

# STEM for the Creatives

## Assignment 3

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### The Research Question

Does the tempo of music listened to affect running speed?

### Method

This experiment will require the following equipment and resources:

- Bluetooth and noise-cancelling headphones,
- A series of audio tracks to best fit each runner's average running speed. Each runner will only listen to 4 songs (one at a slightly higher tempo than average running speed, one at a much higher tempo than average running speed, one at a slightly lower tempo than average running speed, one at a much lower tempo than average running speed),
- GPS sensor that tracks average running speed, and
- A track to conduct the experiment in a contained environment.

### Conditions

Tempo of music being played in the runner's headphones.

### Measures

Average running speed detected by the GPS sensor.

### Procedure

15 amateur runners (see the Participants section for our definition of "amateur") will individually complete five 200 meter runs on a track. One run will be without headphones and without music. The tempo of this run will be the baseline for their average running speed and used to select songs with lower and higher tempos. Prior to the runs with music, we will ask the participants to provide their favorite genre of music of which the different tempo songs will be selected. The next four runs are as follows: one will be with headphones listening to music with a tempo *slightly lower* than their average running speed, one will be with headphones listening to music with a tempo *much lower* than their average running speed, one will be with headphones listening to music with a tempo *slightly higher* than their average running speed, and the final run will be with headphones listening to music with a tempo *much higher* than their average running speed. During every run, the runner will wear a GPS sensor connected to a computer tracking their average running speed through out each run. They will complete this test three times over three weeks. The average of the three trials at each pace will be calculated, graphed, and analyzed under our Results section.

### Participants

Participation for this experiment will be voluntary. Participants will be recruited through advertisements, bulletins, and email marketing. As we are looking at each runner's individual

results rather than comparing them against the group, demographics such as age, gender, etc. are not significant factors in the recruitment process, however, they are factors that will be recorded to track each participant as they will otherwise remain anonymous. What is more important is ensuring the individual's amateur running status.

For this experiment, we define "amateur" as someone who runs approximately 3-6 hours per week. As such, our advertisements will specifically target those who consider themselves amateurs based on our definition.

## **Results**

During this experiment, we will be testing the following hypothesis:

Hypothesis 1: Music with a faster tempo will increase running speed above the individual's average running speed, while music with a slower tempo will decrease running speed below the individual's average running speed.

Hypothesis 2: Music with a faster tempo will increase running speed above the individual's average running speed, however, when listening to music at a slower tempo runner's will maintain their average running speed.

## **Statistical Tests**

Since we are testing multiple different tempos of music (i.e. multiple dependent variables) against multiple individual's (i.e. multiple independent variables), a MANOVA statistical test will be used to assess our data.

## **Discussion**

### **Identify possible confounding variables and experimental errors**

One confounding variable we have determined is the runner's taste in music. Though it would be another experiment to determine whether a subject's favorite versus detested music affects their running speed, to ensure we maintain consistent results, we want all runners to listen to music that affects them positively.

As discussed in the procedure, we will keep a large selection of music available to not only adjust the music tempo, but to also ensure the songs selected are within the participants favorite genre.

### **Reflect on how you have balanced internal and external validity in your experiment design**

We have balanced internal and external validity in several ways. To ensure internal validity, we have reduced potential errors by utilizing GPS technology to track running speed to ensure an accurate reading. We have also opted to use headphones when listening to music to reduce the potential influence of environmental noise.

Regarding external validity, we have allowed participants of any age, gender, etc. to participate so long as they fit the definition of an amateur runner as we have described (3-6 running hours

per week). This ensures our results are representative for amateur runners across age and gender boundaries.

**Consider any ethical issues that may arise. How have you accounted for this in your experimental design?**

The biggest ethical concern that comes to mind is anonymity. Though it would be far more efficient to conduct the experiment with all individual's at once. To maintain anonymity, participants will be tested one-at-a-time. In addition, only details such as age, gender, and running speeds will be recorded and disclosed in our results.