

INTRODUCTION

Emotion States and Gait

Current literature [1], [2] suggests emotions influence gait characteristics such as:

- Joint range of motion
- Upper body posture
- Spatiotemporal parameters

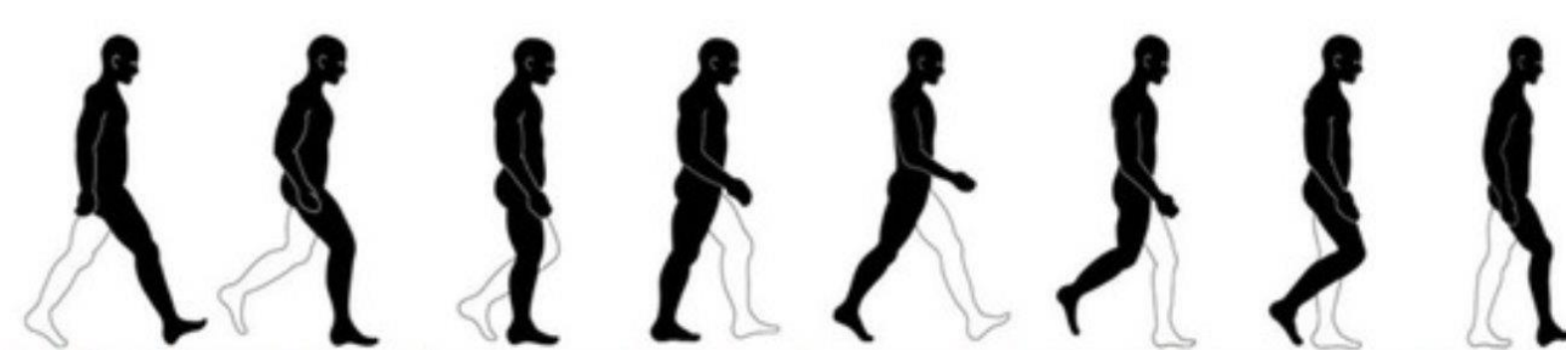


Figure A: Representation of a walking trial.

Target Emotions



Machine Learning and Biomechanics

ML prediction could possibly predict emotional states using emotion-related changes in gait.

OBJECTIVE

Hypothesis

- Emotional states impact gait characteristics
- Biomechanical variables can predict emotional classifications
- ML can classify emotions using biomechanical datasets

Goal

- Assess biomechanics under emotional states during walking.
- Apply ML techniques to predict emotional states using gait biomechanics data sets.

EMOTION INDUCTION

Autobiographical Memory Paradigm

- Emotion Induction [3]

“Think of a time in your life when...”

- Emotion Survey: 5-Point Likert Scale

“...how you felt while you were walking”

METHODS

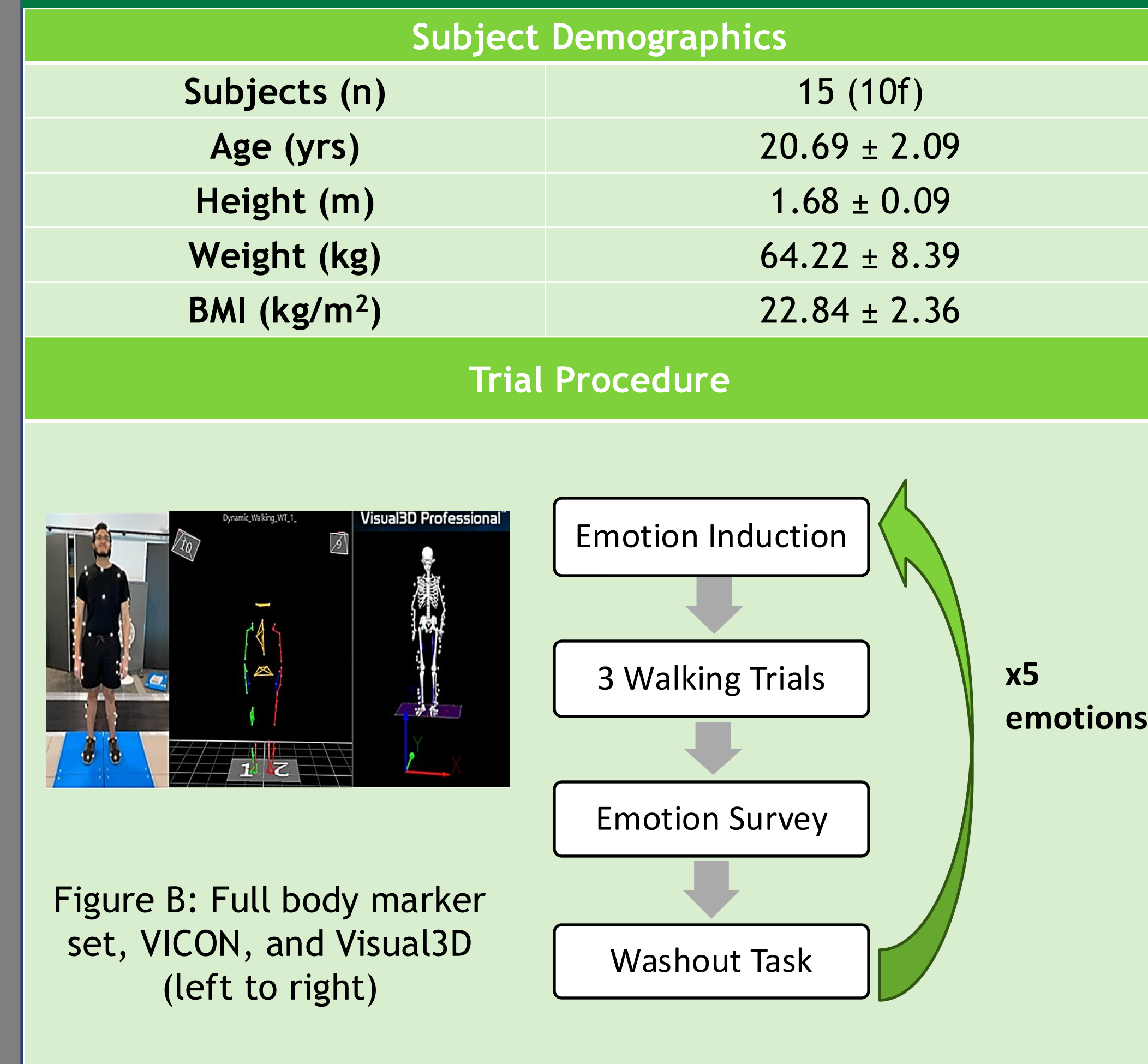


Figure B: Full body marker set, VICON, and Visual3D (left to right)



Figure C: Software used (left to right): Vicon Nexus™, MATLAB™, Visual3D Professional™

ML Techniques Used
 Multilayer Perceptron
 Random Forest
 K-nearest Neighbours
 Logistic Regression

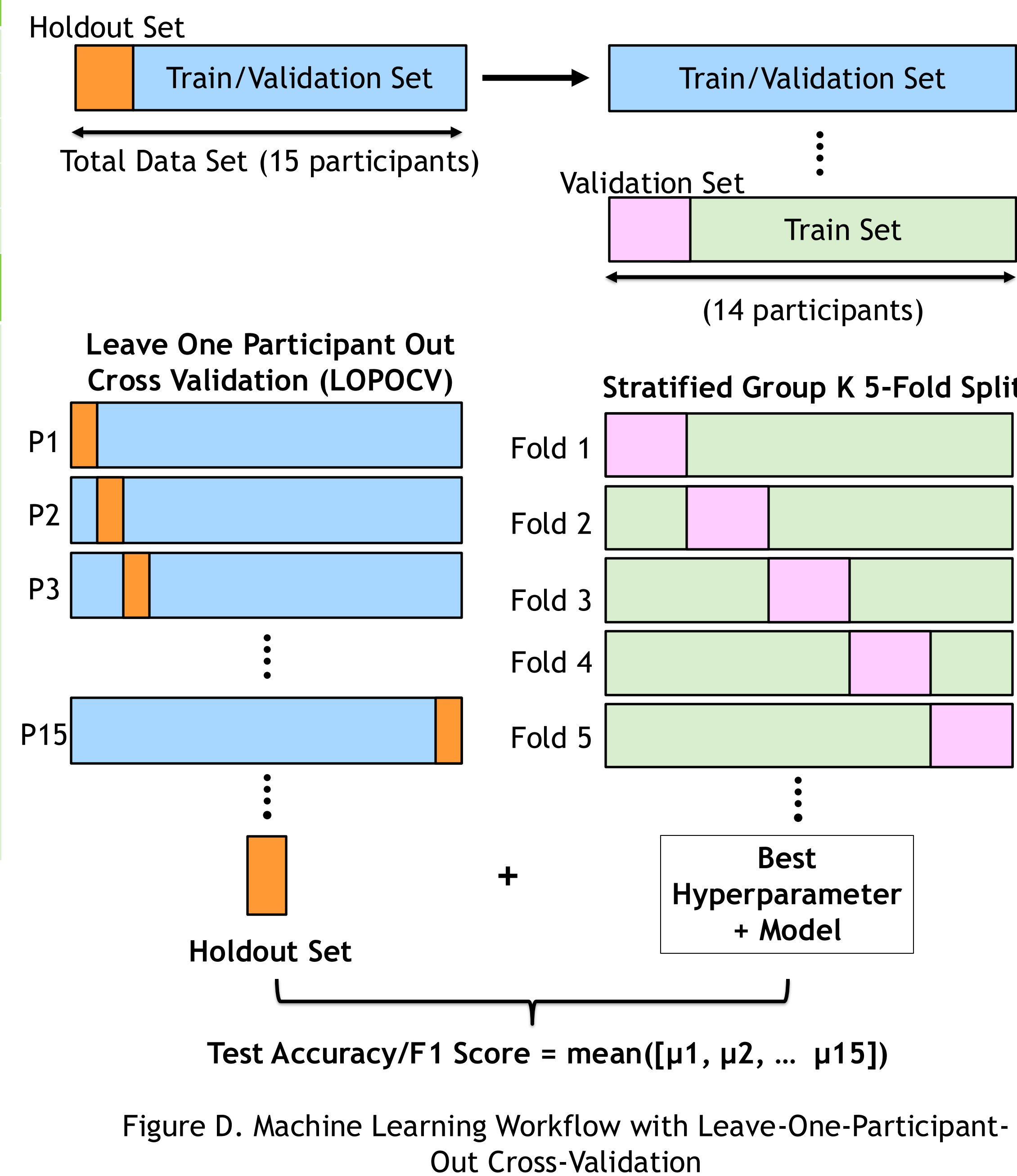
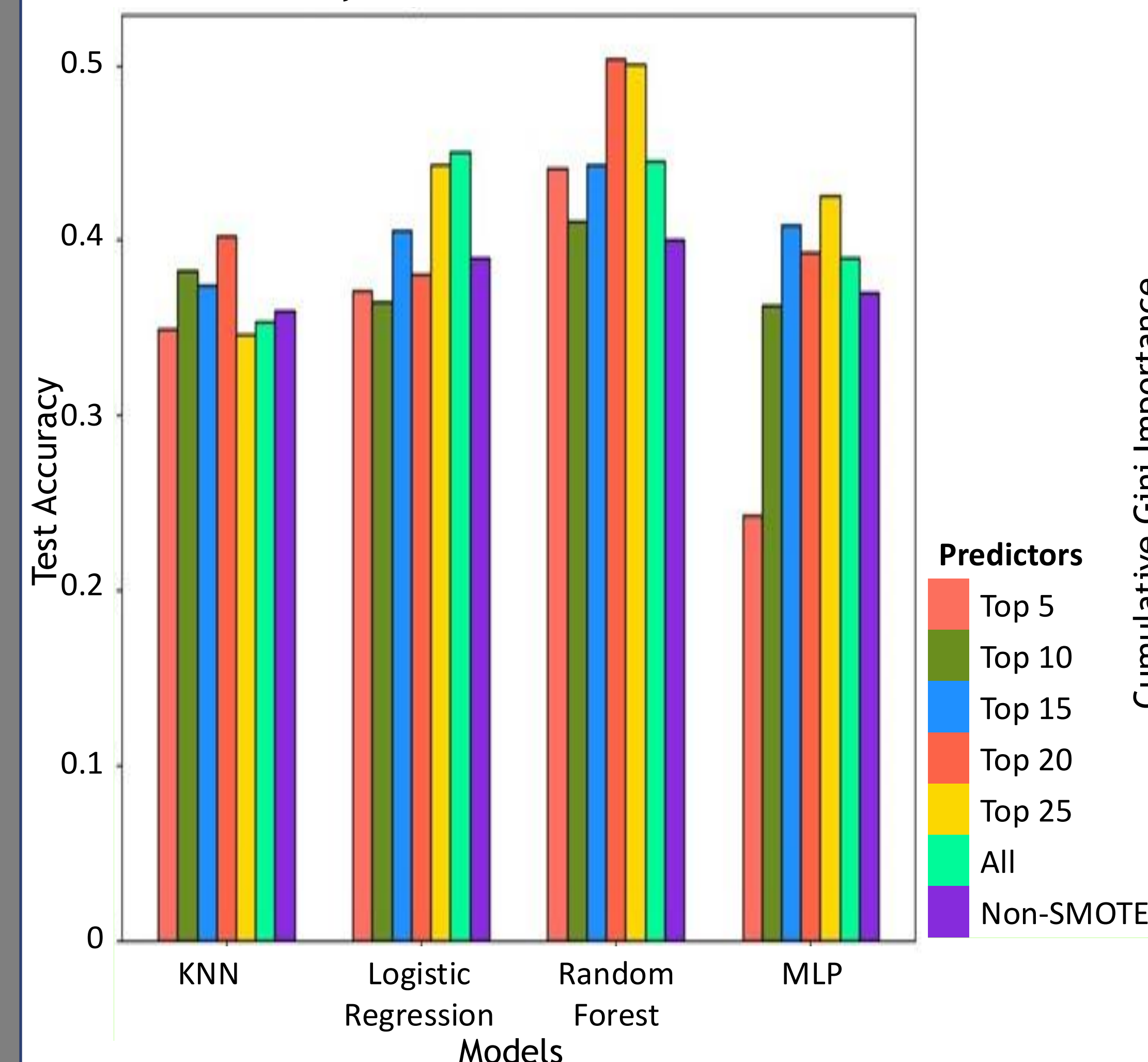


Figure D: Machine Learning Workflow with Leave-One-Participant-Out Cross-Validation

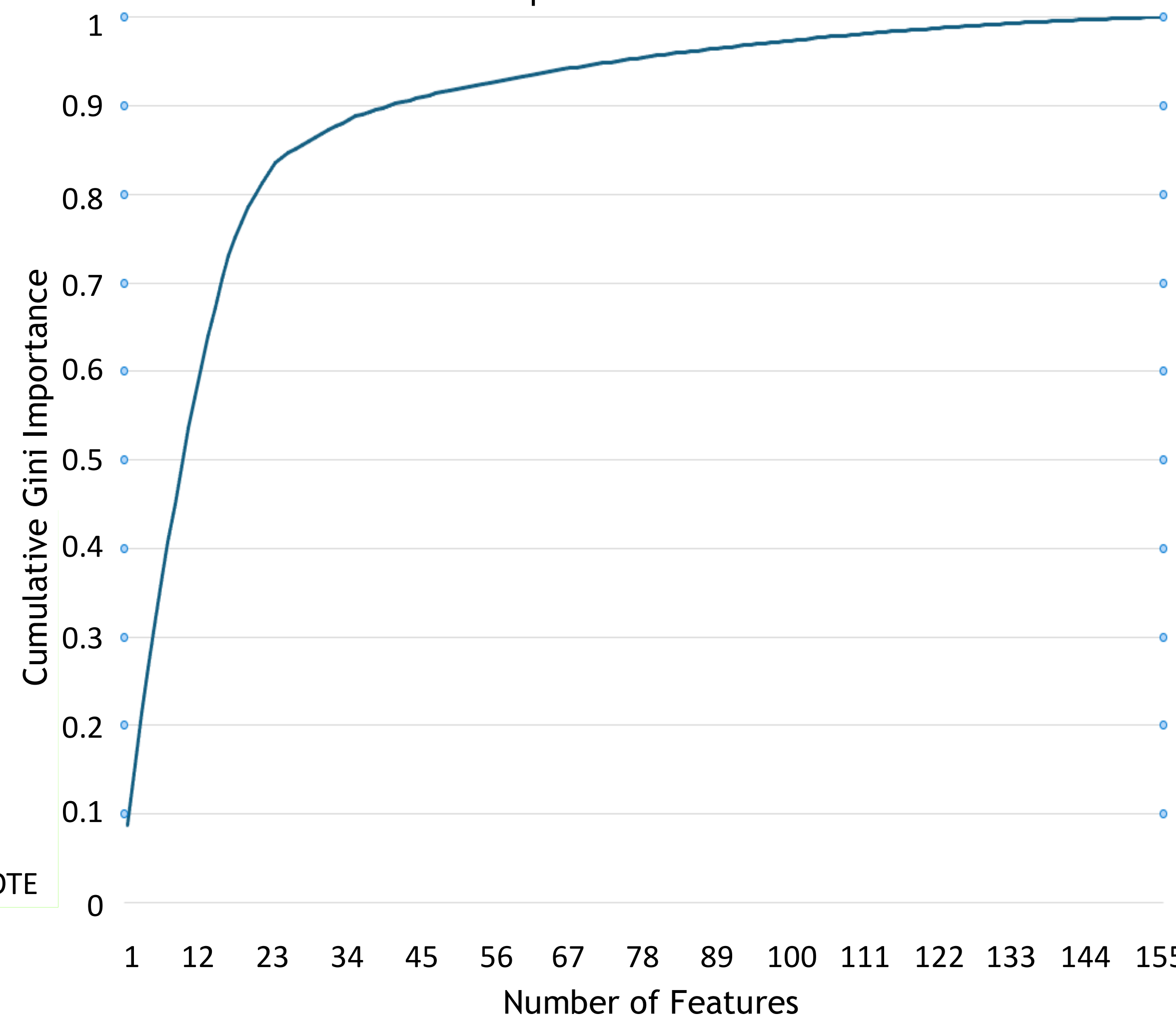
RESULTS

Outcomes	Anger	Sad	Neutral	Joy	Fear	P
Stride Time (s)	1.09 ± 0.10	1.17 ± 0.23	1.12 ± 0.09	1.08 ± 0.10	1.10 ± 0.13	< 0.001*
Gait Speed (m/s)	1.36 ± 0.17	1.24 ± 0.25	1.27 ± 0.15	1.39 ± 0.21	1.34 ± 0.23	< 0.001*
Stride Length (m)	1.47 ± 0.10	1.40 ± 0.15	1.42 ± 0.09	1.49 ± 0.12	1.45 ± 0.11	< 0.001*

Test Accuracy for Different Models and Predictors



Cumulative Gini Importance vs. Number of Features



CONCLUSIONS

Significant Findings

Gait varies across emotional states

- Sadness → longer spatiotemporal outcomes
- Anger & joy → shorter outcomes.
- Significant differences in joint movements

Results show ML can predict emotions

- Baseline models achieved accuracies above random chance
- Random Forest had the highest accuracy followed by Logistic Regression, MLP, and KNN

Conclusion

- Gait biomechanics is altered by emotional states.
- Prediction models based on human movement can be effective in classifying/prediction emotions.

Future Goals

- Increase sample size
- Explore advanced machine learning techniques
- Refine parameters
- Assess one-to-all predictor data set

REFERENCES

- [1] Kang and Gross. (2015), *Hum Mov Sci*, 40, 341-351
- [2] Kang and Gross. (2016), *J Biomech* 49, 4022-4027
- [3] Gross et al. (2012), *Hum Mov Sci* 31, 202-221;

ACKNOWLEDGEMENTS

Thank you to all the participants for giving their time to be involved in the study. Thank you for the support from the BE Researchers program.