**Results**

In order to perform data analysis, the two-way ANOVA method was used. Before this analysis can be performed, the data needs to meet the prerequisite assumptions of homoscedasticity and zero outliers. To test for outliers, the data was arranged in the table shown in Figure 2, with 9 samples and their corresponding FC5 beta values for each stimulus. After this, outlier testing was performed for each individual (column) (see Figure 3). When this was done, it was noticed that Participant 6’s stimuli 2b value was an outlier; hence, their data was removed. Next, an outlier test was performed across all the samples for each difficulty level and time duration (see Figure 4); majority of Participant 8’s data was found to be outliers and was also removed.

7 samples were then left, which were then arranged in a table as seen below in Figure 5.

**Table

Description automatically generated**

Figure 2: FC5 beta values obtained from each participant for each stimulus. The green cells indicate outlier values.

**Table

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Figure 3: Outlier testing for each participant is performed. In order to find upper-bound the formula used is Q3+(3\*IQR). The formula used to find the lower bound is Q1-(3\*IQR).

Table

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Figure 4: Outlier testing across different participants. A represents more time duration and B represents less time duration. The formula used to find upper bound is Q3+(3\*IQR). The formula used to find the lower bound is Q1-(3\*IQR).

Table

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Figure 5: The research data from 7 subjects. The values indicate power level of the frequency of activation measured by the FC5 electrodes’ beta values

Now, since the required assumption of lack of outliers has been met, we then move on to testing homoscedasticity. Performing the graphical Levene’s test using a box plot, it was possible to say that there was homogeneity of variance, i.e., homoscedasticity (see Figure 6). In a box plot, the groups satisfy the condition for homoscedasticity if the ratio of the largest sample variance to the smallest sample variance was approximately 2.0 and the variation around the mean for each group was similar; we can see that was true in our case as the blue box was about half the size of the grey one and the IQR line similar (Rosopa et al., 2013, p. 9). Finally, having met the required assumptions, the two-way ANOVA test was performed.

Chart, box and whisker chart

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Figure 6: The box plot representation of Leven’s test. The variance around the mean is seen to be minimal with the lines being around the same value and the blue box (smallest) being half the size of the grey one (largest).

Conducting the two-way ANOVA test yielded 3 tables. The first table (figure 7) provided the means of the EEG FC5 beta values for different participants across different difficulty levels for type ‘more time’. The second table (figure 8) provided the mean for type ‘less time’. Finally, table 3 (figure 9) provided the two-way ANOVA result, using which the following null hypothesis were tested:

H1: The population means of the first factor are equal. This is like the one-way ANOVA for the row factor.

H2: The population means of the second factor are equal. This is like the one-way ANOVA for the column factor.

H3: There is no interaction between the two factors. This is similar to performing a test for independence with contingency tables.

Table

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Figure 7: The average, sum, and variance for each difficulty level over type ‘More Time’ are displayed.

Table

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Figure 8: The average, sum, and variance for each difficulty level over type ‘Less Time’ are displayed.

Testing hypothesis 1 in figure 9 for row ‘Sample’, the F value (0.5392) was less than the critical factor (4,1132) and the p-value (0,4675) was significantly greater than the alpha value of 0,05, it was thus wasn’t possible to reject the first null hypothesis H1. Hence, there was not any statistically significant difference in FC5 beta values for factor type ‘duration of test’. Similarly, testing hypothesis 2 in figure 9 row ‘Columns’; it was observed that the F value (2,1358) was less than the critical factor (3,2594) and the p-value (0,1328) was greater than the alpha value of 0,05; it was thus not feasible to reject the second null hypothesis H2. Hence, it was noted that there was not any statistically significant difference in FC5 beta values for factor type ‘difficulty level’. Lastly, testing hypothesis 3 using row ‘interaction’, it was noted that the F value (0,4600) was less than the critical factor (3,2594) and the p-value (0,6349) was significantly greater than the alpha value of 0.05; the third null hypothesis H3 was thus not rejected, thereby confirming that there was no interaction between the factors ‘difficulty level’ and ‘duration of test’.

Table

Description automatically generated

Figure 9: The ANOVA results calculate for SS (sum of squares), df (degree of freedom), MS (mean sum of squares), F (test statistic from the F-test), P-value (probability statistic) and F crit (Critical value of F)