

# Statistical Methods In Research - COSC 6323

## MicroSurgery Data Inferences

Team 8

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## 1 INTRODUCTION

In this experiment, 22 medical students participated to find the relationship between stress and skill in learning the micro surgical tasks like cutting and suturing. Each of the subject attended 5 sessions, lasting one hour each where each subject practiced micro-surgical cutting and suturing. Before the first session, each subject completed a biographic questionnaire and a travel anxiety inventory. TAI scores gave an indication of the subjects stress level prior to the execution of the protocol. At the last session, each subject had to complete post study questionnaire.

Every session includes three treatments. All the subjects were facially recorded by a thermal and visual camera to collect the perinasal signals.

**Baseline:** During this treatment, the subjects relaxed for 5 min listening to music.

**Cutting:** The subjects had to do precision cutting in the inanimate simulator.

**Suturing:** The subjects had to do precision suturing in the inanimate simulator.

After both cutting and suturing treatments, each subject filled a NASA-TLX questionnaire which has five subscales namely, Mental Demand, Physical Demand, Temporal Demand, Performance and Frustration. The NASA-TLX questionnaire throws light on the subjects perceptions regarding task difficulty after each treatment (cutting and suturing).

Key aims of this investigation are:

- (a) To find if the subjects learn over time by practicing the tasks of cutting and suturing.
- (b) To understand the relationship between stress and skill in dexterous tasks.
- (c) To understand how the performance of the subjects is affected by the various factors.

## 2 Summarizing plots that reveal patterns

### 2.1 Bio Graphic Data

From the histogram of Age distribution, it can be seen that the data is right skewed. This implies that the mean is greater than the median.

From the bar plot of gender distribution, it can be observed that the number of females in comparison to males is quite less implying that the data is unbalanced in terms of gender.

### 2.2 Time Plots

As per the goal of the experiment, it is expected that the time taken for a student to complete the task should decrease over time as the sessions progress which can be clearly seen from the above Time Bar Plots for both Cutting and Suturing implying that the students learned the process with time.

### 2.3 Accuracy Plots

As the Sessions progress, the subject is learning the cutting and suturing tasks, which is quite evident from the gradual increase in the accuracy scores.

### 2.4 Stress Signals

In general, the Stress signal is more for subjects while performing Suturing task when compared to Cutting Task.

When the session progress, the time taken by the subject to complete the suturing task decreases.

As the time progresses, the stress signal for Suturing increases when compared to cutting and there is a sudden raise in the stress signals after which the subjects stop doing the respective task.

### 2.5 State Psychometric Data

As the sessions progress the TAI score for performance and the mental demand is increasing. The physical demand is decreasing, so with time, the subjects are becoming more at ease with the physical conditions but have to concentrate more.

## 3 Statistical Inference

### 3.1 Linear Model

#### Hypothesis

$H_0$  : There is no relationship between Score(Accuracy) and the independent variables, i.e, Perinasal Perspiration, Sessions, Tasks, Age, Sex and Scorers.

$H_1$  : There is a relationship between accuracy Score and the independent variables(Perinasal Perspiration, Sessions, Tasks, Age, Sex and Scorers).

In order to find the relationship between the Accuracy Score and the independent variables we perform a linear Regression on the dataset with Accuracy as the Response Variable and the Predictor

Variables.

The results are as follows :

```
> summary(sum1)

Call:
lm(formula = Score ~ PP + Sessions + Task + Age + Sex + Scorer,
   data = df_MicrosurgeryPerformance)

Residuals:
    Min      1Q  Median      3Q     Max 
-9.3457 -2.2022  0.3603  2.5450  8.4418 

Coefficients:
            Estimate Std. Error t value Pr(>|t|)    
(Intercept) -4.050e-01  9.509e+00 -0.043  0.96606  
PP          -1.841e+00  2.022e+00 -0.911  0.36327  
Sessions2    4.153e+00  6.929e-01  5.994  6.66e-09 *** 
Sessions3    6.274e+00  7.065e-01  8.879  < 2e-16 *** 
Sessions4    7.570e+00  7.128e-01 10.621  < 2e-16 *** 
Sessions5    7.925e+00  7.215e-01 10.983  < 2e-16 *** 
TaskSuturing -1.190e+00  4.325e-01 -2.751  0.00635 **  
Age          4.552e-01  1.750e-01  2.601  0.00983 **  
SexMale      -2.043e+00  4.739e-01 -4.310  2.30e-05 *** 
Scorer2      -4.010e-15  4.320e-01  0.000  1.00000  
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 3.589 on 266 degrees of freedom
(24 observations deleted due to missingness)
Multiple R-squared:  0.4425,    Adjusted R-squared:  0.4236 
F-statistic: 23.46 on 9 and 266 DF,  p-value: < 2.2e-16
```

## INFERENCES

### Based On P Values

The p-value for each independent variable tests the null hypothesis that the variable has no correlation with the dependent variable.

Except Perinasal Perspiration and Scorer all the other Predictor values have a significant effect on the Score. This can be seen from the P values in the above linear regression model. If the value of test statistic is less than the value of significance  $\alpha = 0.05$ , it provides enough evidence that the Predictor variable is significant.

Age and Task do affect the scores but not as significant as Sessions. \*\* indicates the significance level.

The scores depend on the sex of the subject, showing that females had better scores. But since the data is unbalanced with very few females we cannot take this into consideration.

### Based On Coefficient Values

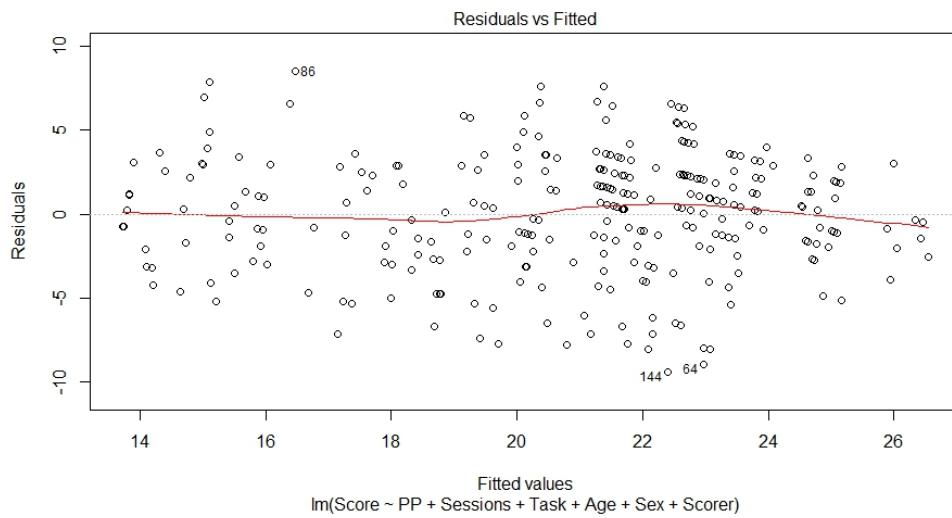
Score=(-1.841283e+00)\*PP + (4.152710e+00)\*Sessions2 + (6.273522e+00)\*Sessions3 + (7.570456e+00)\*Sessions4 + (7.924544e+00)\*Sessions5 + (-1.189866e+00)\*Task + (4.551897e-01)\*Age + (-2.042521e+00)\*Sex + (-4.009654e-15)\*Scorer + -4.050251e-01      Sessions and Age have a positive relationship. Perinasal Perspiration, Task, Sex and Scorer have a Negative relationship.

The estimate for Tasks is -1.19. The magnitude indicates that there is a difference between the two tasks. The two tasks were not equally easy or equally difficult. The negative correlation indicates that Cutting was easier when compared to Suturing.

```
> cor(Scorer1, Scorer2)
```

```
[1] 0.8687656
```

If the Correlation coefficient is closer to '1', then it indicates that the two variables are strongly correlated. The correlation between Scorer 1 and Scorer 2 is high which can be seen from the correlation coefficient. Meaning that the Scorers are in agreement. **Residuals**



Residuals are randomly spread around a horizontal line (red color line) without any distinct patterns. That is a good indication that there is NO non-linear relationships and a linear regression model is appropriate for the data.

NO distinctive non-random patterns are seen in this Residual Plot, so it indicates a good Regression Model.

Residual Standard Error is measure of the quality of a linear regression fit. Theoretically, every linear model is assumed to contain an error term E. Due to the presence of this error term, we are not capable of perfectly predicting our response variable from the predictor variables. The Residual Standard Error is the average amount that the response will deviate from the true regression line. Here we have 3.589(which is less) but still an error.

**R- Squared Value**  $R^2$  is a measure of the linear relationship between our predictor variable and our response / target variable (Score). It always lies between 0 and 1 (i.e.: a number near 0 represents a regression that does not explain the variance in the response variable well and a number close to 1 does explain the observed variance in the response variable).

In our example, the  $R^2$  we get is 0.4404. Or roughly 44% of the variance found in the response variable (Score) can be explained by the predictor variables.

## 3.2 Mixed Effects Model

### Hypothesis

H0 : There is no relationship between Score(Accuracy) and the independent variables, i.e, Perinasal Perspiration, Sessions, Tasks, Age, Sex and Scorers and the Random Effect of the Subjects.

H1 : There is a relationship between accuracy Score and the independent variables(Perinasal Perspiration, Sessions, Tasks, Age, Sex and Scorers)and the Random Effect of the Subjects.

In order to find the relationship between the Accuracy Score and the independent variables we perform a linear Regression on the dataset with Accuracy as the Response Variable and the Predictor Variables.

The results are as follows :

```

Linear mixed model fit by REML ['lmerMod']
Formula: Score ~ PP + Sessions + Task + Age + Sex + Scorer + (1 | Subjects)
Data: df_MicrosurgeryPerformance

REML criterion at convergence: 1359.1

Scaled residuals:
    Min      1Q  Median      3Q     Max 
-3.00610 -0.55024  0.05832  0.65881  2.36090 

Random effects:
 Groups   Name        Variance Std.Dev. 
 Subjects (Intercept) 6.956    2.638  
 Residual            7.335    2.708  
Number of obs: 276, groups: Subjects, 15

Fixed effects:
            Estimate Std. Error t value
(Intercept) -5.236e-01 1.572e+01 -0.033
PP          -2.542e+00 1.832e+00 -1.388
Sessions2    3.678e+00 5.293e-01  6.950
Sessions3    5.910e+00 5.485e-01 10.775
Sessions4    7.185e+00 5.557e-01 12.929
Sessions5    7.232e+00 5.633e-01 12.838
TaskSuturing -1.093e+00 3.269e-01 -3.342
Age          3.592e-01 5.767e-01  0.623
SexMale      -2.262e+00 1.540e+00 -1.469
Scorer2      1.290e-14 3.261e-01  0.000

Correlation of Fixed Effects:
              (Intr) PP      Ssnsns2 Ssnsns3 Ssnsns4 Ssnsns5 TskStr Age      SexMal
PP             0.493
Sessions2     -0.068 -0.081
Sessions3     -0.187 -0.331  0.529
Sessions4     -0.169 -0.304  0.522  0.580
Sessions5     -0.158 -0.271  0.518  0.564  0.561
TaskSuturing -0.039 -0.061  0.004  0.020  0.018  0.013
Age           -0.876 -0.021  0.013  0.014  0.008  0.013 -0.001
SexMale       -0.272  0.031  0.009 -0.004  0.001  0.008 -0.003  0.261
Scorer2       -0.010  0.000  0.000  0.000  0.000  0.000  0.000  0.000

```

The predictor variables Perinasal Perspiration, Session 2 have a significant effect on the Score. The PP and Scorer2 predictor variables are significant in Random effect model but not in Linear regression Model. The variance value for the subjects is around 6 which states that there is a difference between the subjects variance.

### 3.3 Linear Regression Model - Including Predictor Variable Time

#### Hypothesis

H0 : There is no relationship between Score(Accuracy) and the independent variables, i.e, Perinasal Perspi-

ration, Sessions, Tasks, Age, Sex, time and Scorers.

H1 : There is a relationship between accuracy Score and the independent variables(Perinasal Perspiration, Sessions, Tasks, Age, Sex,time and Scorers).

In addition to the predictor variables that we used in Linear Model above, we can include Time as another variable.

The results are as follows :

```
Call:
lm(formula = Score ~ PP + Sessions + Task + Age + Sex + Scorer +
    Time, data = df_MicrosurgeryPerformance)

Residuals:
    Min      1Q Median      3Q     Max 
 -9.303 -2.030  0.248  2.354  8.775 

Coefficients:
            Estimate Std. Error t value Pr(>|t|)    
(Intercept) -8.464e-01 9.360e+00 -0.090 0.92801  
PP          -2.164e+00 1.993e+00 -1.086 0.27839  
Sessions2    3.607e+00 7.042e-01  5.122 5.82e-07 *** 
Sessions3    5.633e+00 7.254e-01  7.766 1.78e-13 *** 
Sessions4    6.514e+00 7.799e-01  8.353 3.75e-15 *** 
Sessions5    6.958e+00 7.755e-01  8.972 < 2e-16 *** 
TaskSuturing 3.785e+00 1.660e+00  2.280 0.02340 *  
Age         5.038e-01 1.730e-01  2.913 0.00389 ** 
SexMale     -1.915e+00 4.682e-01 -4.090 5.72e-05 *** 
Scorer2     -4.303e-15 4.252e-01  0.000 1.00000  
Time        -5.718e-03 1.844e-03 -3.101 0.00214 ** 
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 3.532 on 265 degrees of freedom
(24 observations deleted due to missingness)
Multiple R-squared:  0.462,    Adjusted R-squared:  0.4417 
F-statistic: 22.76 on 10 and 265 DF,  p-value: < 2.2e-16
```

## INFERENCES

Score=(-2.164283e+00)\*PP+(3.607159e+00)\*Sessions2+(5.633192e+00)\*Sessions3+(6.514346e+00)\*Sessions4+(6.958117e+01)\*Age+(-1.915315e+00)\*Sex+(-4.303109e-15)\*Scorer+(-5.717742e-03)\*Time+(-8.464335e-01)

Sessions, Task, Age have a positive effect whereas Sex, Scorer and Time have a negative effect.

Except Perinasal Perspiration and Scorer, all the Predictor variables have a significant effect on the Score of the Subjects.

Time also plays a very important role as the test statistic is 0.00214 which is less than the significance level, showing that it has a significant effect on the Score.

It can be observed that with the addition of time as a predictor variable, the significance level of the Tasks has dropped. This is because there is a difference in the time taken by the two different tasks.

Also, tasks have a positive effect now with the addition of time, meaning that the different tasks have a significant difference in the time taken to perform them.

### 3.4 Linear Regression Model - Including Predictor Variable Number of Sutures

#### Hypothesis

H0 : There is no relationship between Score(Accuracy) and the independent variables, i.e, Perinasal Perspiration, Sessions, Age, Sex, Number of Sutures and Scorers.

H1 : There is a relationship between accuracy Score and the independent variables(Perinasal Perspiration, Sessions, Age, Sex, Number of Sutures and Scorers).

In addition to the predictor variables that we used in Linear Model above, we can include Suturing Number of Sutures as another variable. But, tasks have to be removed because No of Sutures is present only for the task Suturing.

The results are as follows :

```
Call:
lm(formula = Score ~ PP + Sessions + Age + Sex + Scorer + NoSutures,
  data = df_MicrosurgeryPerformance)

Residuals:
    Min      1Q  Median      3Q     Max 
-8.8530 -1.2350  0.1196  1.3110  5.7783 

Coefficients:
            Estimate Std. Error t value Pr(>|t|)    
(Intercept) 15.4389    9.1661   1.684   0.0945 .  
PP          0.2889    1.8561   0.156   0.8765    
Sessions2   0.8499    0.7490   1.135   0.2586    
Sessions3   0.4861    0.8610   0.565   0.5734    
Sessions4   1.0136    0.9328   1.087   0.2793    
Sessions5   1.2060    0.9655   1.249   0.2139    
Age         -0.1795   0.1867  -0.961   0.3382    
SexMale     0.0239    0.5113   0.047   0.9628    
Scorer2     0.4638    0.4322   1.073   0.2853    
NoSutures   2.0681    0.1969  10.505  <2e-16 *** 
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 2.539 on 128 degrees of freedom
(162 observations deleted due to missingness)
Multiple R-squared:  0.7143,    Adjusted R-squared:  0.6942 
F-statistic: 35.56 on 9 and 128 DF,  p-value: < 2.2e-16
```

#### INFERENCES

Score=(0.28894888)\*PP+(0.84988770)\*Sessions2+(0.48610317)\*Sessions3+(1.01361628)\*Sessions4+(1.20595665)\*Sessions5-0.17948945)\*Age+(0.02389601)\*Sex+(0.46376812)\*Scorer+(2.06811317)\*NoSutures+(15.43892303)

Inferences:

With the addition of this new variable Number of Sutures, it can be clearly seen that all the Predictor variables have become insignificant except for Number of Sutures. This is because we are loosing half of the data which belongs to the Cutting Sessions, as Cutting doesn't have Number of Sutures.

### 3.5 Interaction Model

#### Hypothesis

H0: The interaction between Task and Session does not have any significant effect on the measurements.

The results are as follows :

```

Call:
lm(formula = Score ~ Task * Session)

Residuals:
    Min      1Q  Median      3Q     Max 
 -10.633  -2.500   0.500   2.567   8.333 

Coefficients:
                Estimate Std. Error t value Pr(>|t|)    
(Intercept) 16.66667  0.69914 23.839 < 2e-16 ***
TaskSuturing -1.93333  0.98873 -1.955  0.05150 .  
Session2      3.66667  0.98873  3.708  0.00025 ***
Session3      6.06667  0.98873  6.136  2.77e-09 ***
Session4      6.96667  0.98873  7.046  1.34e-11 ***
Session5      6.80000  0.98873  6.878  3.75e-11 ***
TaskSuturing:Session2 0.83333  1.39827  0.596  0.55166
TaskSuturing:Session3  0.06667  1.39827  0.048  0.96201
TaskSuturing:Session4  0.63333  1.39827  0.453  0.65093
TaskSuturing:Session5  0.96667  1.39827  0.691  0.48991
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

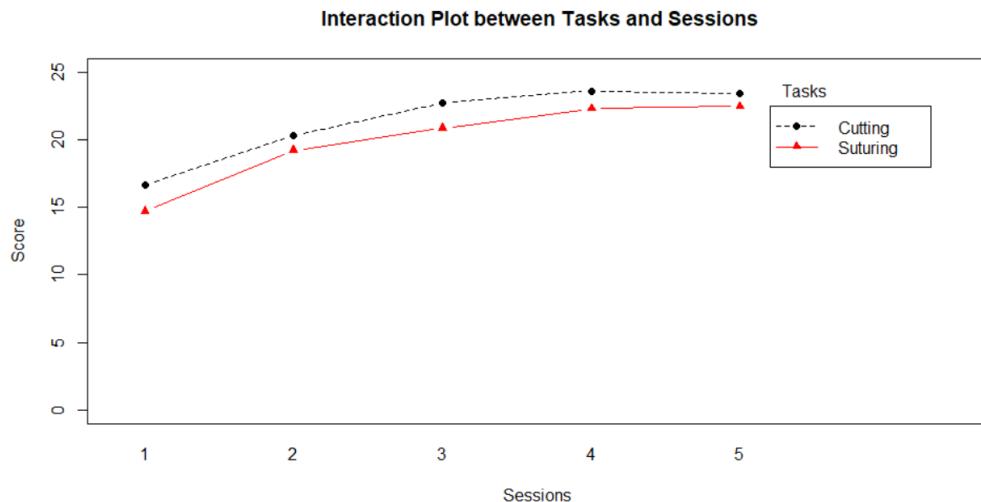
Residual standard error: 3.829 on 290 degrees of freedom
Multiple R-squared:  0.3621, Adjusted R-squared:  0.3423 
F-statistic: 18.29 on 9 and 290 DF,  p-value: < 2.2e-16

```

The performance of the subjects are slightly affected by the interaction between Task and sessions.

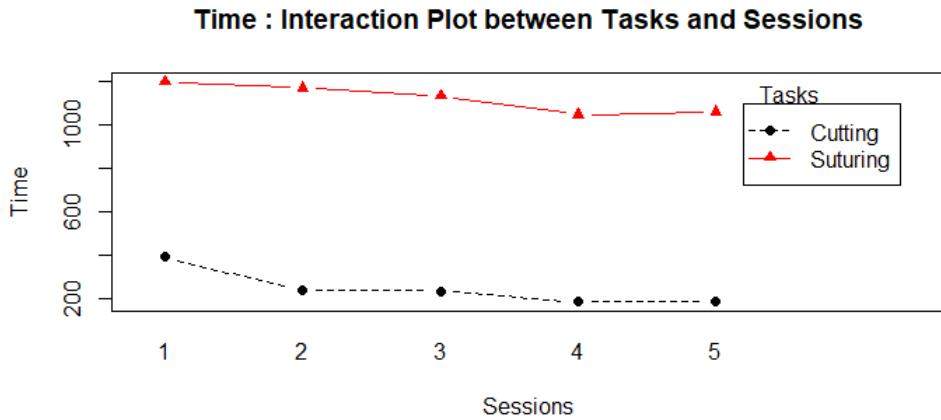
#### Interaction Plots

#### Interaction Between Score, Task and Session



The Cutting tasks Score is significantly higher than the Suturing tasks Score. As the sessions progresses, there is a gradual increase in the performance score with respect to the tasks performed.

#### Interaction Between Time Task and Session

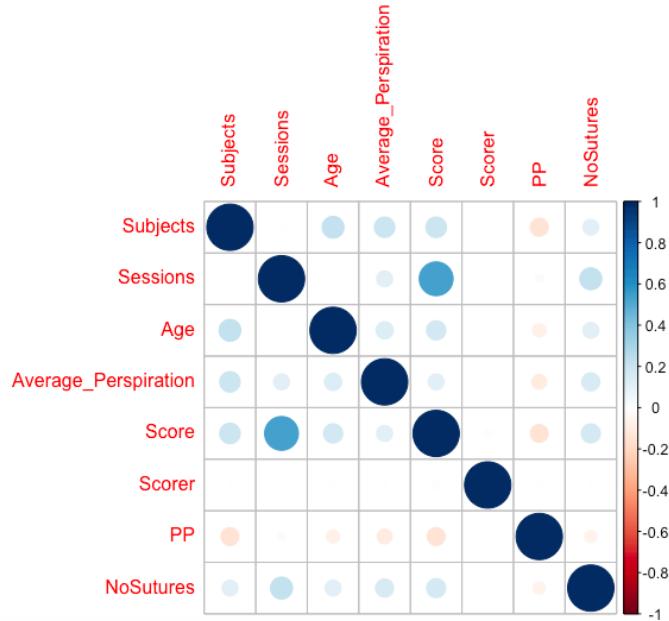


The above interaction plot between Time, Tasks, Sessions shows that as sessions progress the time taken to complete the task of cutting and suturing decreases. This again reiterates the fact that subjects are learning over time.

## 4 Discussion

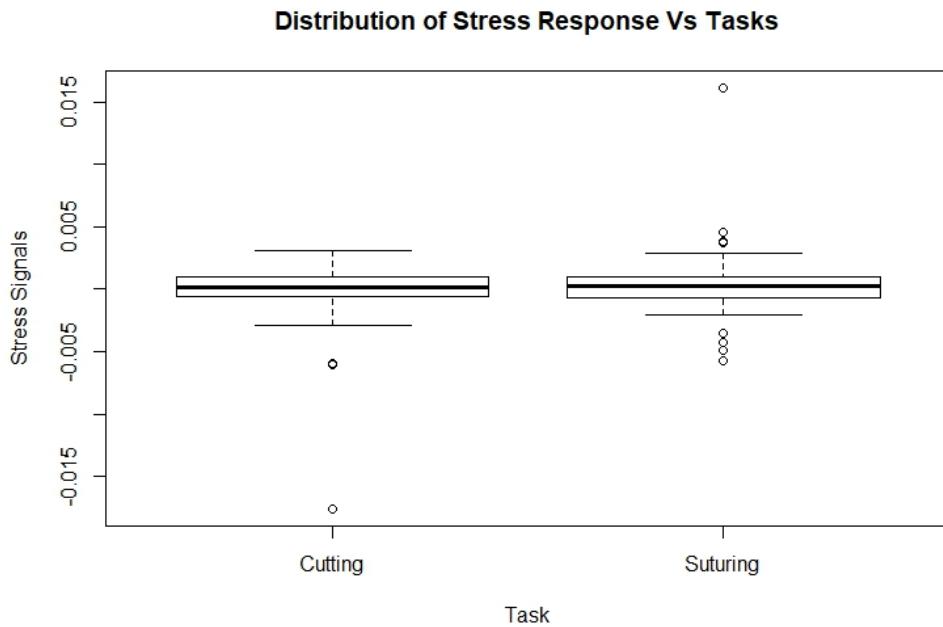
### 4.1 Correlation Plots

In order to find the correlation between the Response variables and the Predictor variables, we do a Correlation Plot.



From the above plot it can be seen that Only Score and Sessions have correlation, even though it is not a strong correlation. And Perspiration has a negative correlation with all the other variables.

## 4.2 Distribution of Stress Signals



There are more suspected outliers in Suturing Task when compared to Cutting Task. All the Stress Signals are distributed equally around the mean for both the task. The Stress data span much the same range of values for both the Tasks(Cutting and Suturing).

## 4.3 Normality Test

Before applying linear modelling, we perform a check for normality as below:

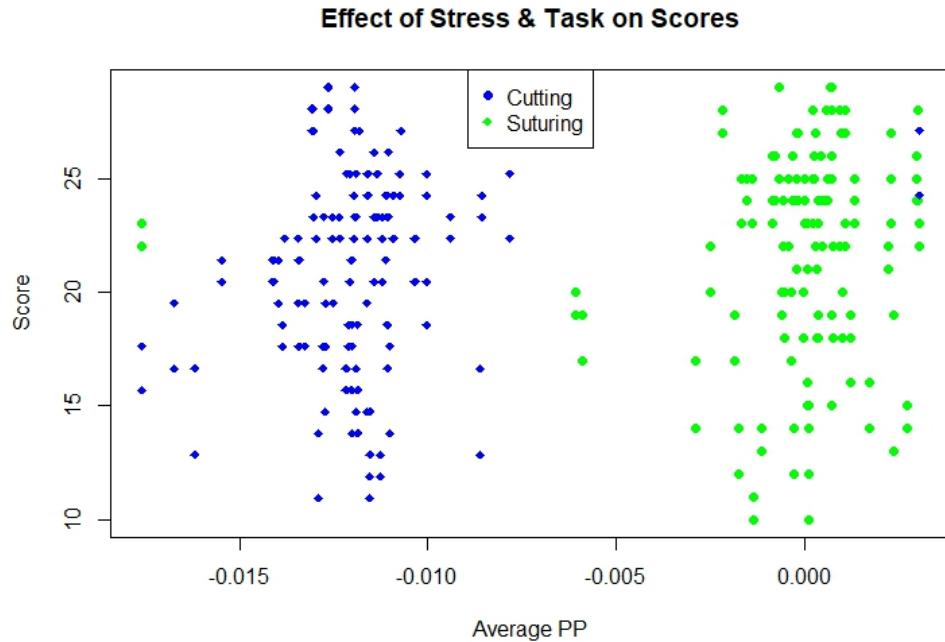
```
> shapiro.test(sum1$residuals)

Shapiro-Wilk normality test

data: sum1$residuals
W = 0.9899, p-value = 0.0527
```

From the shapiro.test it can be seen that the data is not normally distributed since the test statistic is greater than the significance level.

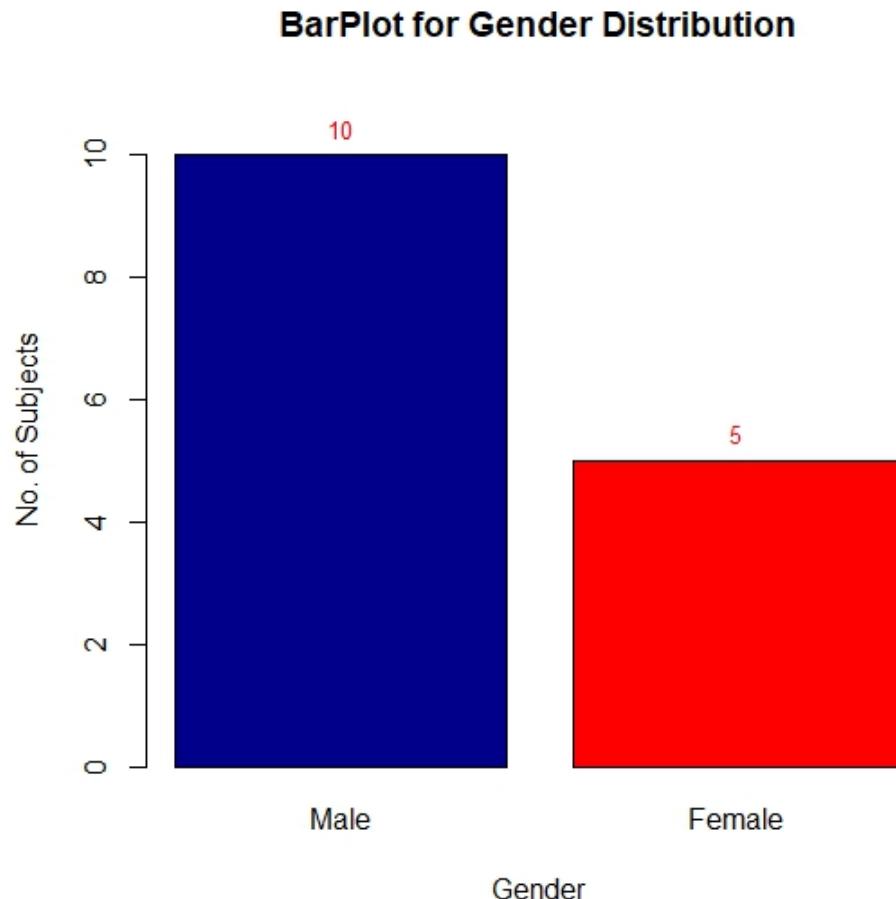
#### 4.4 Effect of Stress and Tasks on Scores



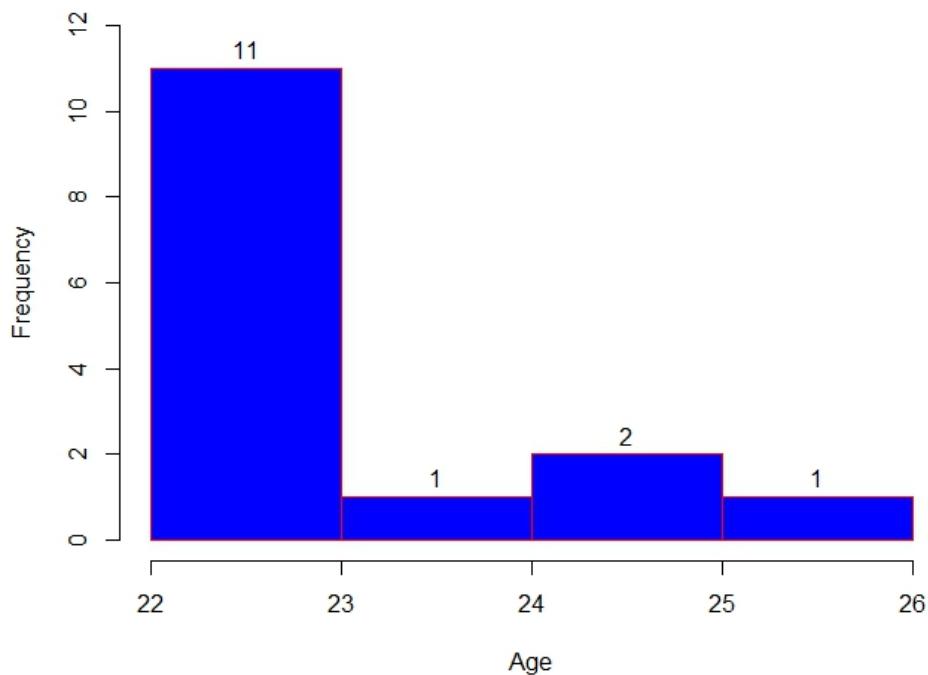
The performance of Subjects is affected by the Stress based on the type of task(Cutting and Suturing) they perform. The Stress signal for Cutting Task is less when compared to the overall stress signal of Suturing. But the score is distributed equally for both the tasks. The stress and the tasks are strongly correlated.

## 5 Appendix

### 5.1 Bio-Graphic Data

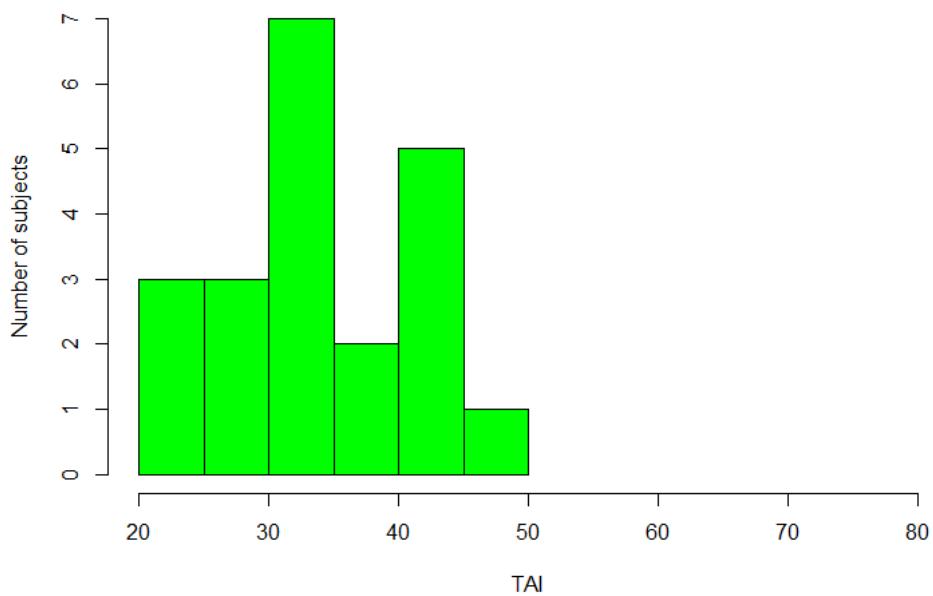


**Histogram for Age Distribution**

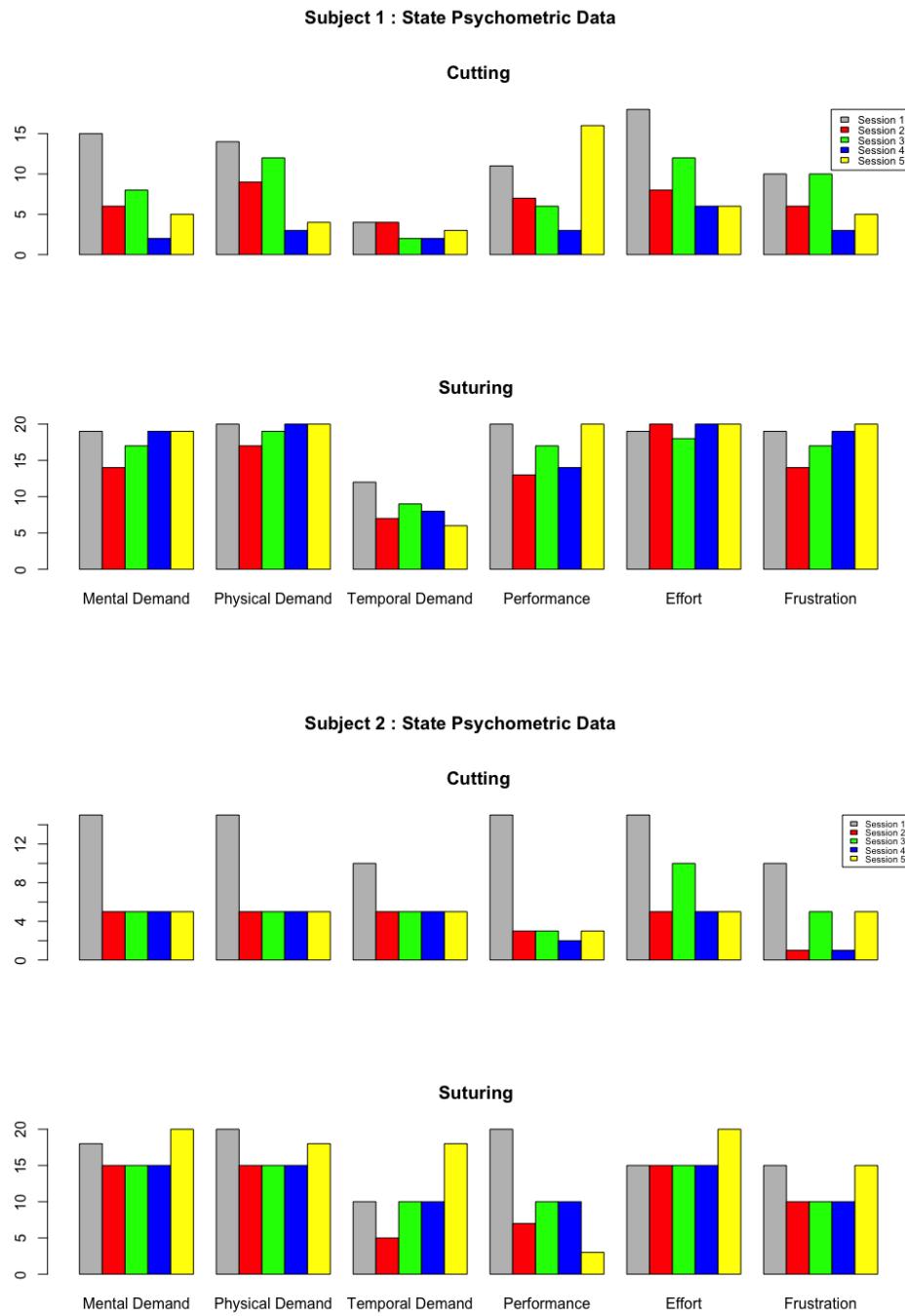


## 5.2 Trait - Psychometric Data

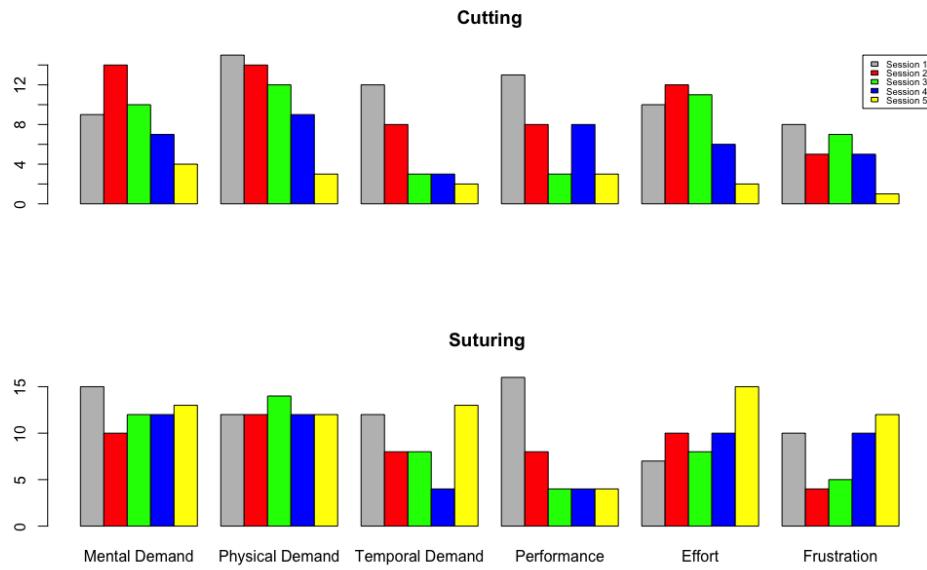
**Histogram of TAI scores**



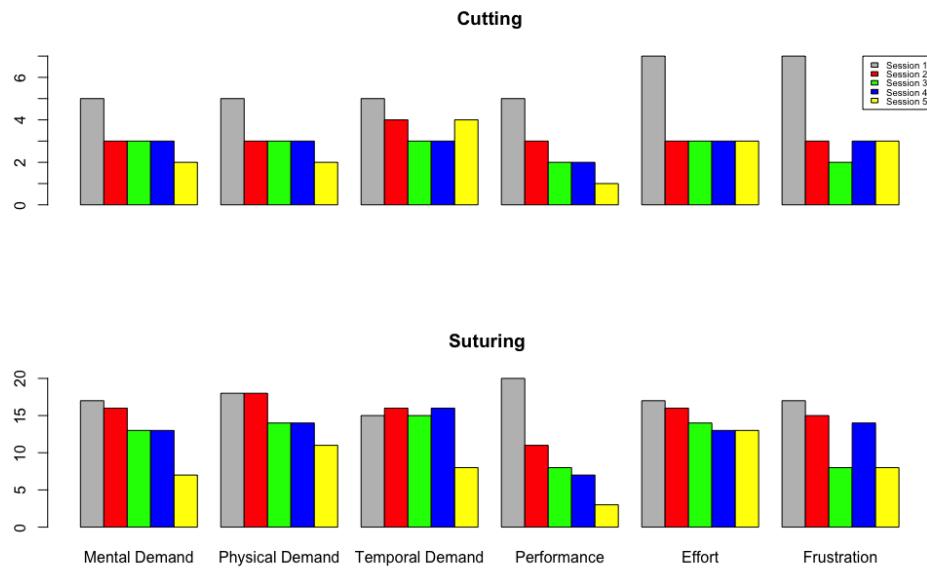
### 5.3 State Psychometric Data



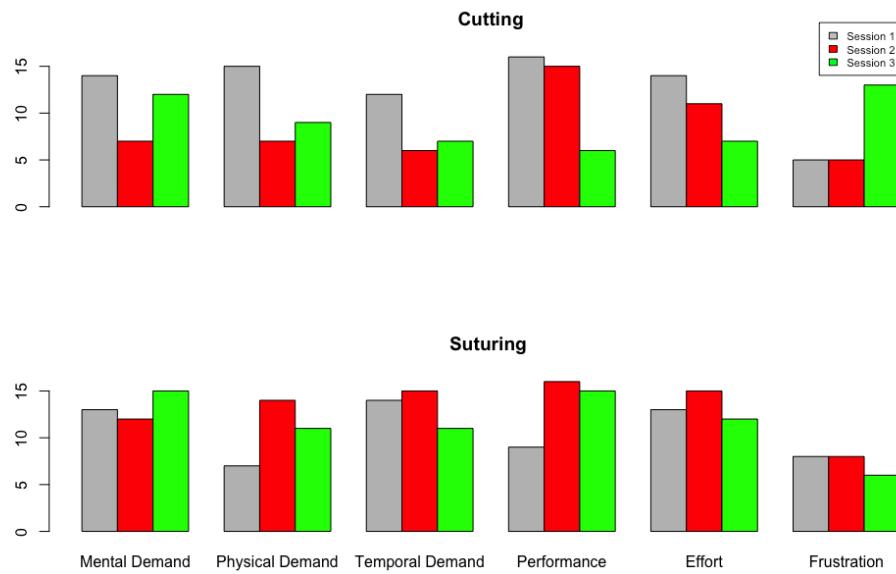
### Subject 3 : State Psychometric Data



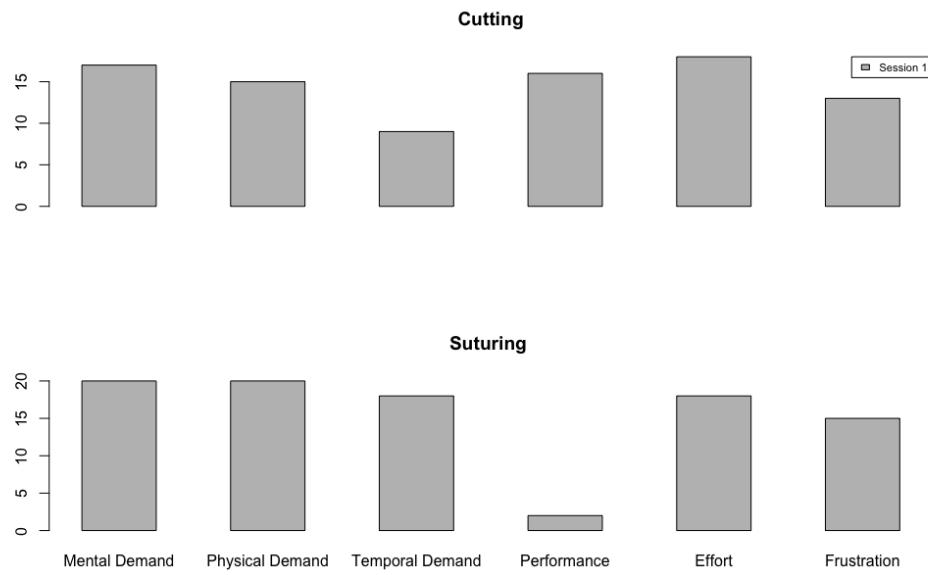
### Subject 4 : State Psychometric Data



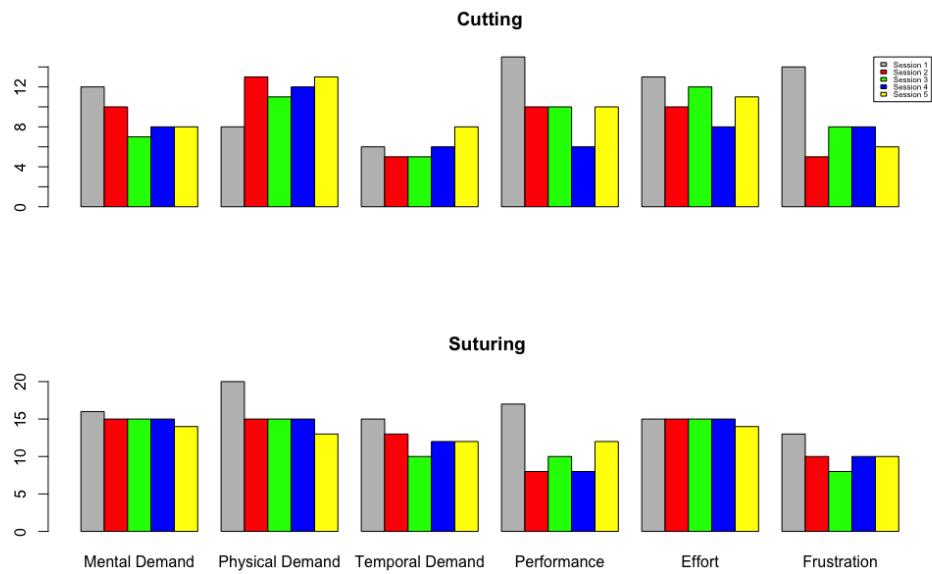
### Subject 5 : State Psychometric Data



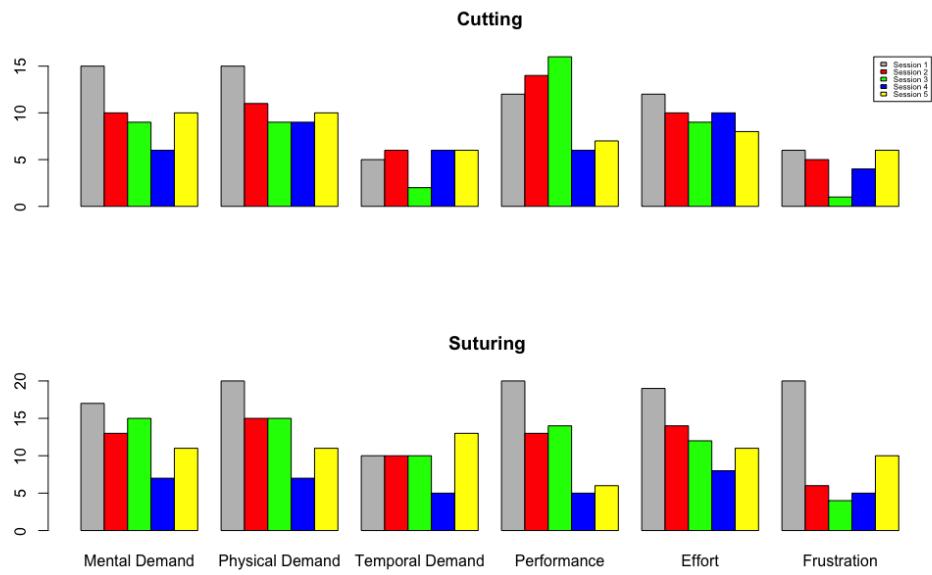
### Subject 6 : State Psychometric Data



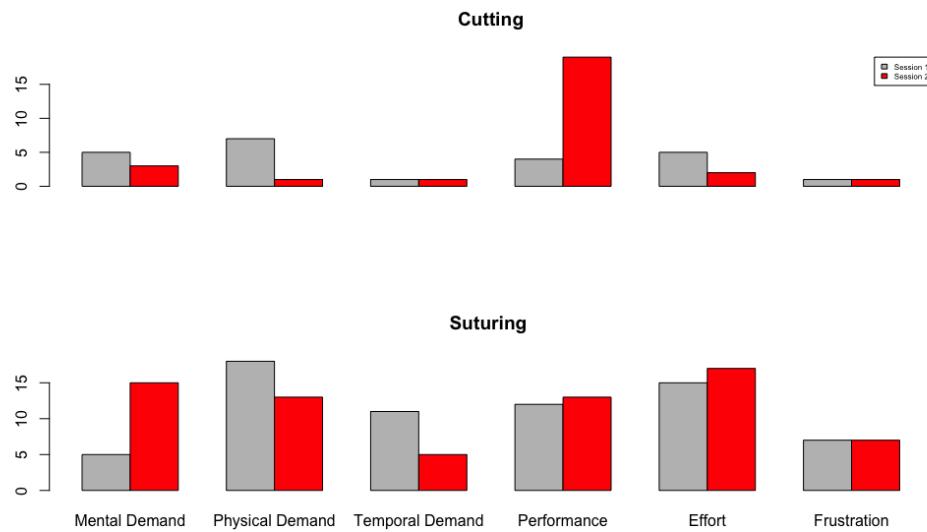
### Subject 7 : State Psychometric Data



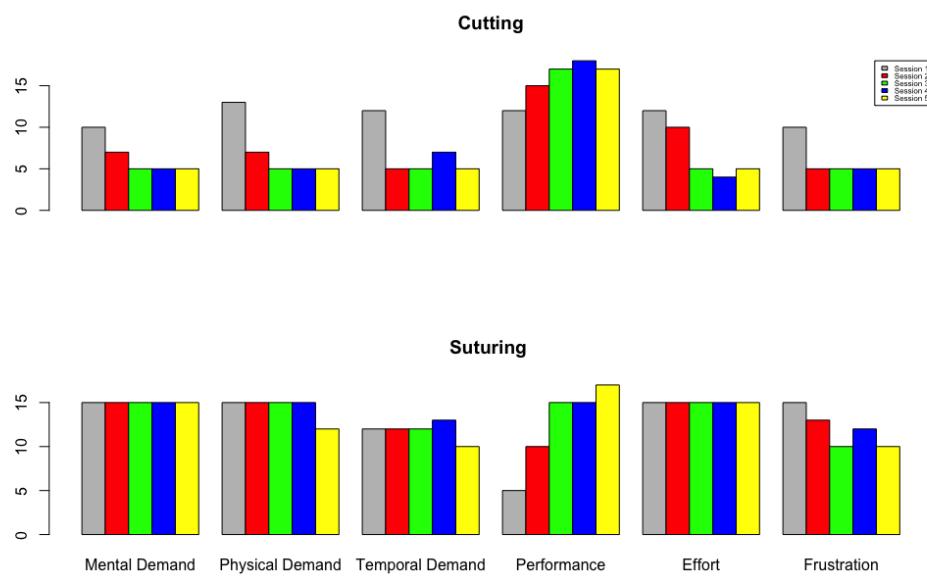
### Subject 8 : State Psychometric Data



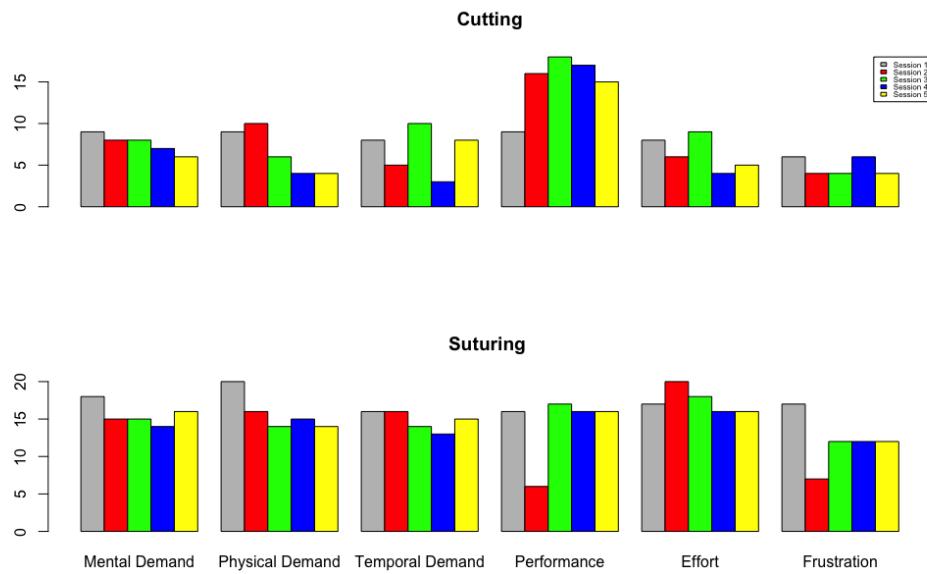
### Subject 9 : State Psychometric Data



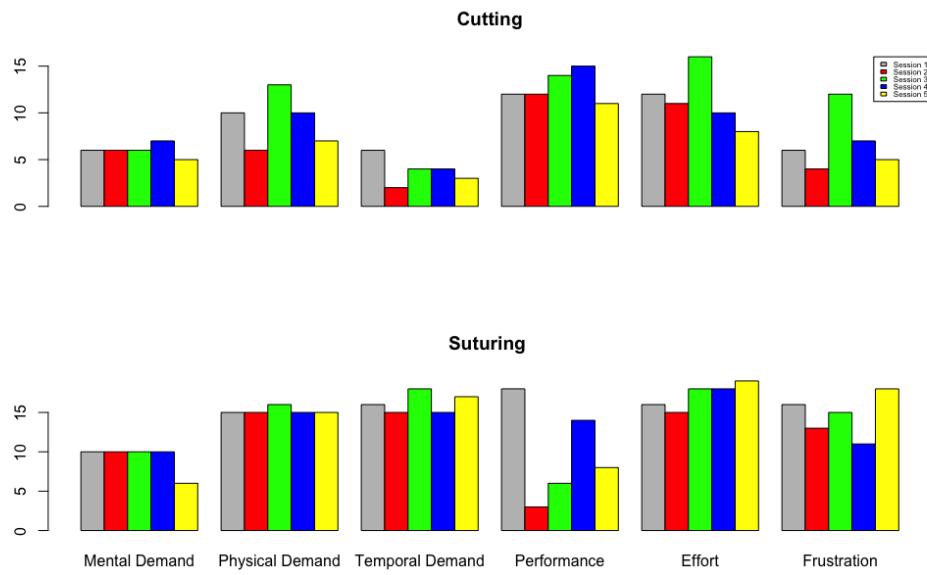
### Subject 10 : State Psychometric Data



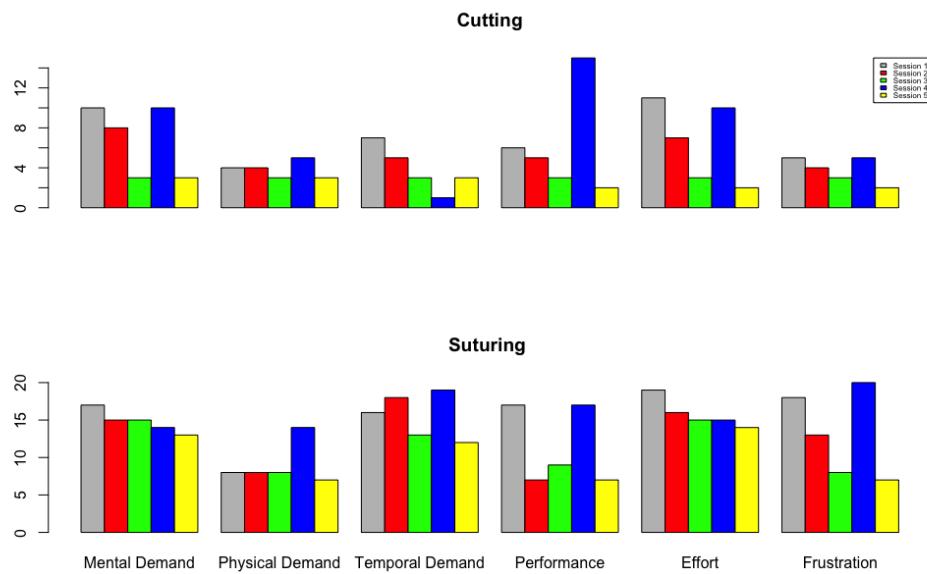
### Subject 11 : State Psychometric Data



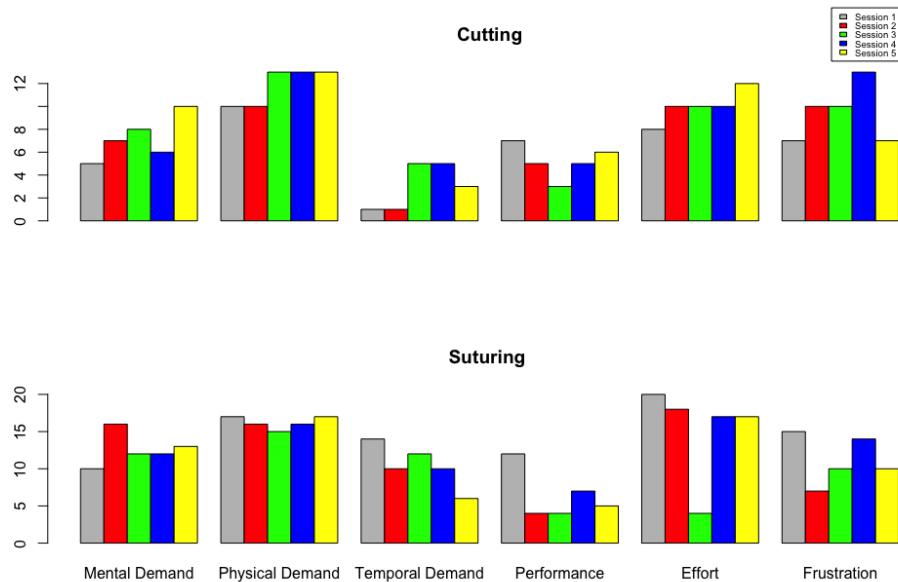
### Subject 12 : State Psychometric Data



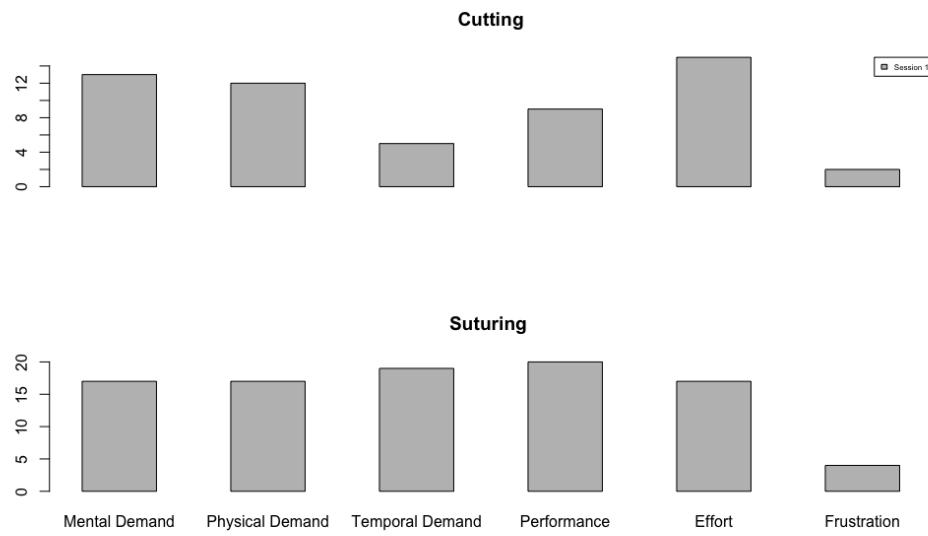
### Subject 13 : State Psychometric Data



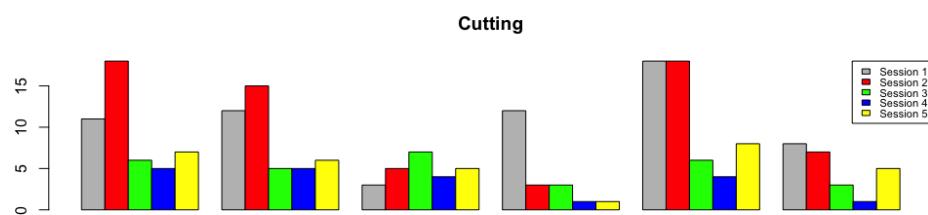
### Subject 19 : State Psychometric Data



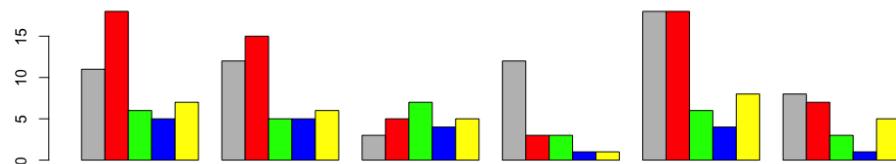
### Subject 20 : State Psychometric Data



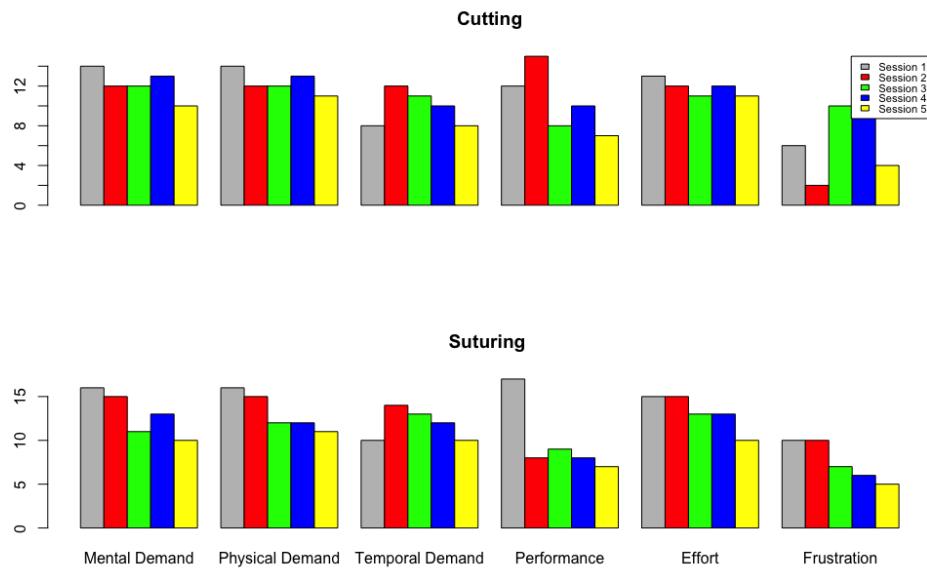
### Subject 21 : State Psychometric Data



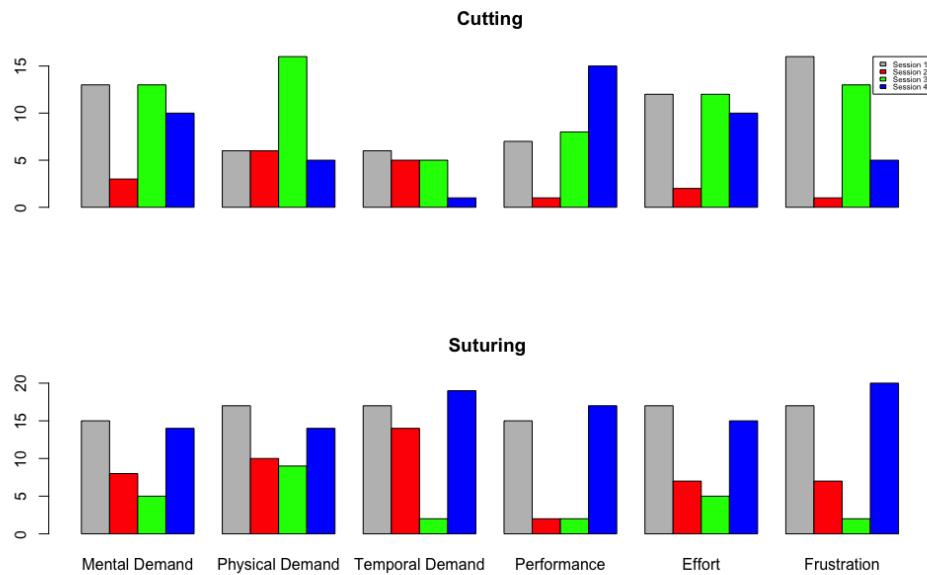
### Suturing



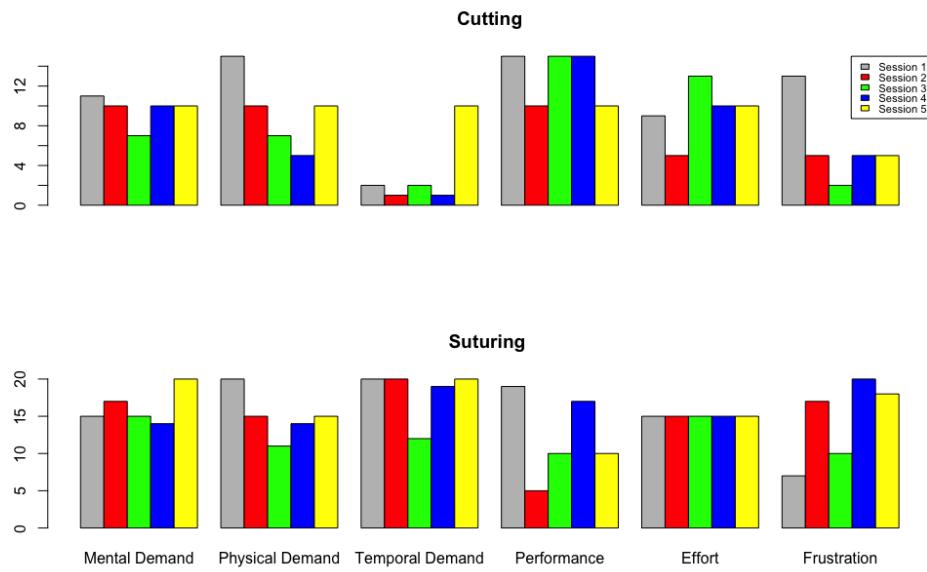
### Subject 22 : State Psychometric Data



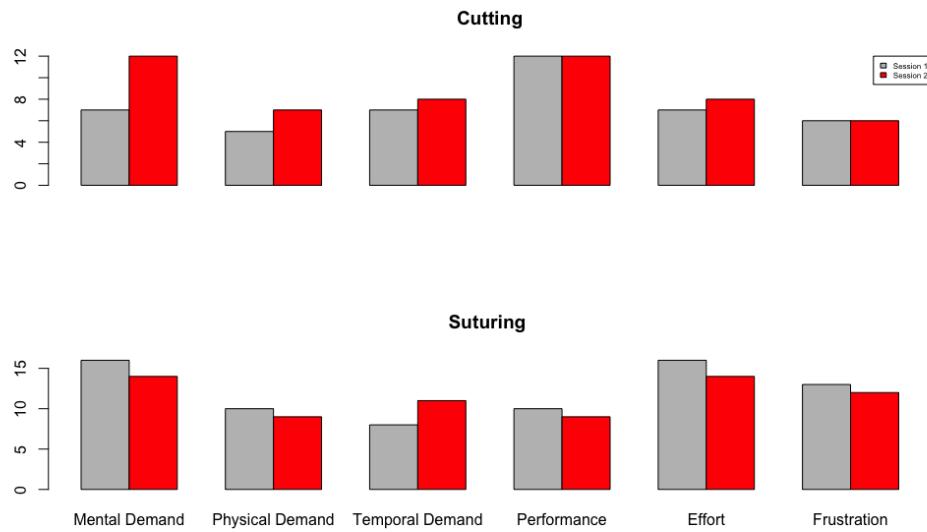
### Subject 23 : State Psychometric Data



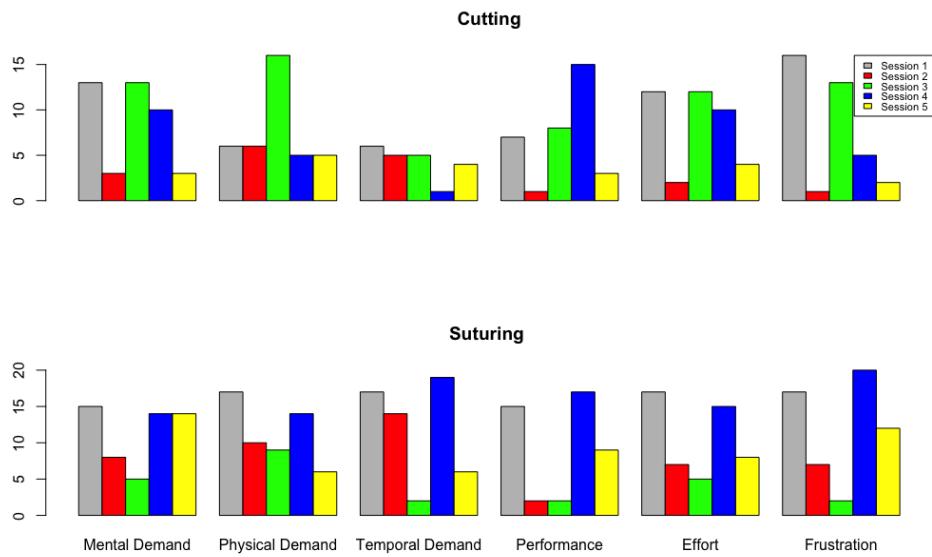
### Subject 24 : State Psychometric Data



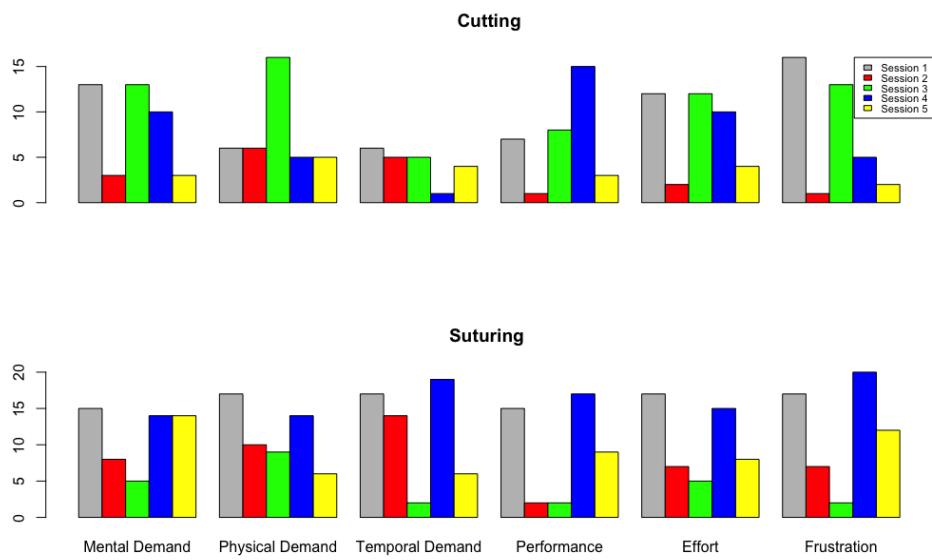
### Subject 25 : State Psychometric Data

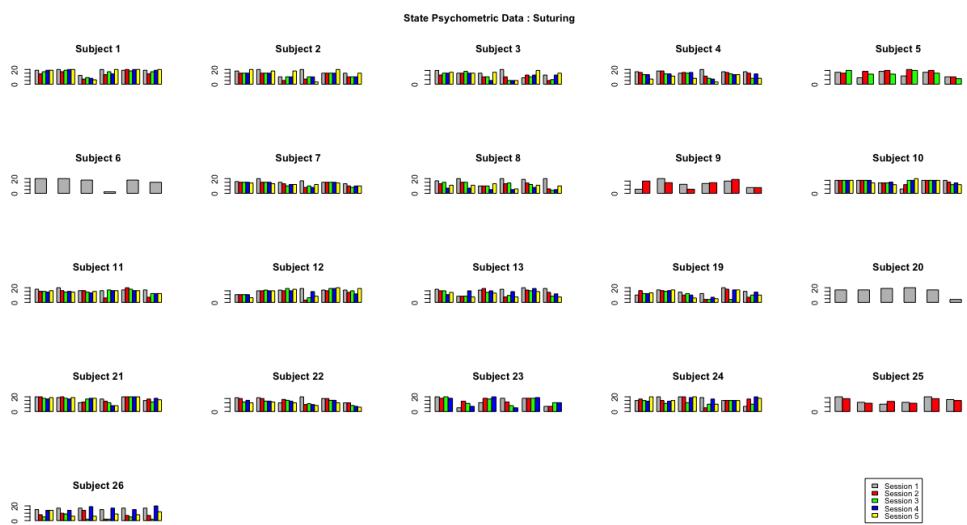
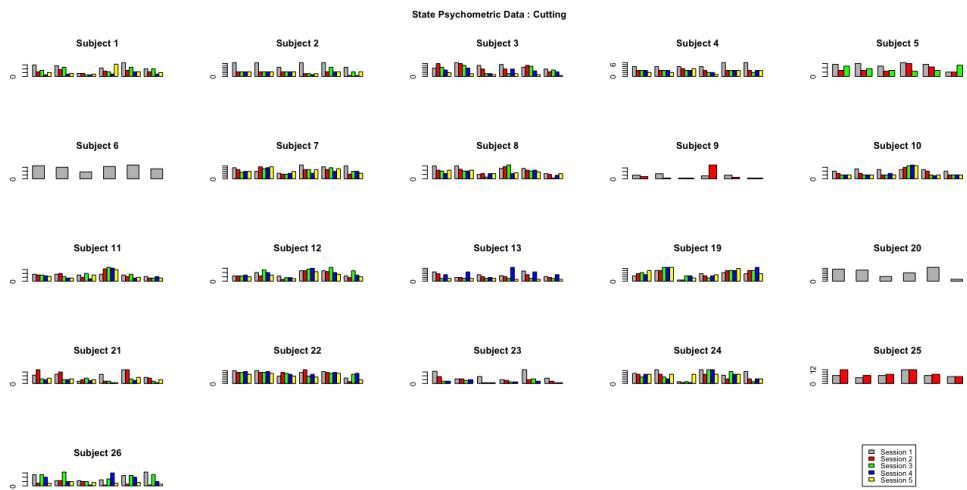


### Subject 26 : State Psychometric Data

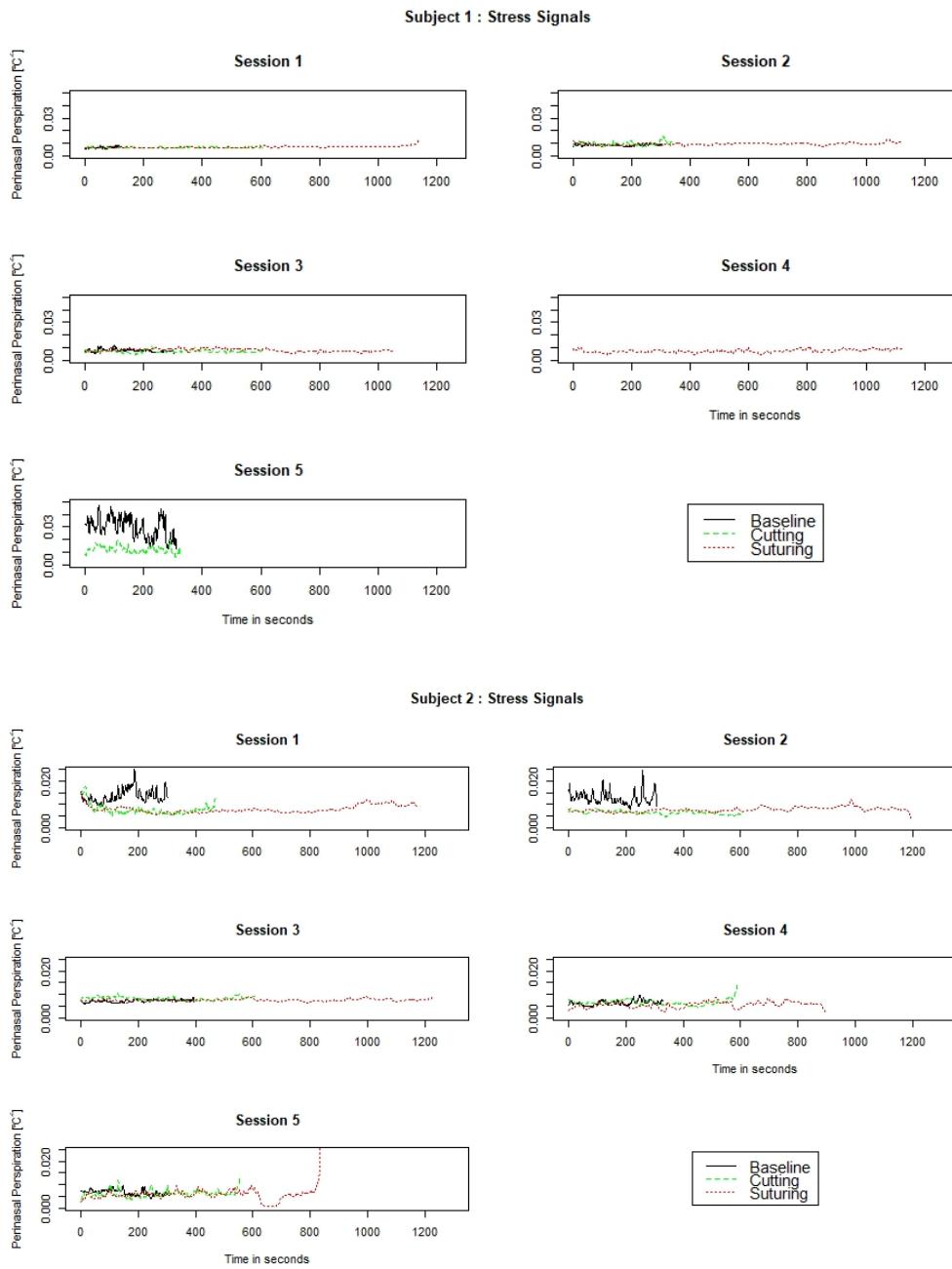


### Subject 26 : State Psychometric Data

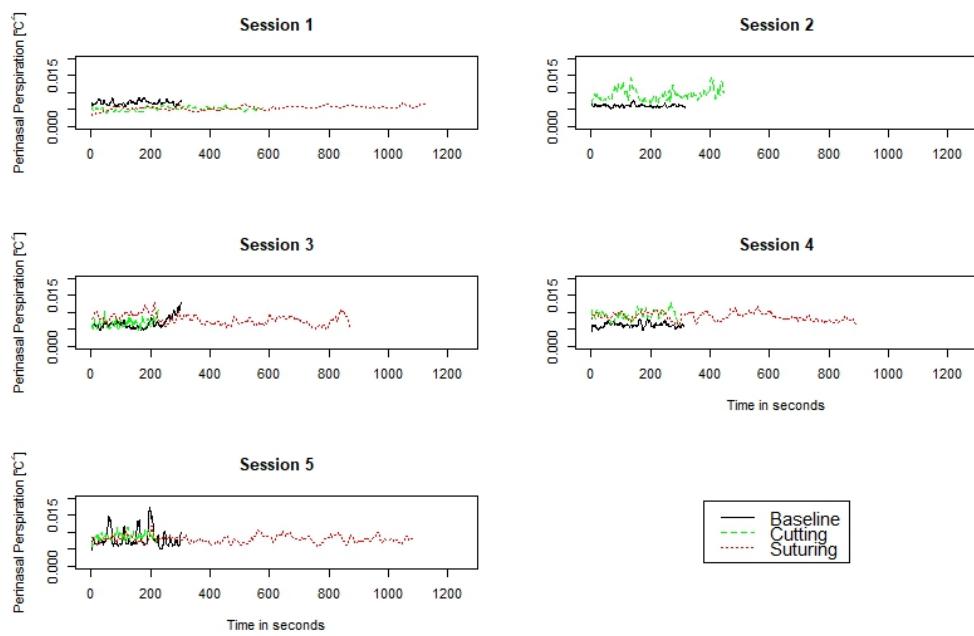




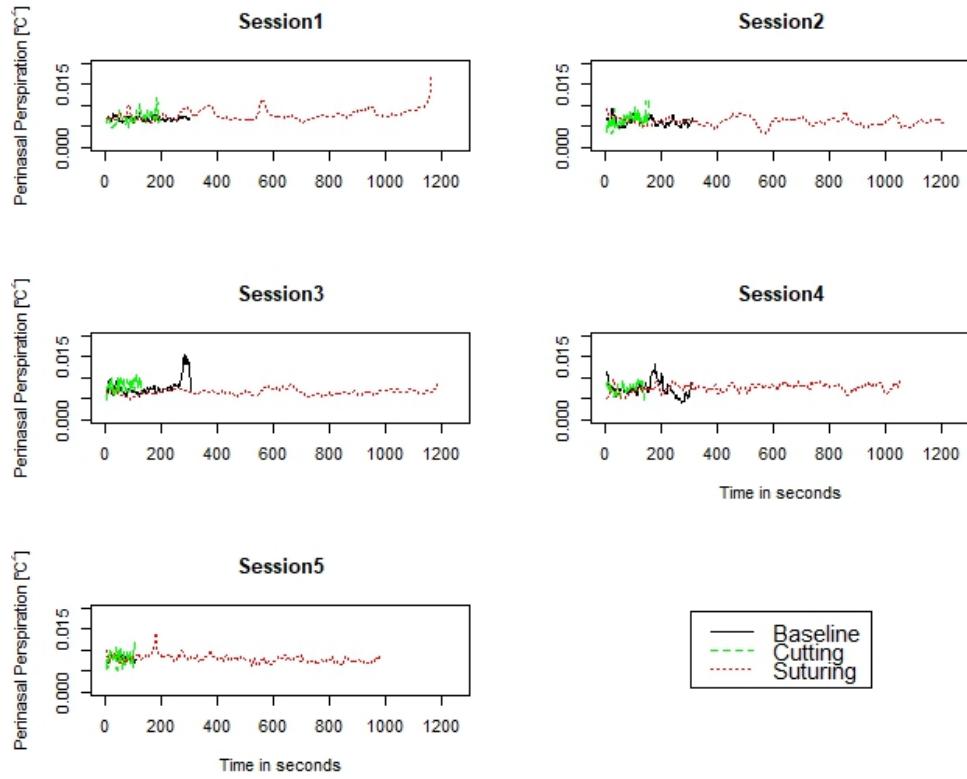
## 5.4 Perinasal Perspiration(Stress) Signal Data



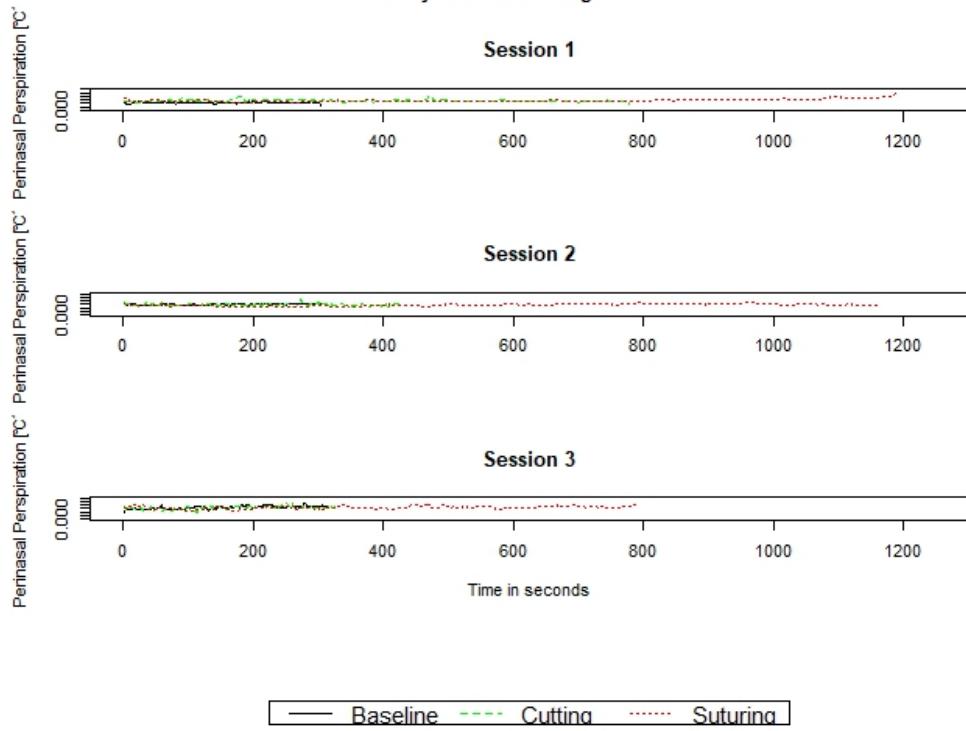
### Subject 3 : Stress Signals



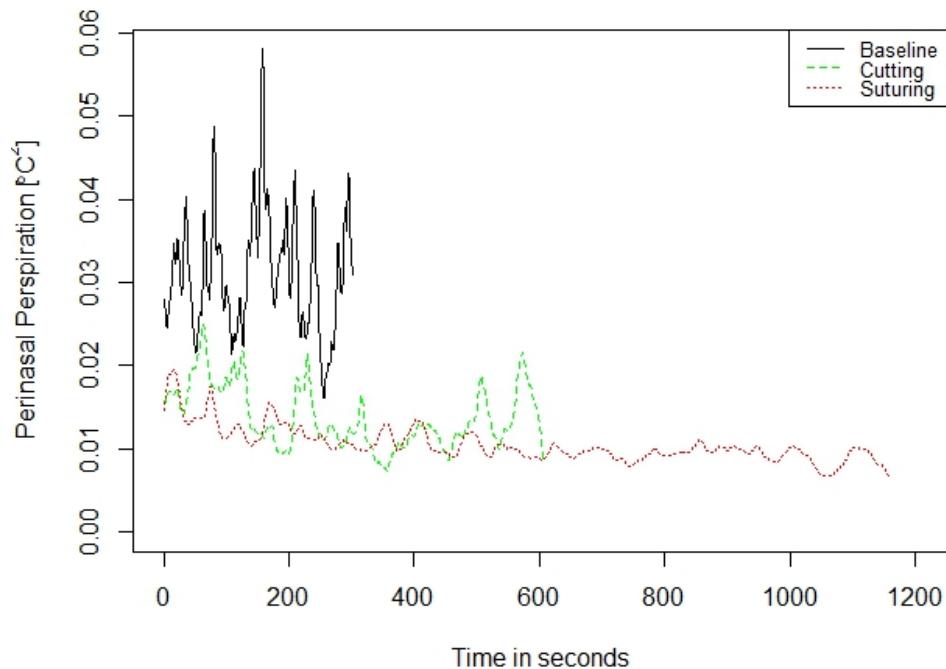
### Subject 4 : Stress Signals



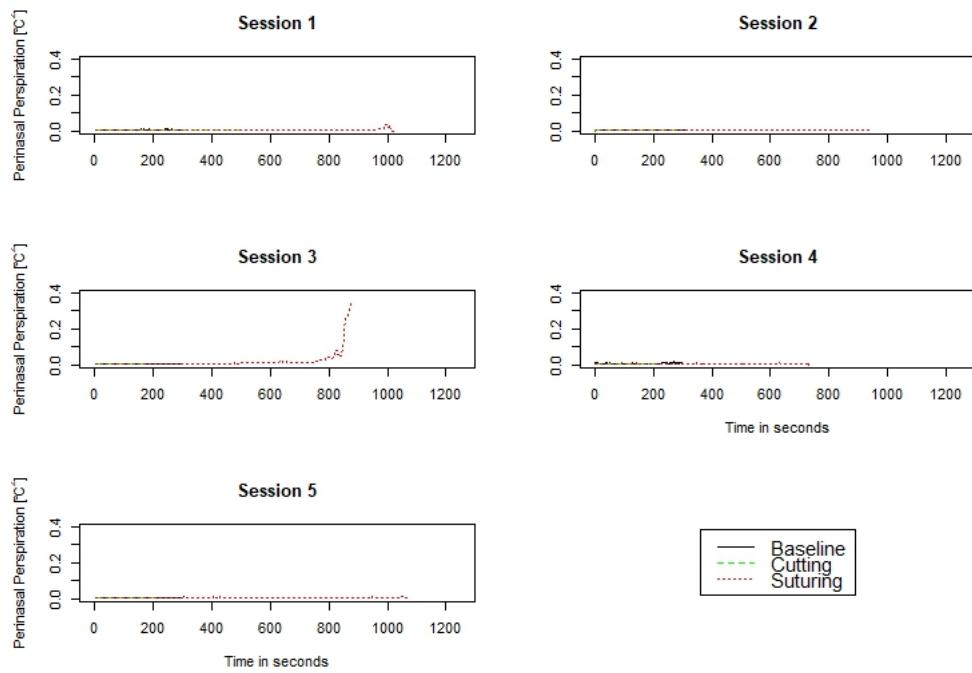
### Subject 5 : Stress Signals

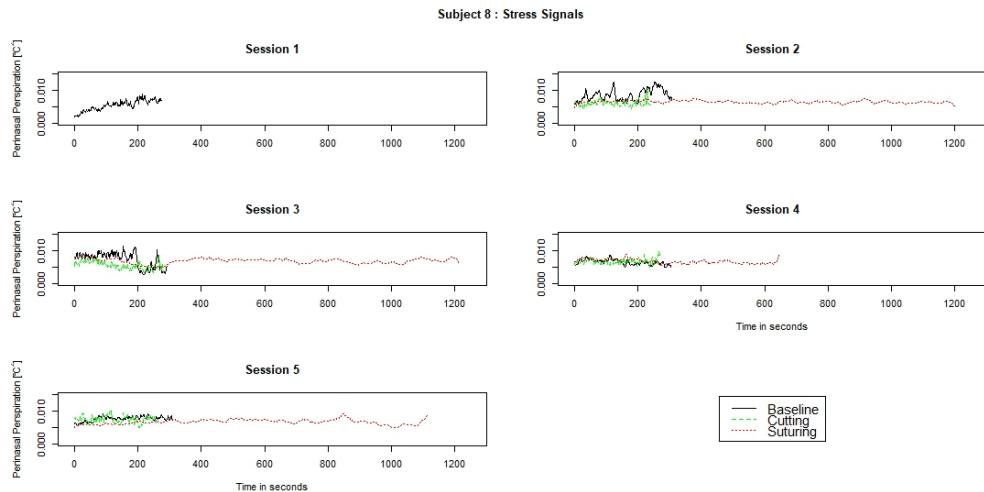


### Subject 6 : Session1 Stress Signals

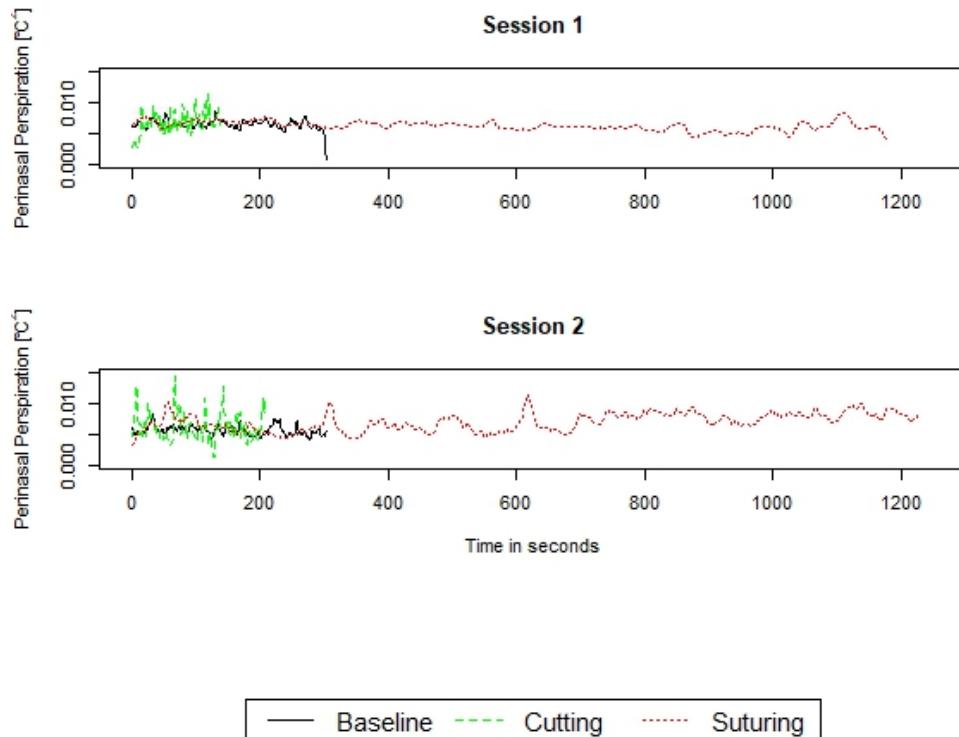


### Subject 7 : Stress Signals

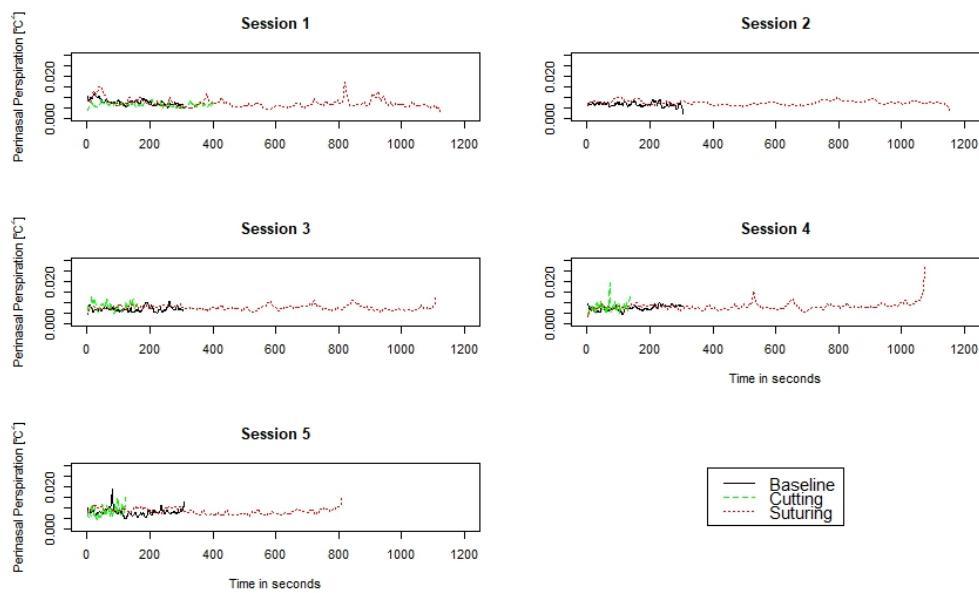




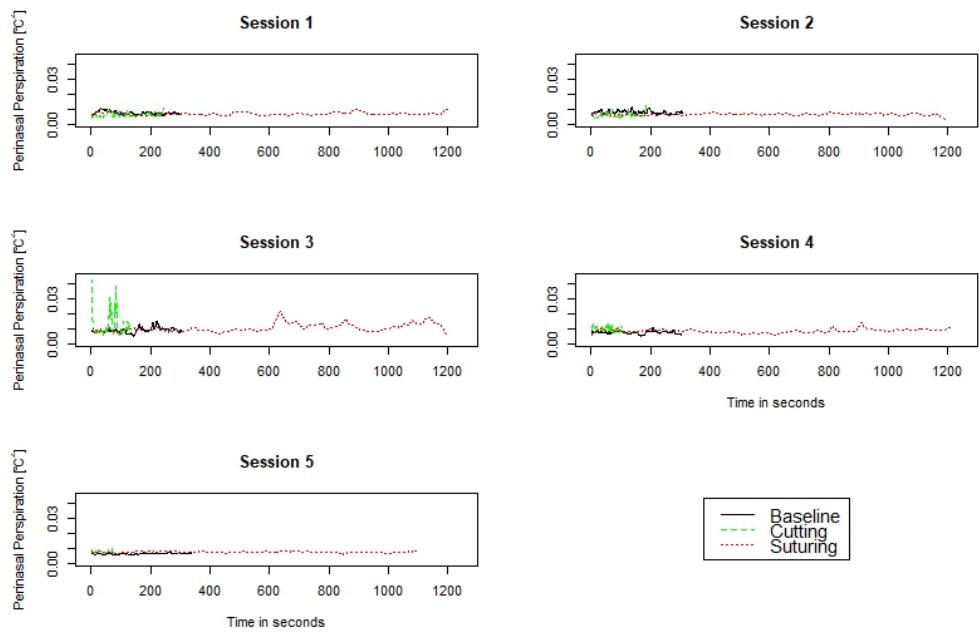
### Subject 9 : Stress Signals



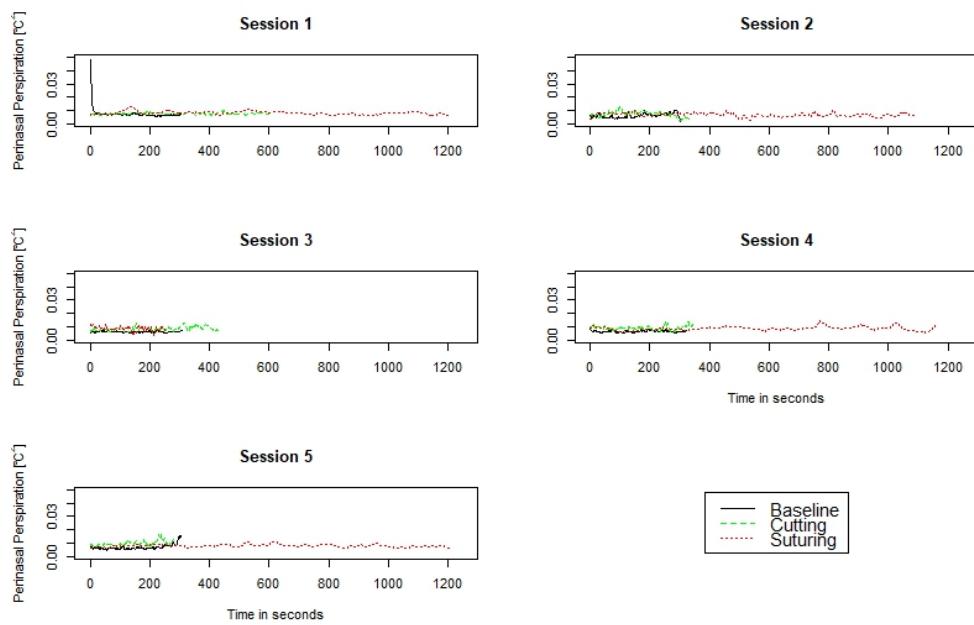
### Subject 10 : Stress Signals



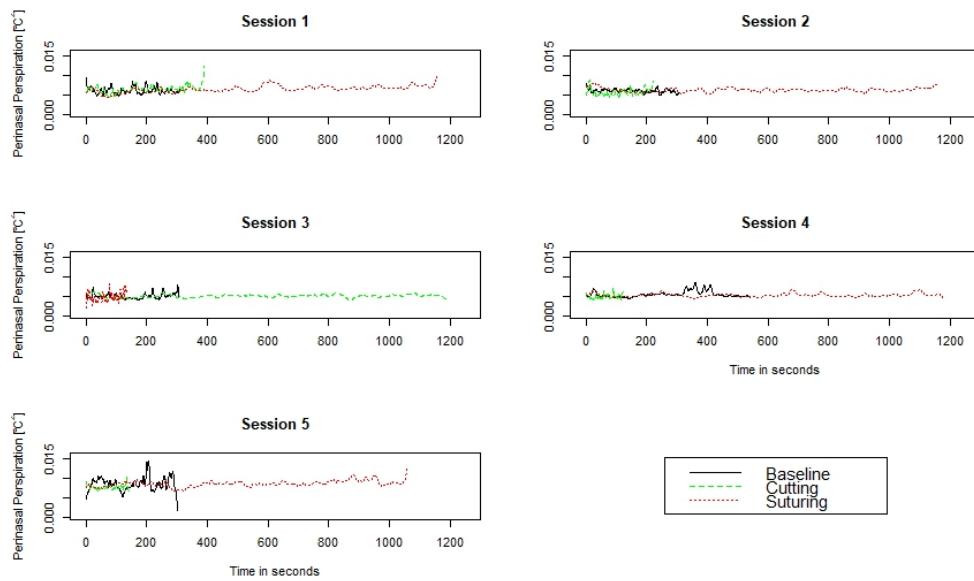
### Subject 11 : Stress Signals



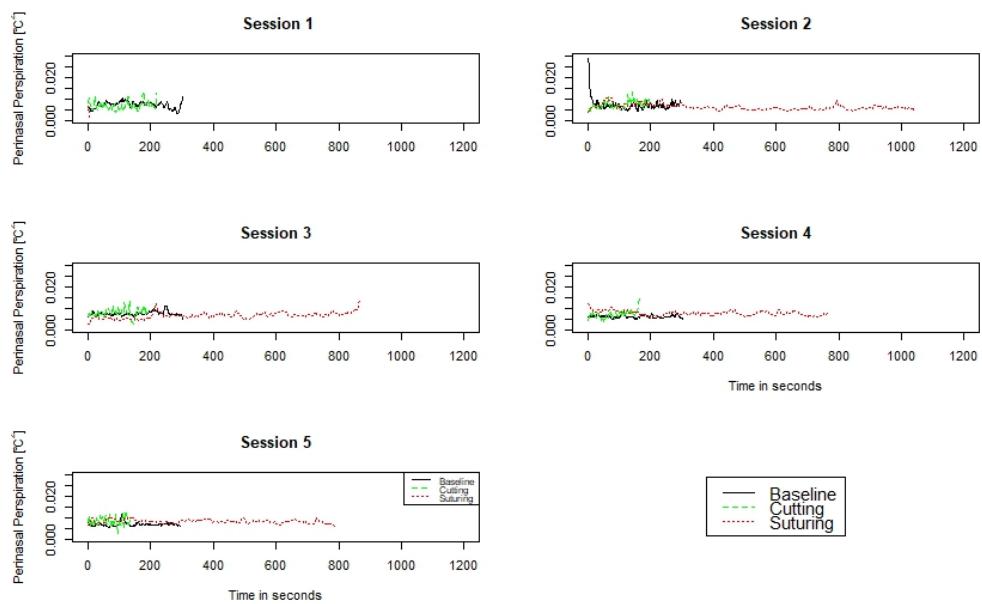
### Subject 12 : Stress Signals



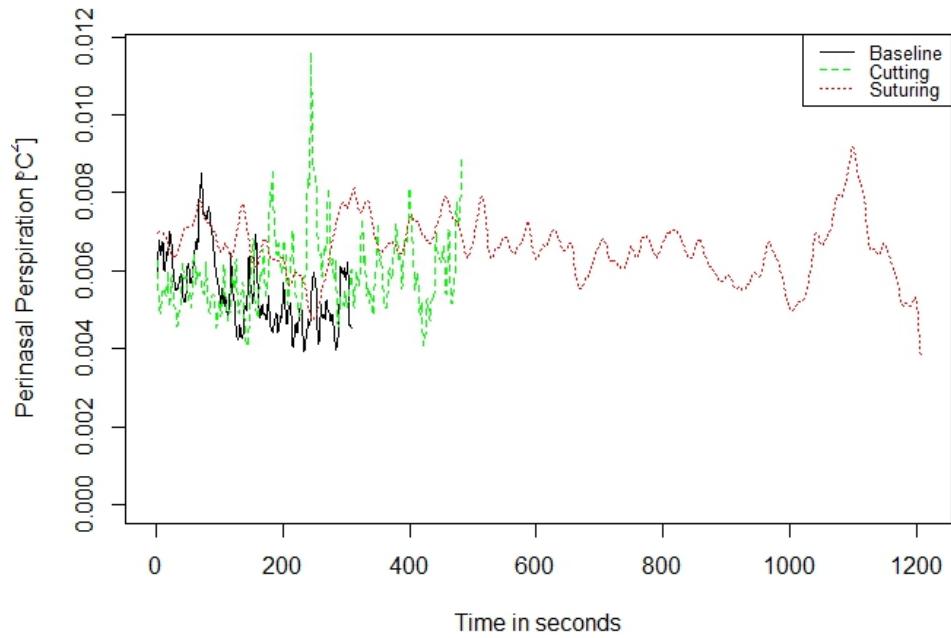
### Subject 13 : Stress Signals



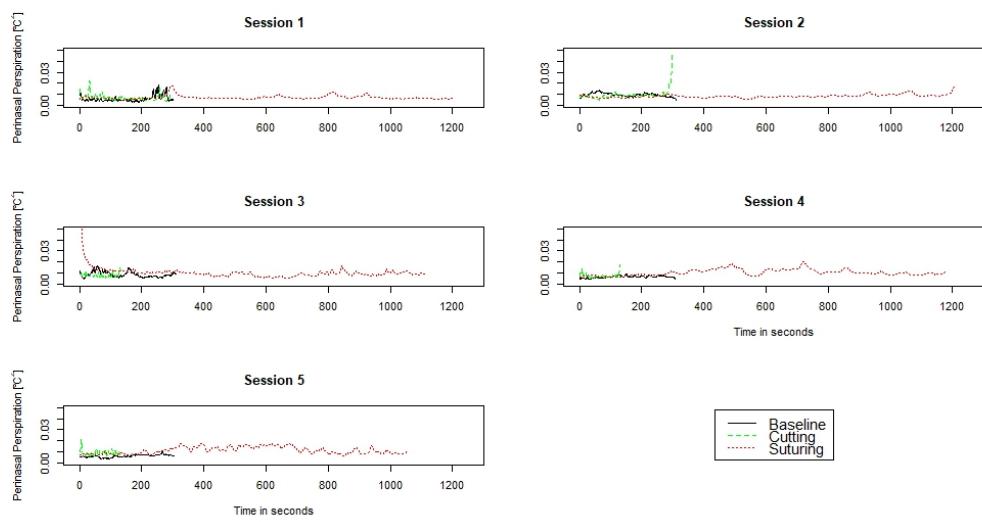
### Subject 19 : Stress Signals



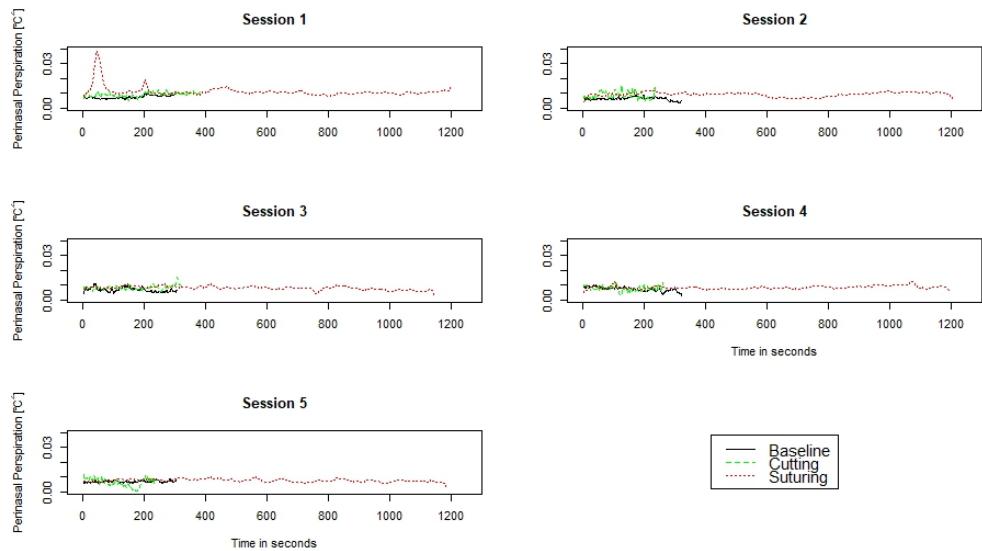
### Subject 20 : Session 1 Stress Signals



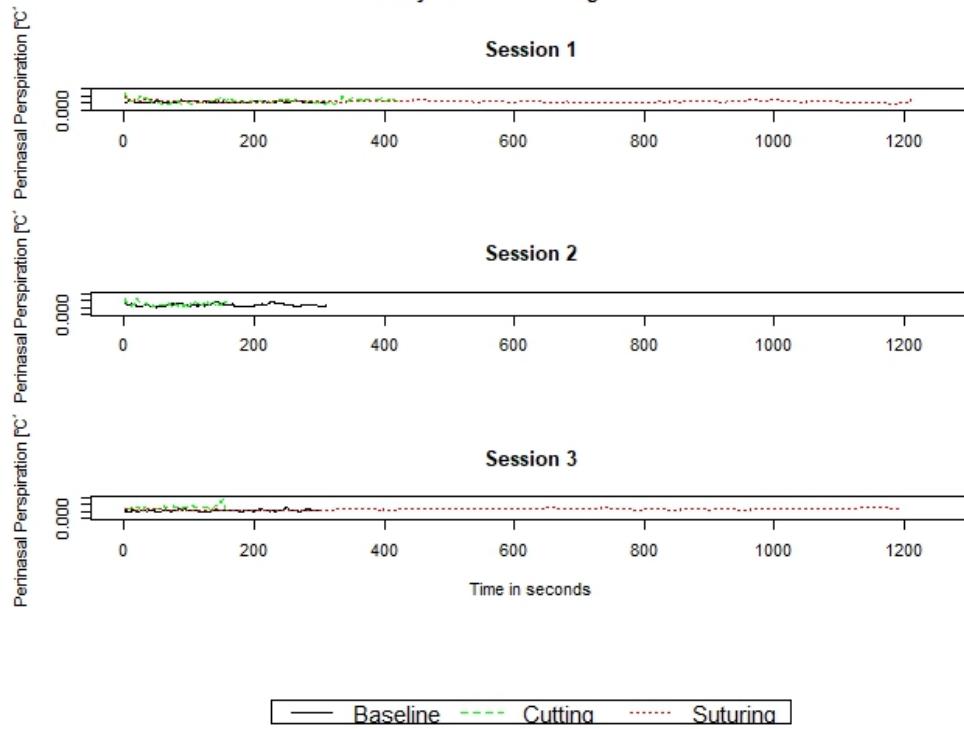
### Subject 21 : Stress Signals



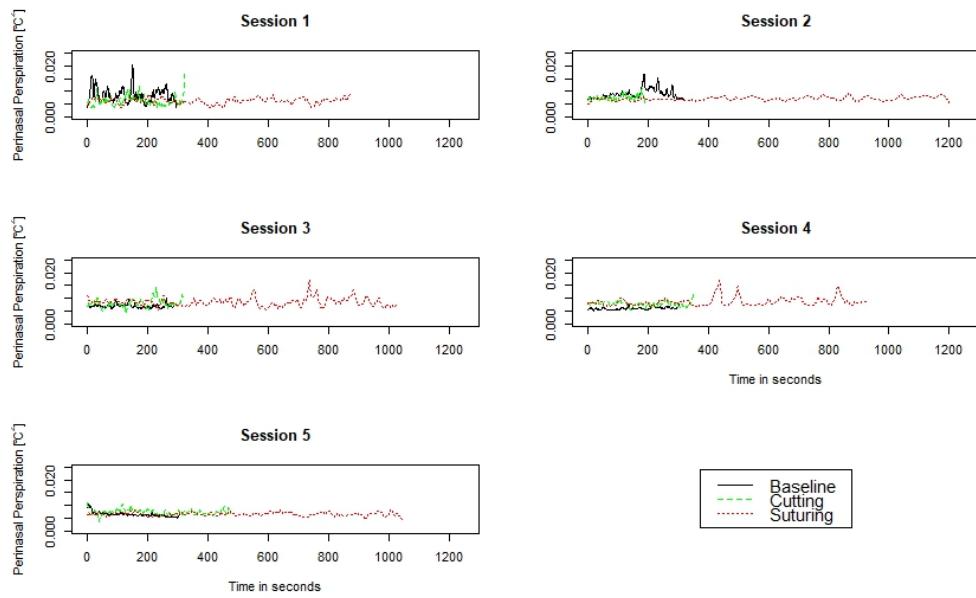
### Subject 22 : Stress Signals

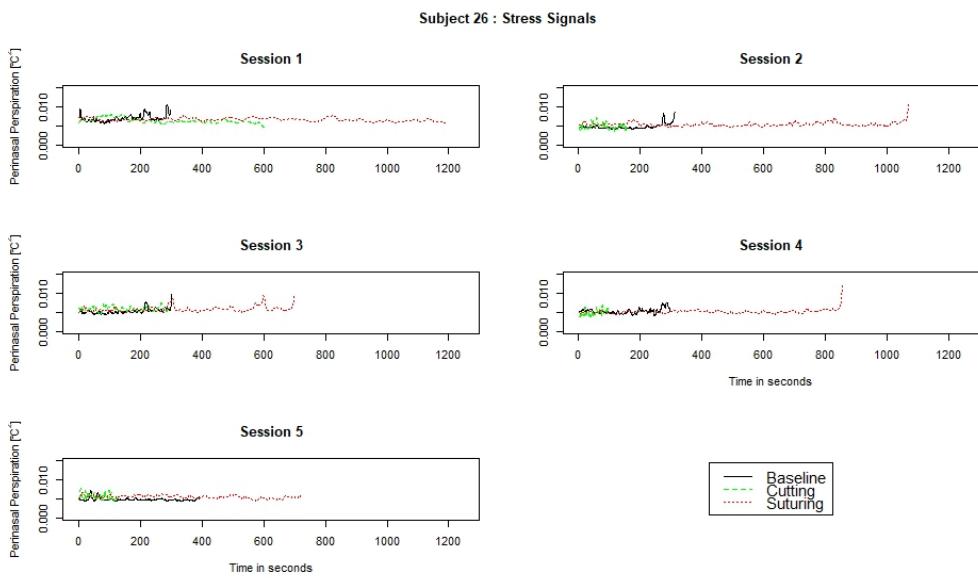
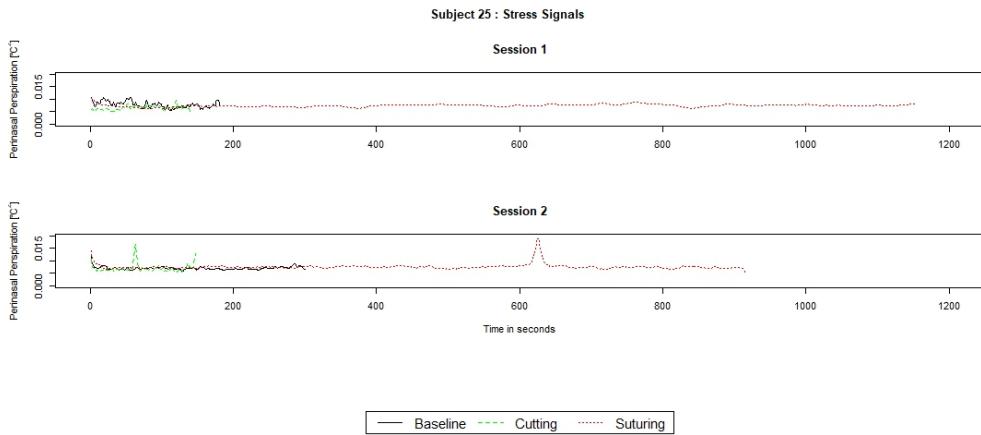


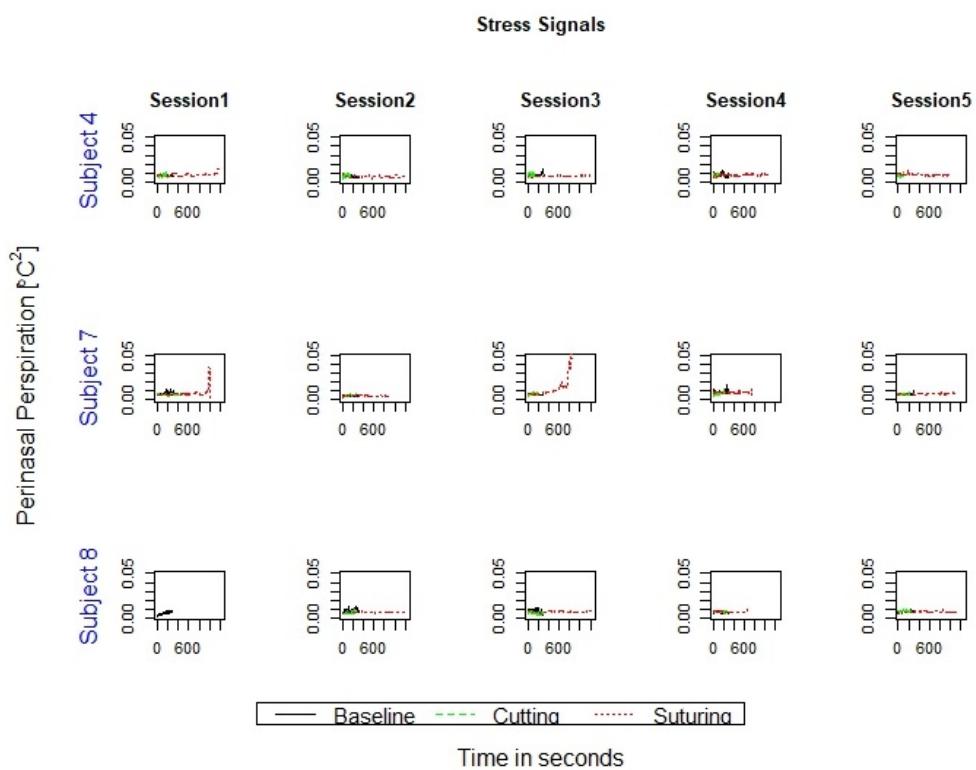
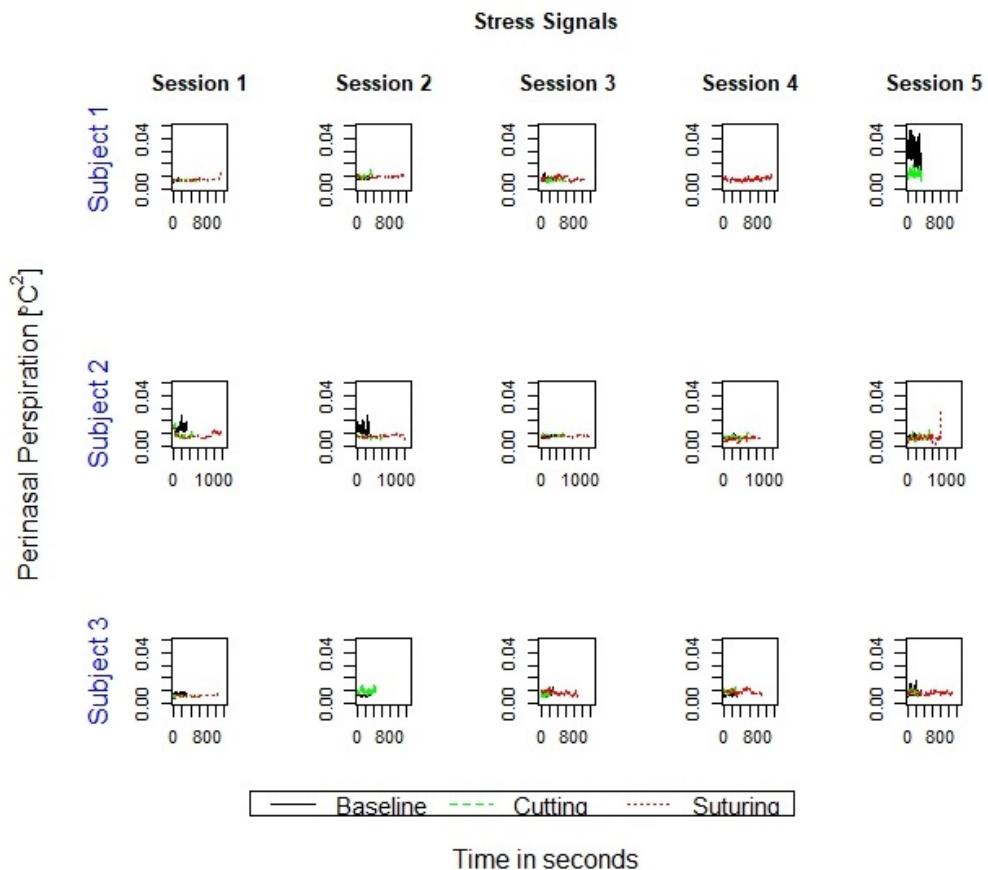
### Subject 23 : Stress Signals

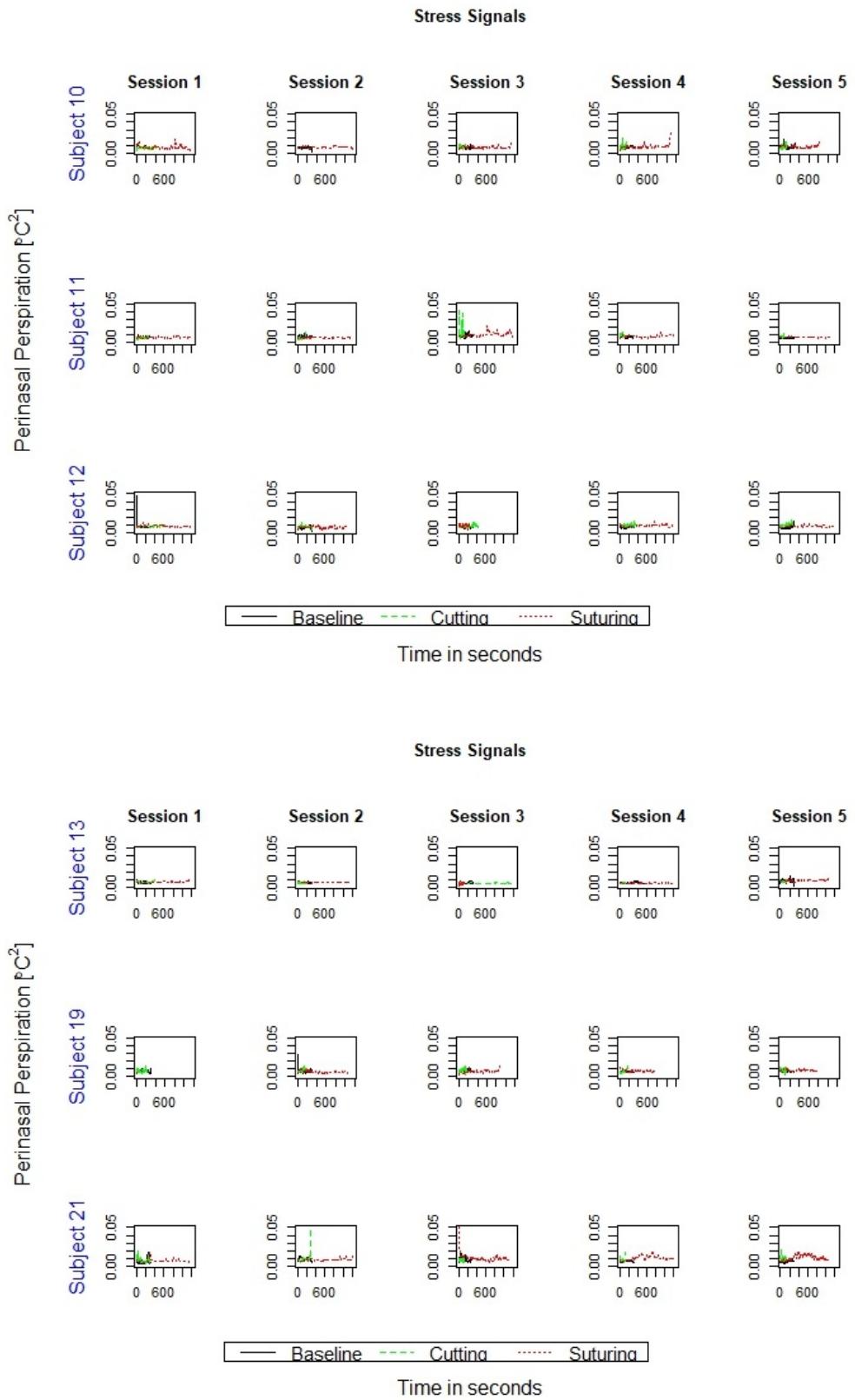


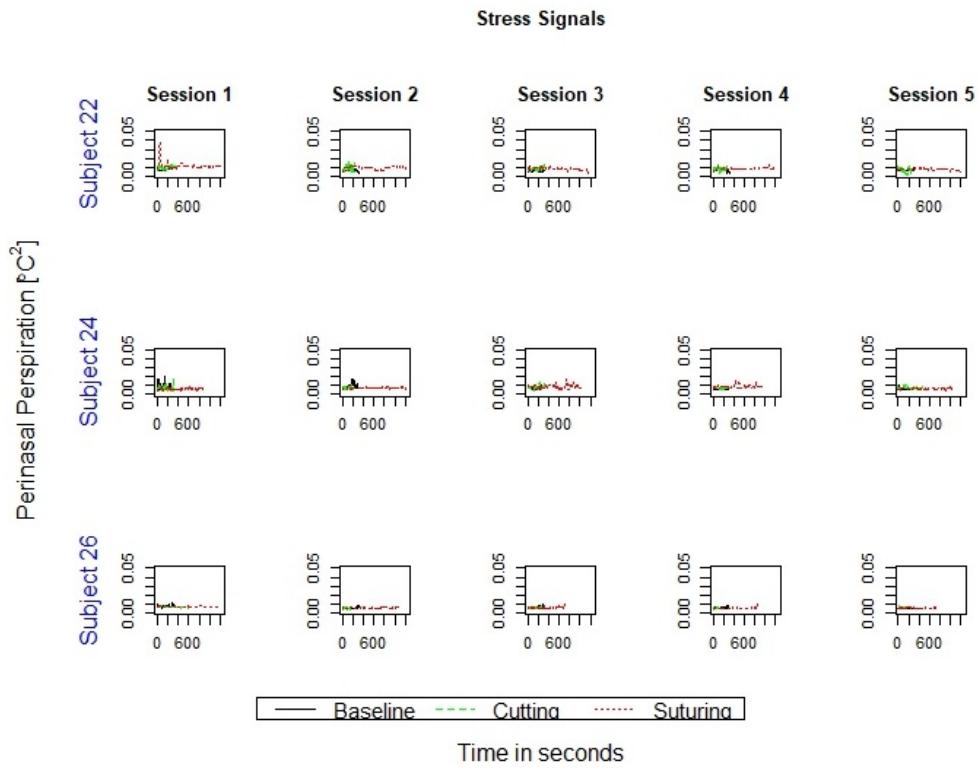
### Subject 24 : Stress Signals





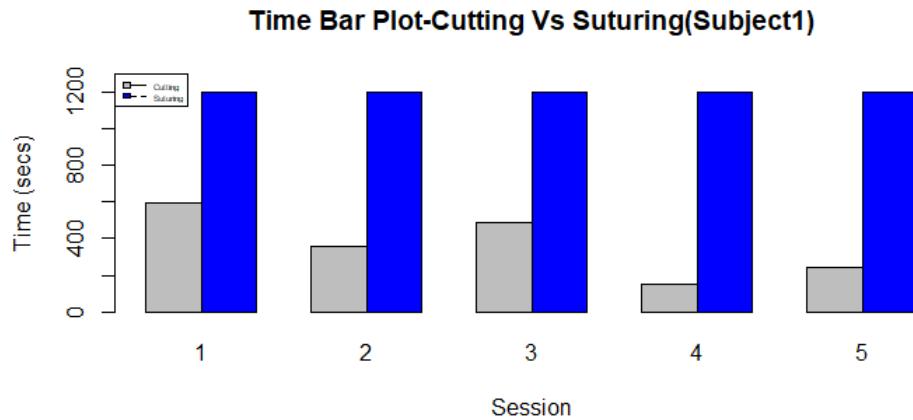




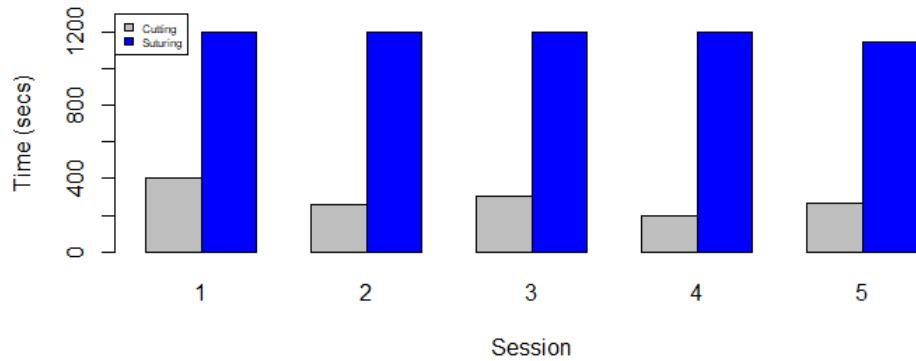


## 5.5 Performance Data

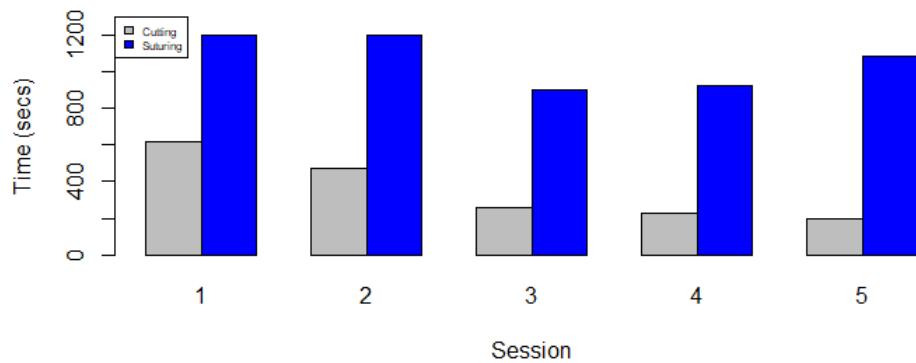
### Time Bar Plots



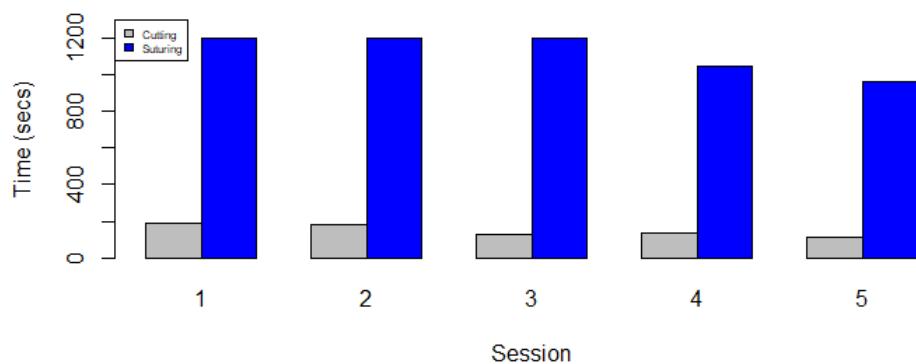
**Time Bar Plot-Cutting Vs Suturing(Subject2)**



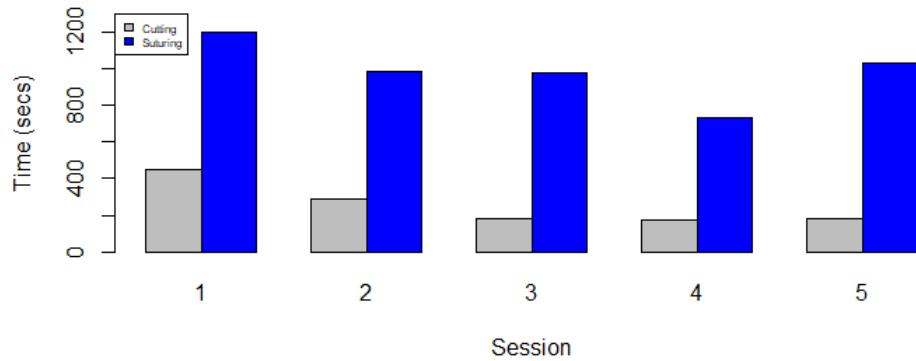
**Time Bar Plot-Cutting Vs Suturing(Subject3)**



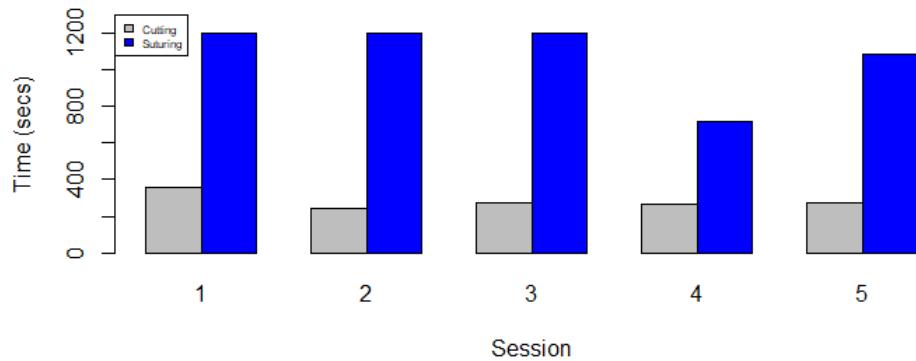
**Time Bar Plot-Cutting Vs Suturing(Subject4)**



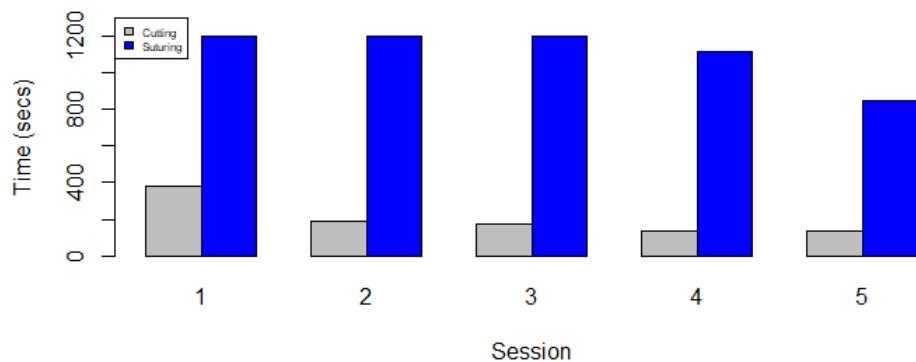
**Time Bar Plot-Cutting Vs Suturing(Subject7)**



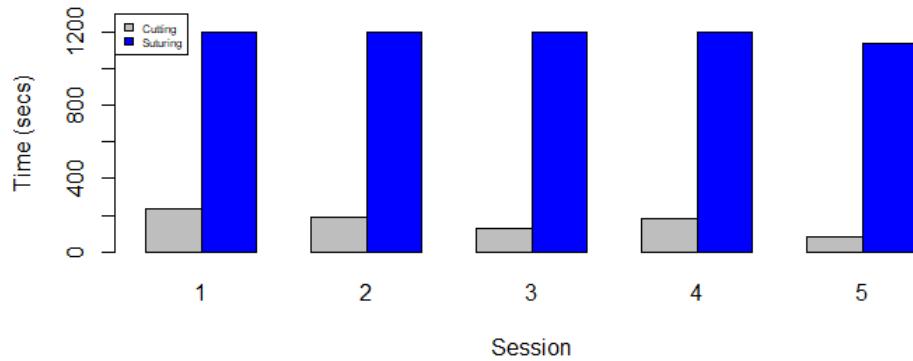
**Time Bar Plot-Cutting Vs Suturing(Subject8)**



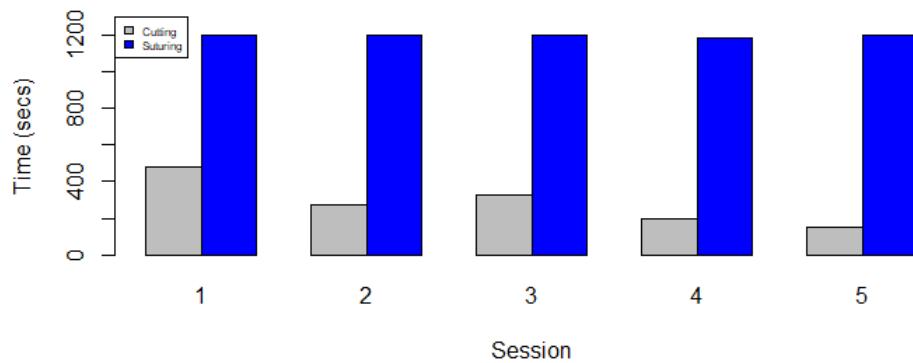
**Time Bar Plot-Cutting Vs Suturing(Subject10)**



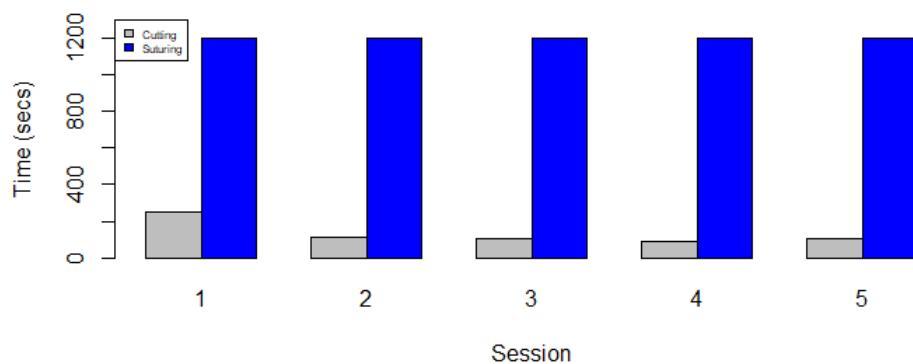
**Time Bar Plot-Cutting Vs Suturing(Subject11)**



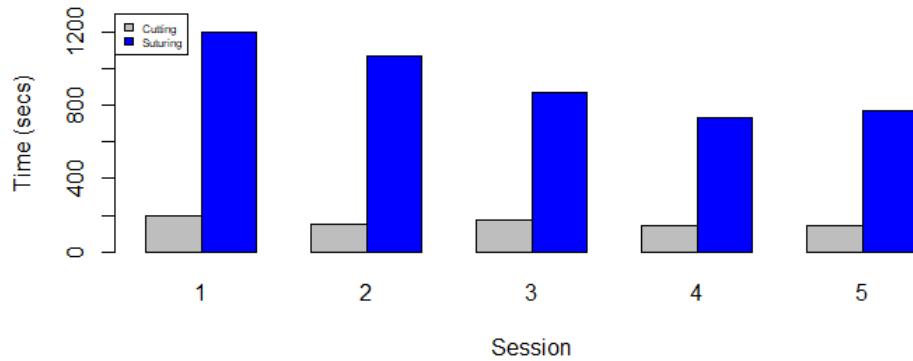
**Time Bar Plot-Cutting Vs Suturing(Subject12)**



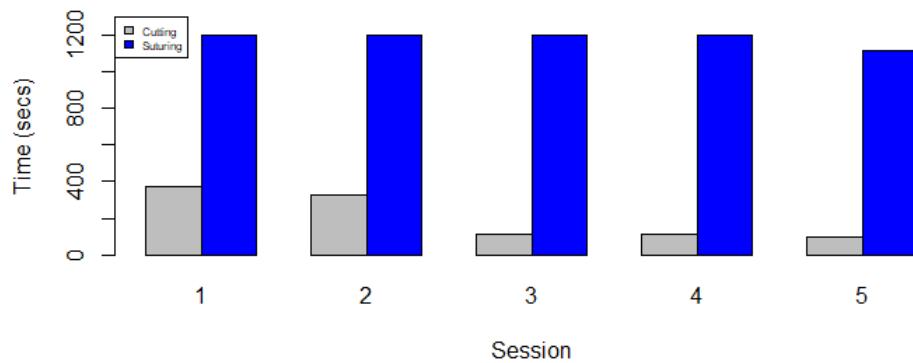
**Time Bar Plot-Cutting Vs Suturing(Subject13)**



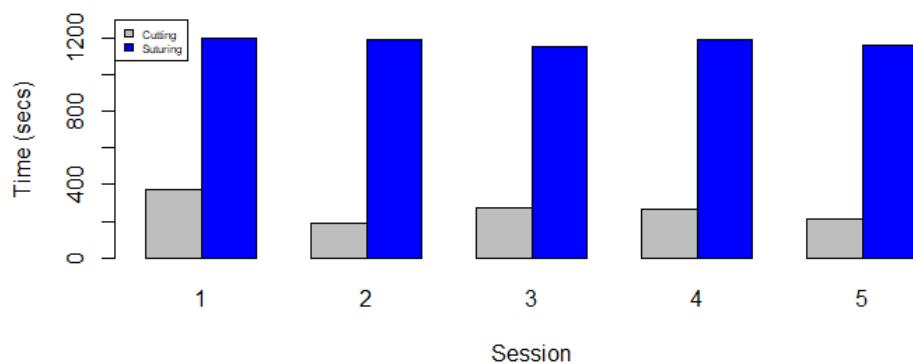
**Time Bar Plot-Cutting Vs Suturing(Subject19)**



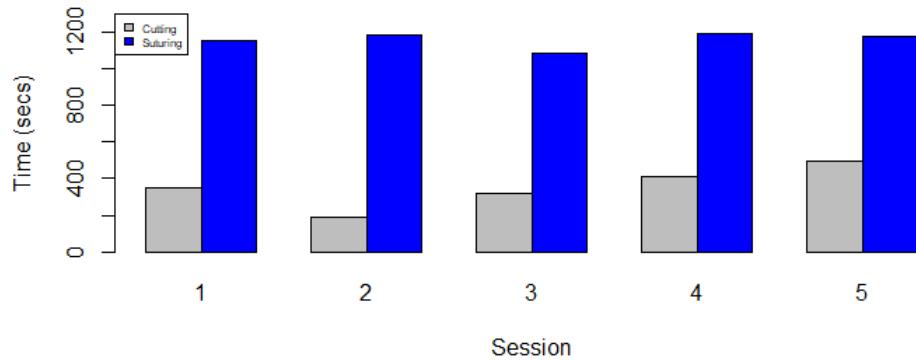
**Time Bar Plot-Cutting Vs Suturing(Subject21)**



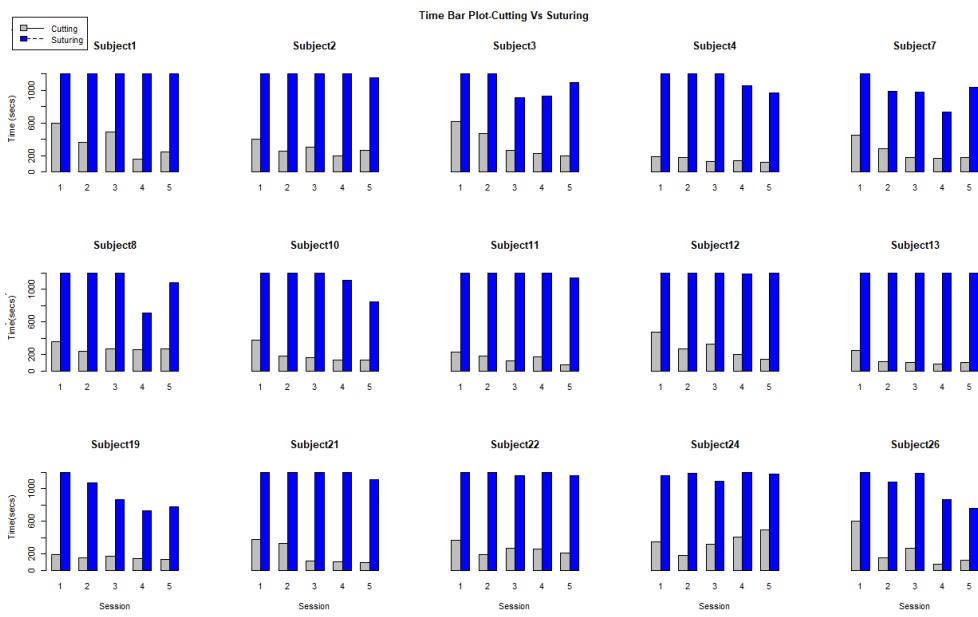
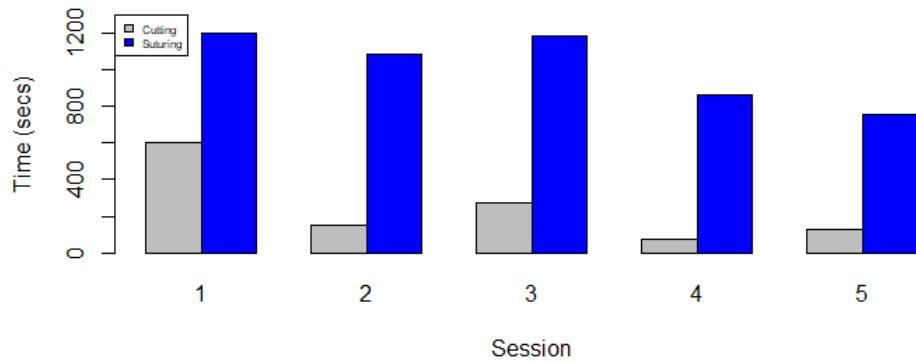
**Time Bar Plot-Cutting Vs Suturing(Subject22)**



**Time Bar Plot-Cutting Vs Suturing(Subject24)**

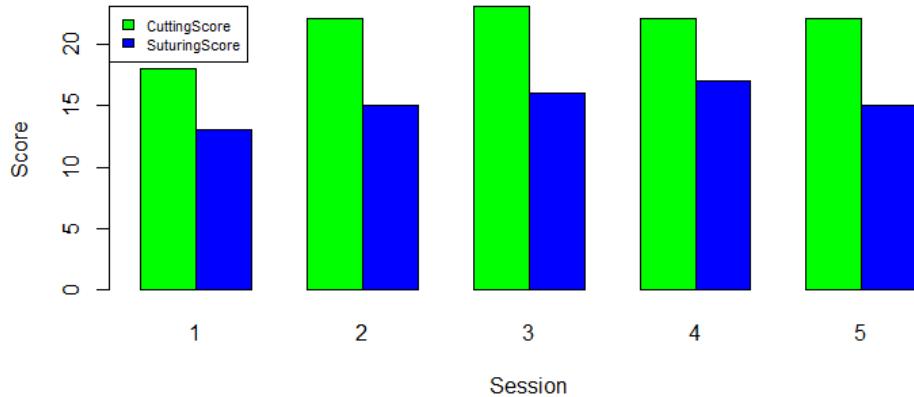


**Time Bar Plot-Cutting Vs Suturing(Subject26)**

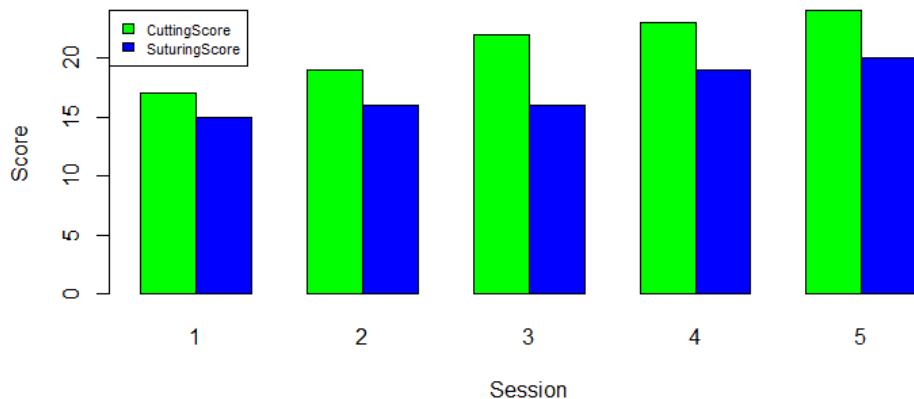


**Accuracy Bar Plots**

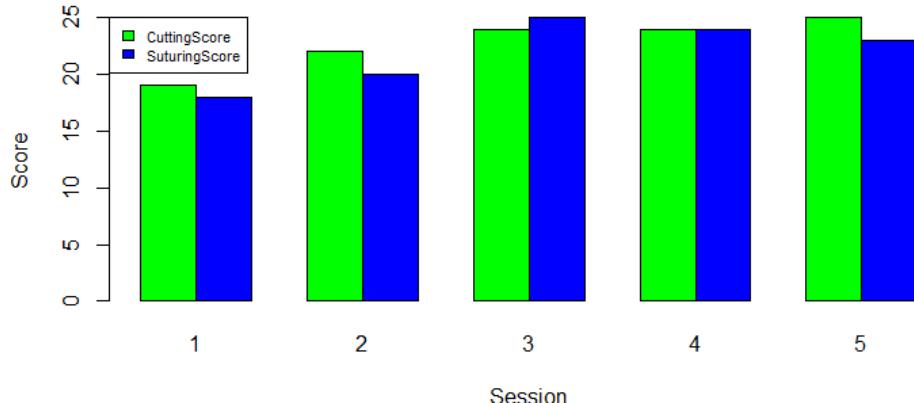
**Accuracy Bar Plot-Cutting Vs Suturing as per Scorer1(Subject1)**



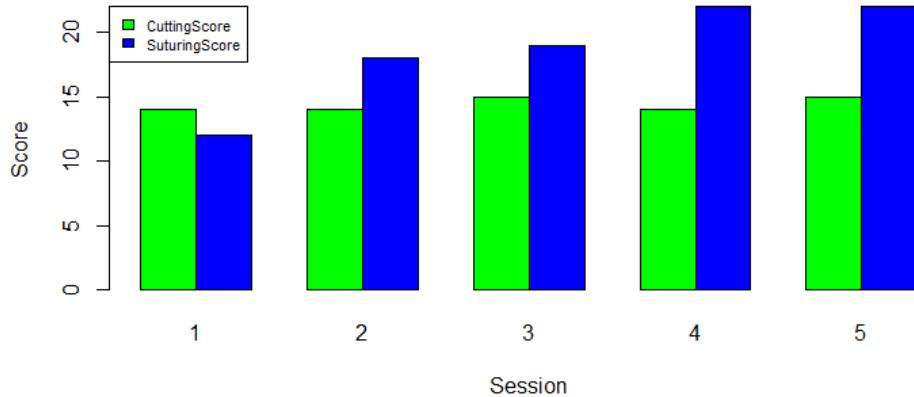
**Accuracy Bar Plot-Cutting Vs Suturing as per Scorer1(Subject2)**



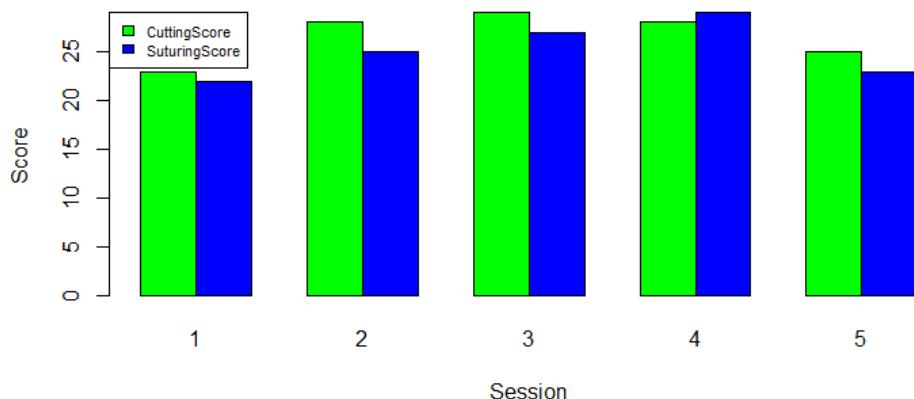
**Accuracy Bar Plot-Cutting Vs Suturing as per Scorer1(Subject3)**



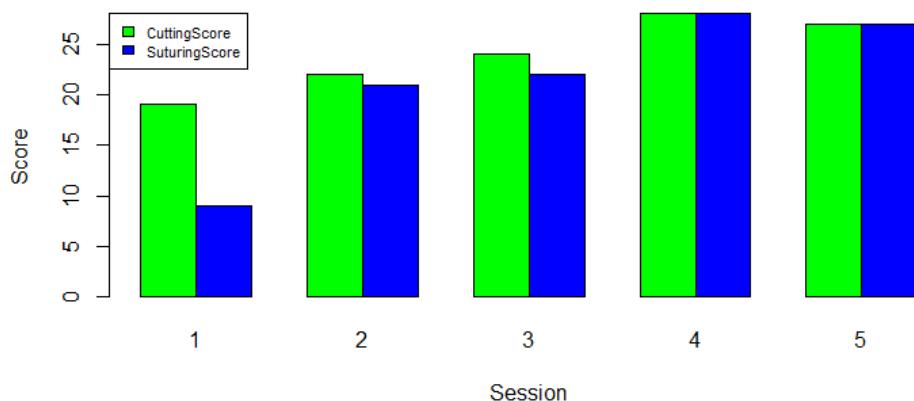
**Accuracy Bar Plot-Cutting Vs Suturing as per Scorer1(Subject4)**



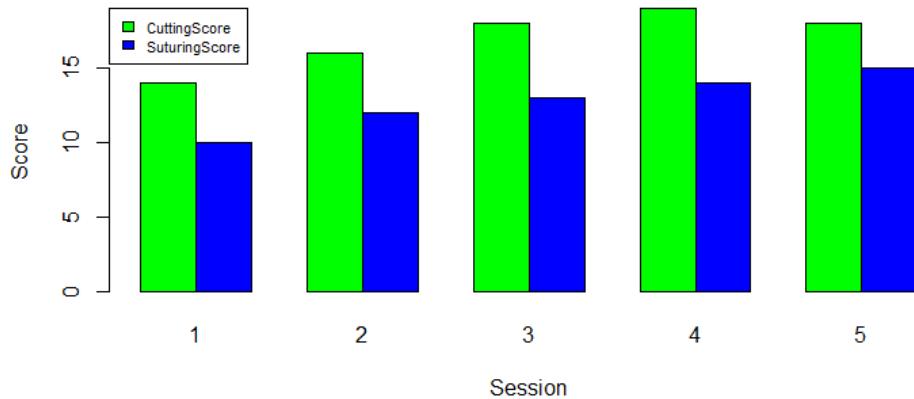
**Accuracy Bar Plot-Cutting Vs Suturing as per Scorer1(Subject7)**



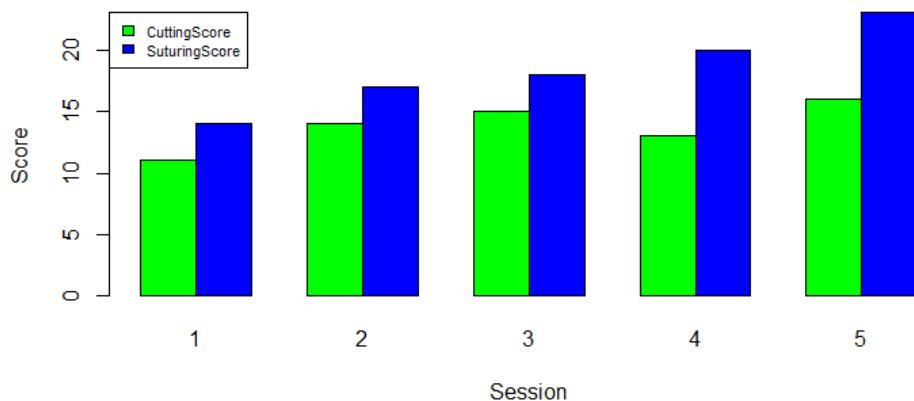
**Accuracy Bar Plot-Cutting Vs Suturing as per Scorer1(Subject8)**



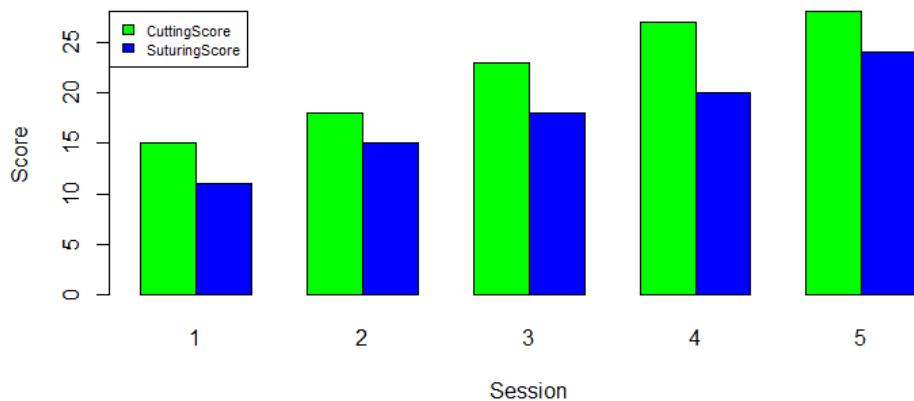
**Accuracy Bar Plot-Cutting Vs Suturing as per Scorer1(Subject10)**



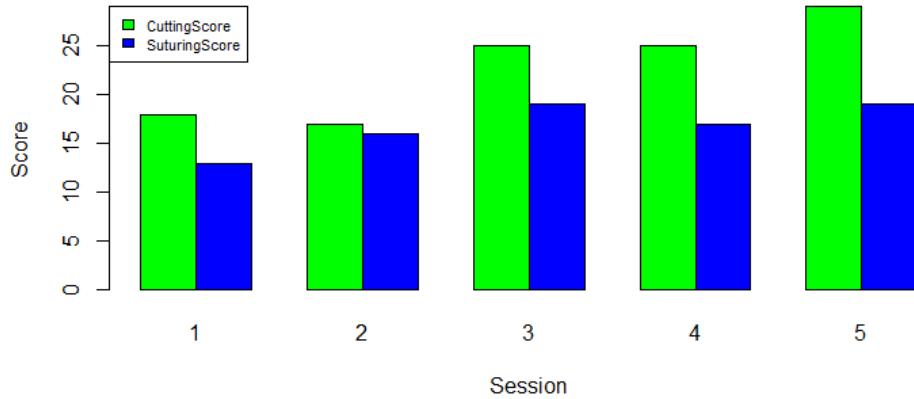
**Accuracy Bar Plot-Cutting Vs Suturing as per Scorer1(Subject11)**



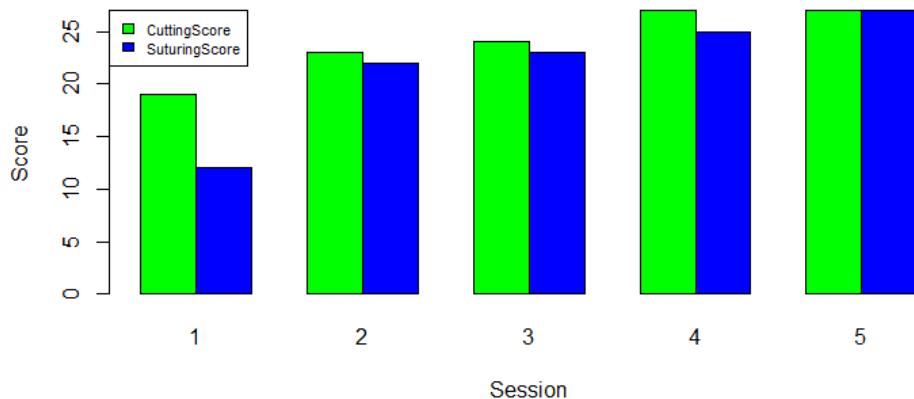
**Accuracy Bar Plot-Cutting Vs Suturing as per Scorer1(Subject12)**



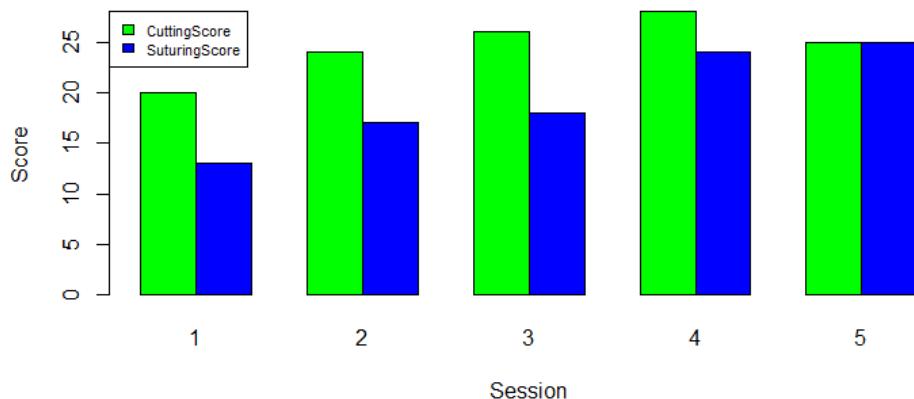
**Accuracy Bar Plot-Cutting Vs Suturing as per Scorer1(Subject13)**



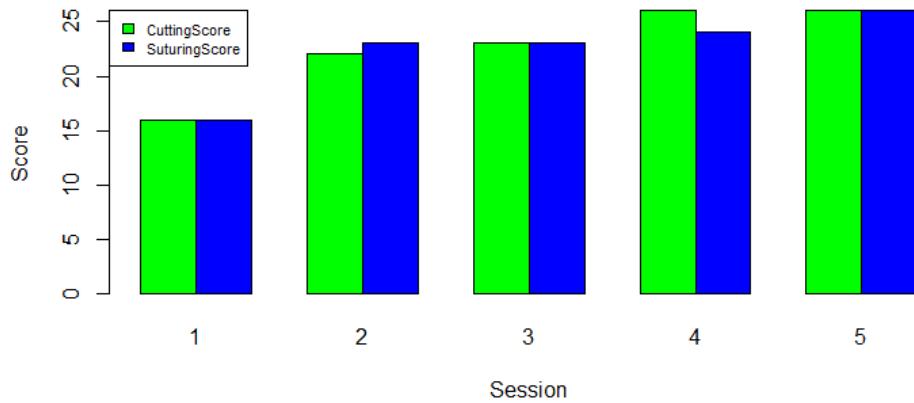
**Accuracy Bar Plot-Cutting Vs Suturing as per Scorer1(Subject19)**



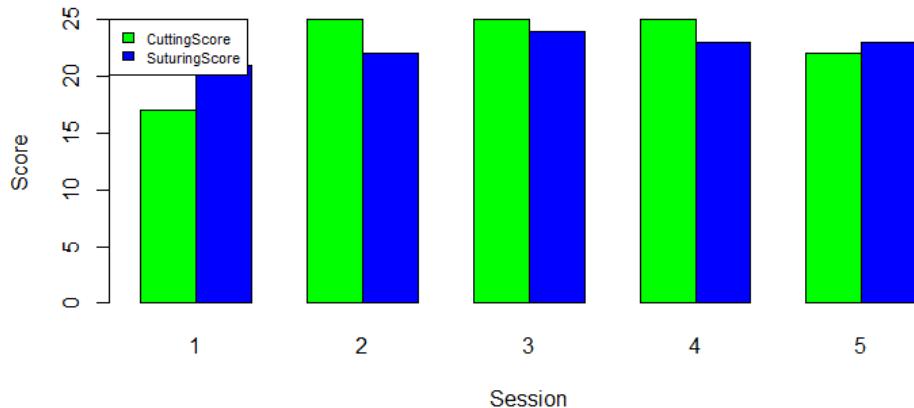
**Accuracy Bar Plot-Cutting Vs Suturing as per Scorer1(Subject21)**



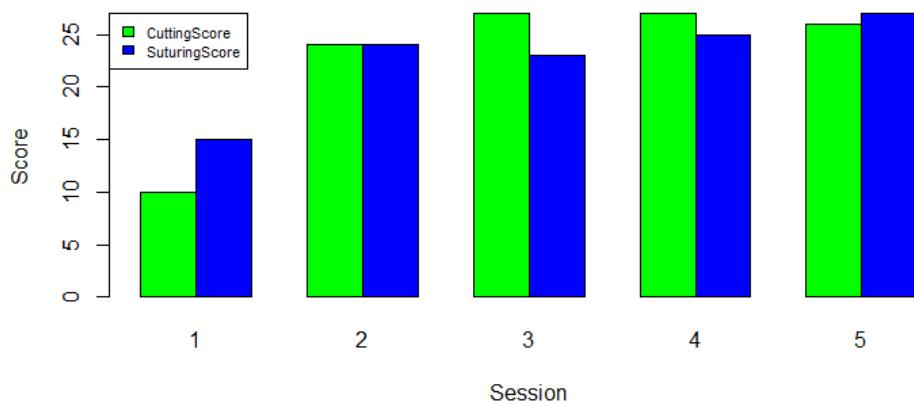
**Accuracy Bar Plot-Cutting Vs Suturing as per Scorer1(Subject22)**



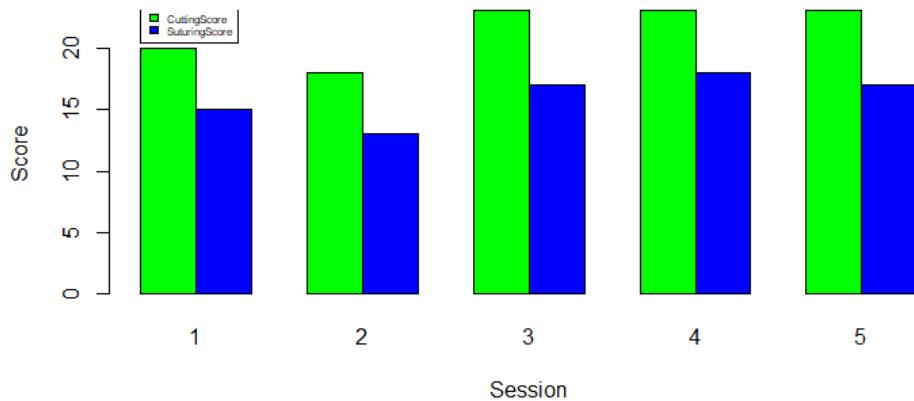
**Accuracy Bar Plot-Cutting Vs Suturing as per Scorer1(Subject24)**



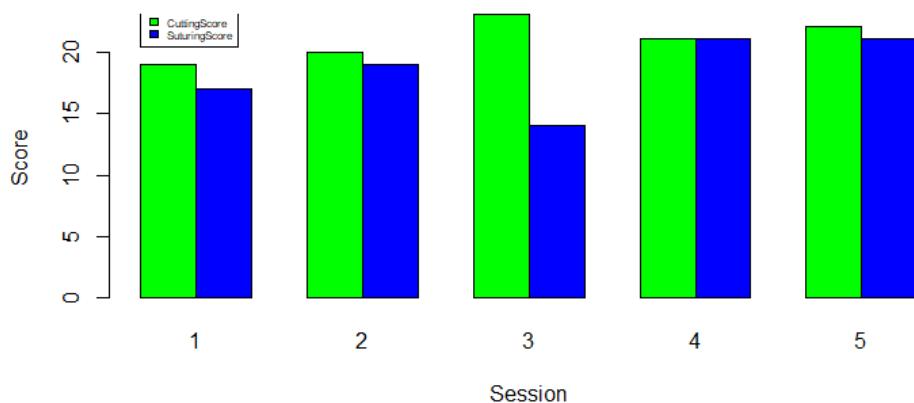
**Accuracy Bar Plot-Cutting Vs Suturing as per Scorer1(Subject26)**



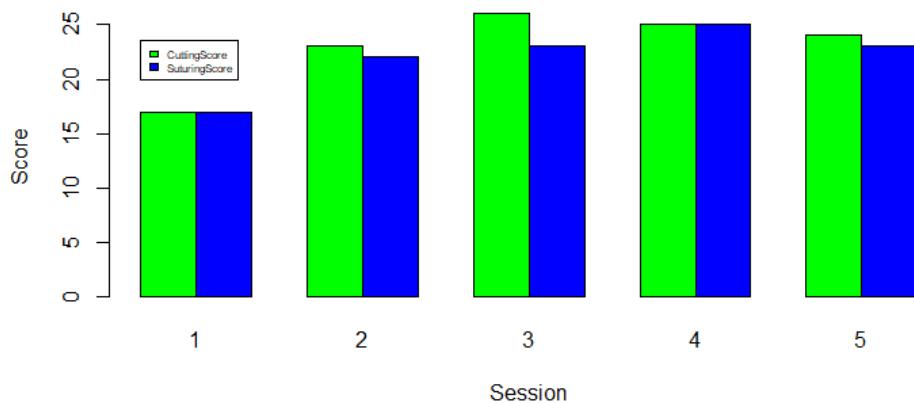
**Accuracy Bar Plot-Cutting Vs Suturing as per Scorer2(Subject1)**



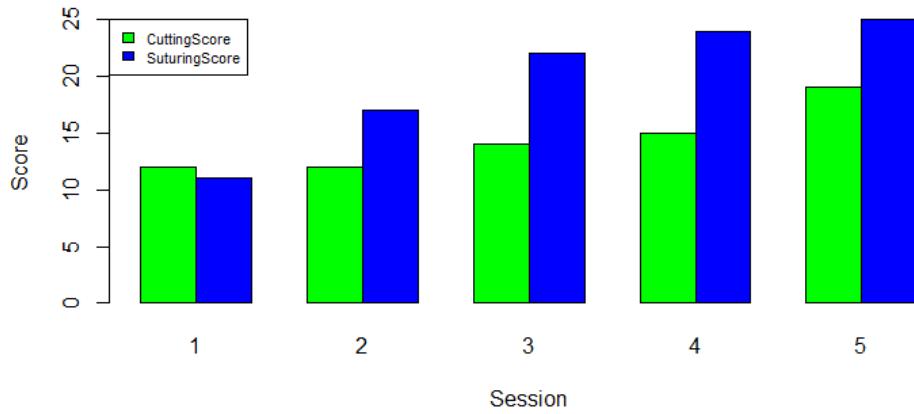
**Accuracy Bar Plot-Cutting Vs Suturing as per Scorer2(Subject2)**



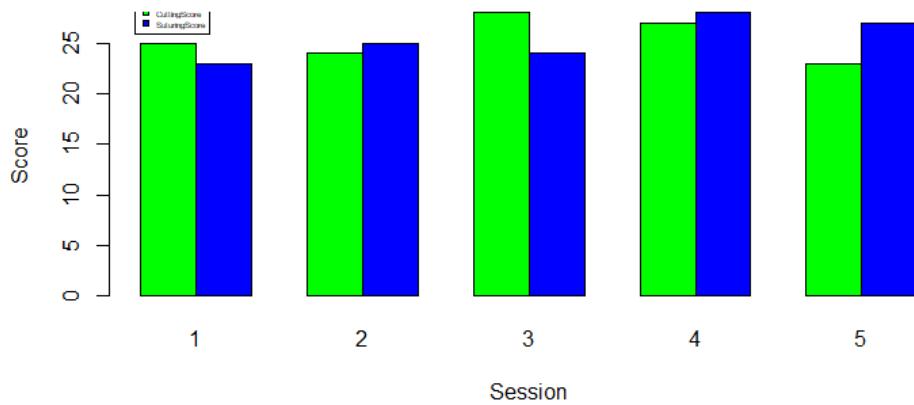
**Accuracy Bar Plot-Cutting Vs Suturing as per Scorer2(Subject3)**



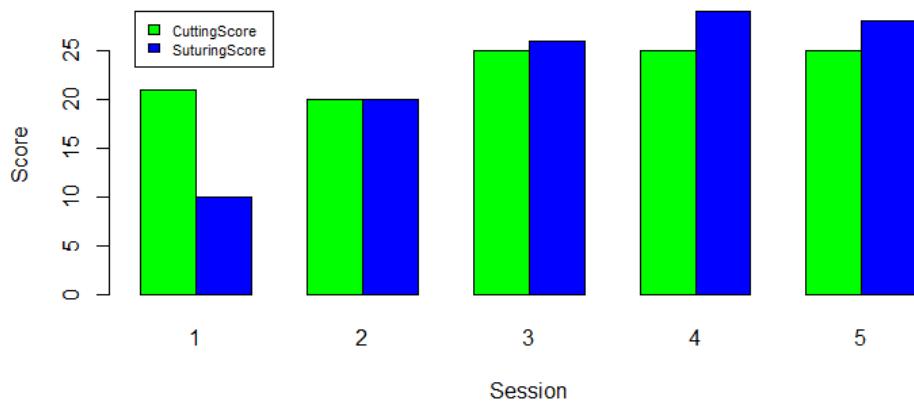
**Accuracy Bar Plot-Cutting Vs Suturing as per Scorer2(Subject4)**



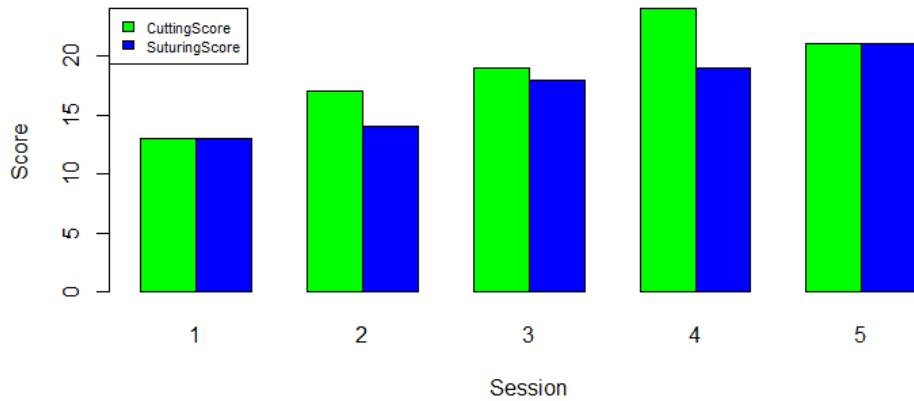
**Accuracy Bar Plot-Cutting Vs Suturing as per Scorer2(Subject7)**



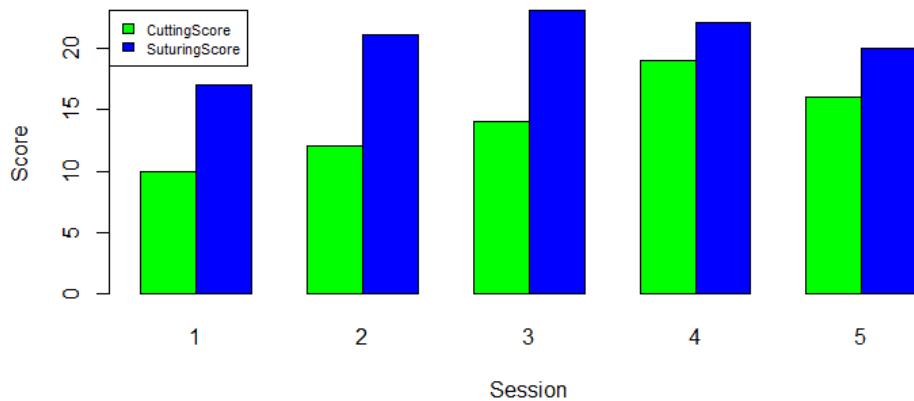
**Accuracy Bar Plot-Cutting Vs Suturing as per Scorer2(Subject8)**



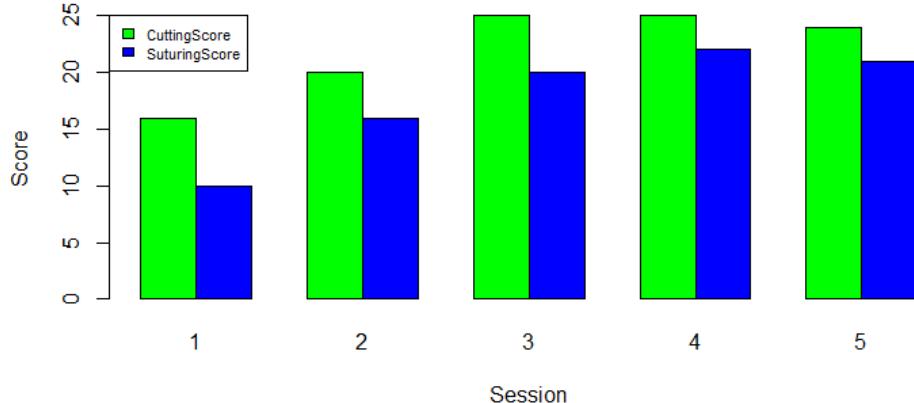
**Accuracy Bar Plot-Cutting Vs Suturing as per Scorer2(Subject10)**



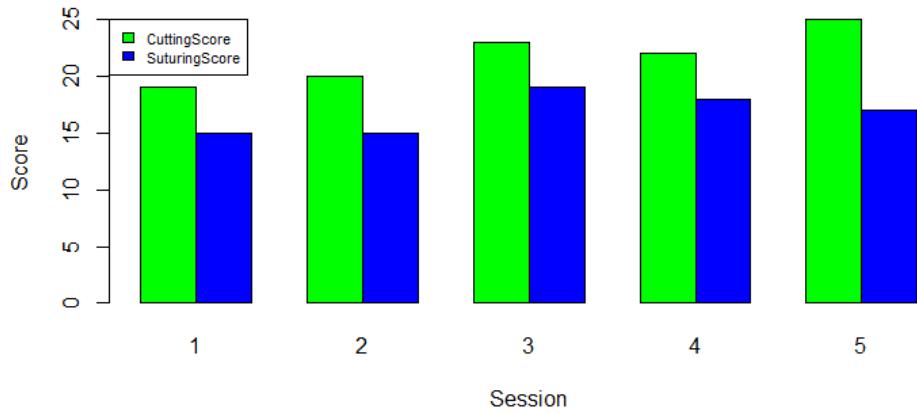
**Accuracy Bar Plot-Cutting Vs Suturing as per Scorer2(Subject11)**



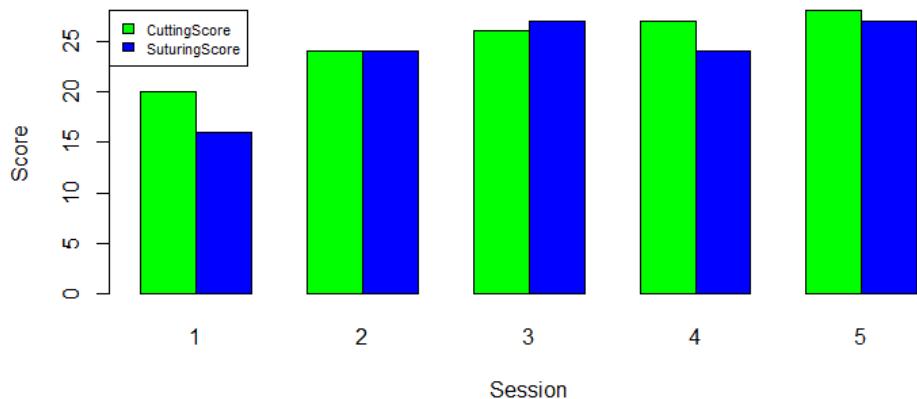
**Accuracy Bar Plot-Cutting Vs Suturing as per Scorer2(Subject12)**



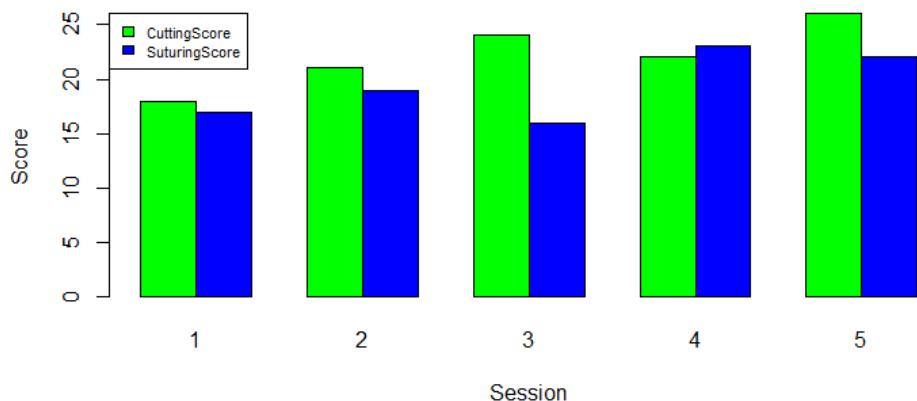
**Accuracy Bar Plot-Cutting Vs Suturing as per Scorer2(Subject13)**



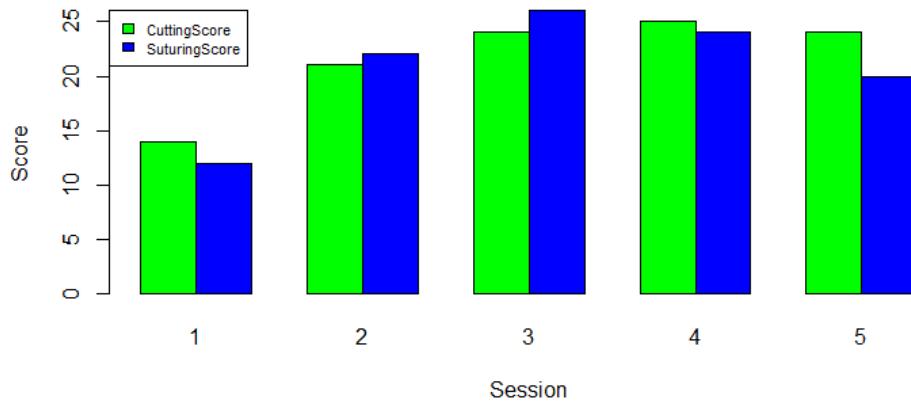
**Accuracy Bar Plot-Cutting Vs Suturing as per Scorer2(Subject19)**



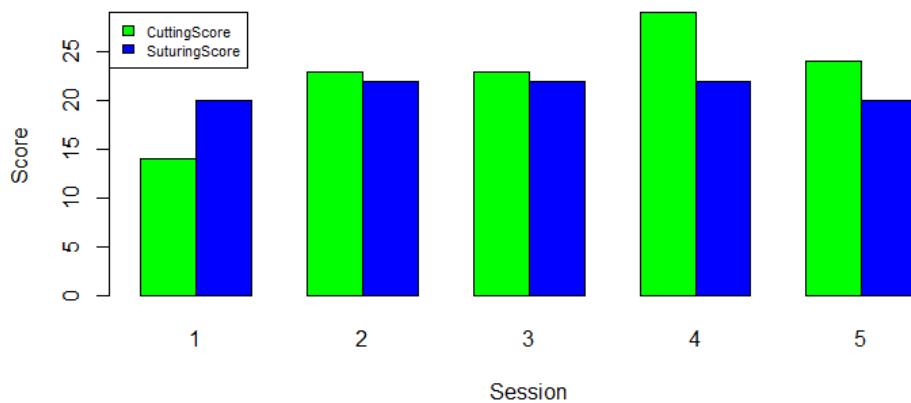
**Accuracy Bar Plot-Cutting Vs Suturing as per Scorer2(Subject21)**



**Accuracy Bar Plot-Cutting Vs Suturing as per Scorer2(Subject22)**



**Accuracy Bar Plot-Cutting Vs Suturing as per Scorer2(Subject24)**



**Accuracy Bar Plot-Cutting Vs Suturing as per Scorer2(Subject26)**

