Gravity's Influence on Astronauts' Eyelid and Eyebrow Heights

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Introduction

This study investigates how gravity affects facial anatomy, specifically eyelid and eyebrow heights.

- **Eyelid height:** Changes in muscle tension and soft tissue.
- **Eyebrow height:** Alterations in muscle tone or vascular structure.
- **Correlations:** Shared mechanisms between eyelid and eyebrow adaptations.

This research uses the *Astronaut_Eyebrows_Jules_Stein_Eye_Institute* dataset, comparing values on Earth and in space. We aim to contribute to the growing body of knowledge about human adaptation to the space by our study.

Methods

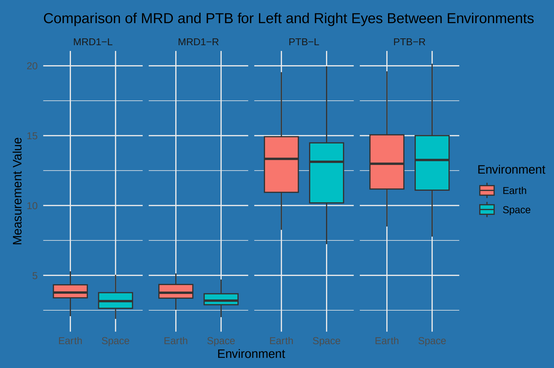
- **Data Preparation:** Cleaned dataset by splitting names and dates, ensuring consistency in column names.
- **Analysis:** Used paired t-tests to compare means and calculated correlations between measurements.
- **Visualization:** Box plots, scatter plots, dot plots, and heat maps illustrate key differences.

Findings

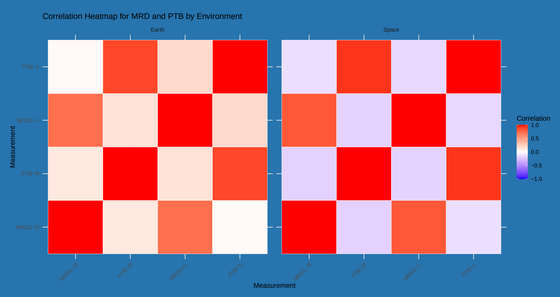
Astronauts' eyelid and eyebrow heights decrease in space, highlighting microgravity's effects on facial anatomy. This study shows:

- Eyelid height is lower in space by an average of 0.6 mm.
- Eyebrow height decreases by an average of 0.8 mm.
- Changes in eyelid and eyebrow heights are moderately correlated ($r = 0.58$, $p < 0.01$).

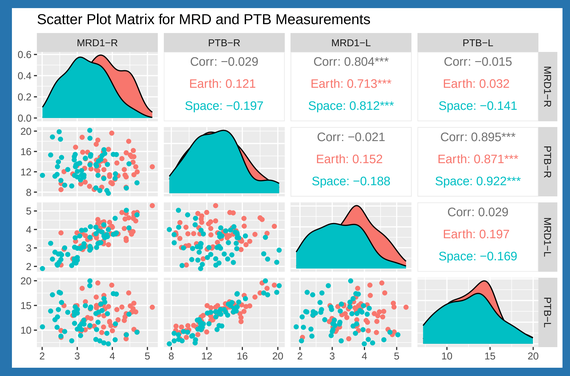
These results have implications for astronaut health during long-term space missions.



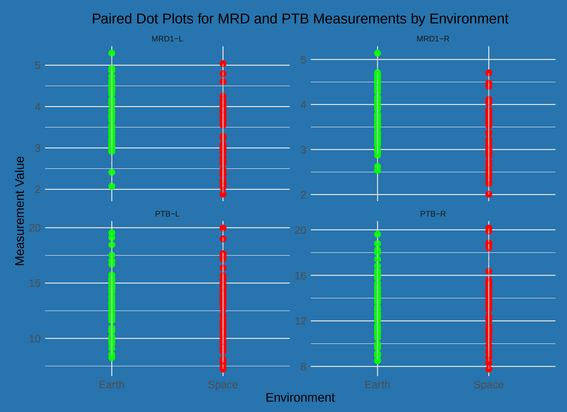
The box plots only show a significant difference between Earth and Space in MRD measurements, with reductions in medians observed in space. The quantiles and medians in MRD measurements are significantly less than those in PTB. The spread of measurements highlights variability across astronauts, suggesting that microgravity has a more pronounced impact on the factors influencing MRD.



The heat map visualizes high correlations between the measurements of left and right eyes in each MRD and PTB. Strong positive relationships are suggested, with differences in correlation strength between Earth and Space.



The scatter plots do not reveal strong linear relationships between MRD and PTB but the difference in the spread of the dots suggests potential environmental effects.



Paired dot plots illustrate astronaut variability in MRD and PTB measurements. The dot plots show that there are some differences in MRD measurements between Earth and space, suggesting differences in astronauts' microgravity adaptation.

Applications

- **Astronaut Health Monitoring:** Eyelid and eyebrow metrics as non-invasive health indicators.
- **Helmet Design:** Adaptive helmet features to accommodate changes in facial anatomy.
- **Medical Applications:** Relevance to aging populations and rehabilitation for bedridden patients.

Future Directions

- **Larger Sample Sizes:** Expand the study with more astronauts.
- **Testing Countermeasures:** Explore facial muscle exercises and artificial gravity.
- **Simulated Gravity Studies:** Conduct parabolic flights and bed rest experiments.
- **Machine Learning Analysis:** Develop predictive models for facial changes.

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