

Temperature, Emotion and Pressure Pain Threshold

A'sland

(Jiayu Lyu, Xunye Qian, Xingruo Zhang, Rosy Zhou)

University of California, Los Angeles

Introduction

Based on historical researches and analysis, evidence suggests that, first, human's sensation of pain may be altered by cool (cold) and warm (hot) temperature (Strigo, Carli & Bushnel, 2000). Second, bad emotion adds to the sensation of pain (Leventhal & Everhart, 1979). Since the perception of pain could be associated with environmental temperature and emotion, our goal is to investigate if environmental temperature and emotion significantly affect human threshold of pain. To effectively measure pain threshold, we apply the concept of pressure pain threshold, which is the minimum force, measured in kPa, that induces pain.

With respect to the literatures, our current hypothesis is that people have higher pressure pain threshold under high temperature and/or in happy emotion.

The result of our study would be informative in determining the desired condition for athletic training. Pain threshold influences following exercise and is desired to be maximized. Hence, if our hypothesis is true, which means people can endure more pressure pain in high environmental temperature in a happy emotion, people would conduct athletic training better in warm gyms while watching happy videos.

We performed a test study on 12 islanders, with two participants under each condition (3 different levels of temperatures and 3 different kinds of emotions), and observed that there are differences in participants' pressure pain thresholds under different conditions. Therefore, we expect to see some effects of environmental temperature and emotion on pressure pain threshold in our complete study.

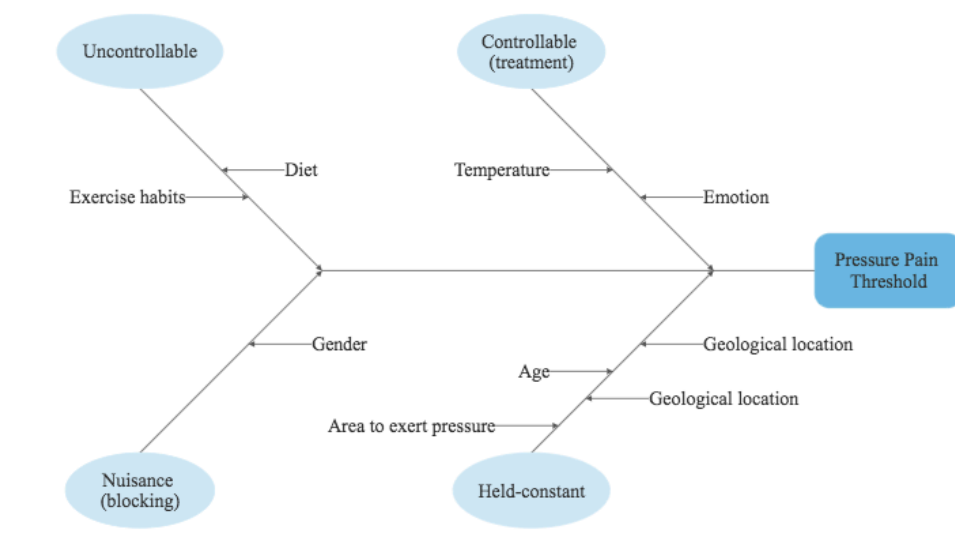


Figure 1. Cause and Effect Diagram for Pressure Pain Threshold

Methods

Participants

Our samples come from a simulated Population known as the *Island*. Since temperature varies among different geographical locations, in order to control the base environmental temperature, the sampling frame will be limited to residents from Macondo, the biggest city on the Island, which provides a sufficient population to be sampled from.

According to the Medical Expenditure Panel Survey conducted by the Agency for Healthcare Research and Quality, adults between 18 and 44 years old are the most active exercisers (Rhoades, 2005). As discussed in the introduction section, our study intends to determine the most beneficial environment for strength training, so the sampling frame will also zoom in to people from age 18 to 44. In the meantime, studies suggest that there is significant gender difference in pain perception. Since we are only interested in the effects of different temperatures and emotions in this project, gender will be our blocking factor. Half of the participants will be females, and the other half will be males. Also, to eliminate the effects of diseases, only healthy individuals (without any disease indicated on their profiles) will be selected.

Based on our Randomized Complete Block Design with one block and two factors (the block has two levels, the first factor has 3 levels, and the second factor has 3 levels), our sample would be divided into 18 groups. GPower suggests that in order to identify an effect size of 0.25 with power of 0.8 at significance level of 0.05, a total sample size of 197 is required. To adopt a balanced design, the sample size has to be a multiple of 18. Thus, we will select 198 people in total with a sample size of 11 for each group. The 99 selected participants in each block will be assigned into treatment groups randomly using R to avoid selection bias.

Design

The study will be set up as a Randomized Complete Block Design with one block and two factors. The treatment groups and blocking factors are specified below:

Response Variable	Pressure Pain Threshold Biceps		
Treatment 1	Control	Cold 5°C	Heat 40°C

(Environmental Temperature)	(Room Temperature)		
Treatment 2 (Reliving Memories)	Control (No Reliving Memories)	Happy Memories	Sad Memories
Blocking (Gender)	Male		Female

Table 1. Table of Variables in the Design

The factor diagram is detailed below:

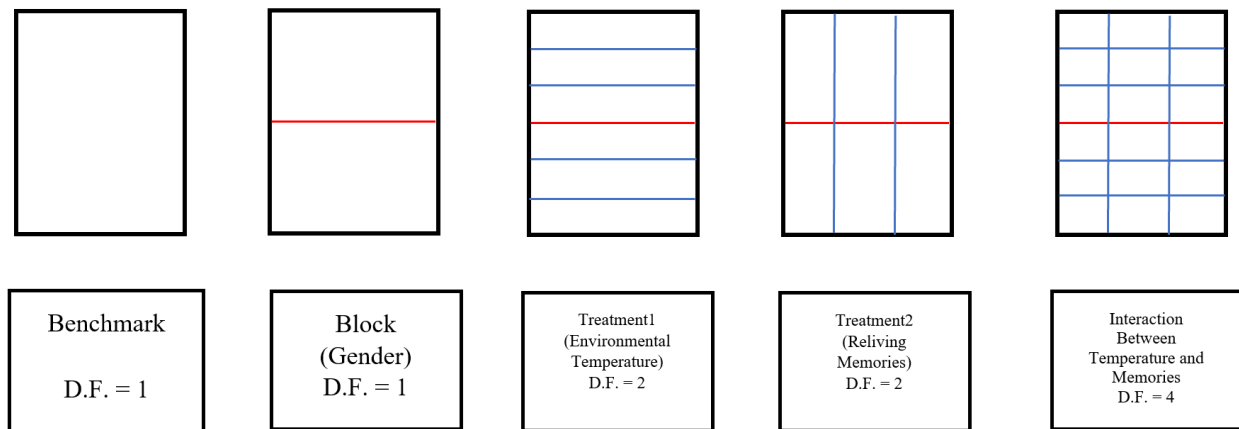


Figure 2. Factor Diagram

Among the factors affecting the pressure pain threshold, we choose to focus on the environmental temperature and emotion based on the research studies found. To control the participants' emotion, we let them relive sad memories or happy memories. To avoid the difference in pressure pain threshold between different genders, we introduce gender as the blocking factor. Since we are exploring the relationship between the response variable and two different factors, and we want to reduce error through the blocking factor, we adopt the Randomized Complete Block Design.

Instruments

The response variable, participants' pain thresholds, will be measured by an algometer at the midpoint of the muscle fibers of the long head of the biceps. Biceps were chosen over the

other option, trapezius, because biceps are highly related to exercising behaviors. Change in the values of the first independent variable, environmental temperature, will be achieved by the exposure of participants in rooms at different temperatures (participants will be tested after sitting at room temperature or 5 °C or 40 °C for 15 minutes). The second independent variable, emotion, will be controlled by triggering memories of the participants (no memory triggered, triggering happy memories for one minute, or triggering sad memories for one minute).

Procedure

Step 1: Find subjects from Macondo on the Island who are healthy and willing to participate in our study, in the age range of [18, 44].

Step 2: Divide the group of participants based on their genders, and randomly assign participants into different treatment groups use R. The groups in the experiments are:

Room temperature without reliving memories	Cold 5°C temperature without reliving memories	Heat 40°C temperature without reliving memories
Room temperature reliving happy memories	Cold 5°C temperature reliving happy memories	Heat 40°C temperature reliving happy memories
Room temperature reliving sad memories	Cold 5°C temperature reliving sad memories	Heat 40°C temperature reliving sad memories

Table 2. Groups in the Experiments

Step 3: For each participant, apply the assigned treatments by first controlling the environmental temperature for 15 minutes (room temperature, cold 5°C, heat 40°C) and then triggering their emotion (No reliving memories, happy memories, sad memories).

Step 4: For each participant, measure his or her pressure pain threshold of biceps, and the number will be our response variable.

Step 5: Apply analysis of variance (ANOVA) with F-tests at a significance level of 0.05 on the collected data.

References

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