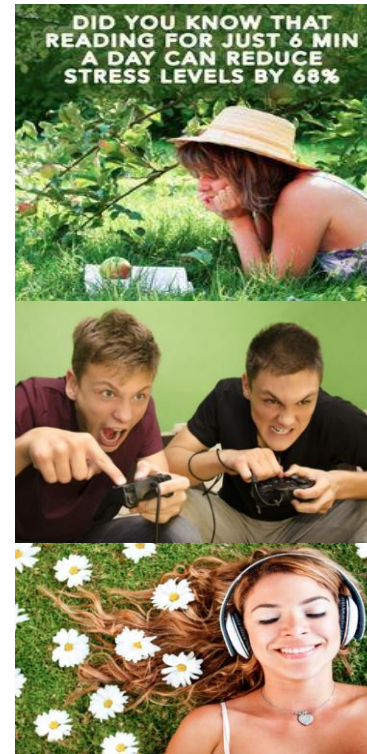
- gender (female-male)
- weight condition (overweight-not overweight)
- Exercise habits (exercise-not exercise)
- Timing (During Measuring and after respect to baseline)
- Each factor has 2 levels → there are $2 \times 2 \times 2 \times 2 = 16$ groups per measurement
- For Blood Pressure Measurements applied only after every activity

Measurements

		Reading		Video Gaming		Music Listing	
Heart Rate & GSR	Baseline	During Reading	After Reading	During Playing	After Playing	During Listening	After Listening
Blood Pressure	Baseline	-	After Reading	-	After Playing	-	After Listening

How Experiment Performed?

- Performed 3 different activities on 14 subjects and study the effect of each activity on stress
- Activities chosen :
 - Entertaining reading (1 min)
 - Playing video games (2 min)
 - Listing to music (2 min)



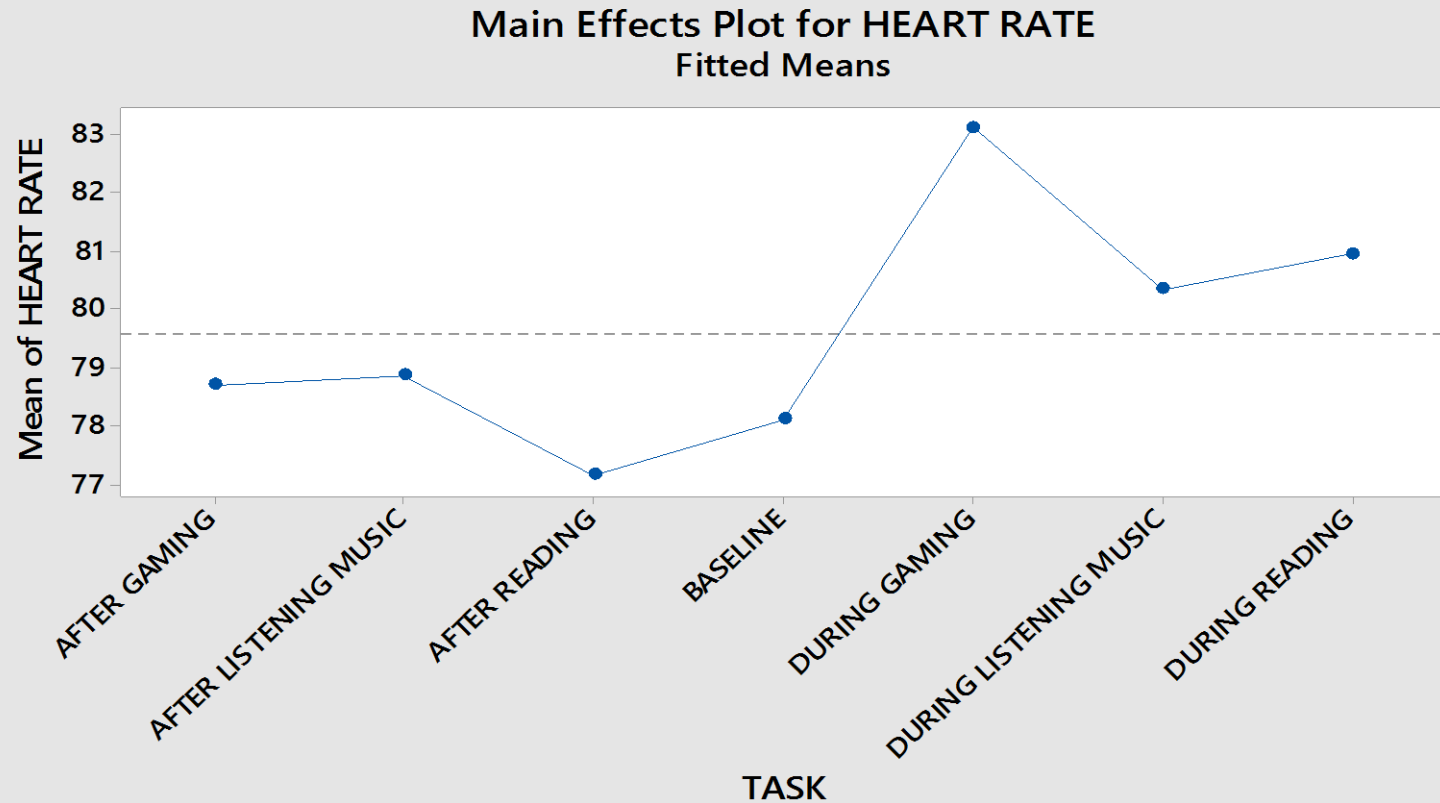
Hypothesis

Null Hypothesis	Alternative Hypothesis
Activity has no effect on Heart Rate	Activity has effect on Heart Rate
Activity has no effect on GRS	

- Statistical Test will run to study if there is significant change by an activity on stress
- The chosen statistical test considered in the study is Repeated Measure ANOVA (Analysis of Variance)
- RM ANOVA is equivalent to the one-way ANOVA but for related, not independent groups, where that fit our study case!
- It is extension of dependent t-test

Analysis Results

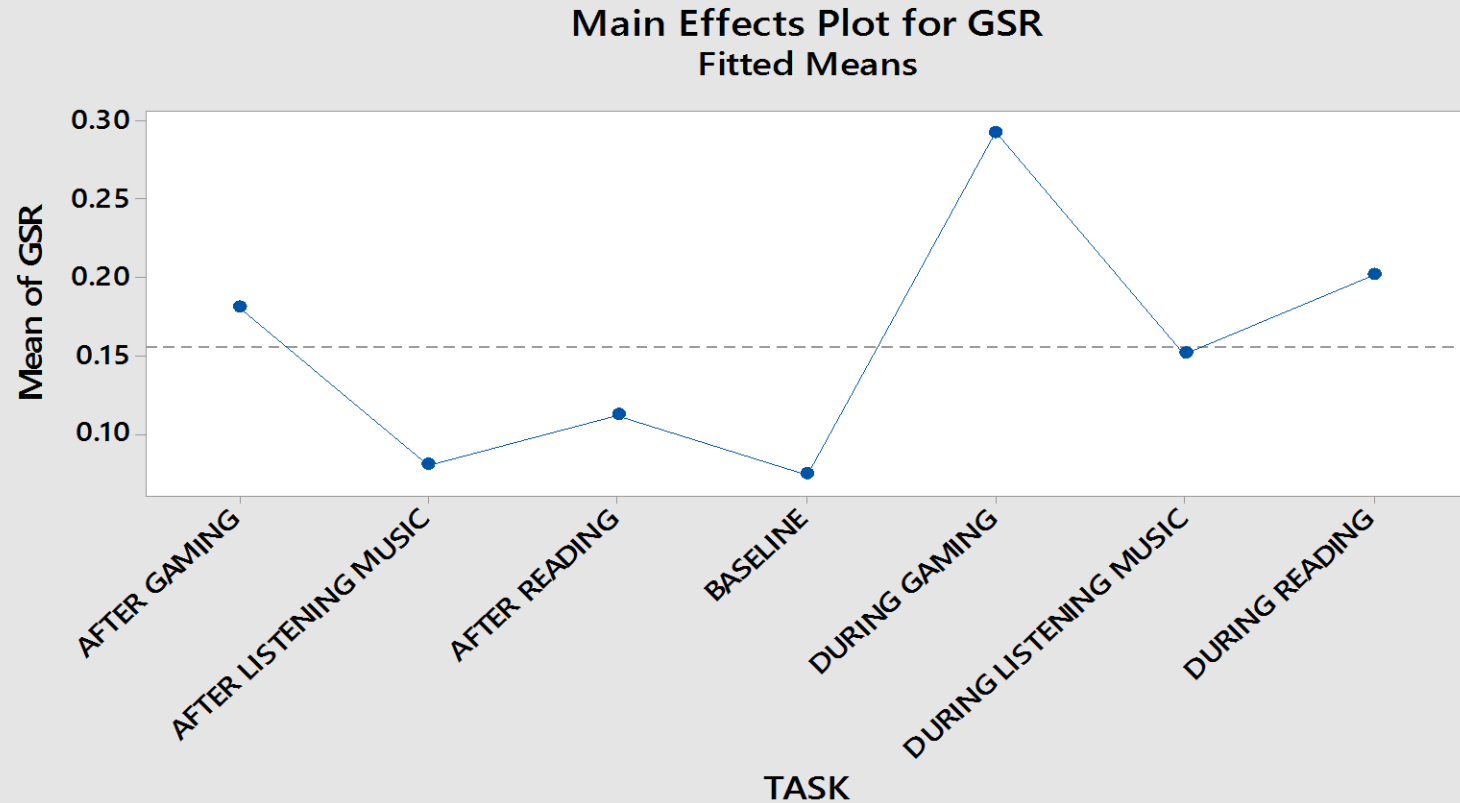
Heart Rate Changes on all subjects during and after activities



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Analysis Results

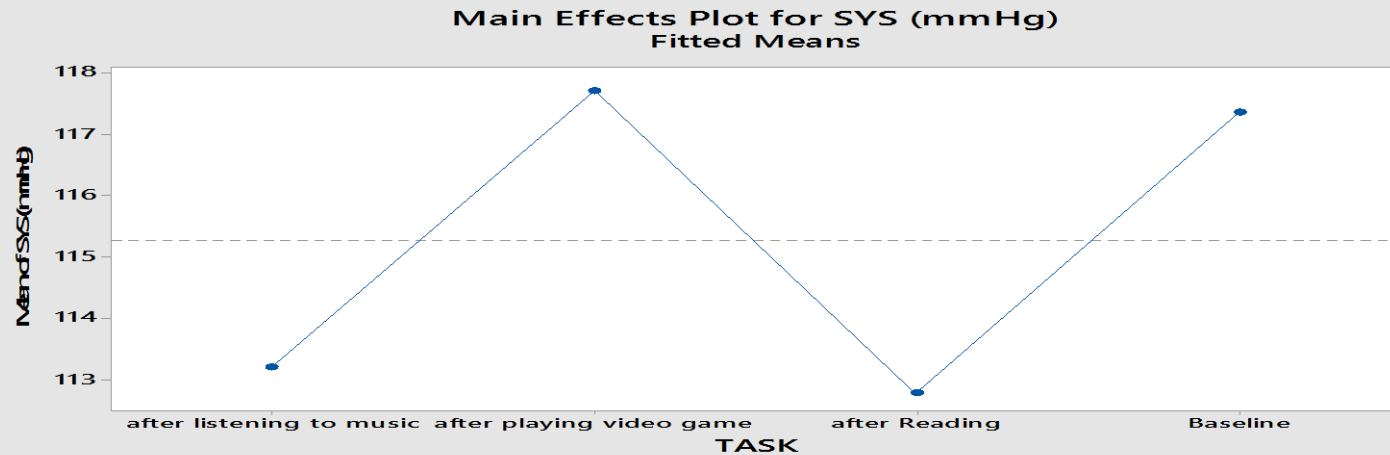
GSR changes on all subjects during and after activities



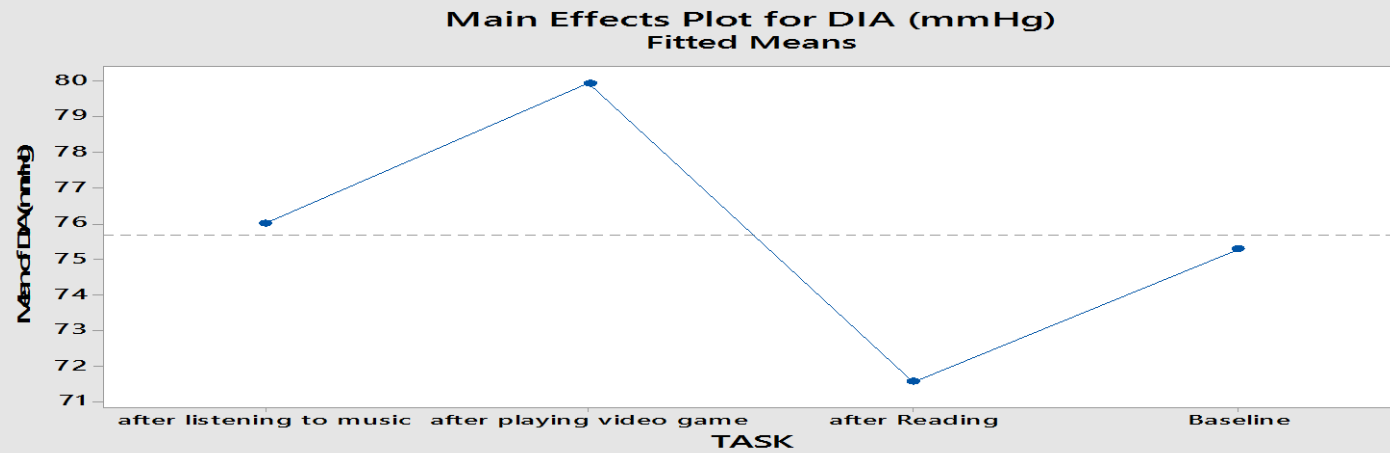
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Analysis Results

Blood Pressure changes on all subjects after activities



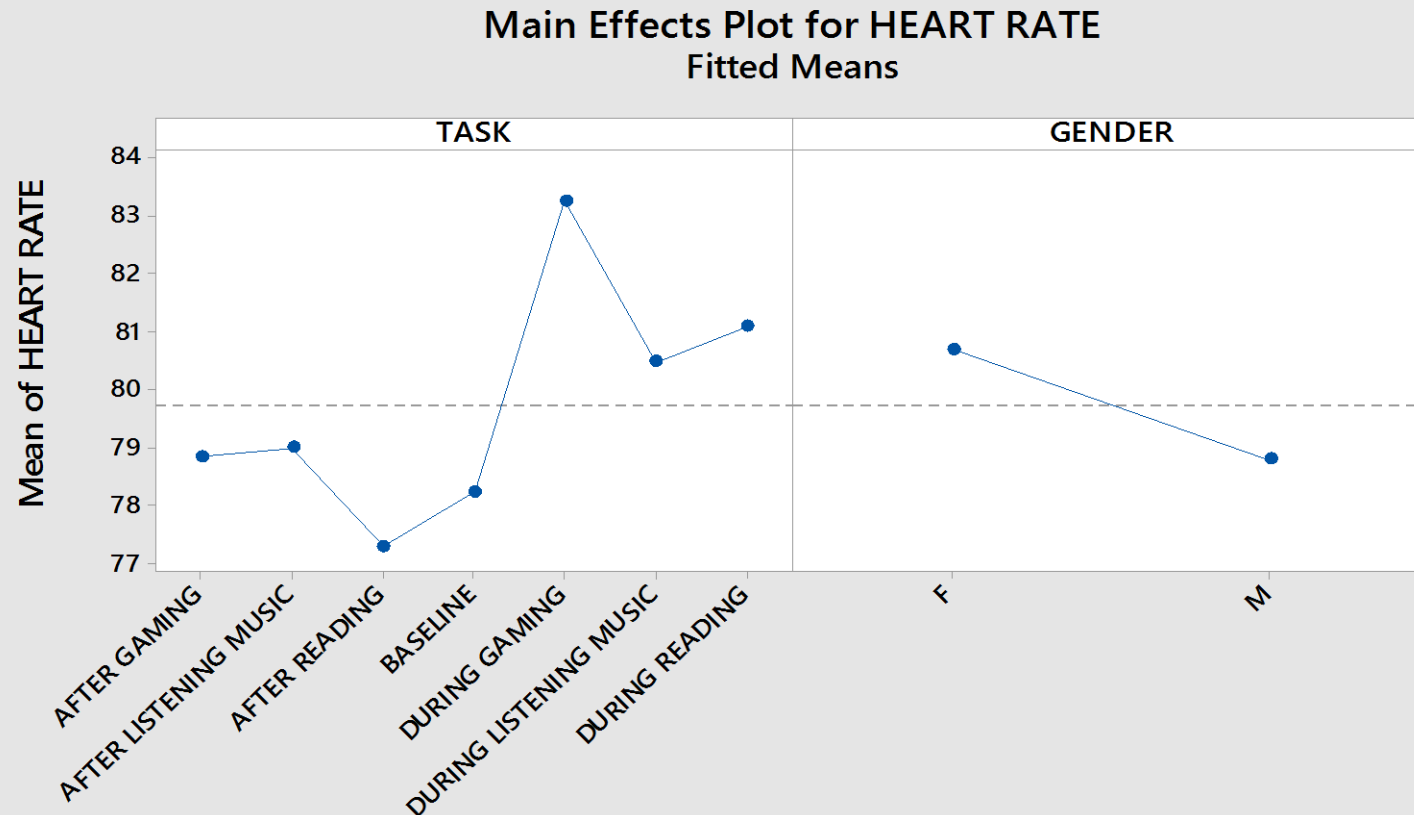
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Analysis Results

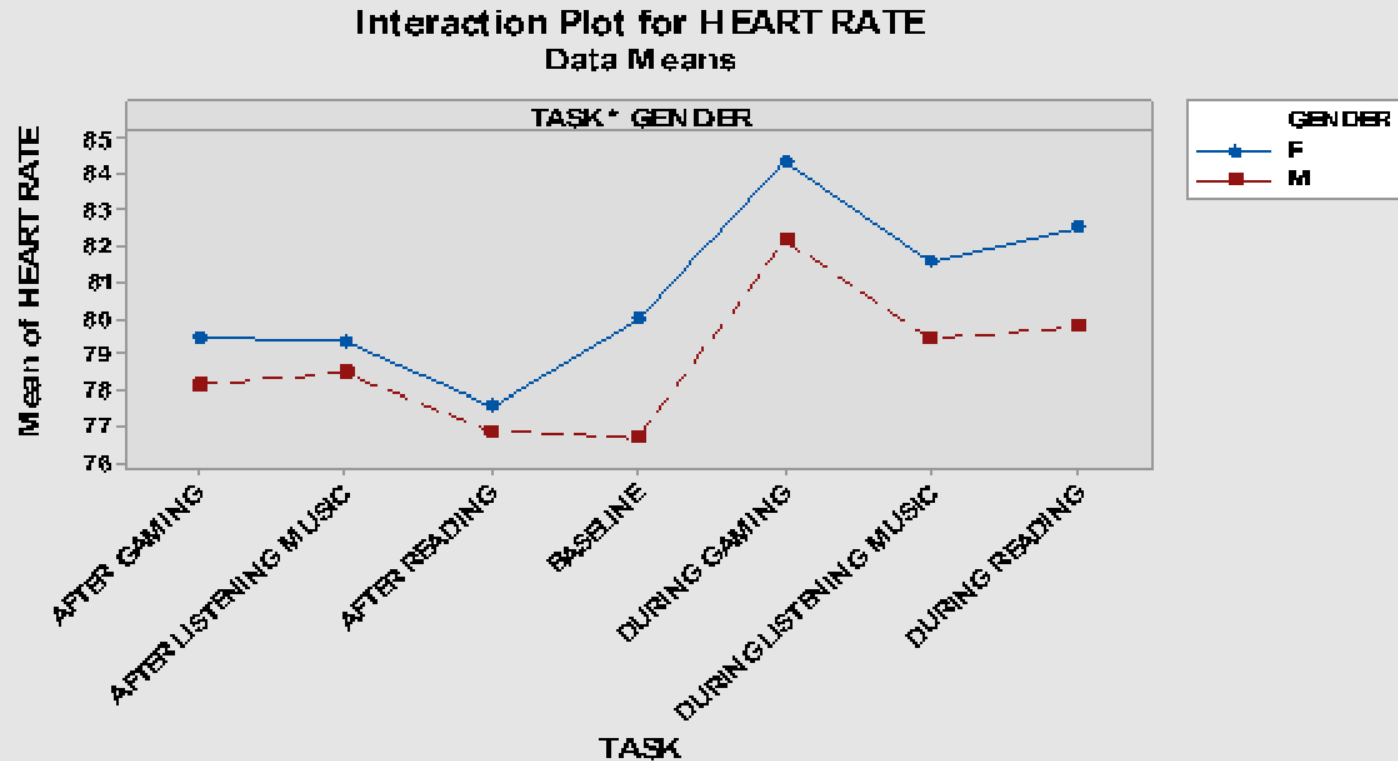
Heart Rate Changes based on actives and gender



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Analysis Results

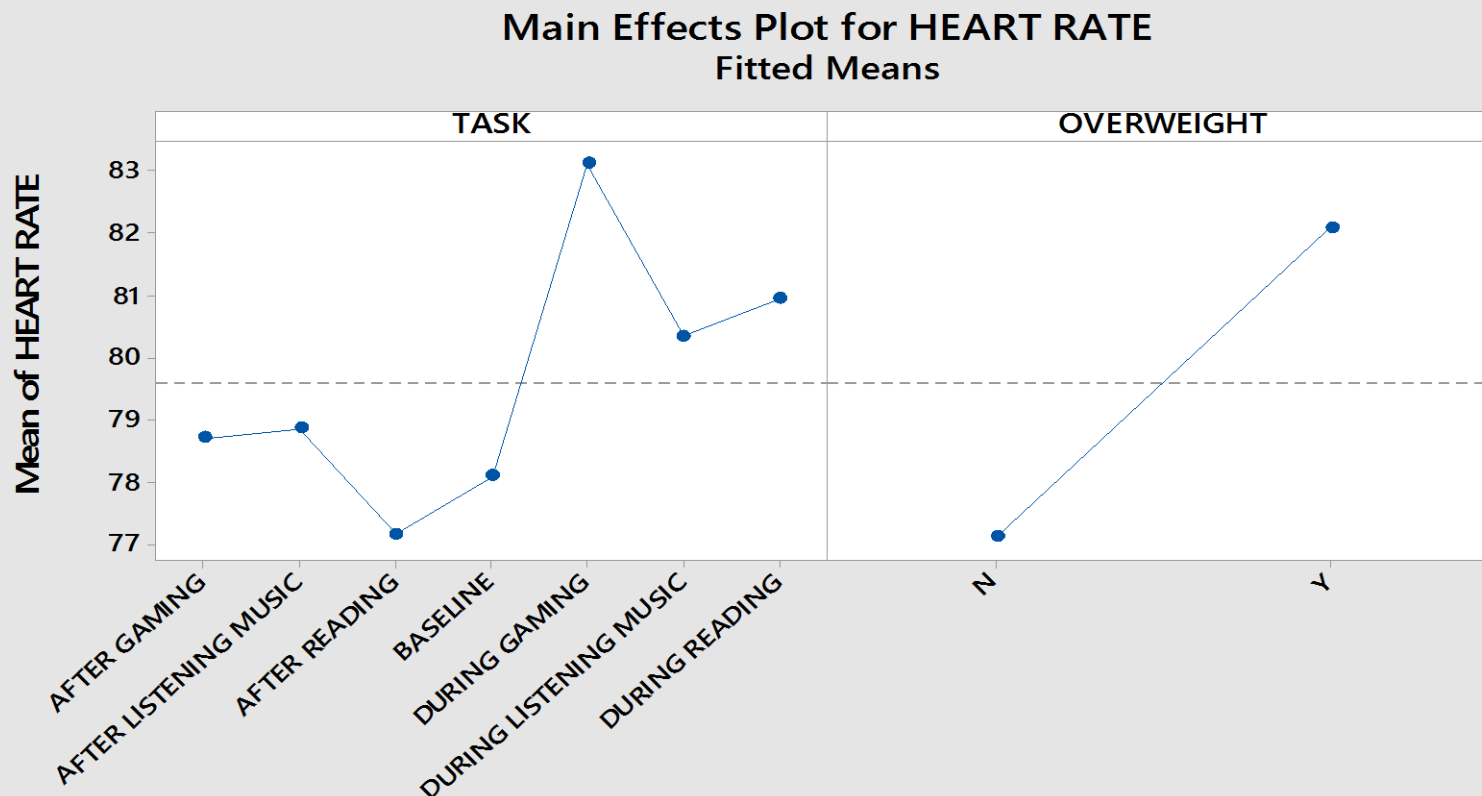
Heart Rate Changes based on actives and gender



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Analysis Results

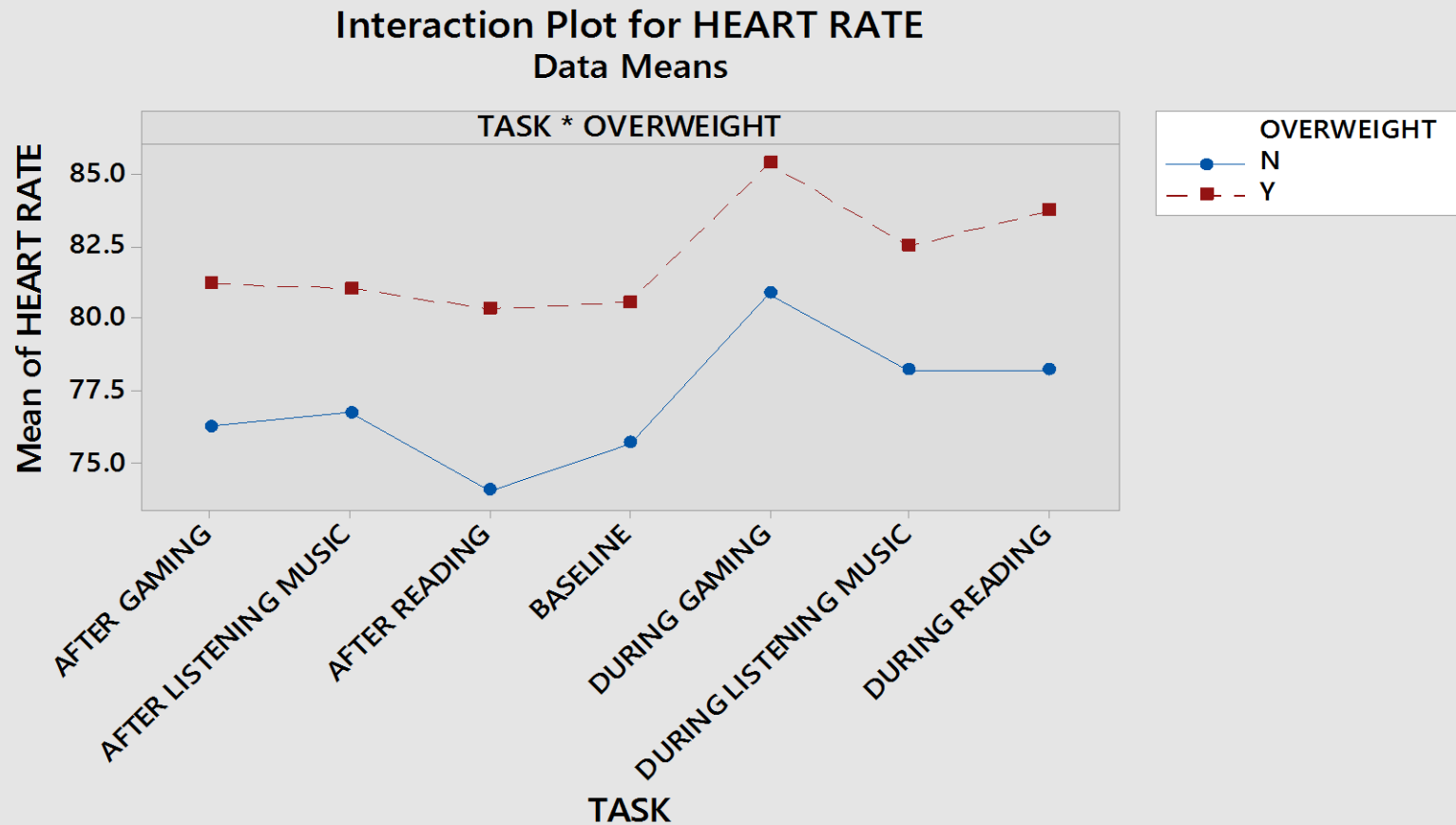
Heart Rate Changes based on actives and weight



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Analysis Results

Heart Rate Changes based on actives and weight

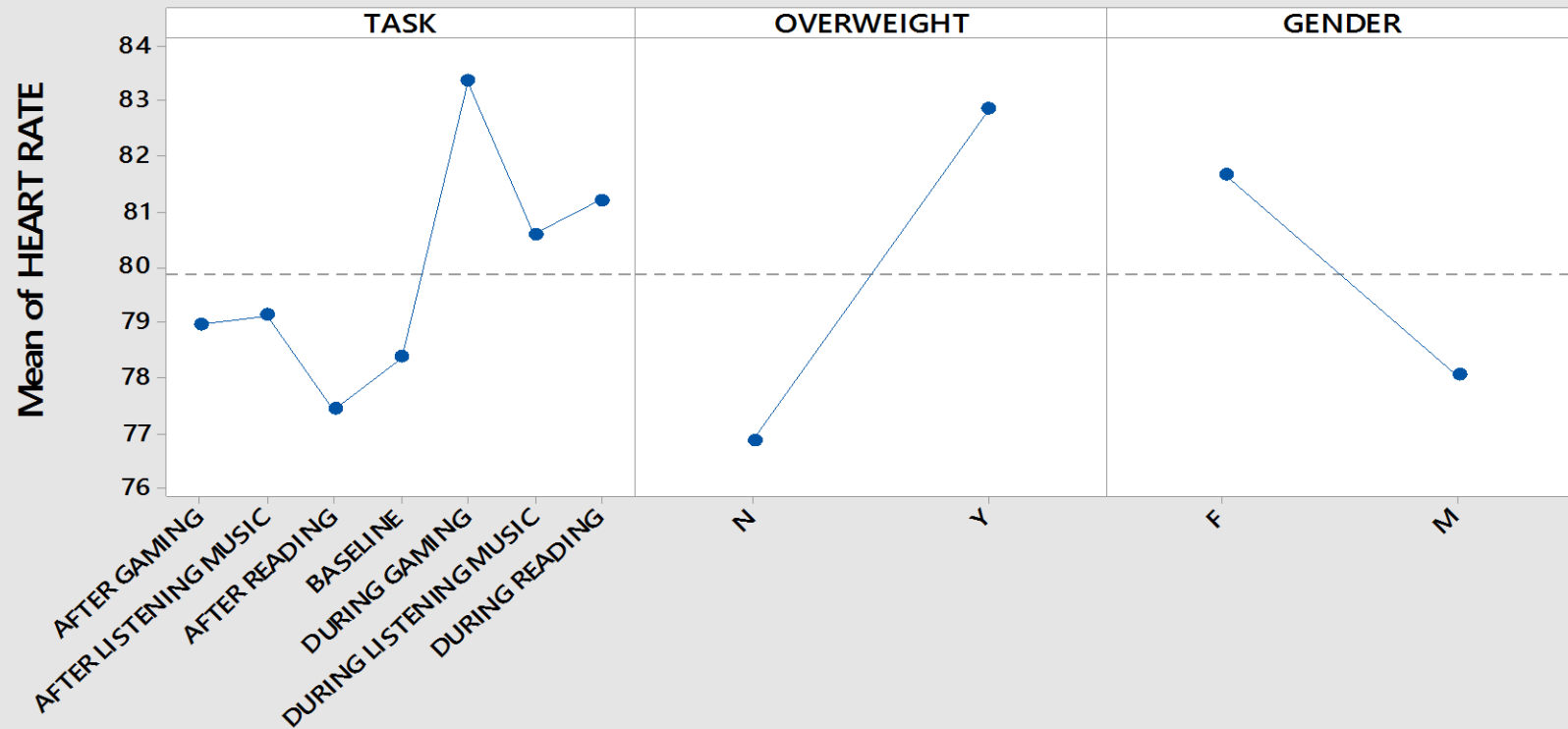


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Analysis Results

Heart Rate Changes based on actives, weight and gender

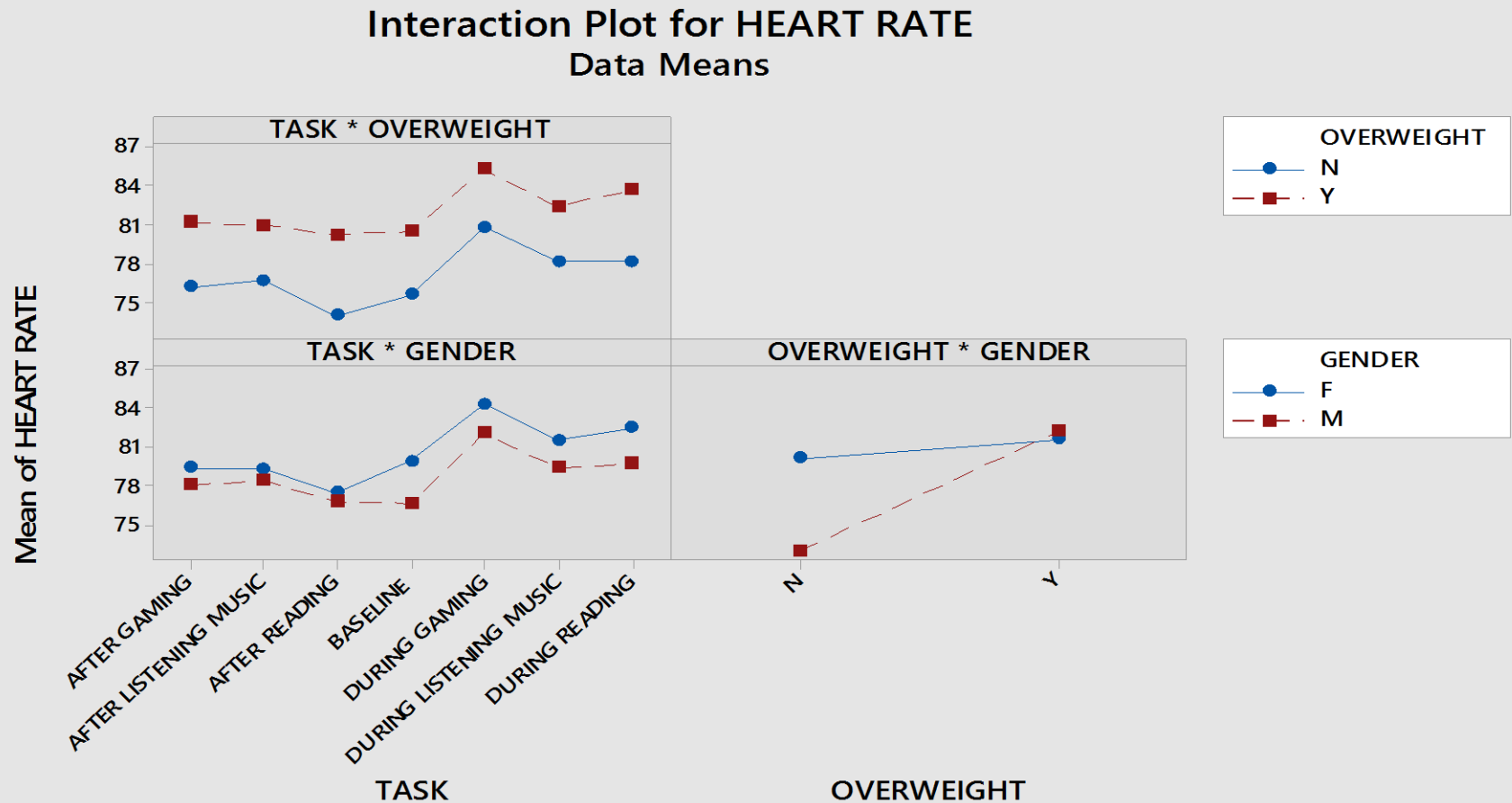
Main Effects Plot for HEART RATE
Fitted Means



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Analysis Results

Heart Rate Changes based on actives, weight and gender

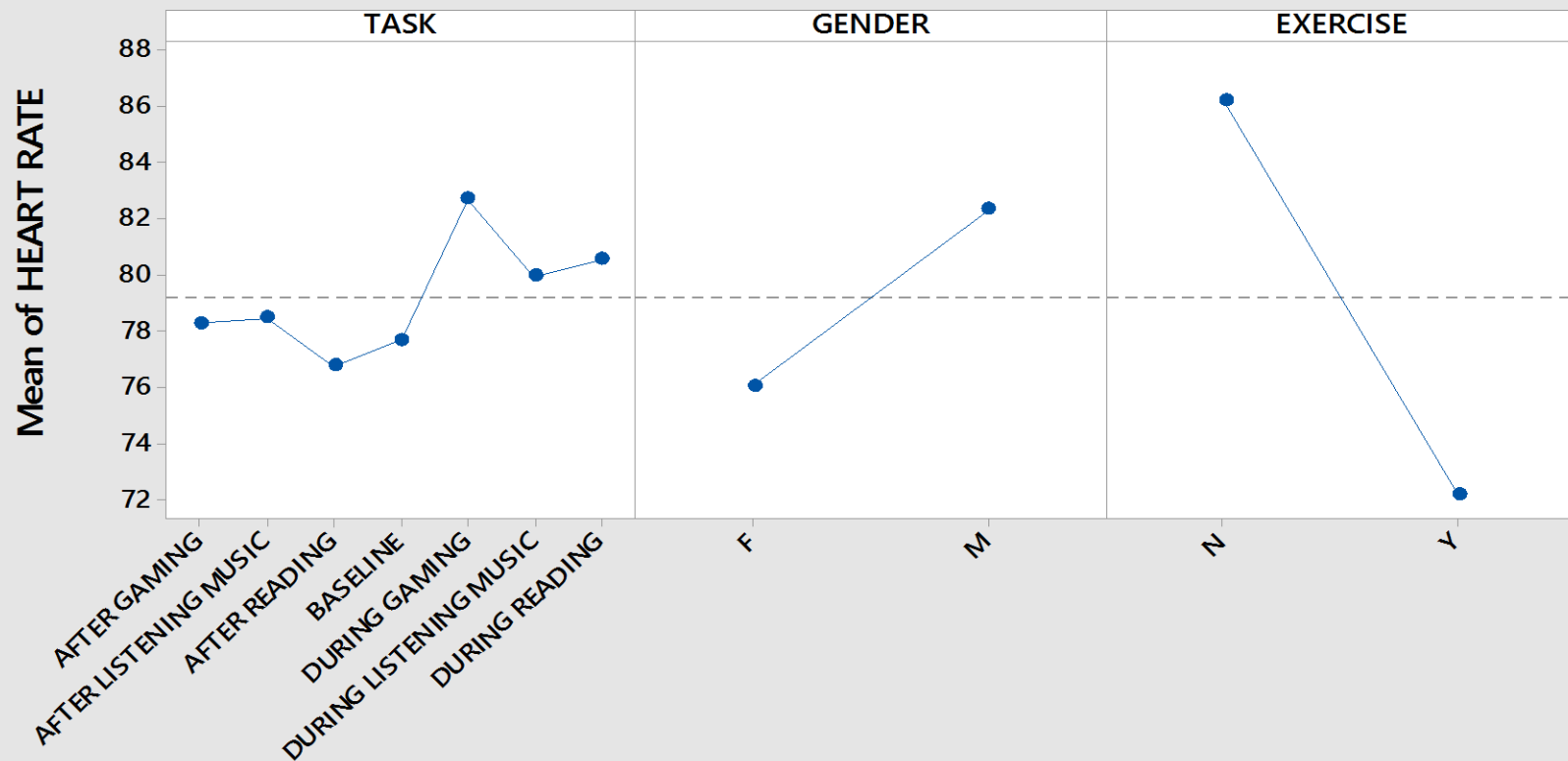


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Analysis Results

Heart Rate Changes based on actives, gender and exercise habits

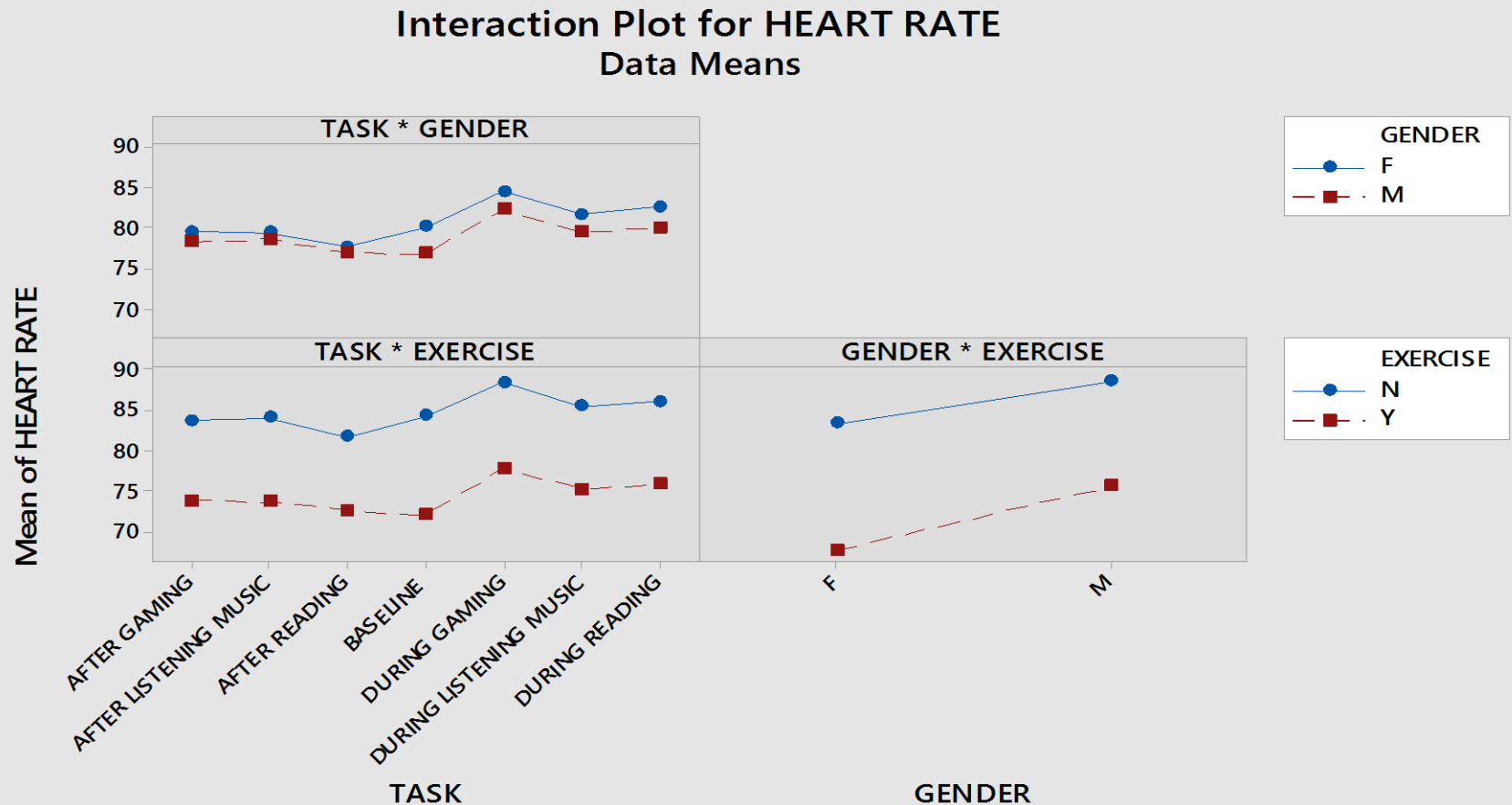
Main Effects Plot for HEART RATE
Fitted Means



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Analysis Results

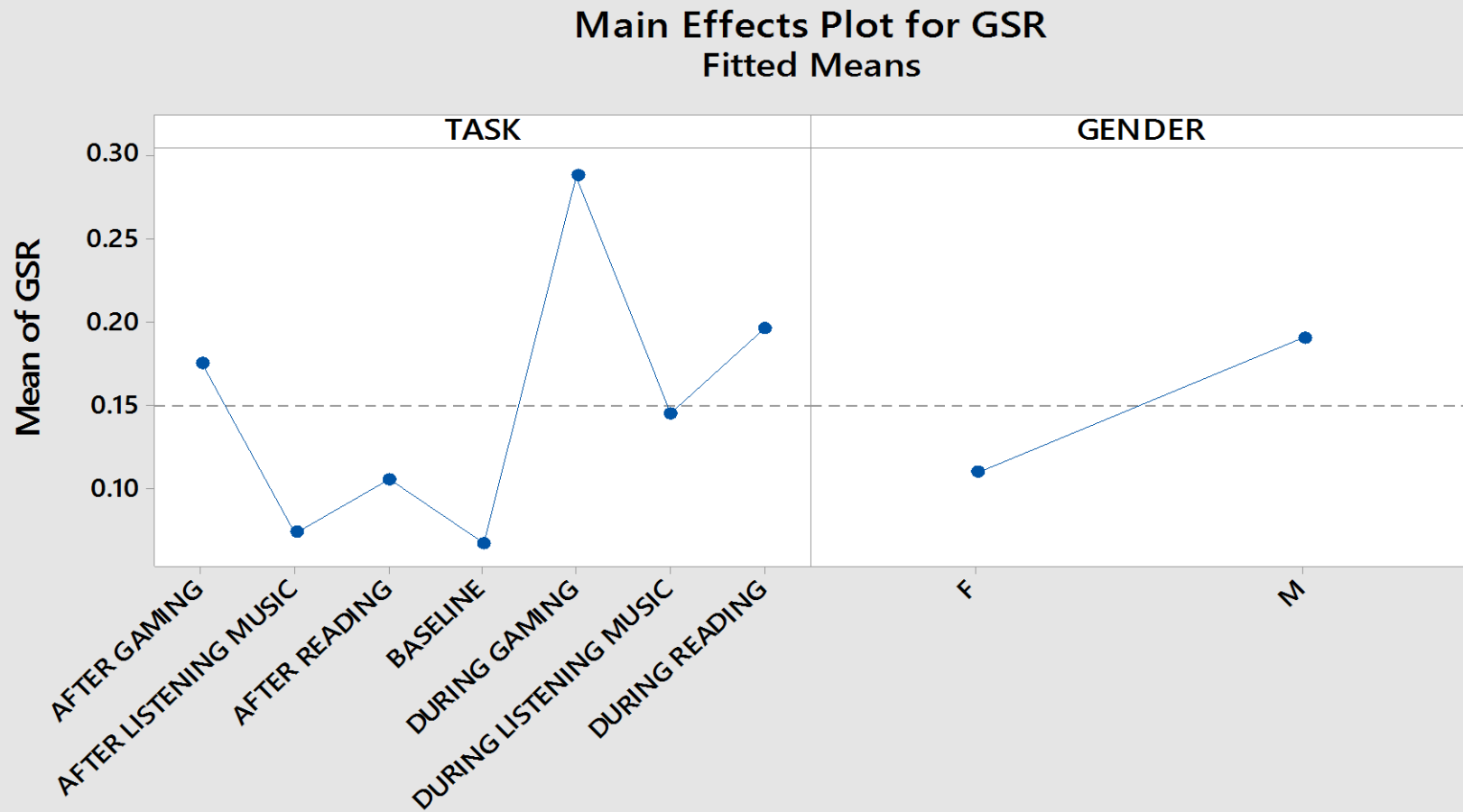
Heart Rate Changes based on actives, gender exercise habits



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Analysis Results

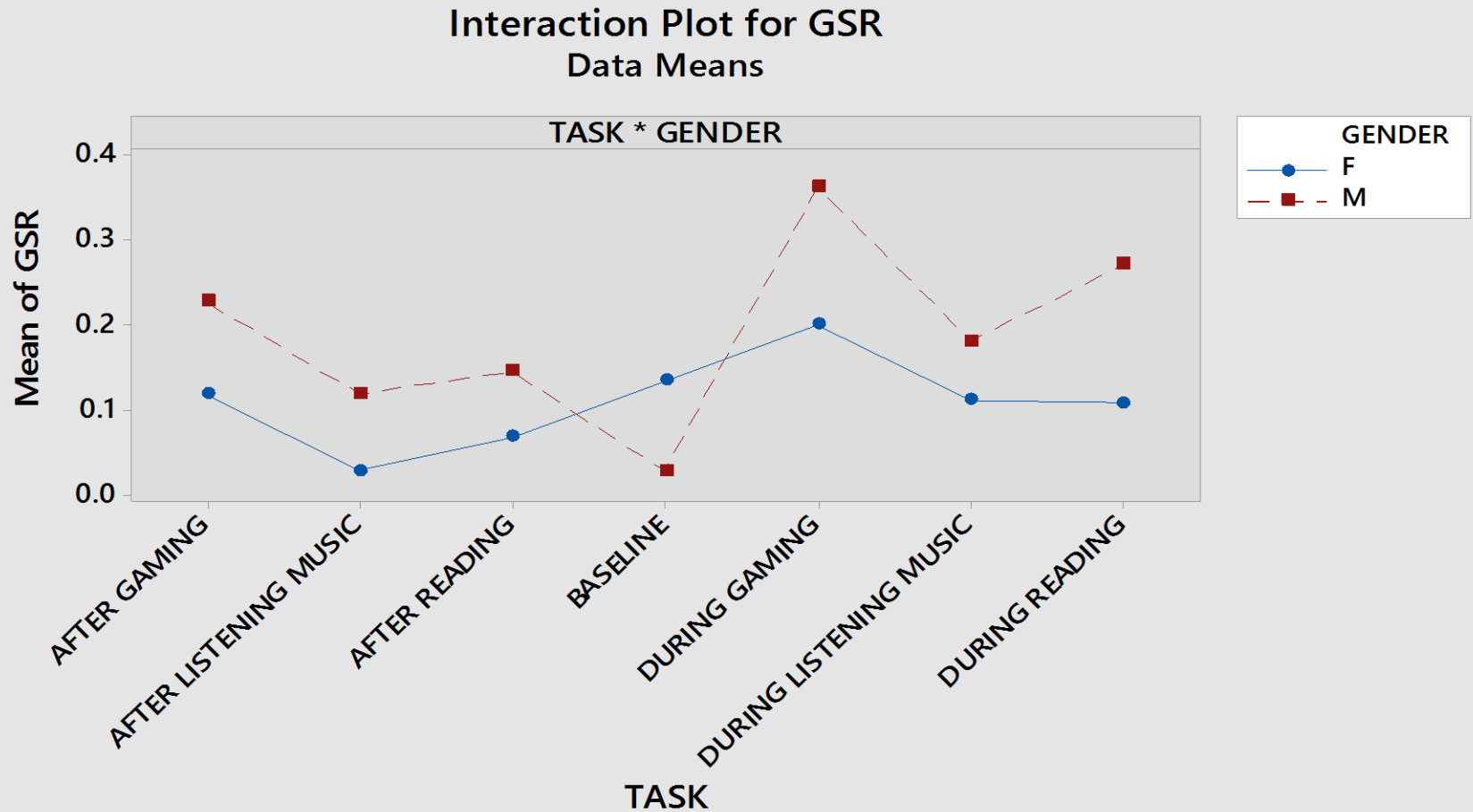
GSR Changes based on actives and gender



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Analysis Results

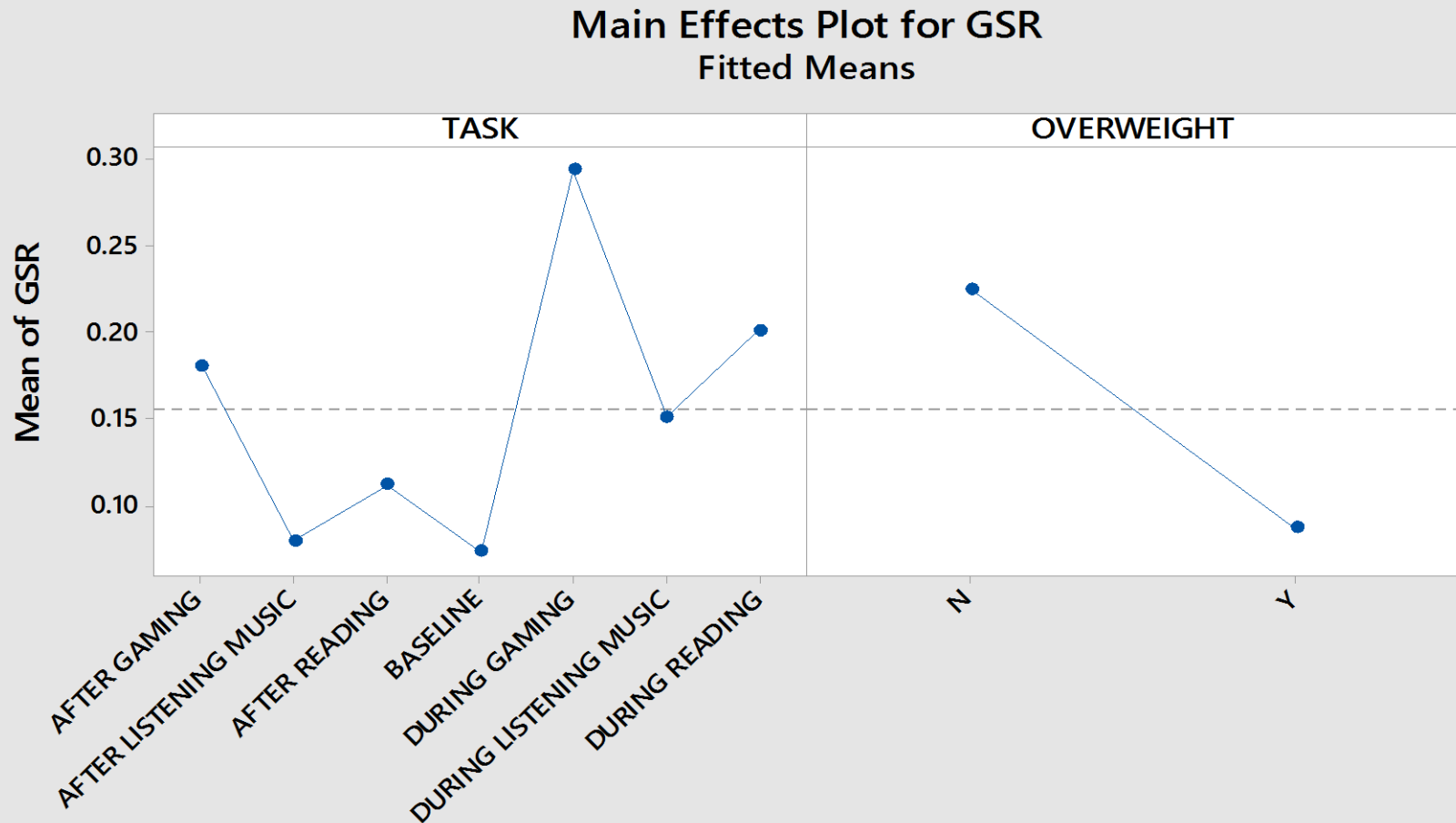
GSR Changes based on actives and gender



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Analysis Results

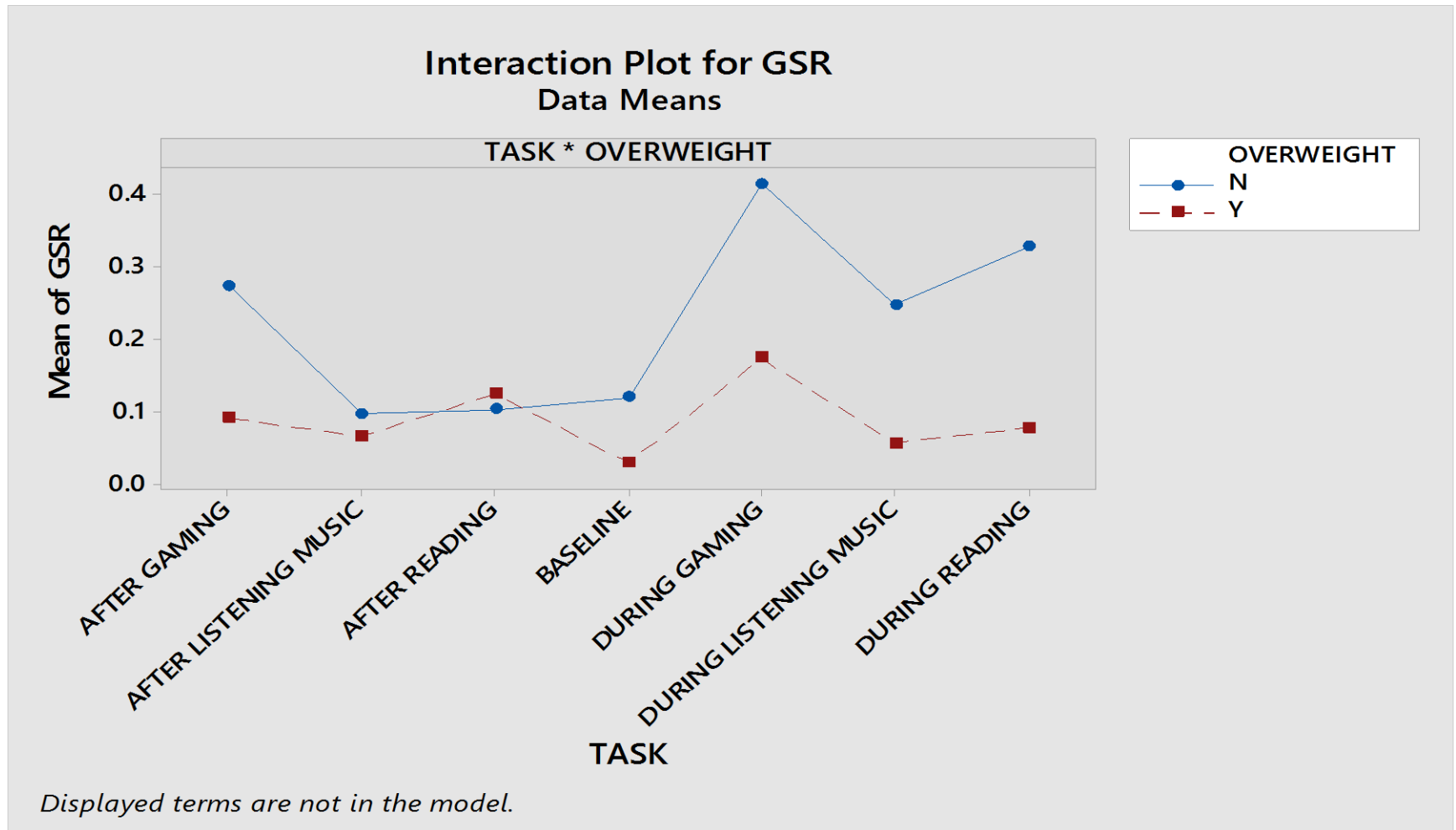
GSR Changes based on actives and weight



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Analysis Results

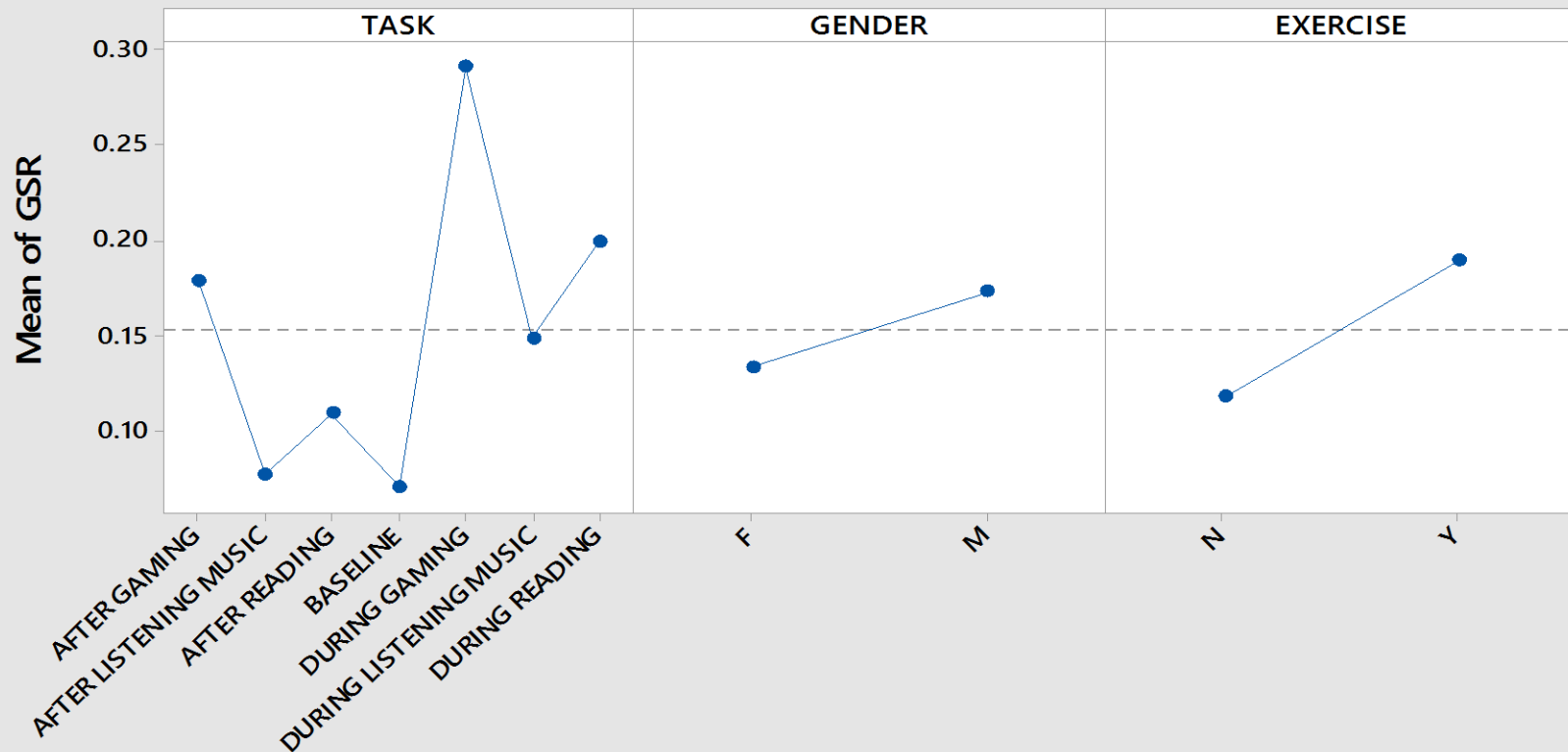
GSR Changes based on actives and weight



Analysis Results

GSR Changes based on actives, gender and exercise habits

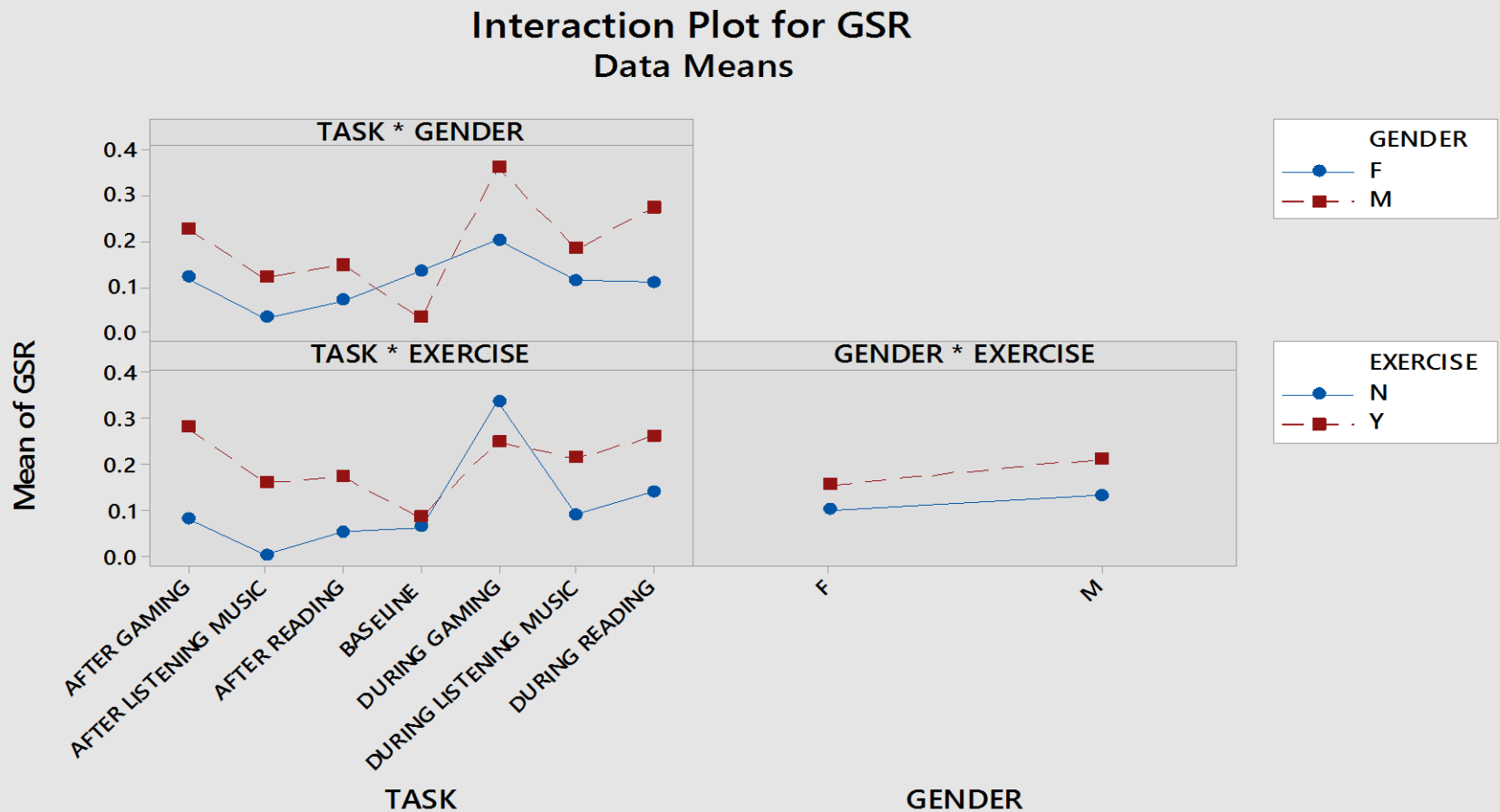
Main Effects Plot for GSR
Fitted Means



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Analysis Results

GSR Changes based on actives, gender and exercise habits

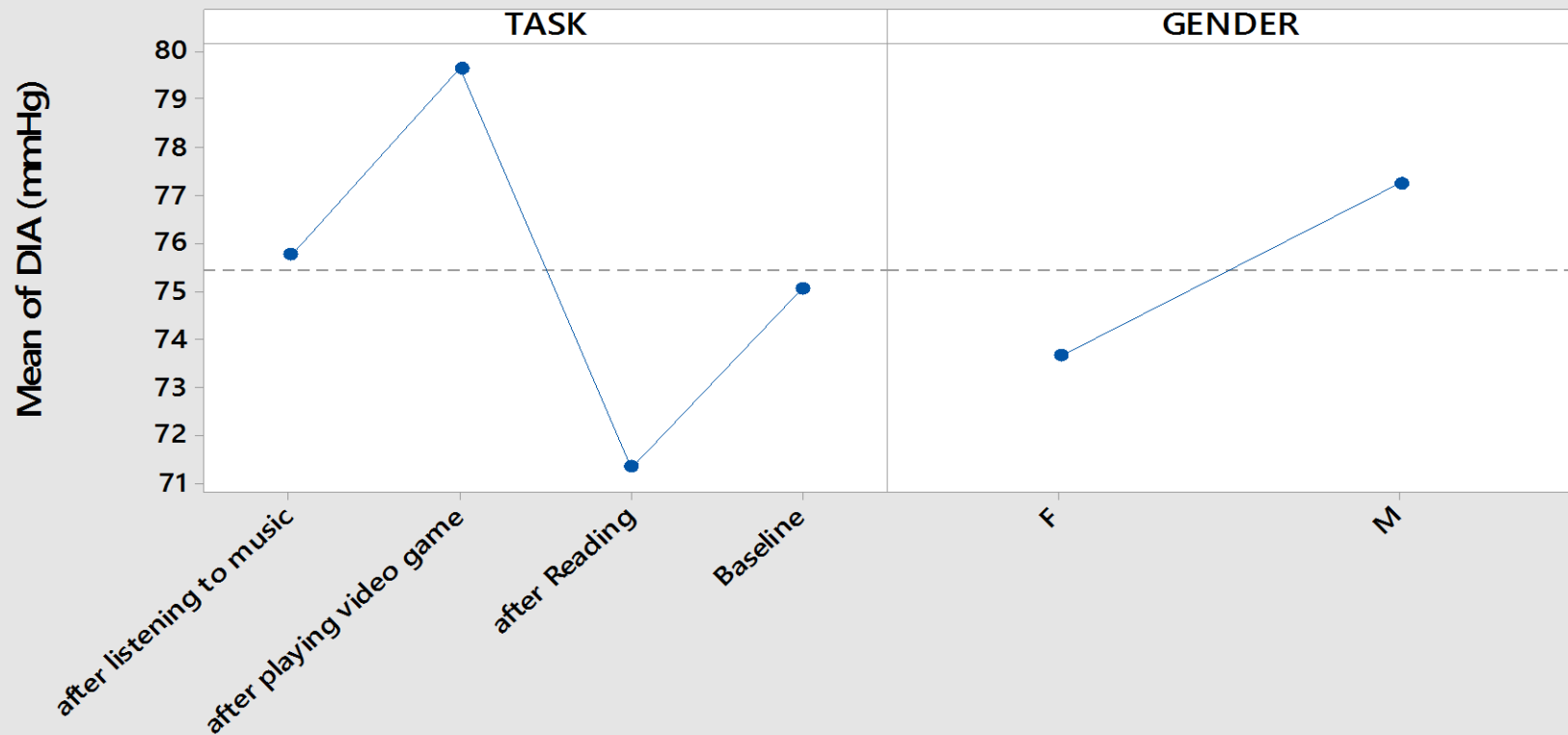


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Analysis Results

Blood Pressure Changes based on actives, and gender

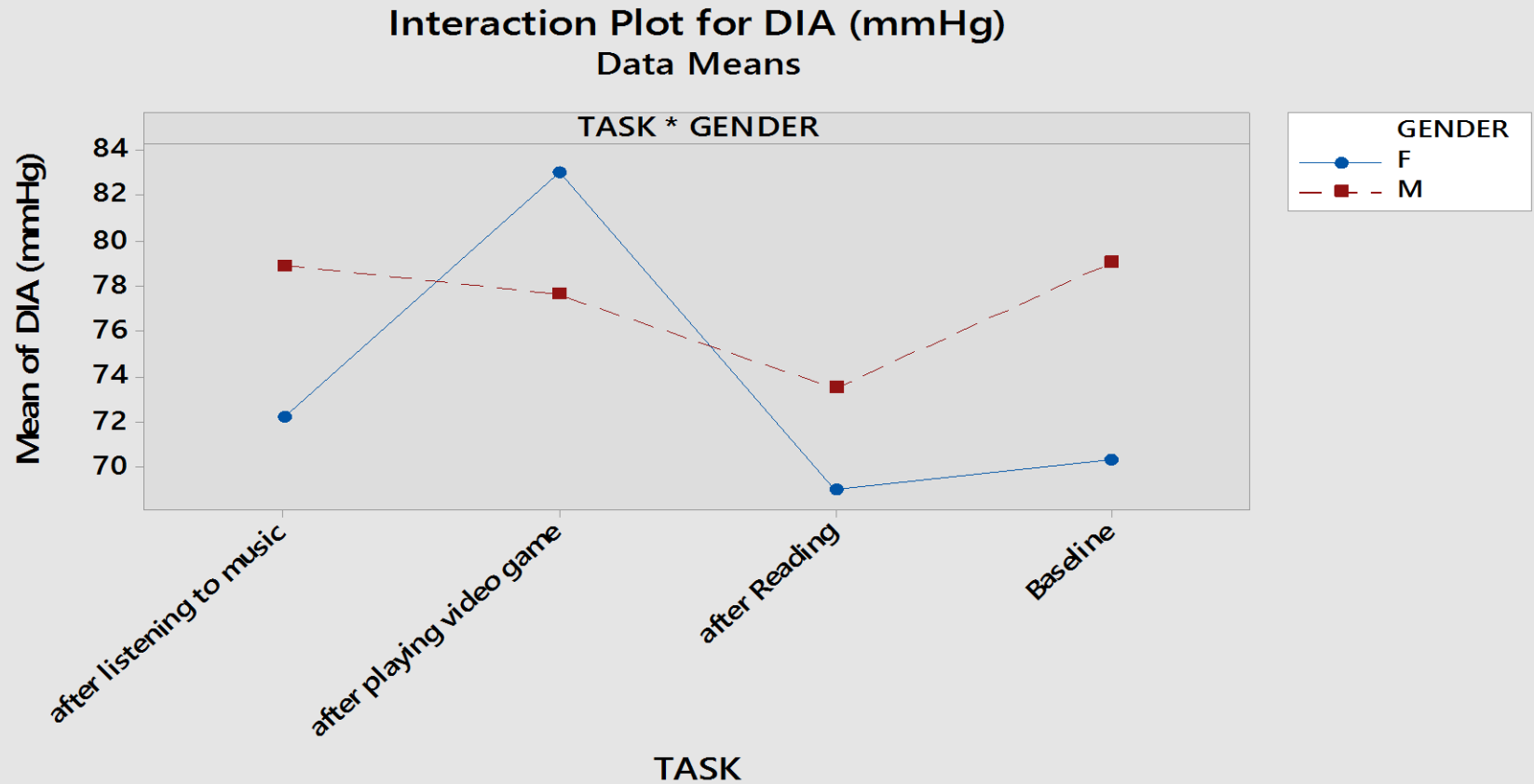
Main Effects Plot for DIA (mmHg)
Fitted Means



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Analysis Results

Blood Pressure Changes based on actives, and gender

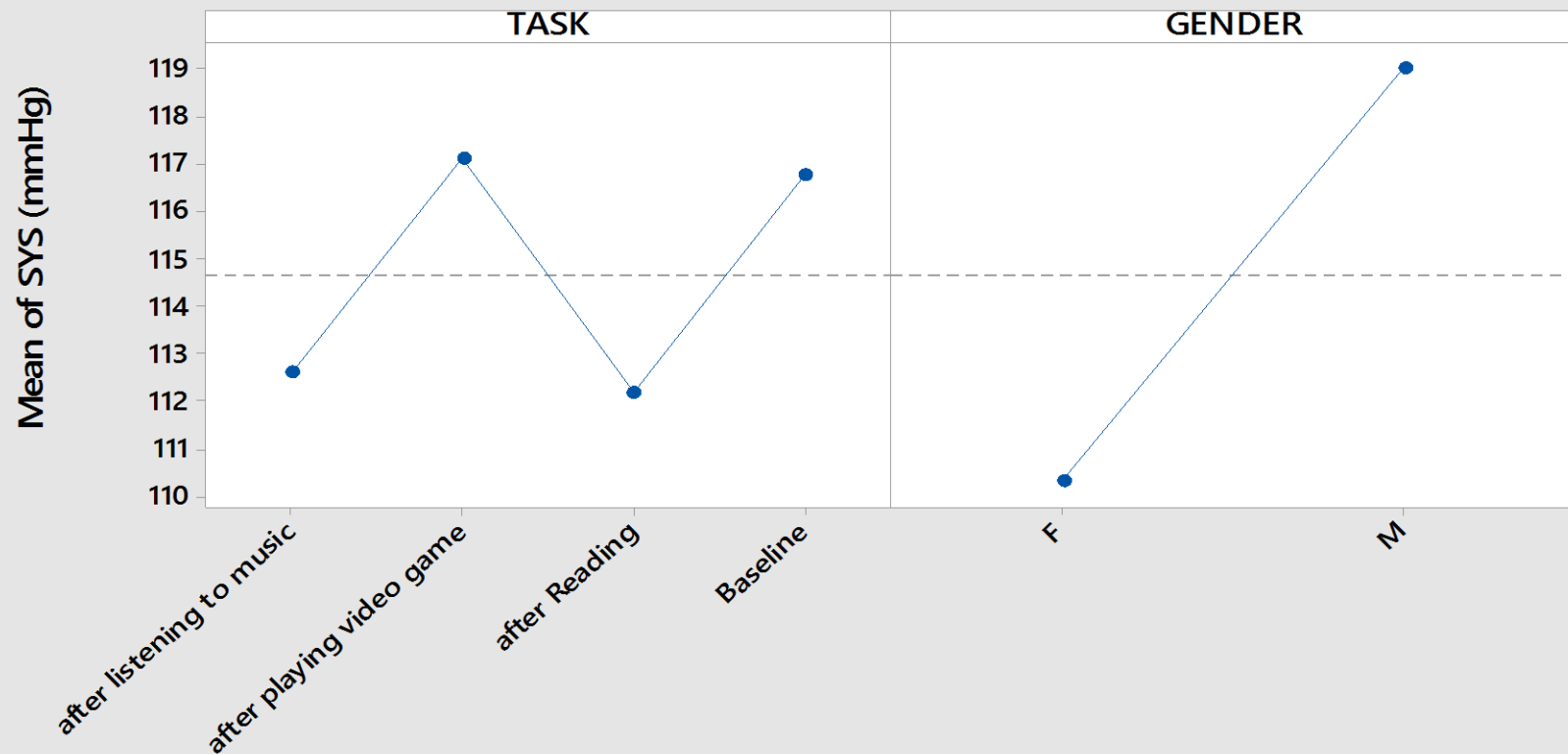


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Analysis Results

Blood Pressure Changes based on activities, and gender

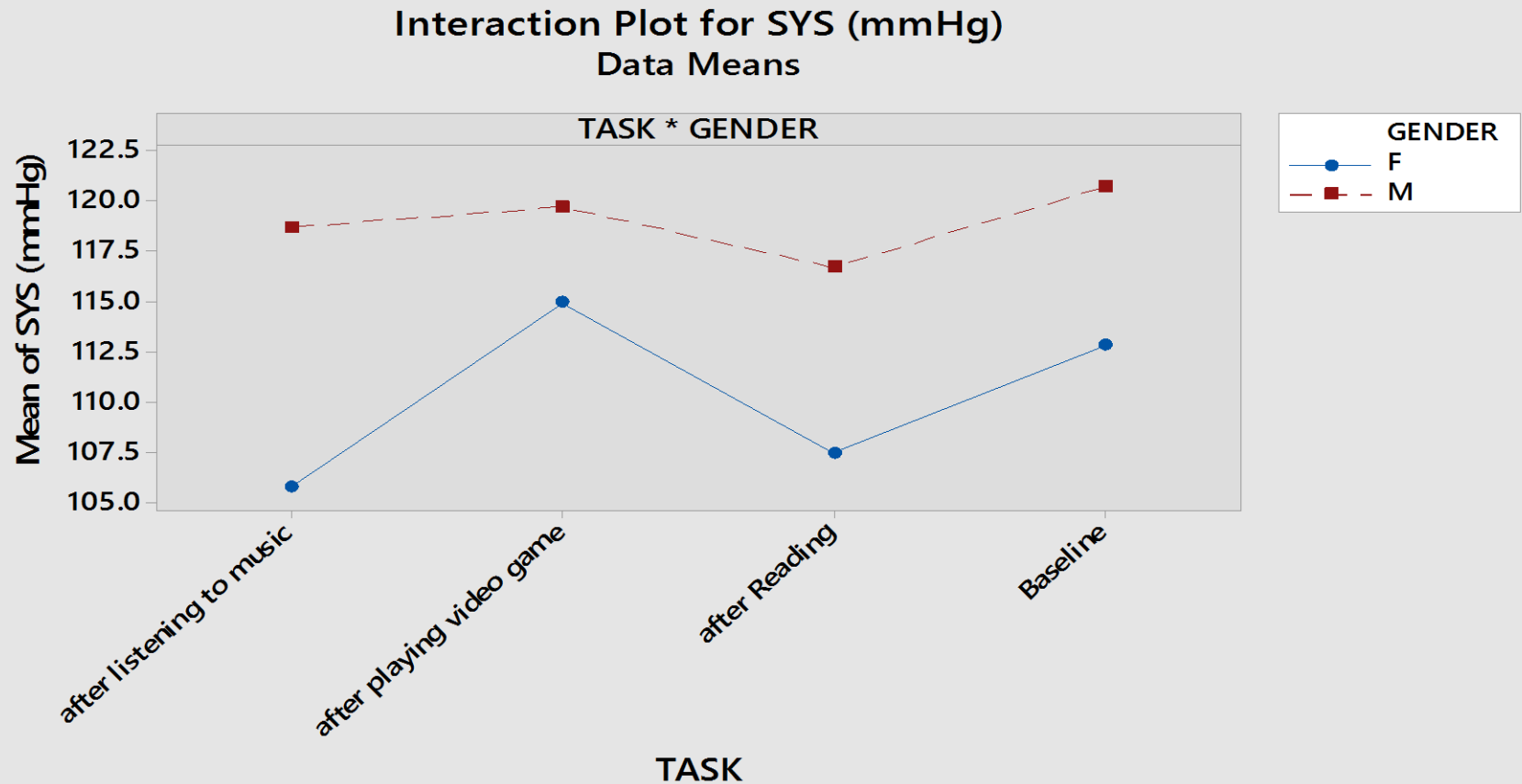
Main Effects Plot for SYS (mmHg)
Fitted Means



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Analysis Results

Blood Pressure Changes based on actives, and gender



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