Correlation Analysis

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12/04/2024

```r
library(readxl)
data2 <- read_excel("NASA_Astronaut2-6-2020.xlsx", sheet = 2)
# Extract MRD and PTB columns
earth_data <- data2[, c("MRD1- R Avg (E)", "MRD1- L Avg (E)", "PTB R (E) Avg", "PTB L (E) Avg")]
space_data <- data2[, c("MRD1- R Avg (S)", "MRD1- L Avg (S)", "PTB R (S) Avg", "PTB L (S) Avg")]
colnames(earth_data) <- c("MRD_R", "MRD_L", "PTB_R", "PTB_L")
colnames(space_data) <- c("MRD_R", "MRD_L", "PTB_R", "PTB_L")
# Pearson correlations
cor_earth <- cor(earth_data, use = "complete.obs", method = "pearson")
cor_space <- cor(space_data, use = "complete.obs", method = "pearson")
# Correlation matrices
cat("Correlation matrix for Earth:\n")
```

```
## Correlation matrix for Earth:
```

```r
print(cor_earth)
```

```
##             MRD_R      MRD_L       PTB_R       PTB_L
## MRD_R  1.00000000  0.9285134 -0.04988999 -0.05827674
## MRD_L  0.92851343  1.0000000 -0.13799337 -0.15270541
## PTB_R -0.04988999 -0.1379934  1.00000000  0.87534571
## PTB_L -0.05827674 -0.1527054  0.87534571  1.00000000
```

```r
cat("\nCorrelation matrix for Space:\n")
```

```
##
## Correlation matrix for Space:
```

```r
print(cor_space)
```

```
##              MRD_R       MRD_L        PTB_R      PTB_L
## MRD_R  1.000000000 0.838483702 -0.006570915 0.05327018
## MRD_L  0.838483702 1.000000000  0.009479456 0.10747914
## PTB_R -0.006570915 0.009479456  1.000000000 0.81881684
## PTB_L  0.053270175 0.107479142  0.818816837 1.00000000
```

Correlation Matrix for Earth:

MRD_R and MRD_L: High positive correlation (0.93), indicating that the MRD measurements for the right and left eyes on Earth are strongly related. This is expected since these measures reflect similar anatomical features under the same condition. MRD and PTB (both sides): Weak to negligible negative correlations (e.g., -0.05 for MRD_R and PTB_R, -0.15 for MRD_L and PTB_L). This suggests that there is no substantial relationship between MRD (eyelid position) and PTB (eyebrow position) measurements under Earth's gravitational condition. PTB_R and PTB_L: Strong positive correlation (0.88), indicating a consistent relationship between the PTB measurements for the right and left sides. This reflects symmetry in eyebrow positioning on Earth.

Correlation Matrix for Space:

MRD_R and MRD_L: Moderate to high positive correlation (0.84), slightly weaker than on Earth. This suggests that while MRD symmetry persists in space, there may be minor differences in gravitational effects on the eyelids. MRD and PTB (both sides): Very weak correlations (e.g., -0.006 for MRD_R and PTB_R, 0.053 for MRD_R and PTB_L). Similar to Earth, there is no significant relationship between MRD and PTB in microgravity. PTB_R and PTB_L: Strong positive correlation (0.82), slightly weaker than on Earth. This indicates that eyebrow positioning symmetry is maintained in space, though microgravity might introduce subtle variations.

Key Findings:

MRD Stability Across Conditions: High correlations between MRD measurements for the left and right sides in both Earth and space suggest robust symmetry and minimal variation due to gravity. Independence of MRD and PTB: Negligible correlations between MRD and PTB measurements across both conditions suggest that eyelid and eyebrow positioning are governed by distinct mechanisms, with gravity having a more pronounced effect on PTB. PTB Variability in Space: The slightly weaker correlation for PTB between the left and right sides in space might reflect microgravity-induced changes in eyebrow positioning, as evidenced by earlier analyses showing significant differences in PTB metrics. These findings align with the hypothesis that gravity impacts eyebrow positioning (PTB) more significantly than eyelid positioning (MRD), and the two are largely independent. This reinforces the need for designing space equipment that accounts for these gravitational effects.