Annabel Stickel, Amishi Desai, Sammie Seewald
10/1/24
Neuro 427s
Music Class

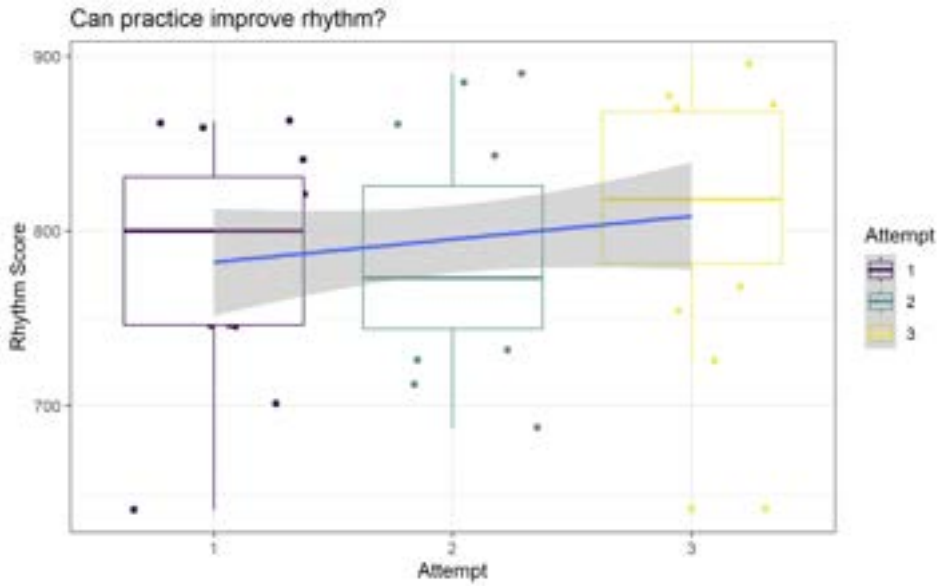
Hypotheses

Hypothesis 1:
Null: Short-term practice has no impact on rhythm test performance.
Alternate: Short-term practice over repeated trials does improve performance on the rhythm test.

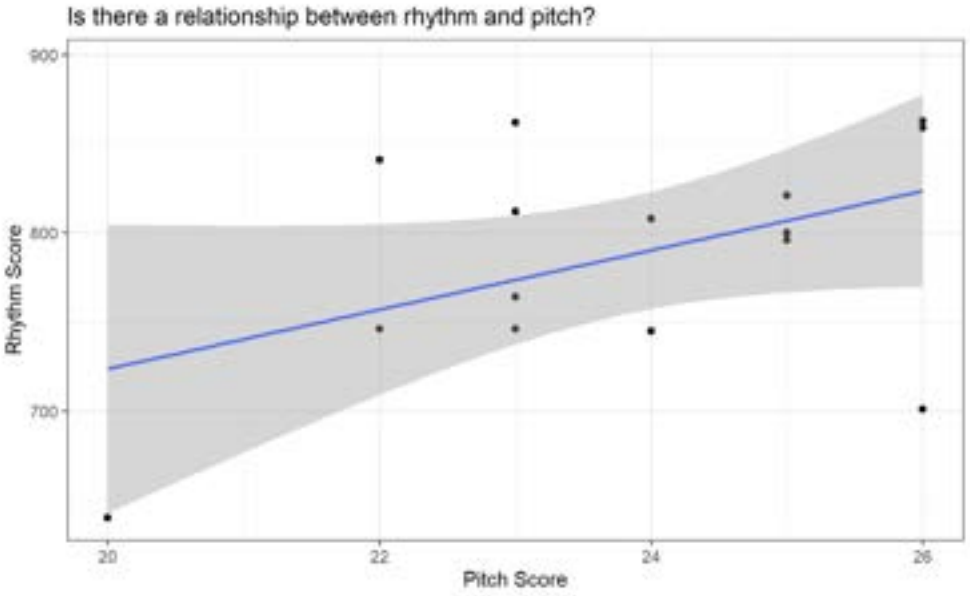
Hypothesis 2:
Null: Music experience does not improve pitch and/or reason.
Alternate: Individuals with previous music experience will perform better on both the rhythm test and the pitch test.

Hypothesis 3:
Null: There is no correlation between performance on pitch test and rhythm test.
Alternate: Higher pitch test performance is correlated with improved rhythm test performance.

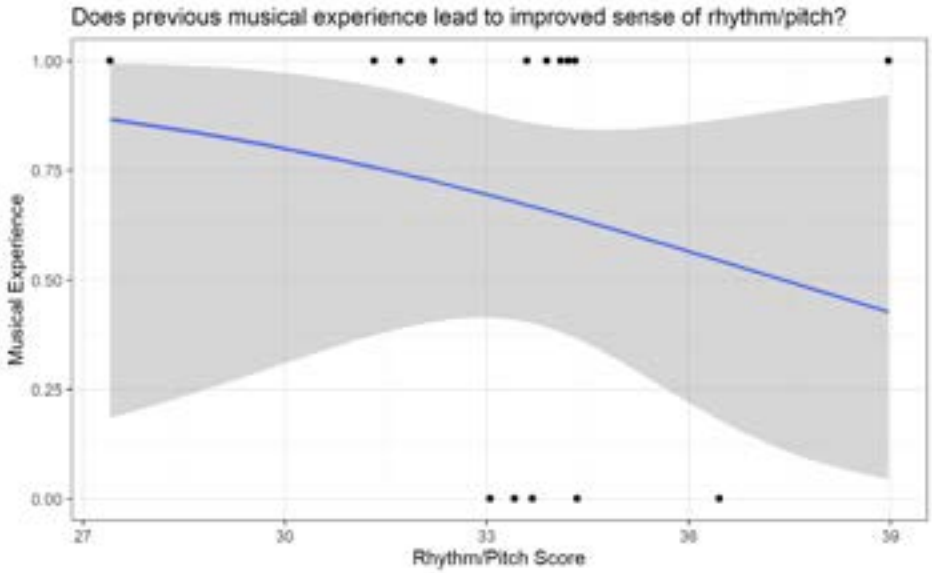
Class Data



The results show that practice does not improve rhythm, as the p value is greater than 0.05 ($p = 0.271$), and therefore we cannot reject the null hypothesis. Given the class data patterns in rhythm scores over the three trials, we did not see a significant increase in performance across trials 1-3, which indicated that short term practice did not affect rhythm overall. We expect that a relationship may emerge if long-term practice (i.e., percussion lessons) was evaluated rather than short-term practice in terms of its impact on rhythm.

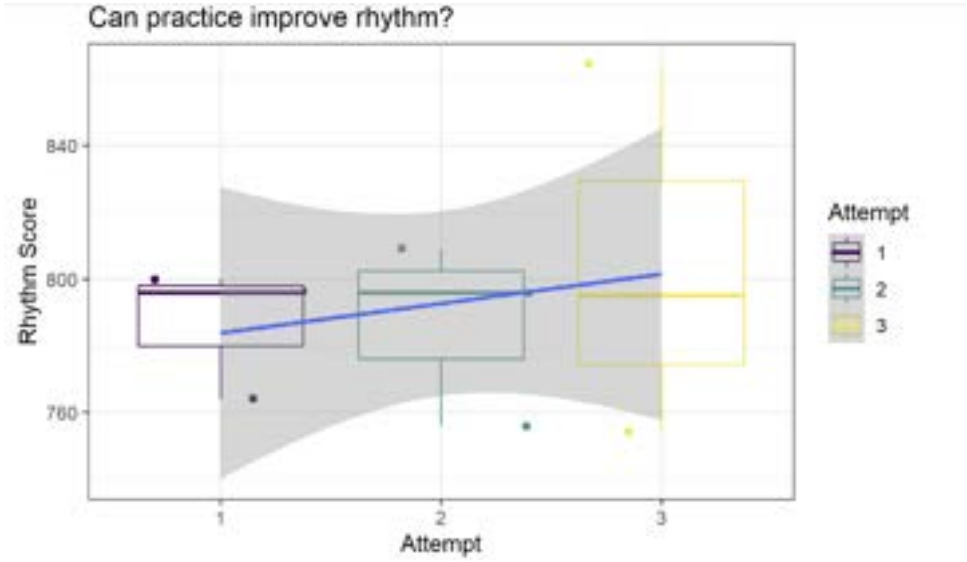


Though the graph shows a slight upward trend, the results are not significant as the p value is greater than 0.05 (0.0880). Therefore, we cannot conclude that there is a relationship between rhythm and pitch based on the class data. This result is expected given the class data, where those members who performed better on either rhythm/pitch did not necessarily do similarly on the other test.

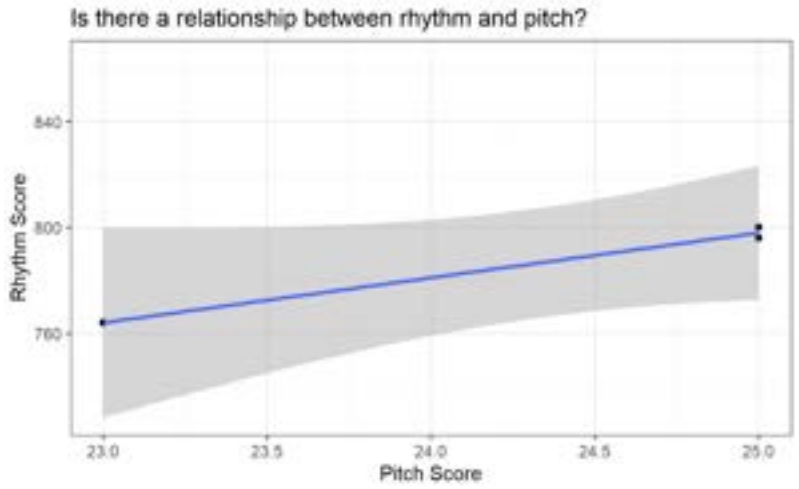


The p-value describing the relationship between musical experience and sense of rhythm and pitch is greater than 0.05 (p = 0.457), so we cannot reject the null hypothesis. Therefore, we cannot conclude that there is a relationship between musical experience and rhythm and pitch performance. If this study were to be conducted with a more thorough measure of musical experience (rather than a scale from 0-1), a relationship could emerge.

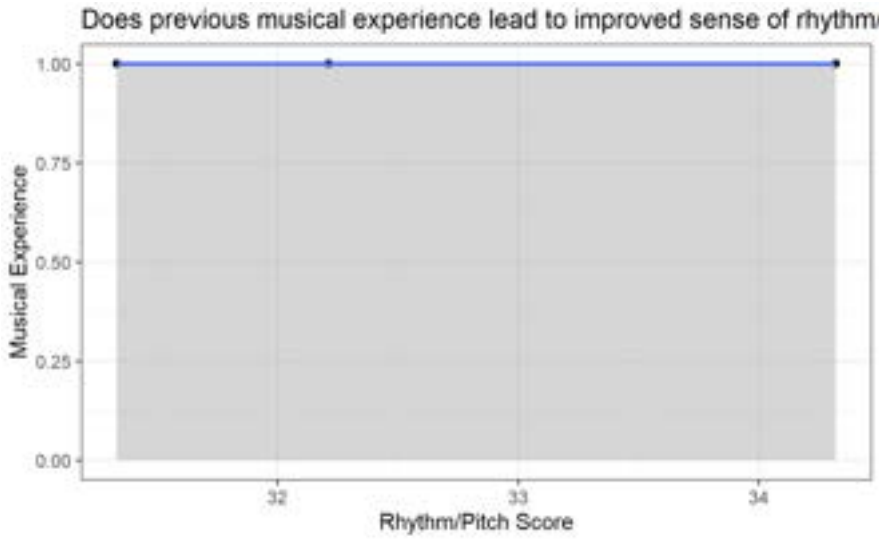
Small Group Data



When looking at the data from the three of us, the results show that practice does not improve rhythm, as the p value is greater than 0.05 (p = 0.557), and therefore we cannot reject the null hypothesis. Therefore, there was no significant increase in performance across trials 1-3, which indicates that short-term practice did not affect rhythm overall. This is consistent with the data from the class, where the p value was also greater than 0.05.



For our smaller group data on rhythm and pitch, we see a smaller gray area (95% confidence interval) than the other graphs, resulting in a p value of 0.0646. However, this is still slightly larger than p = 0.05 and thus we must accept the null hypothesis that there is no significant relationship between rhythm and pitch for our data.



Because all three group members had musical experience, the p-value of this data is 1, so we cannot reject the null hypothesis that there is no correlation between music experience and performance on pitch test and rhythm test. Larger-scale studies are necessary to determine whether a relationship exists between these two variables.

Statement on Class vs. Group Data

For both the class and our smaller group, the data demonstrated that short-term practice does not improve rhythm and that there is not a relationship between pitch and rhythm performance. For the first graph, our p-value was much higher than the class p-value (0.557 versus 0.271), demonstrating the effects of the small sample size. For the second graph, our group p-value (0.0646) was close to significant, but not significant enough to reject the null hypothesis, whereas the class p-value (0.0880) was greater. Because all three members of our group had prior musical experience, our group data was far more homogenous than class data and did not have musical experience as an independent variable, rather it was a constant. Therefore, we cannot adequately compare our group to the class for the third graph.

Claire Benham, Elena Webber, Ryan Azrak

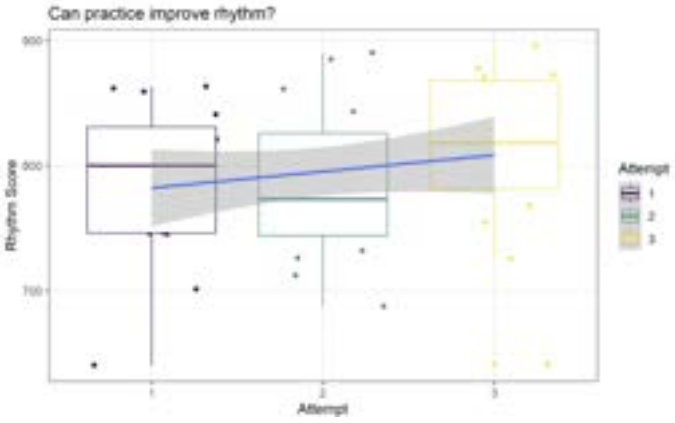
Null Hypotheses:

1. Practice does not improve rhythm across trials.
2. Experience does not improve pitch and/or rhythm.
3. There is no relationship between rhythm and pitch.

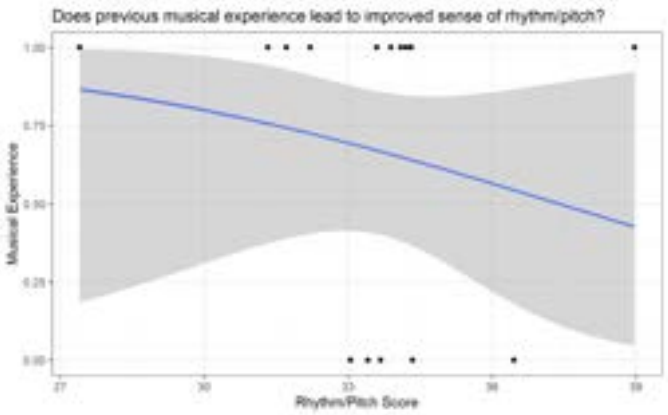
Alternative Hypotheses:

1. Practice on rhythm tests improves across trials.
2. Experience improves both pitch and rhythm.
3. Performance on a pitch test is positively correlated with rhythm.

Significance defined as p-value < 0.05

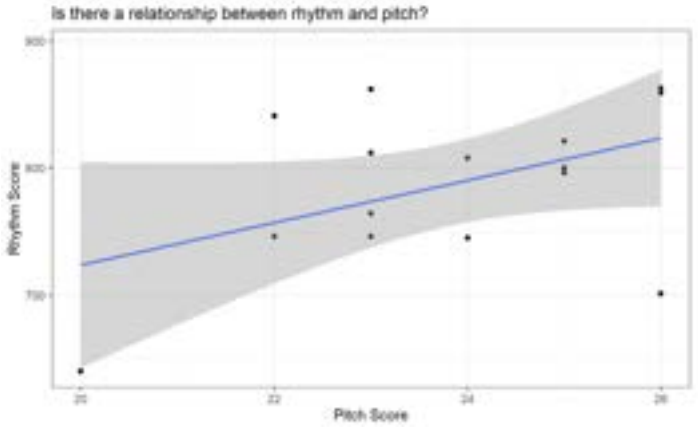


Class Data: Invalidates hypothesis. Rhythm accuracy does not significantly improve with practice across trials. There is a slight drop in the second trial, and a seeming upward trend, but with a p value of 0.271, it is not significant.



Class Data: With a p-value of 0.4, there is no significance in the correlation of experience with both rhythm and pitch. There appears to be a general negative correlation with Rhythm/pitch, but it is not significant.

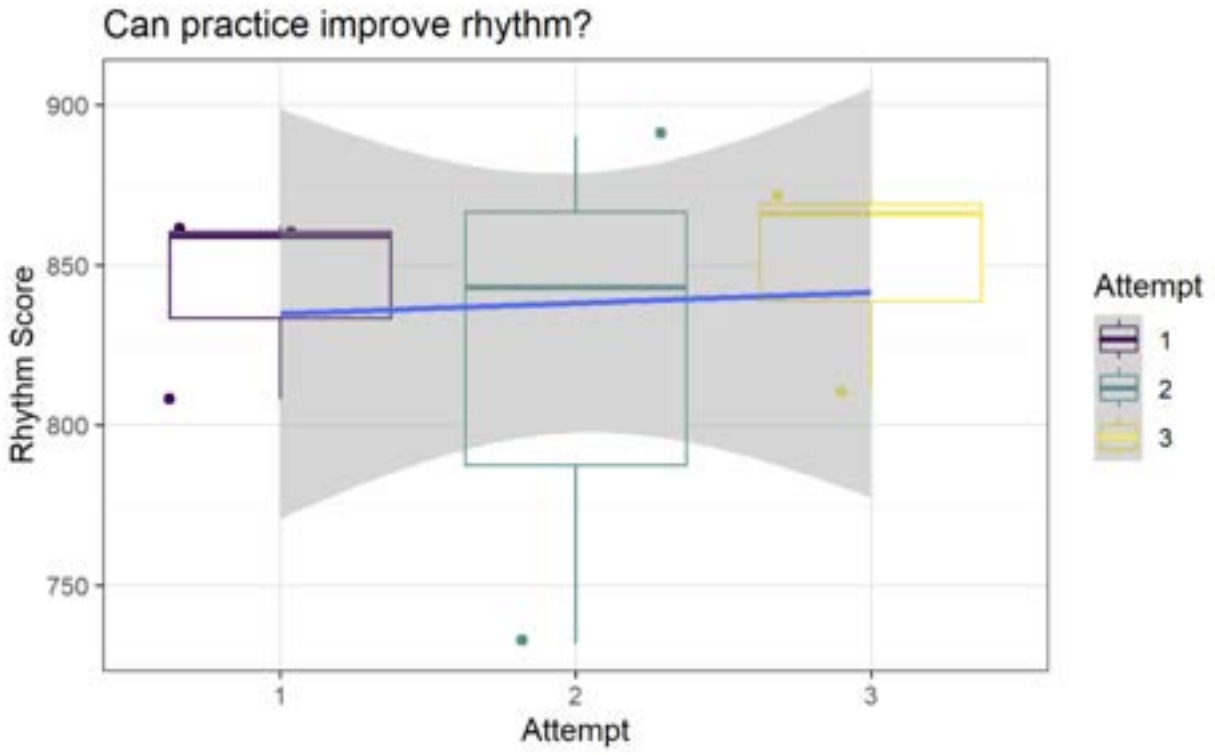
This does not match our initial hypothesis but this is an extremely small sample size and likely would shine true had there been more participants



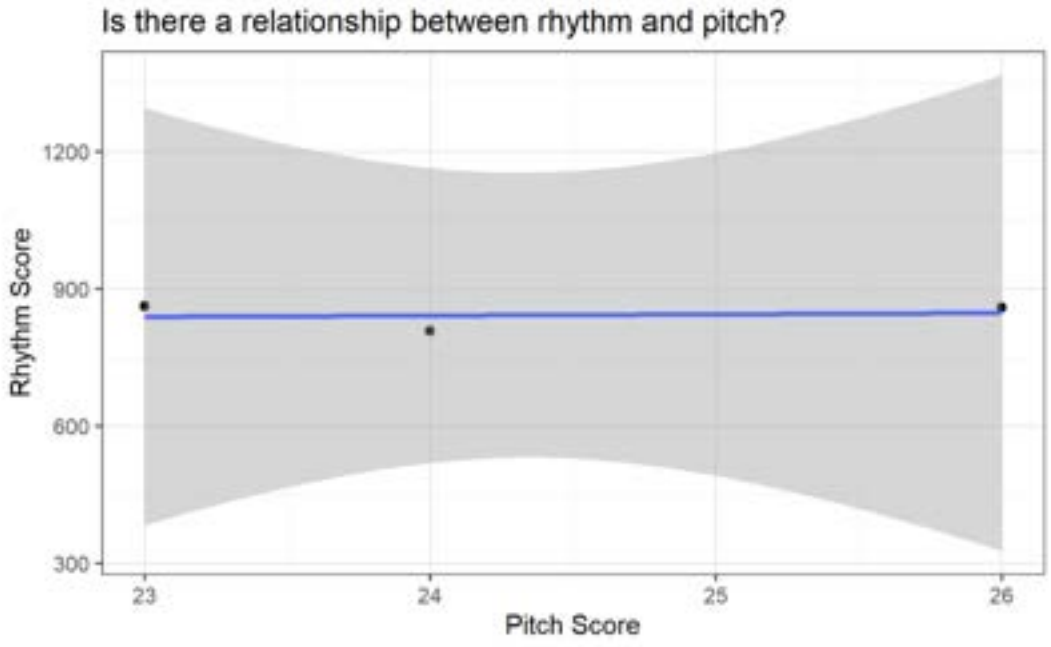
Class Data: With a p-value of 0.088, there is no significant correlation between rhythm and pitch scores.

Although there is a general positive trend in pitch and rhythm, this does not match our hypothesis as the p value is insignificant.

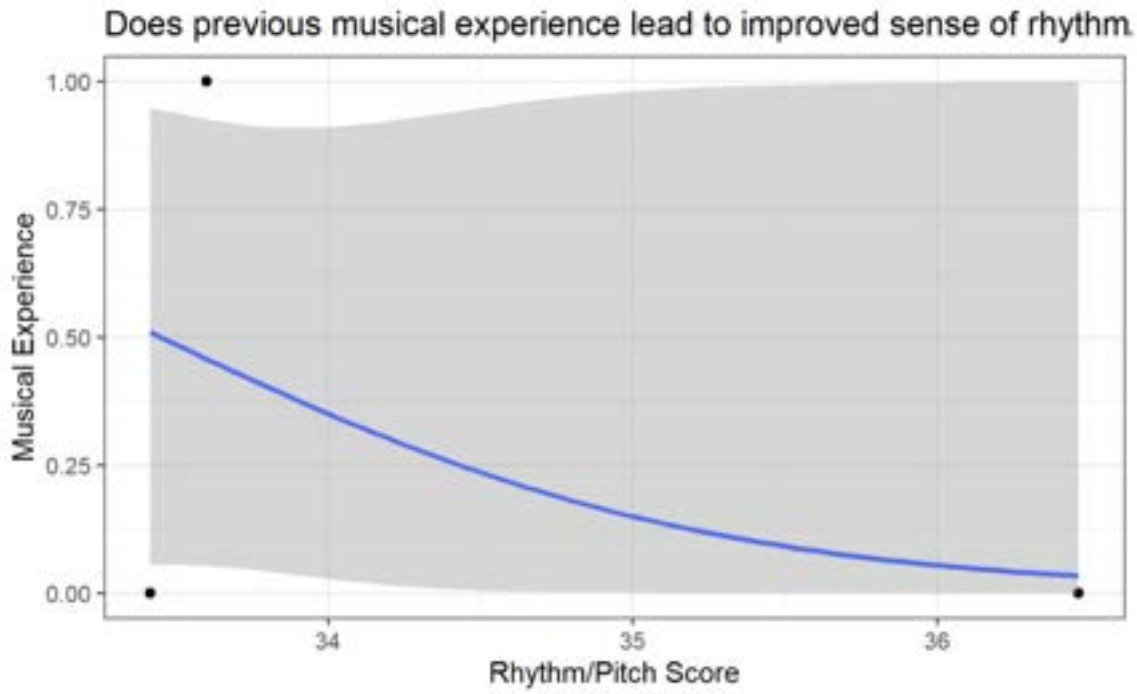
Group Data:



Our p-value is 0.878 meaning that there is no significant relationship between an increase in practice and improvement in rhythm. This does not agree with our hypothesis that more practice would lead to better performance in rhythm.



In this second graph, another extremely high p-value was observed of 0.910 and thus we fail to reject the null hypothesis. There appears to be no correlation in our group between pitch and rhythm score. Thus, this does not match our original hypothesis.



The p-value here is 0.563 meaning there is no significant relationship between musical experience and improved sense of rhythm. Thus, we fail to reject the null hypothesis, against our original conclusion.

Group vs Class Data Overall Conclusions:

It was determined that there was a much more insignificant p-value for all graphs because our group has a much smaller sample size than the entire class. The p-values for the smaller group data are much higher, and therefore less significant. Smaller sample sizes (such as 3 people versus 15) yield higher p-values due to high variability in results. We also had 1 member with musical experience and 2 without, which is not enough to make conclusions about the effect of experience. Our data likely more insignificant as one of our group members' results were reverse of the other two.

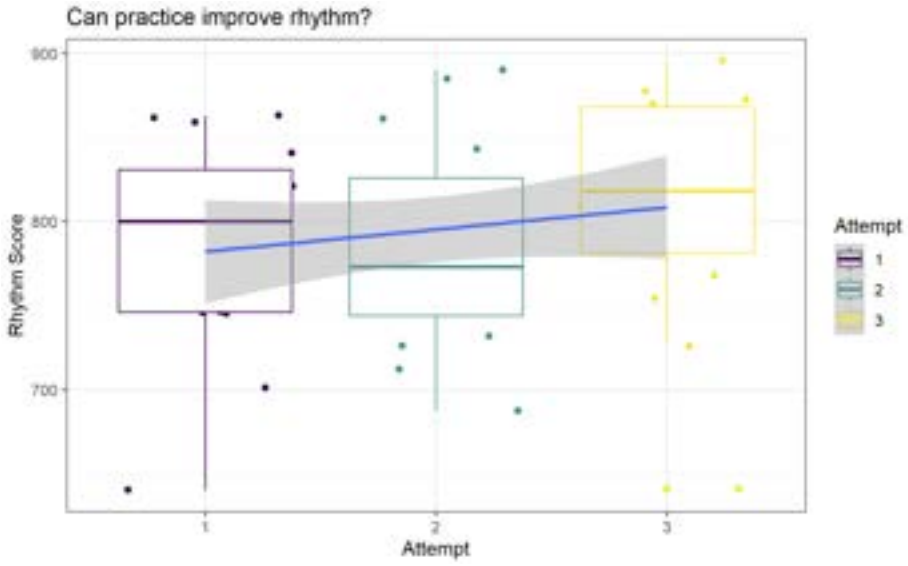
Group Members: Melat Woldetensae, Joshua Gilmer, Disha Jotsinghani

Can Practice Improve Rhythm?
Null: Practice has no impact on rhythm.
Alternative: Practice will improve performance on rhythm tests.

Does Experience Improve Pitch/Rhythm?
Null: Previous music experience has no impact on pitch or rhythm.
Alternative: Previous music experience will improve performance on both pitch and rhythm tests.

Relationship Between Rhythm and Pitch?
Null: There is no relationship between rhythm and pitch.
Alternative: There is a positive correlation between rhythm and pitch.

Can Practice Improve Rhythm? – Class Data Graph and Analysis

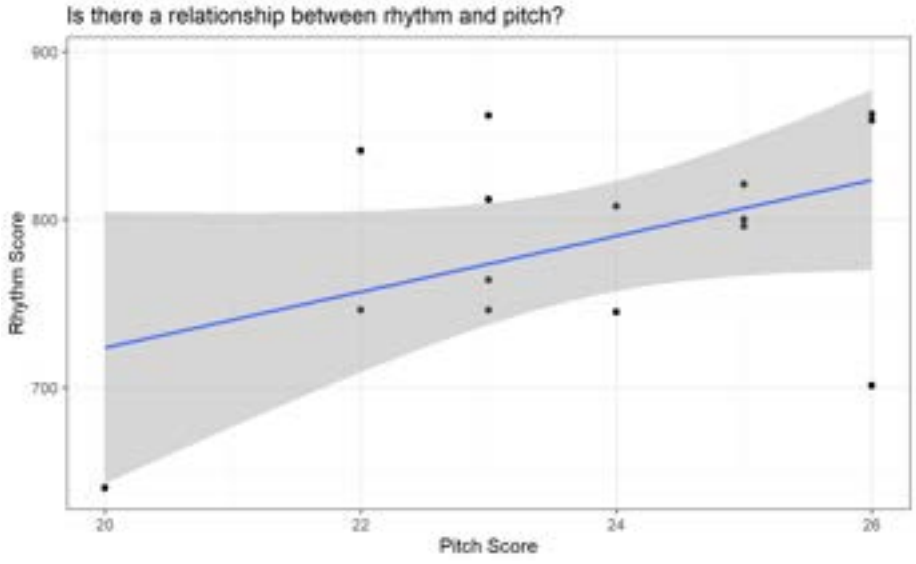


```
Call:
glm(formula = Rhythm ~ Attempt, data = Data)

Deviance Residuals:
     Min        1Q    Median        3Q       Max
-167.433   -37.267     2.567    57.567    94.733

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)   768.93      25.50  30.151   <2e-16 ***
Attempt        13.17      11.81   1.115    0.271
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(Dispersion parameter for gaussian family taken to be 4181.116)

    Null deviance: 184989  on 44  degrees of freedom
Residual deviance: 179788  on 43  degrees of freedom
AIC: 506.88

Number of Fisher Scoring iterations: 2
```

No

Because the p-value is greater than 0.05 (p = 0.271), we fail to reject the null hypothesis.

Does Experience Improve Pitch/Rhythm? – Class Data Graph and Analysis

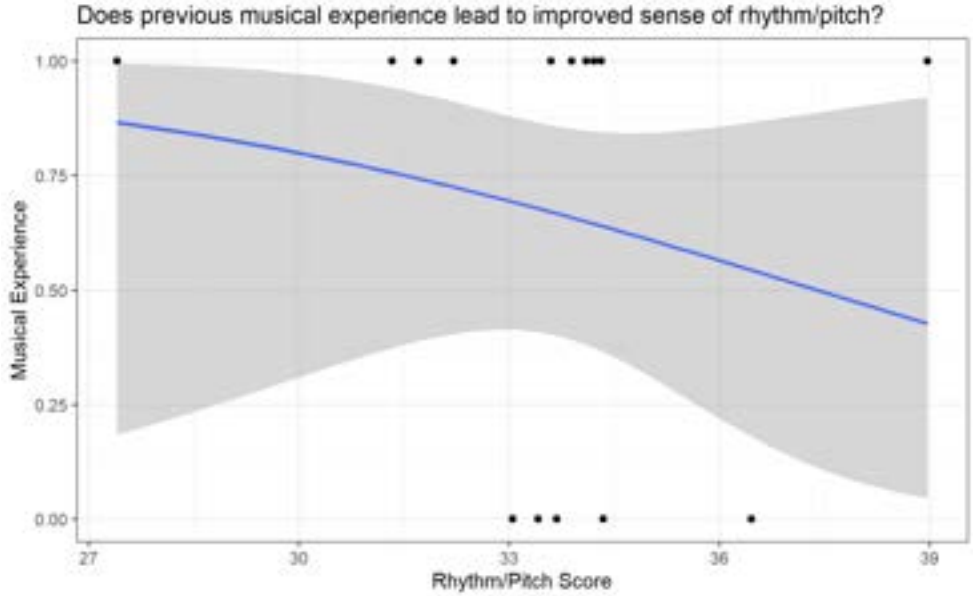


```
Call:
glm(formula = Rhythm ~ Pitch, data = Data)

Deviance Residuals:
     Min        1Q    Median        3Q       Max
-122.555   -19.293    -6.909    36.914    88.384

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  390.753    215.303   1.815   0.0927 .
Pitch         16.646      9.024   1.845   0.0880 .
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(Dispersion parameter for gaussian family taken to be 3452.617)

    Null deviance: 56633  on 14  degrees of freedom
Residual deviance: 44884  on 13  degrees of freedom
  (30 observations deleted due to missingness)
AIC: 168.62

Number of Fisher Scoring iterations: 2
```

No

Because the p-value is greater than 0.05 (p=0.0880), we fail to reject the null hypothesis.

Relationship Between Rhythm and Pitch? – Class Data Graph and Analysis

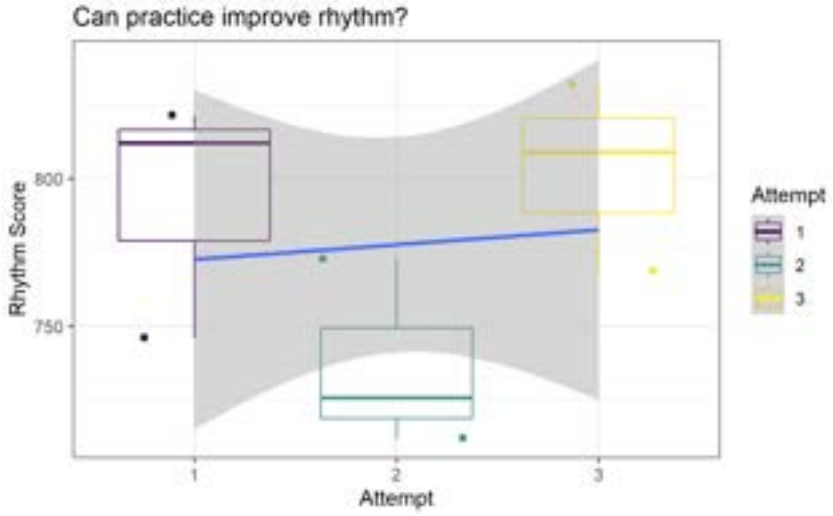


```
Call:
glm(formula = Experience ~ Ratio, family = "binomial", data = Data)

Deviance Residuals:
    Min       1Q   Median       3Q      Max
-1.5358  -1.3398   0.7708   0.9221   1.3044

Coefficients:
            Estimate Std. Error z value Pr(>|z|)
(Intercept)   6.9912     8.5237   0.820    0.412
Ratio        -0.1869     0.2513  -0.744    0.457

(Dispersion parameter for binomial family taken to be 1)

    Null deviance: 19.095  on 14  degrees of freedom
Residual deviance: 18.485  on 13  degrees of freedom
  (30 observations deleted due to missingness)
AIC: 22.485

Number of Fisher Scoring iterations: 4
```

No

Because the p-value is greater than 0.05 (p = 0.457), we fail to reject the null hypothesis.

Can Practice Improve Rhythm? – Group Data Graph and Analysis

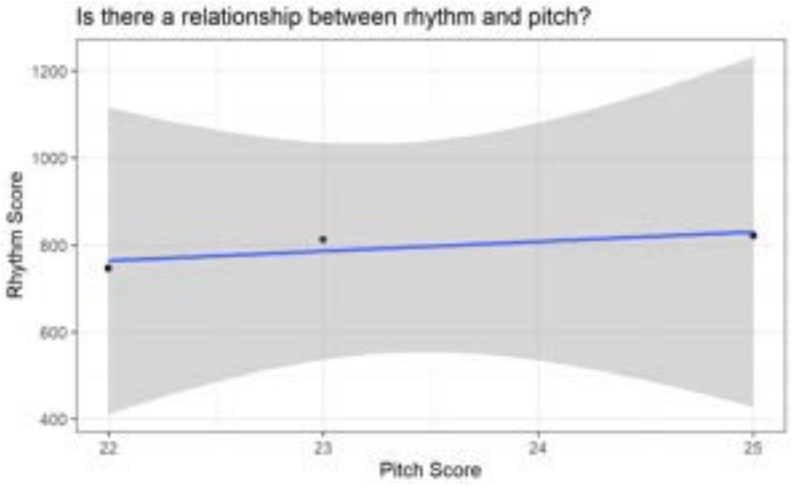


```
Call:
glm(formula = Rhythm ~ Attempt, data = Data)

Deviance Residuals:
    Min       1Q   Median       3Q      Max
-65.667  -26.667   -4.667   39.333   49.333

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)   767.67      40.74  18.842 2.95e-07 ***
Attempt         5.00      18.86   0.265    0.799
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(Dispersion parameter for gaussian family taken to be 2134.286)

    Null deviance: 15090  on 8  degrees of freedom
Residual deviance: 14940  on 7  degrees of freedom
AIC: 98.272

Number of Fisher Scoring iterations: 2
```

No

Because the p-value is greater than 0.05 (p = 0.799), we fail to reject the null hypothesis.

Does Experience Improve Pitch/Rhythm? – Group Data Graph and Analysis

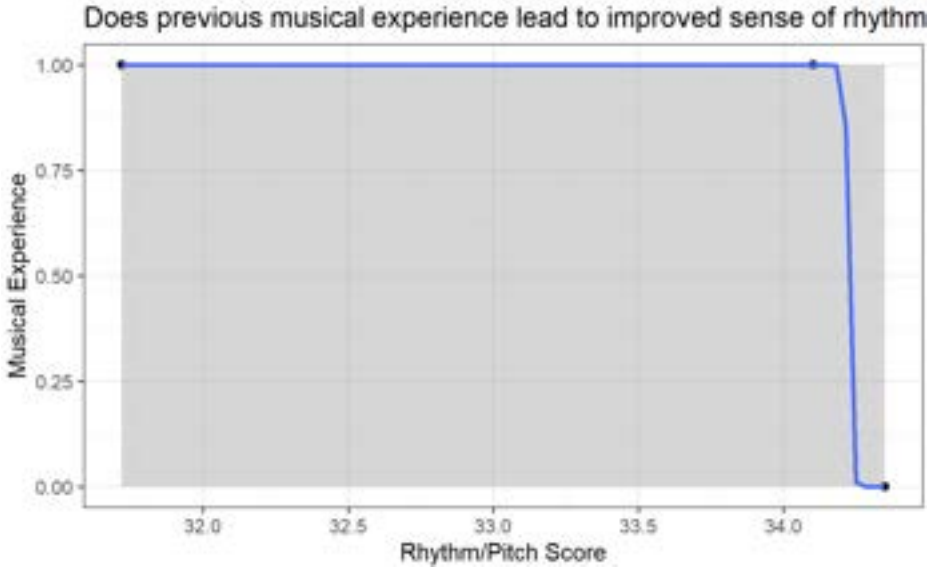



```
Call:
glm(formula = Rhythm ~ Pitch, data = Data)

Deviance Residuals:
      22        43        16
 26.357   -17.571    -8.786

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)   278.00     355.58   0.782    0.578
Pitch          22.07      15.22   1.450    0.384

(Dispersion parameter for gaussian family taken to be 1080.643)

    Null deviance: 3354.0  on 2  degrees of freedom
Residual deviance: 1080.6  on 1  degrees of freedom
  (6 observations deleted due to missingness)
AIC: 32.174

Number of Fisher Scoring iterations: 2
```

No

Because the p-value is greater than 0.05 (p = 0.384), we fail to reject the null hypothesis.

Relationship Between Rhythm and Pitch? – Group Data Graph and Analysis




```
Call:
glm(formula = Experience ~ Ratio, family = "binomial", data = Data)

Deviance Residuals:
        22          43          16
 1.363e-05  -1.327e-05   2.110e-08

Coefficients:
             Estimate Std. Error z value Pr(>|z|)
(Intercept)     6408.1 12499783.2   0.001        1
Ratio           -187.2   365257.4  -0.001        1

(Dispersion parameter for binomial family taken to be 1)

    Null deviance: 3.8191e+00  on 2  degrees of freedom
Residual deviance: 3.6174e-10  on 1  degrees of freedom
  (6 observations deleted due to missingness)
AIC: 4

Number of Fisher Scoring iterations: 25
```

No

Because the p-value is greater than 0.05 (p = 1), we fail to reject the null hypothesis.

Comparison of Class and Group Data

The class data has a much larger sample size (n=15) compared to the group data (n=3). This would explain why our p-values were higher in comparison to the class data's p-values because there is less statistical power in smaller sample sizes. There was also a much wider confidence interval for the group data, which shows a weaker association between the variables.

Glory, Hannah, Angie

1. Alternate: Rhythm accuracy improves with more practice.
    a. Null: Practice does not improve rhythm accuracy
2. Alternate: Having a musical background leads to a better performance identifying pitch and rhythm.
    a. Null: There is no relationship between experience and pitch/rhythm
3. Alternative: There is a direct relationship between rhythm and pitch
    a. Null: There is no relationship between rhythm and pitch

Graph 1:

- Our hypothesis was incorrect and we accept the null hypothesis. The p value was greater than 0.05 (p-value: 0.271), therefore the data was not statistically significant enough to accept the alternate hypothesis, therefore the results are due by chance. Overall, rhythm accuracy does not improve with practice.

Graph 2:

- The alternative hypothesis does not hold true and we accept the null hypothesis. The p-value is 0.0880, which is greater than 0.05 which means the relationship is not statistically significant and the results can be explained by chance. Based on the class data alone, we would assume that there is no relationship between experience and pitch/rhythm. However, it is important to consider the small sample size and the lack of diversity in musical training in the sample size.

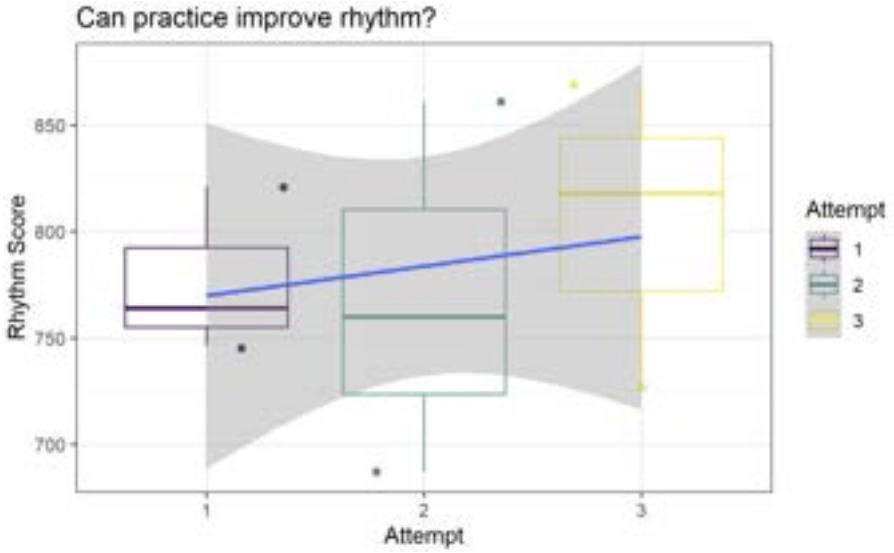
Graph 3:

- The alternative hypothesis is incorrect and we accept the null hypothesis. The p-value is 0.457, which is greater than 0.05 meaning the null hypothesis is not rejected and there is no statistically significant effect. These results indicate there is no relationship between rhythm and pitch.

Group vs Class:

- Graph 1
    - Our group data aligns with the class data–rhythm accuracy does not improve with practice. Our group p-value was 0.62, which is above the accepted p-value of 0.05 (95% confidence). Similarly, the class data had a p-value of 0.271. The smaller p-value for the class data is likely due to a larger sample size. However, the same trend hold true and we can accept the null hypothesis in both situations.

```
Call:
glm(formula = Rhythm ~ Attempt, data = Data)

Deviance Residuals:
    Min       1Q   Median       3Q      Max
-96.667  -23.833   -5.833   51.167   77.333

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)   756.00      57.63  13.118 3.49e-06 ***
Attempt        13.83      26.68   0.519     0.62
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(Dispersion parameter for gaussian family taken to be 4270.548)

    Null deviance: 31042  on 8  degrees of freedom
Residual deviance: 29894  on 7  degrees of freedom
AIC: 104.51

Number of Fisher Scoring iterations: 2
```



- Graph 2
    - Like the class data, the group data shows no statistically significant relationship between experience and pitch/rhythm. The group p-value is 0.148, while the class p-value is 0.0880. From this, we would assume that there is no relationship between experience and pitch/rhythm and the observed result is due to chance.

```
Call:
glm(formula = Rhythm ~ Pitch, data = Data)

Deviance Residuals:
31  16  28
 9   0  -9

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)   -4.000    184.610  -0.022    0.986
Pitch         33.000      7.794   4.234    0.148

(Dispersion parameter for gaussian family taken to be 162)

    Null deviance: 3066  on 2  degrees of freedom
Residual deviance:  162  on 1  degrees of freedom
  (6 observations deleted due to missingness)
AIC: 26.481

Number of Fisher Scoring iterations: 2
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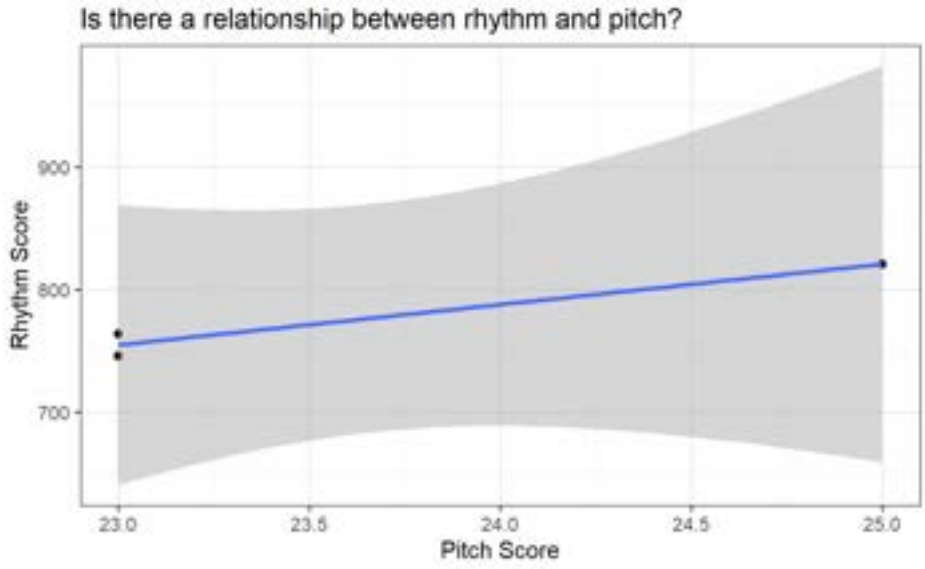
- 

- Graph 3
    - The class data and our group data show similar results that rhythm accuracy does not improve with practice. The class had a p-value of 0.475 and our graph data had a p-value of 0.638. Both p-values are above the accepted p-value of 0.05, meaning there is little evidence against the null hypothesis. Also noteworthy, is the wide confidence interval shown. Overall, both sets of data support the conclusion that there is little relationship between rhythm and pitch.

```
Call:
glm(formula = Experience ~ Ratio, family = "binomial", data = Data)

Deviance Residuals:
     31       16       28
 1.1285   0.5766  -1.3990

Coefficients:
            Estimate Std. Error z value Pr(>|z|)
(Intercept)  21.1656    43.8396   0.483    0.629
Ratio        -0.6134     1.3071  -0.469    0.639

(Dispersion parameter for binomial family taken to be 1)

    Null deviance: 3.8191  on 2  degrees of freedom
Residual deviance: 3.5632  on 1  degrees of freedom
  (6 observations deleted due to missingness)
AIC: 7.5632

Number of Fisher Scoring iterations: 3
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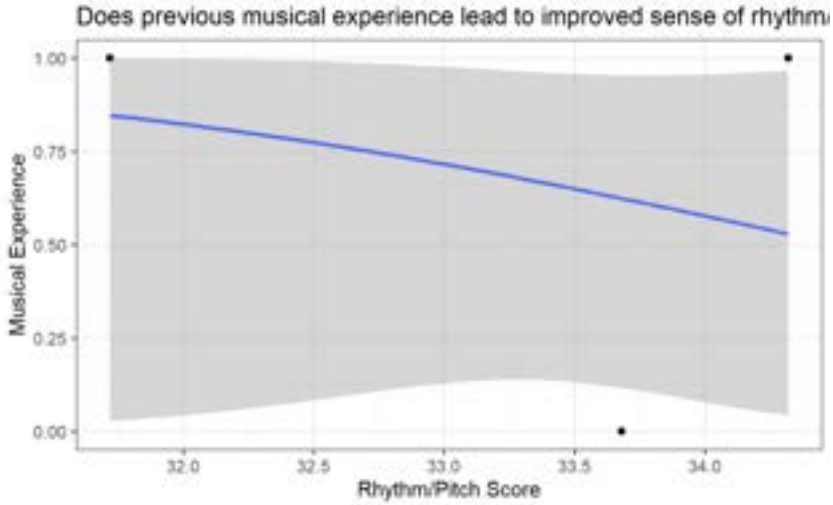


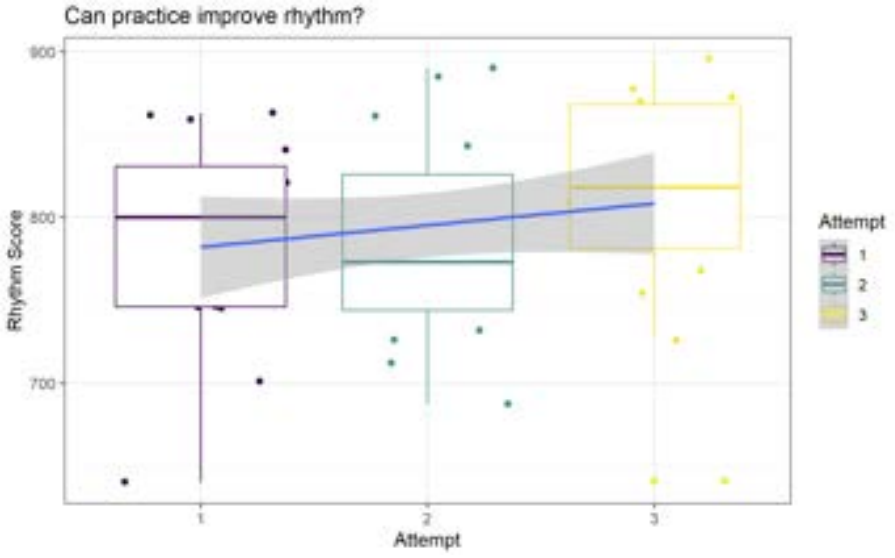
Group 1: Amelia Costello, Claire Song, & Hansel Heres

Hypotheses:

1. Can Practice Improve Rhythm?
    a. Null: there is no relationship between practice and rhythm score
    b. Alternative: there is a positive relationship between practice and rhythm score
2. Is There a Relationship Between Rhythm and Pitch?
    a. Null: there is no relationship between rhythm score and pitch score
    b. Alternative: there is a positive relationship between rhythm score and pitch score
3. Does Previous Musical Experience Lead to Improved Sense of Rhythm/Pitch?
    a. Null: There is no relationship between experience and improved sense of rhythm/pitch
    b. Alternative: There is a positive correlation between musical experience and improved sense of rhythm/pitch

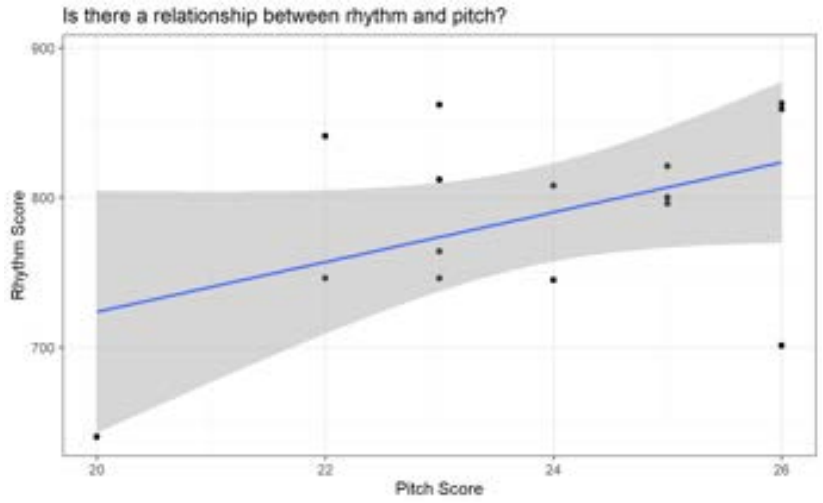
Class Results:

1. Can Practice Improve Rhythm?
    a. We fail to reject the null hypothesis. With a p-value >0.05, There is a 27.1% chance that practice does not improve rhythm.



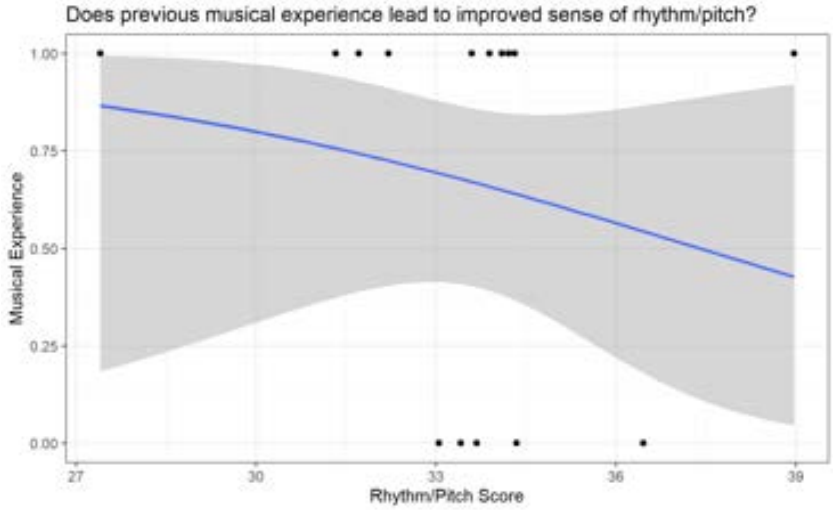

```
Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)   768.93      25.50  30.151   <2e-16 ***
Attempt        13.17      11.81   1.115    0.271
```

2. Is there a relationship between rhythm and pitch?
    a. We have sufficient evidence to reject the null hypothesis. With a p-value of <0.05, there is a statistically significant relationship between rhythm score and pitch score.




```
Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  390.753    215.303   1.815   0.0927 .
Pitch         16.646      9.024   1.845   0.0880 .
```

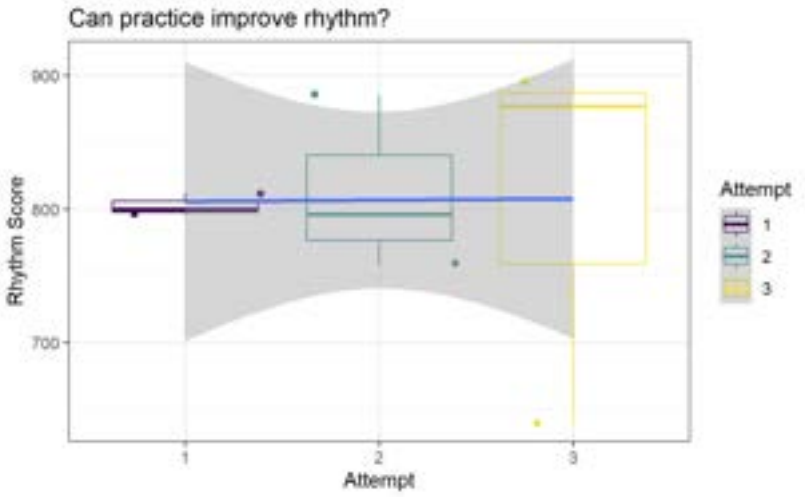
3. Does Previous Musical Experience Lead to Improved Sense of Rhythm/Pitch?
    a. We fail to reject the null hypothesis. The p-value of the data is >0.05, there is a 41.2% chance that previous musical experience does not lead to improved sense of rhythm/pitch. We do not have sufficient data to support the alternative hypothesis.




```
Coefficients:
            Estimate Std. Error z value Pr(>|z|)
(Intercept)   6.9912     8.5237   0.820    0.412
Ratio        -0.1869     0.2513  -0.744    0.457
```

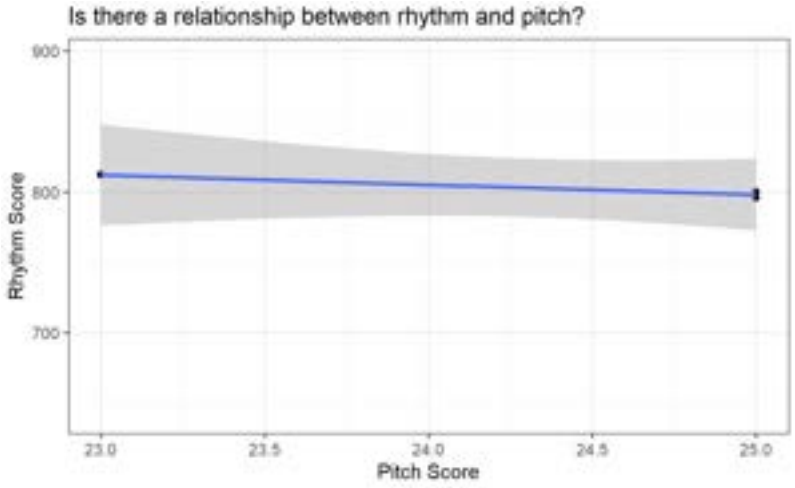
Group Data:

4. Can Practice Improve Rhythm?
    a. We fail to reject the null hypothesis. With a p-value >0.05, we do not have sufficient evidence of a relationship between practice and rhythm.




```
Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)   804.78      73.92  10.888 1.22e-05 ***
Attempt         1.00      34.22   0.029    0.978
```

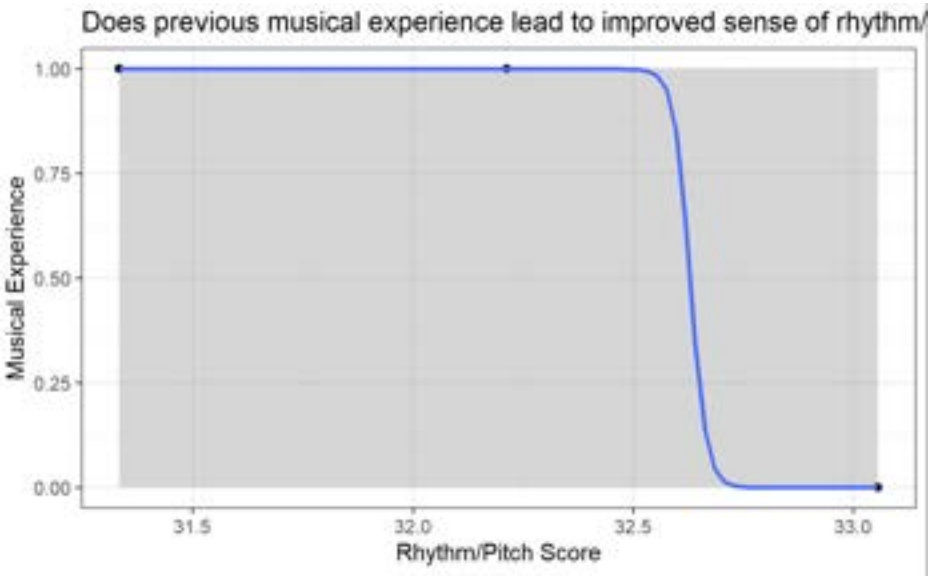
5. Is there a relationship between rhythm and pitch?
    a. We fail to reject the null hypothesis. With a p-value >0.05, we do not have sufficient evidence of a relationship between rhythm score and pitch score.




```
Coefficients:
             Estimate Std. Error z value Pr(>|z|)
(Intercept) 2.357e+01  1.294e+06       0        1
Ratio       2.364e-07  3.973e+04       0        1

(Dispersion parameter for binomial family taken to be 1)
```

6. Does Previous Musical Experience Lead to Improved Sense of Rhythm/Pitch?
    a. We fail to reject the null hypothesis. The p-value of the data is >0.05, there is a 100% chance that previous musical experience does not lead to improved sense of rhythm/pitch. We do not have sufficient data to support the alternative hypothesis.




```
Coefficients:
             Estimate Std. Error z value Pr(>|z|)
(Intercept)   1792.71 3568153.29   0.001        1
Ratio          -54.94  109712.38  -0.001        1
```

Comparison Statement:

For the correlation between practice and improvement in rhythm, both the class and group data showed no statistical significance. For the relationship between rhythm and pitch, the class data showed a positive correlation between rhythm and pitch while our group data showed no correlation between rhythm and pitch. Lastly, for the correlation between musical experience and improved sense of rhythm/pitch, there was again no statistical significance.

The group data had much higher p-values compared to the class data. We suggest this difference may be due to the larger sample size of the class data compared to the group data. A larger sample size gives us greater power to reject the null hypothesis.