How well can you persist a tempo?

MUSIC 251 Final Project

Jingjie Zhang

Hypothesis

The capability of persisting a certain tempo might be related to:

1. Musical training background
2. Daily music exposure level (practicing / active listening)
3. Experience in bands / musical groups
4. Frequency of using metronomes during practice

Experiment Design

5 tapping tests, including 1 training test and 4 formal tests.
4 different BPMs (60, 90, 120, 150) with random order.

Procedure:

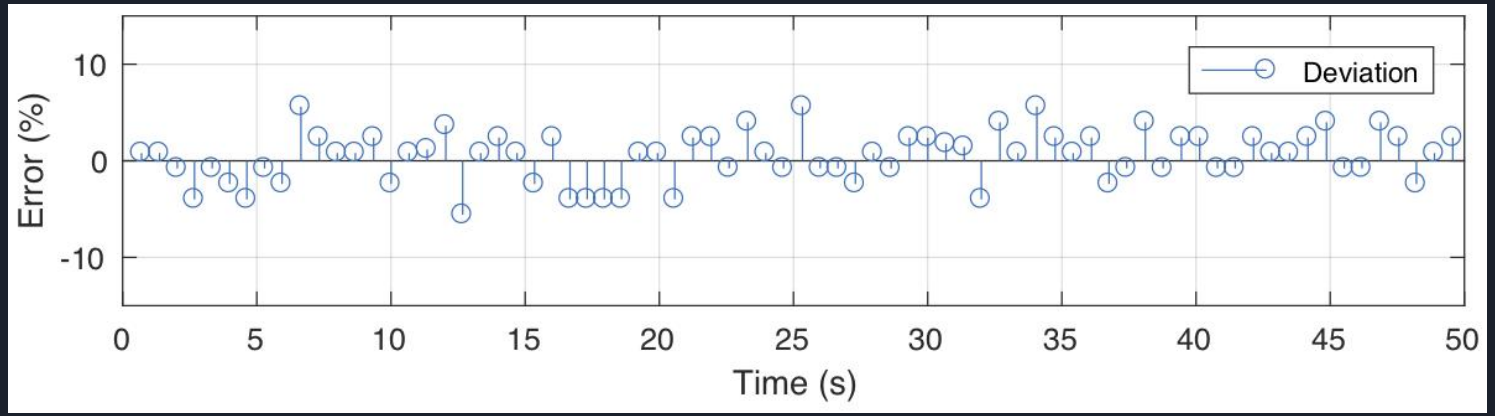
1. Listen to a pulse train
2. Track the tempo by tapping
3. Persist after the pulse train stops

The subjects are allowed to create any context out of each tempo, such as imagining melodies and rhythms that fit in that tempo.

Performance Indicators

The deviation of the instantaneous tapping period from the reference period can be represented by the following error signal:

$$e[n] = \frac{\Delta t[n] - T}{T} \cdot 100\%$$



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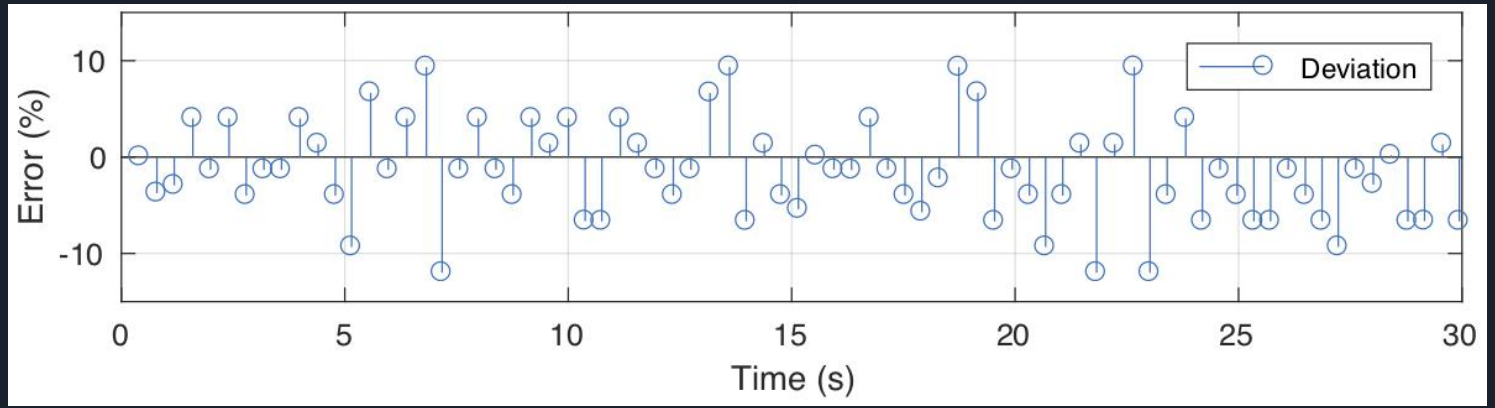

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Two indicators are used to measure the subjects' performance:

1. Mean Squared Error (MSE)

$$\mathrm{MSE} = \frac{1}{N} \sum_{n=1}^{N} e^2[n]$$

2. Linear Regression Slope

$$e[n] = \boldsymbol{k} \cdot n + b + \varepsilon$$

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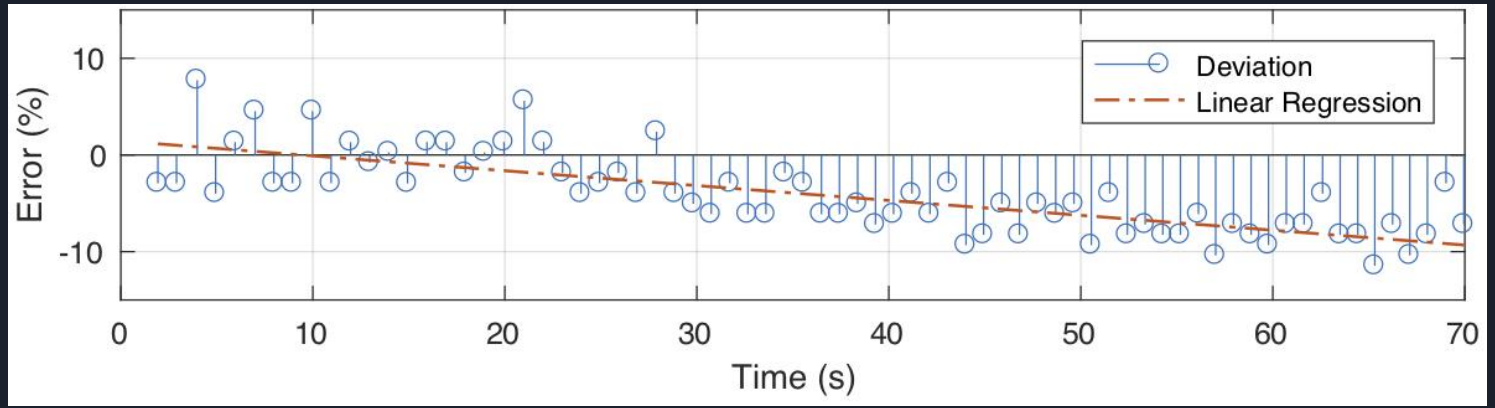

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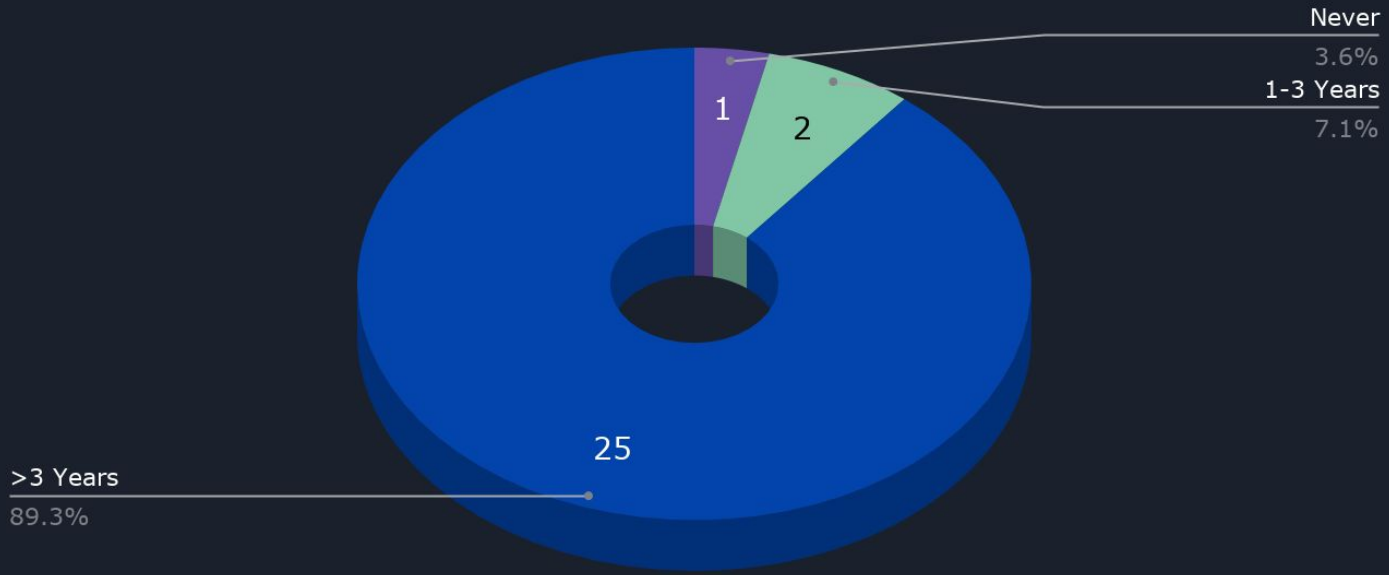
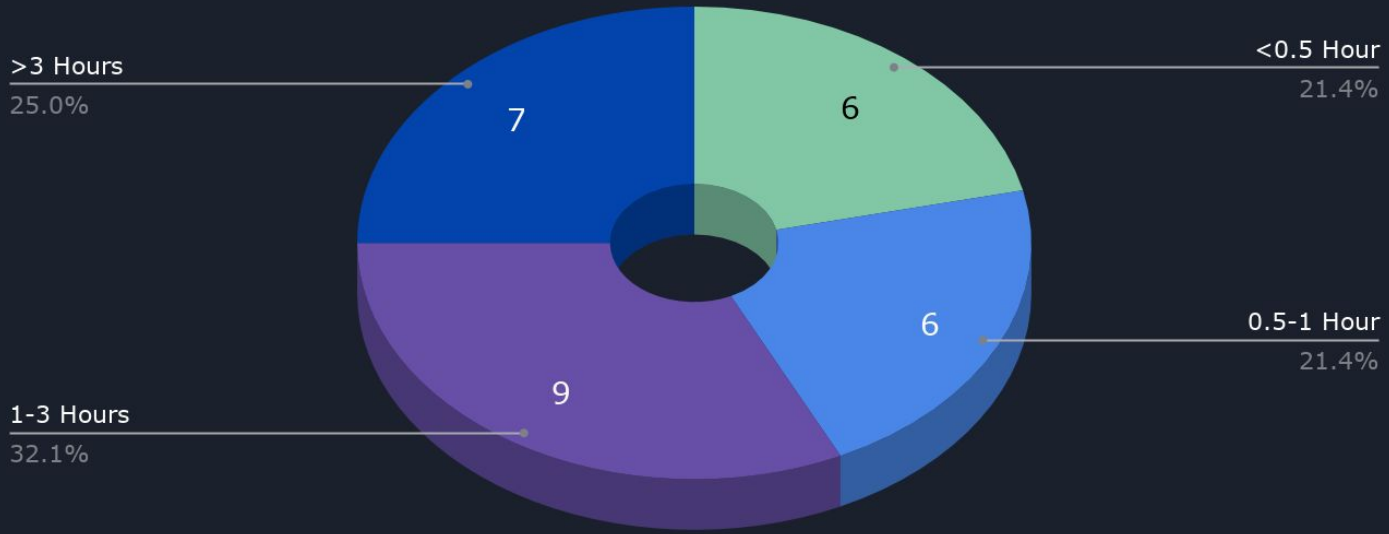
Participants

Musical Training Background



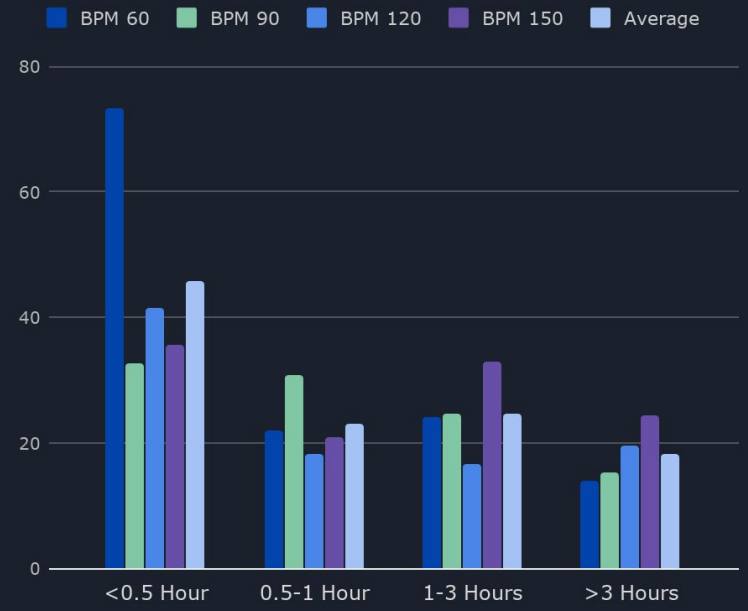
Participants

Daily Music Exposure Level

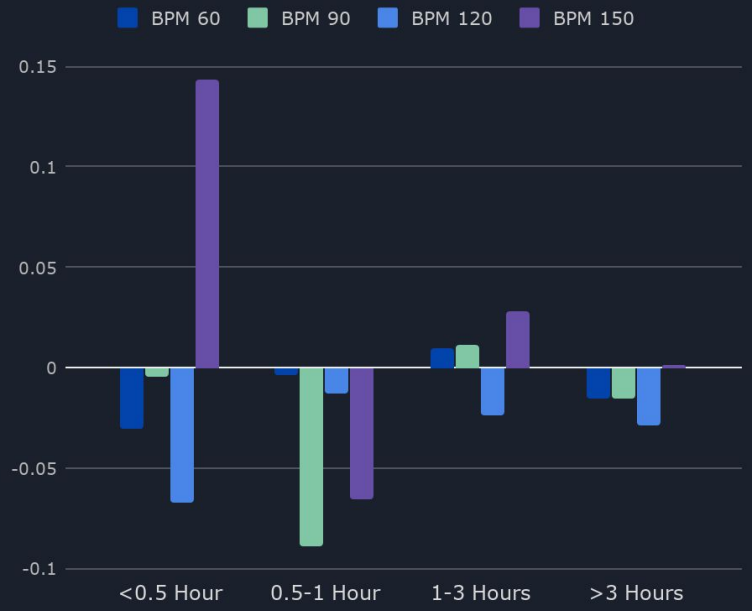


Results

MSE under Different Daily Music Exposure Level

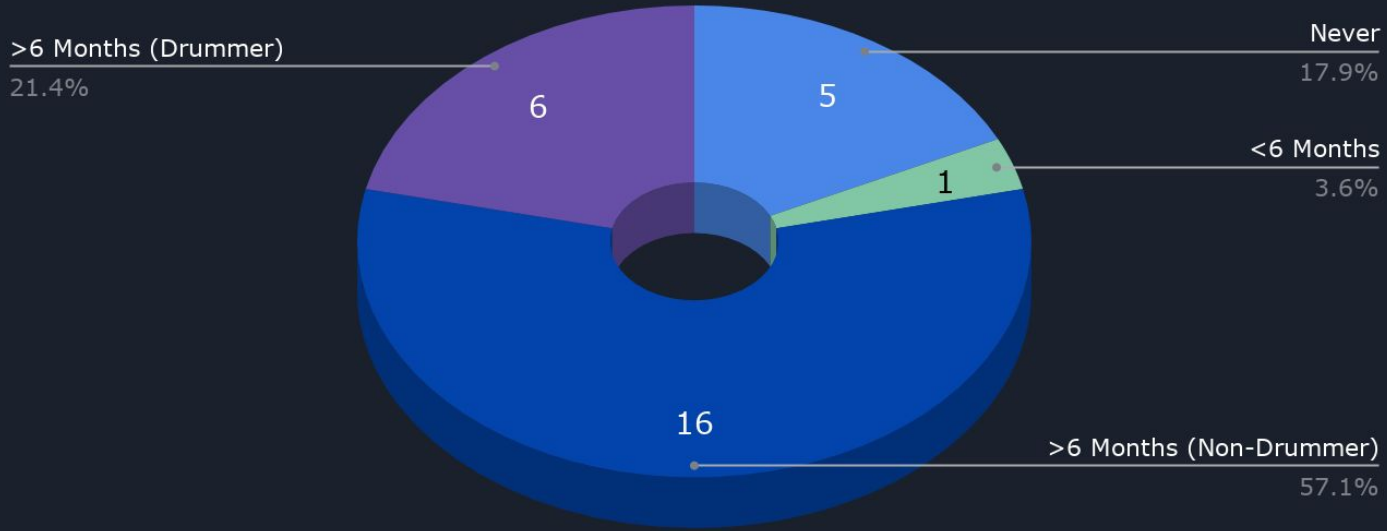


Corresponding Linear Regression Slopes

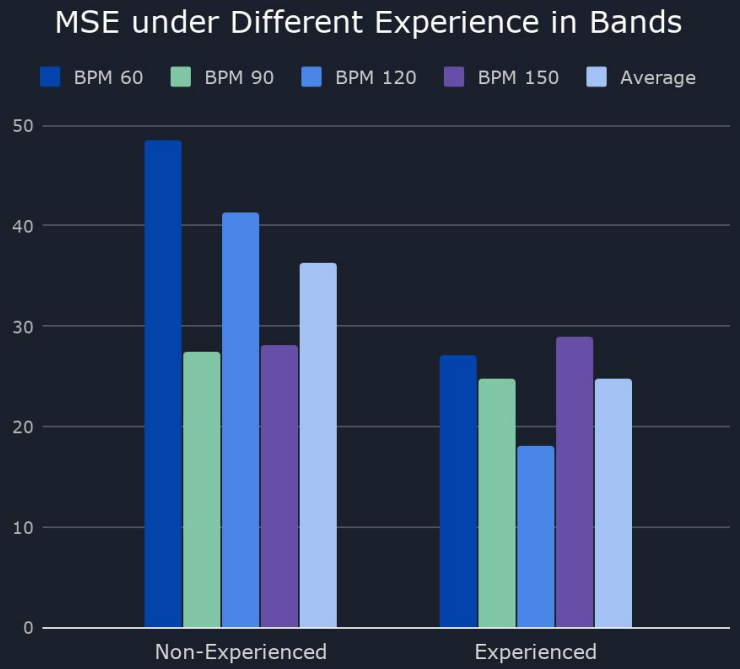


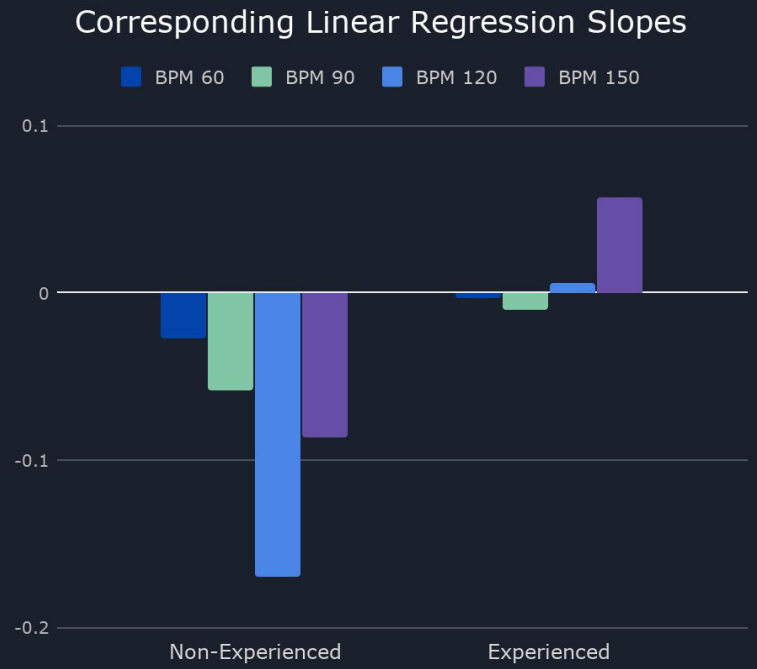
Participants

Experience in Bands / Musical Groups

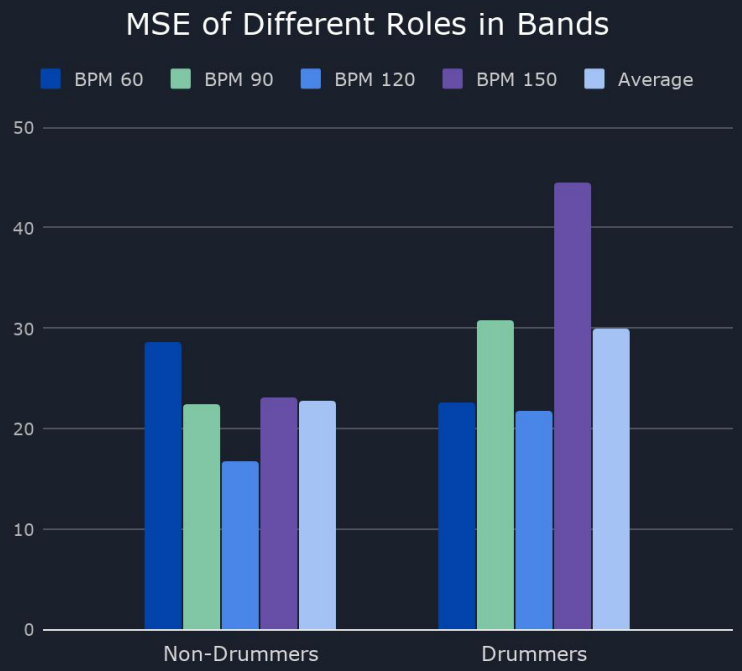


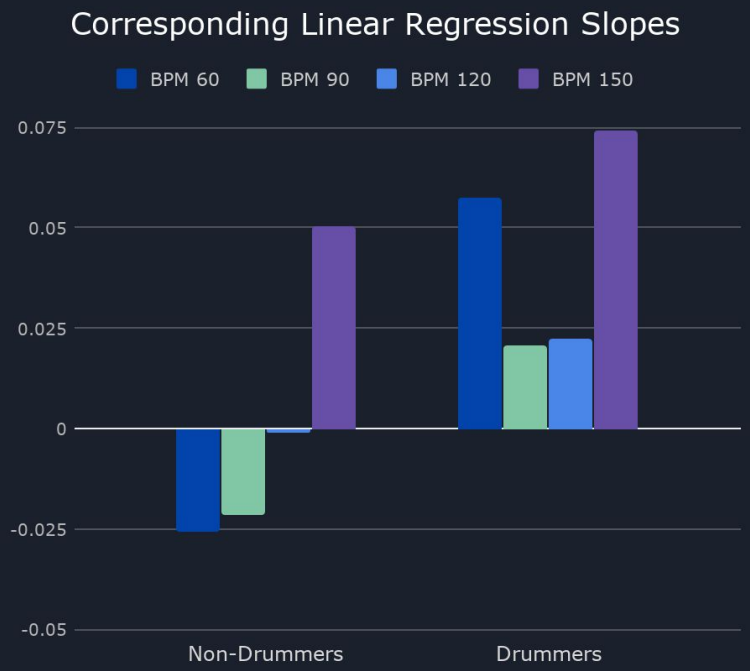
Results


MSE under Different Experience in Bands
BPM 60
BPM 90
BPM 120
BPM 150
Average
50
40
30
20
10
0
Non-Experienced
Experienced


Corresponding Linear Regression Slopes
BPM 60
BPM 90
BPM 120
BPM 150
0.1
0
-0.1
-0.2
Non-Experienced
Experienced

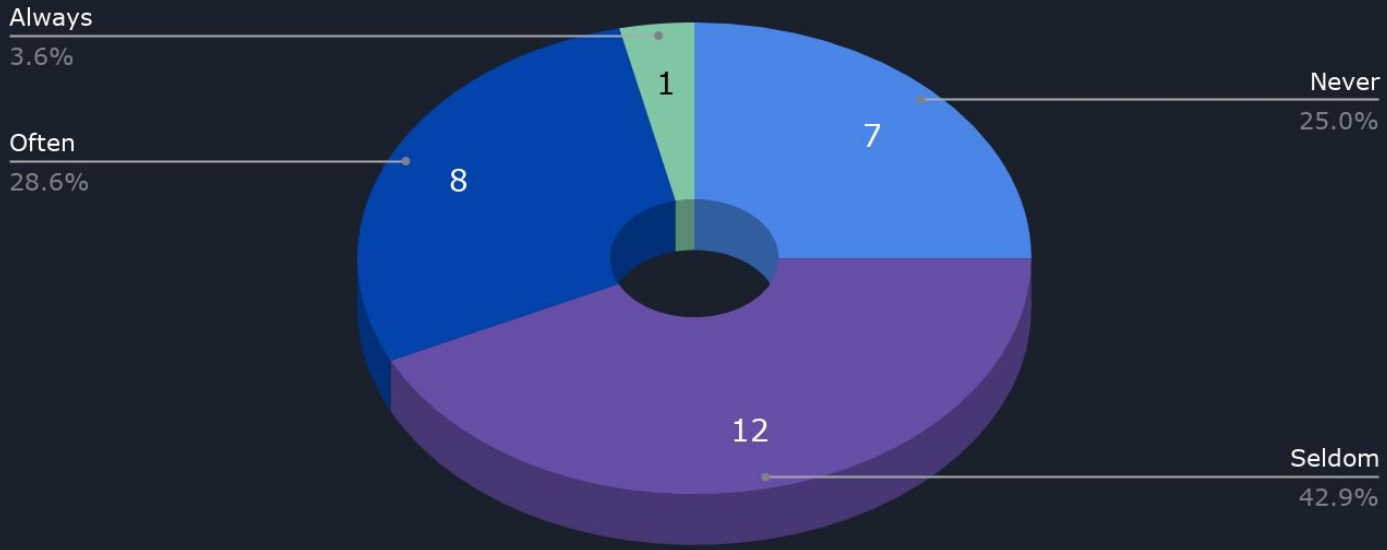
Results


MSE of Different Roles in Bands
BPM 60
BPM 90
BPM 120
BPM 150
Average
50
40
30
20
10
0
Non-Drummers
Drummers

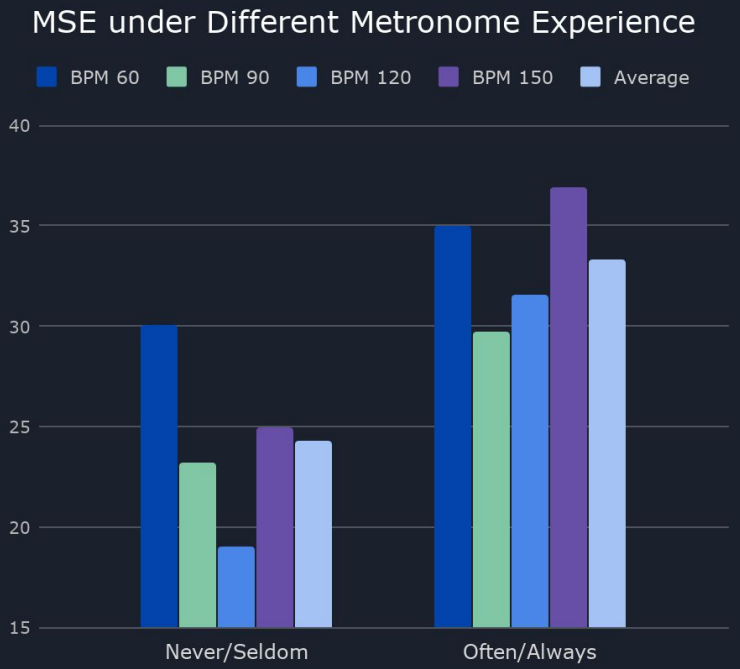

Corresponding Linear Regression Slopes
BPM 60
BPM 90
BPM 120
BPM 150
0.075
0.05
0.025
0
-0.025
-0.05
Non-Drummers
Drummers

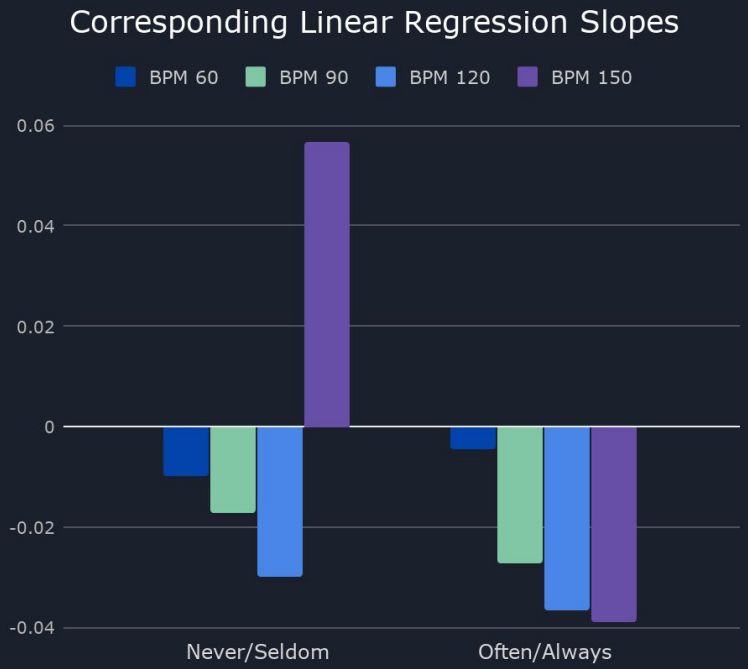
Participants

Frequency of Using Metronomes

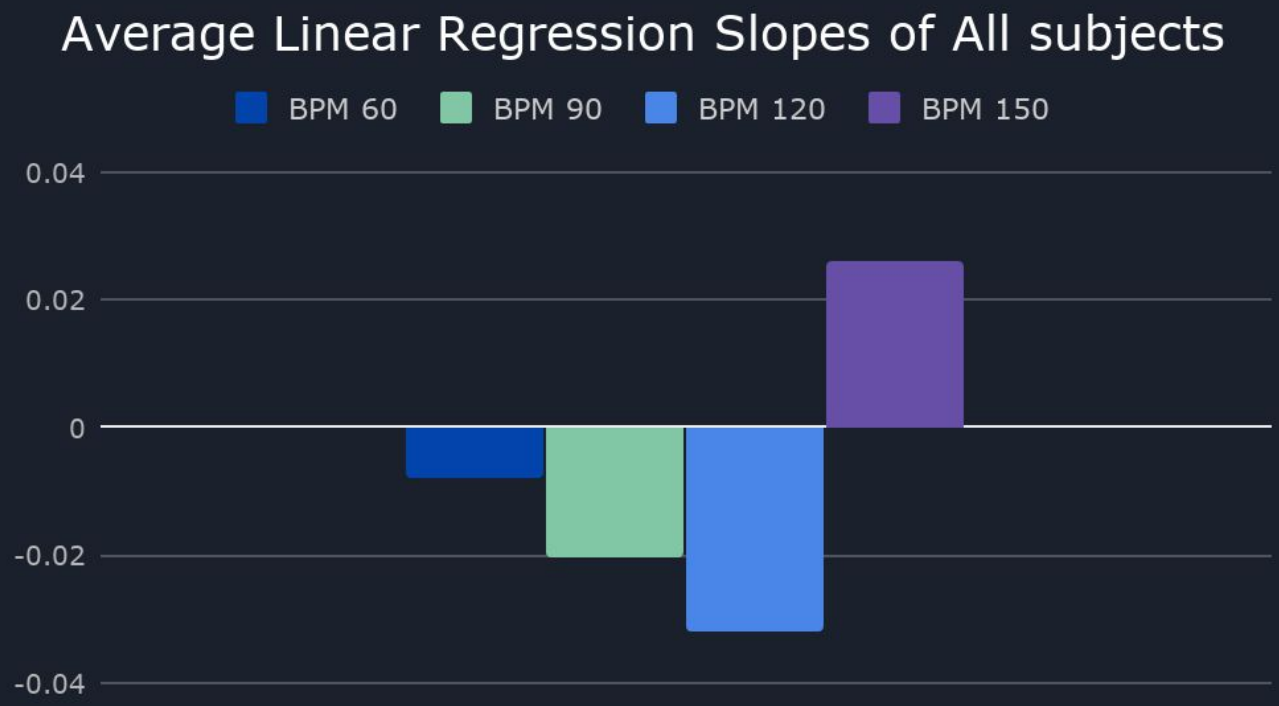


Results


MSE under Different Metronome Experience
BPM 60
BPM 90
BPM 120
BPM 150
Average
40
35
30
25
20
15
Never/Seldom
Often/Always


Corresponding Linear Regression Slopes
BPM 60
BPM 90
BPM 120
BPM 150
0.06
0.04
0.02
0
-0.02
-0.04
Never/Seldom
Often/Always

Results


Average Linear Regression Slopes of All subjects
BPM 60
BPM 90
BPM 120
BPM 150
0.04
0.02
0
-0.02
-0.04

Problems & Confusing Facts

1. Small participant size
2. Is it proper to calculate the average between different slopes?
3. Strategies of dealing with abnormal data points
4. People who use metronomes actually did worse.

References

Jungers, M. K., Palmer, C., & Speer, S. R. (2002). Time after time: The coordinating influence of tempo in music and speech. Cognitive Processing, 1(2), 21-35.

Freedman, D. A. (2009). Statistical models: theory and practice. cambridge university press.

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Thank You!
Any Questions?