EEG-Based Classification of Emotional State Using an Autonomous Vehicle Simulator

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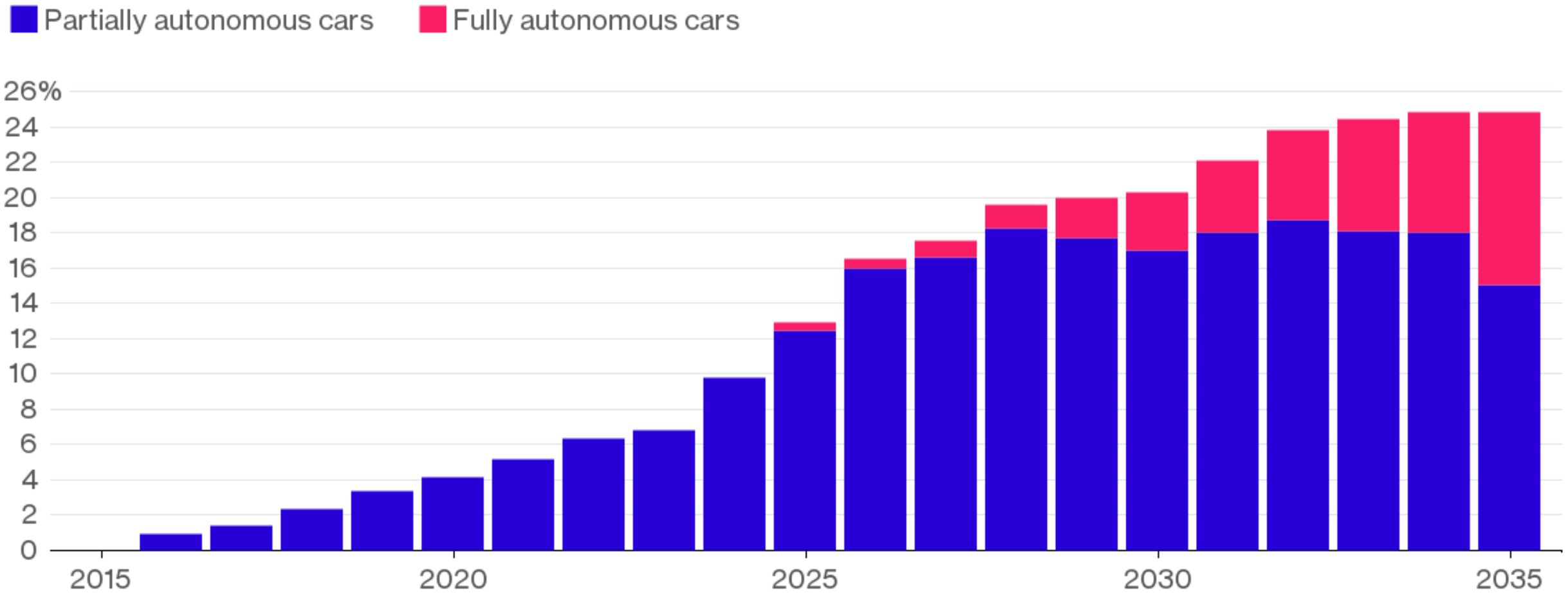
Autonomous Car Sales Will Surge By 2035

The cars will represent 25 percent of the global market



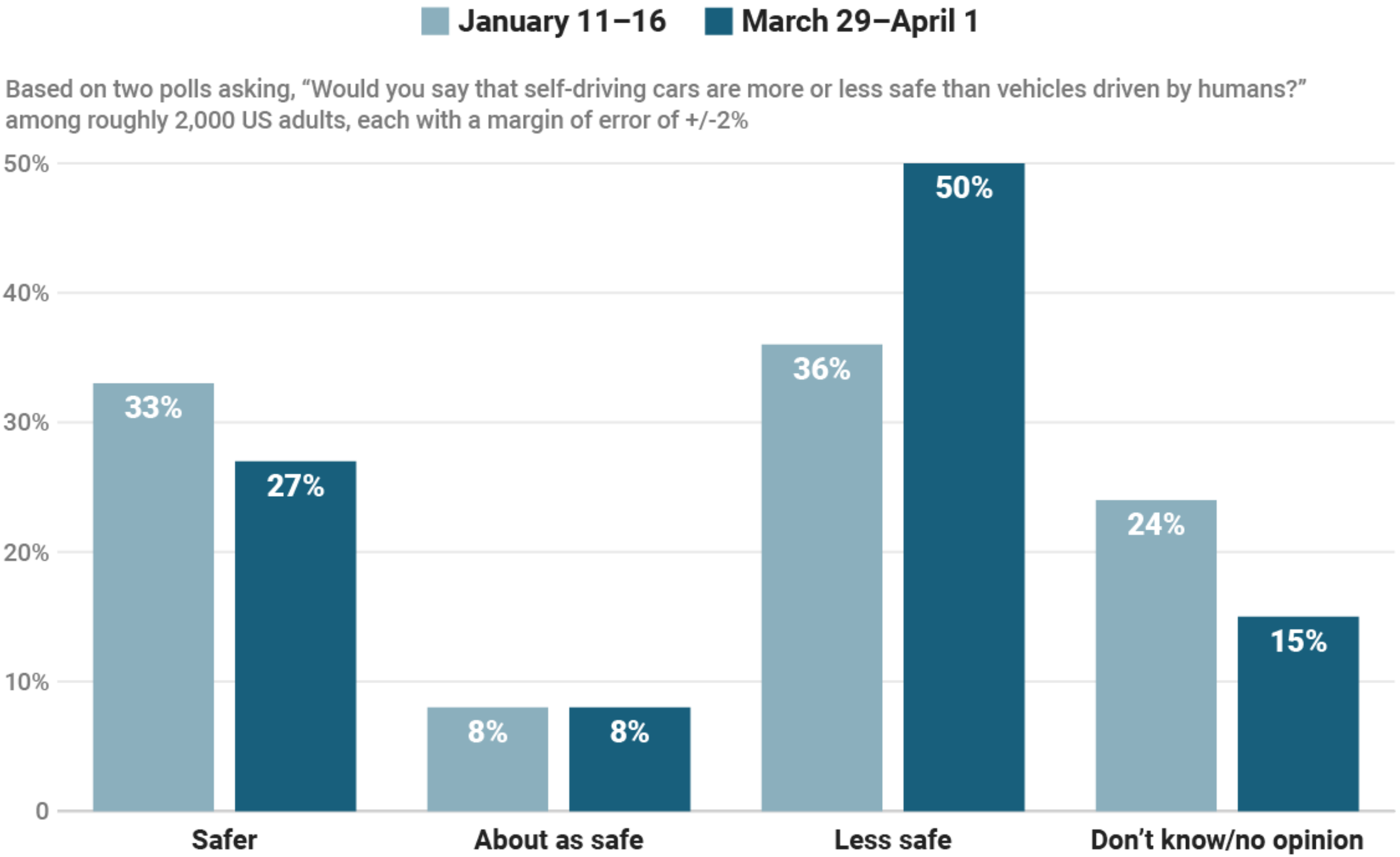
Source: The Boston Consulting Group
Note: 2015 data

Bloomberg


Woman dead after being struck by self-driving Uber

TECH CHART OF THE DAY

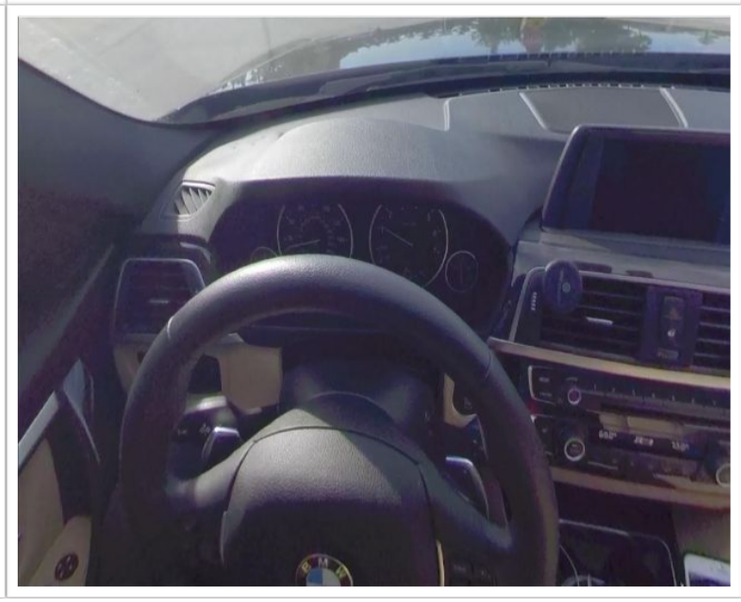
Fatal accidents damage trust in autonomous driving



Source: Morning Consult

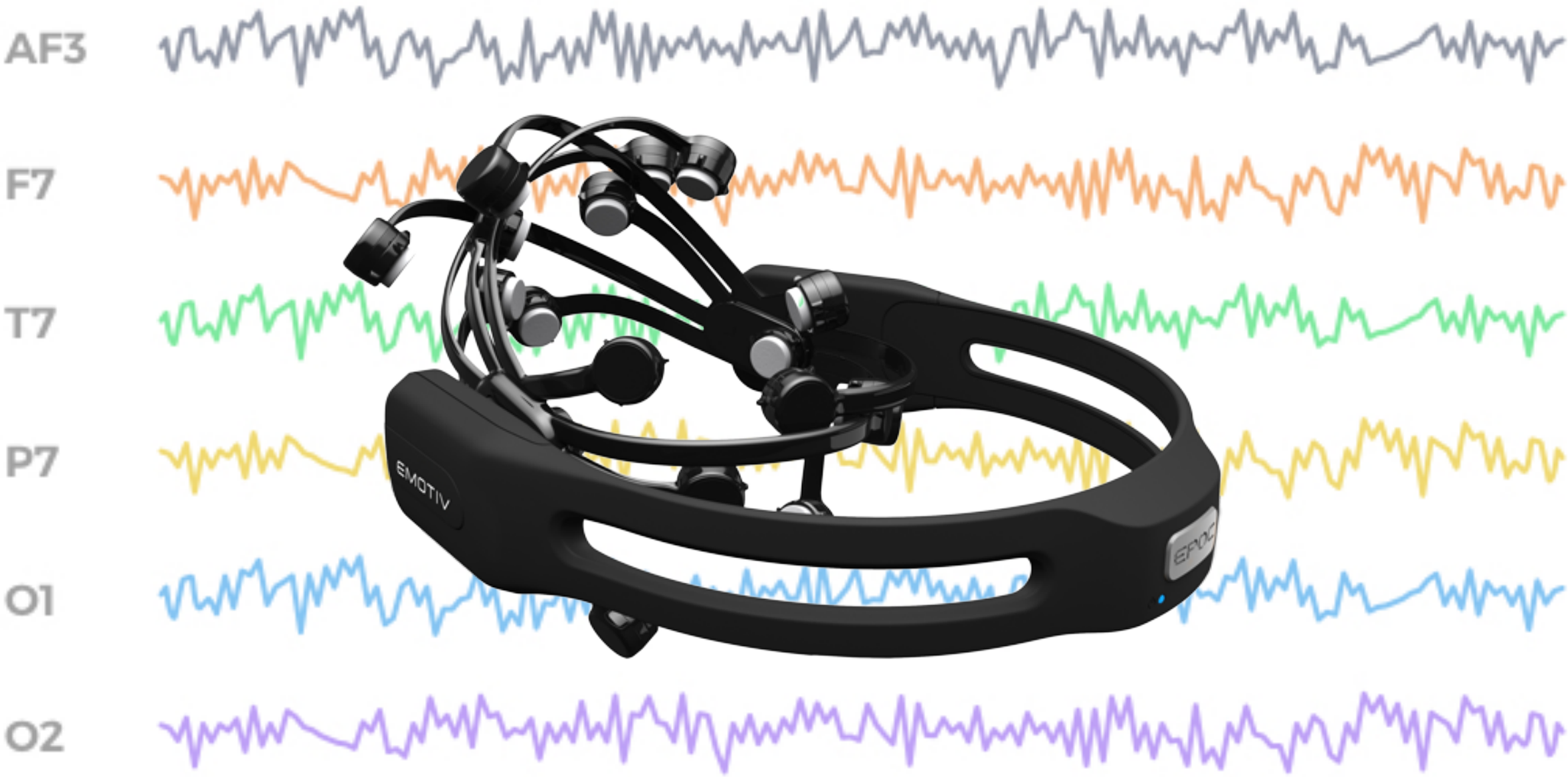
statista | BUSINESS INSIDER

Self Driving Simulator



View from inside the simulation

Each frame represents the participant’s view as they turn their head to look around, illustrating the 360 degree view inside the simulator.



Emotiv Epoc+ EEG

The signal was sampled at 128 Hz

Delta

< 4 Hz

Theta

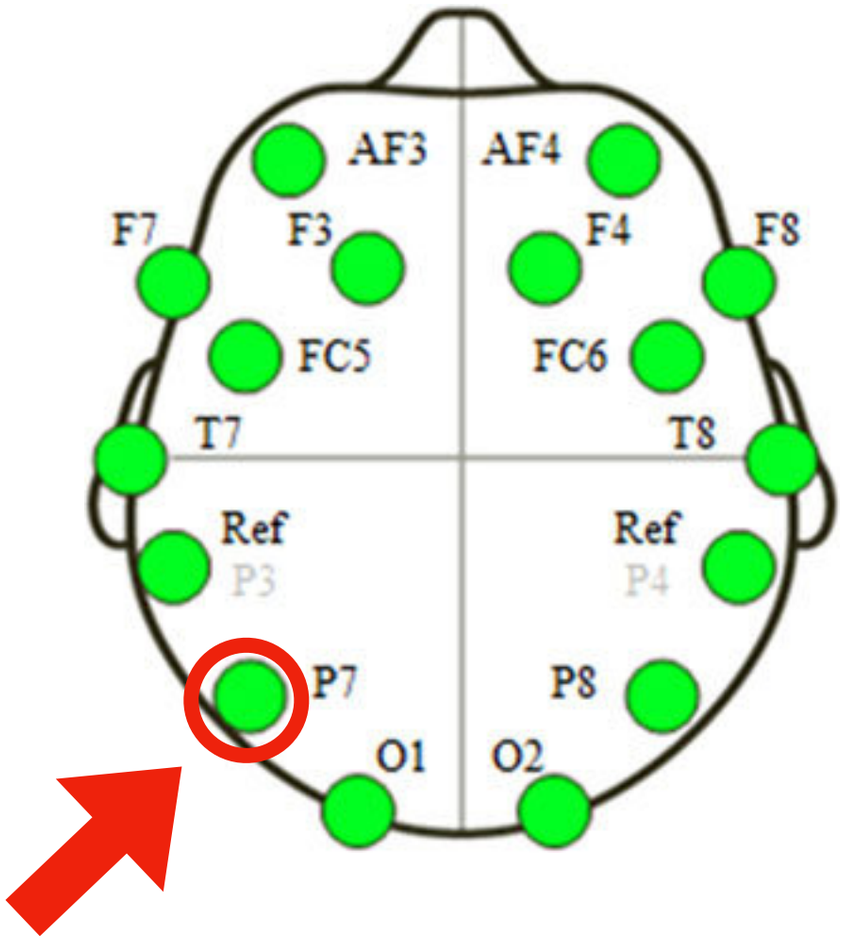
4 - 7 Hz

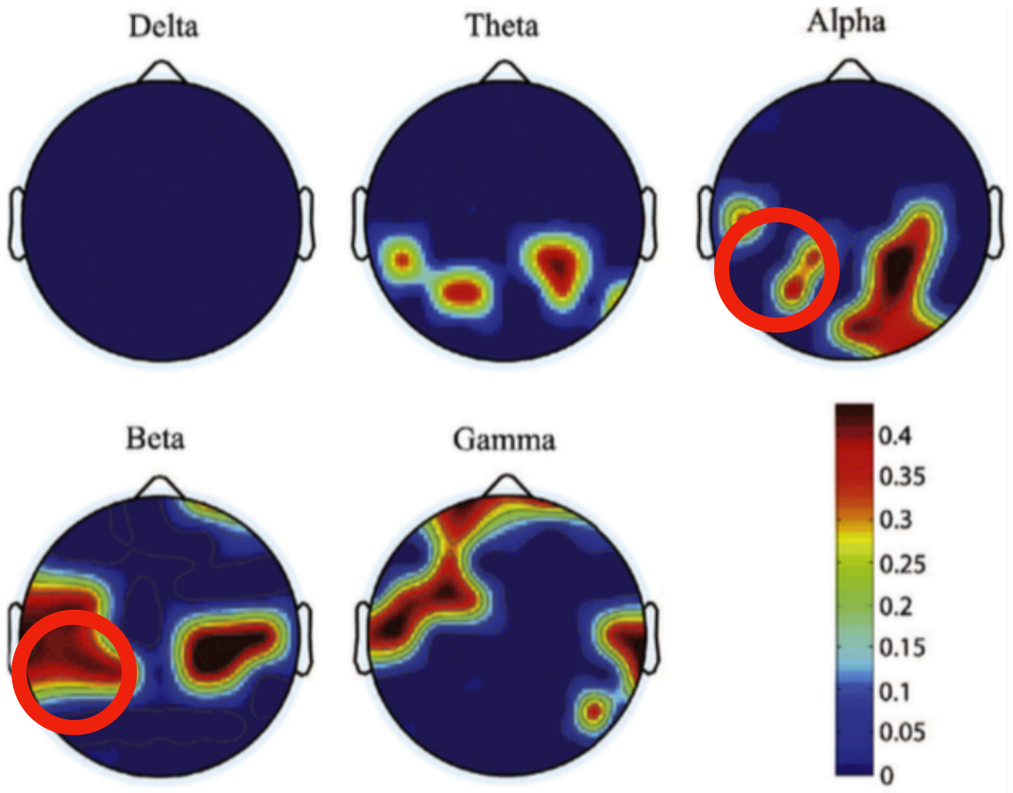
Alpha

7- 12 Hz

Beta

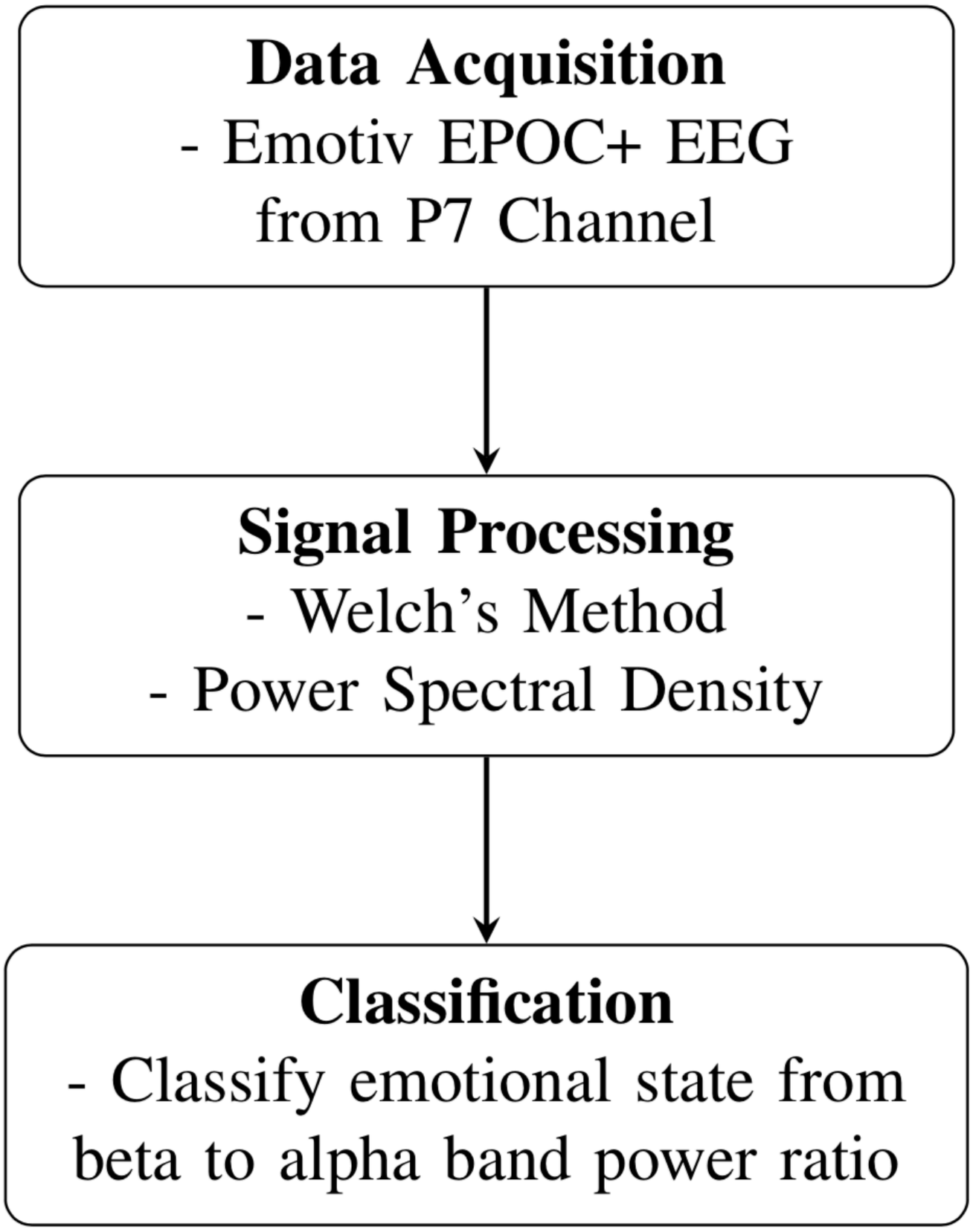
12 - 30 Hz





Channel Selection

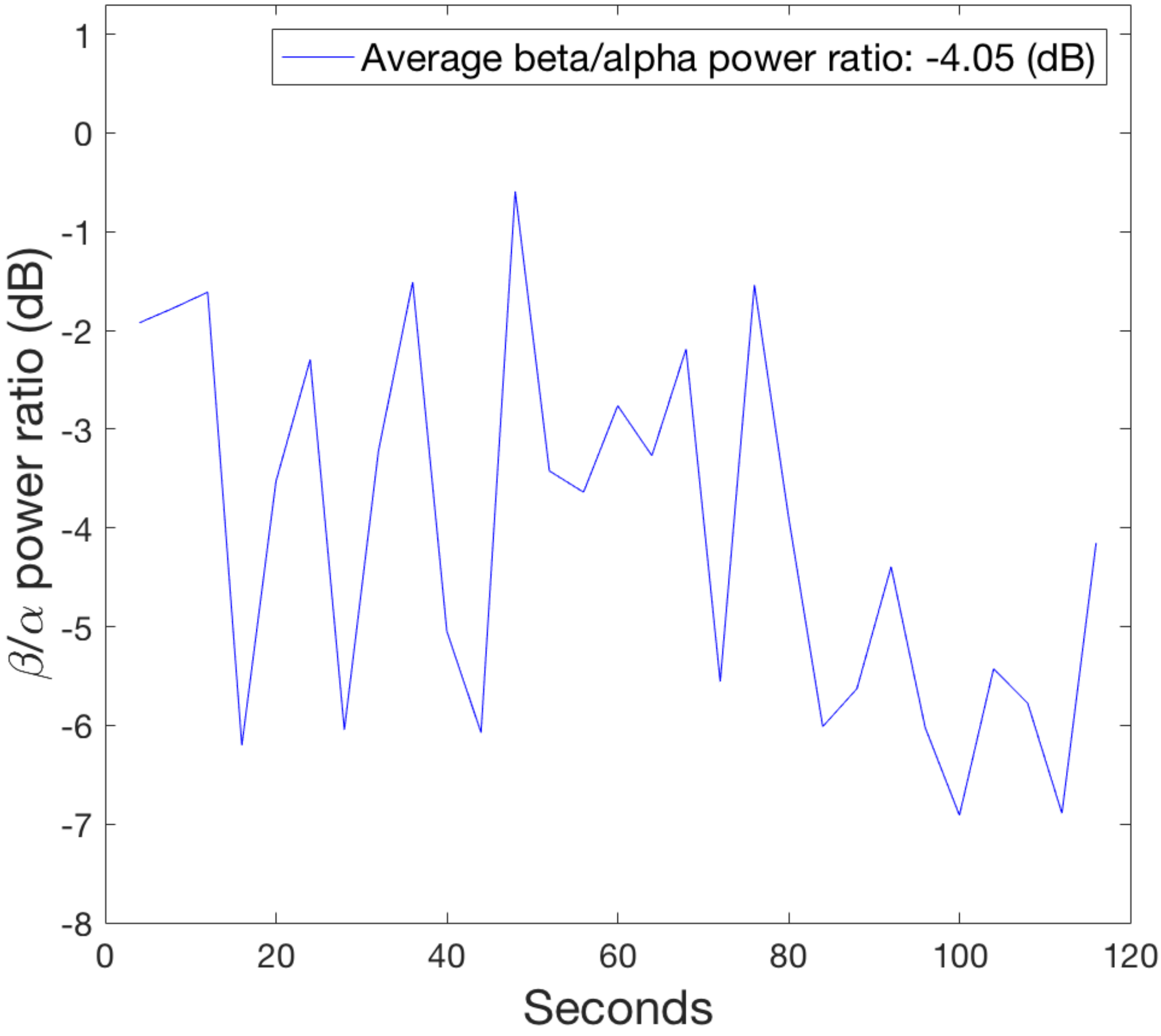
The P7 electrode was the channel used for the signal processing and data analysis.


Data Acquisition
- Emotiv EPOC+ EEG
from P7 Channel
Signal Processing
- Welch's Method
- Power Spectral Density
Classification
- Classify emotional state from
beta to alpha band power ratio

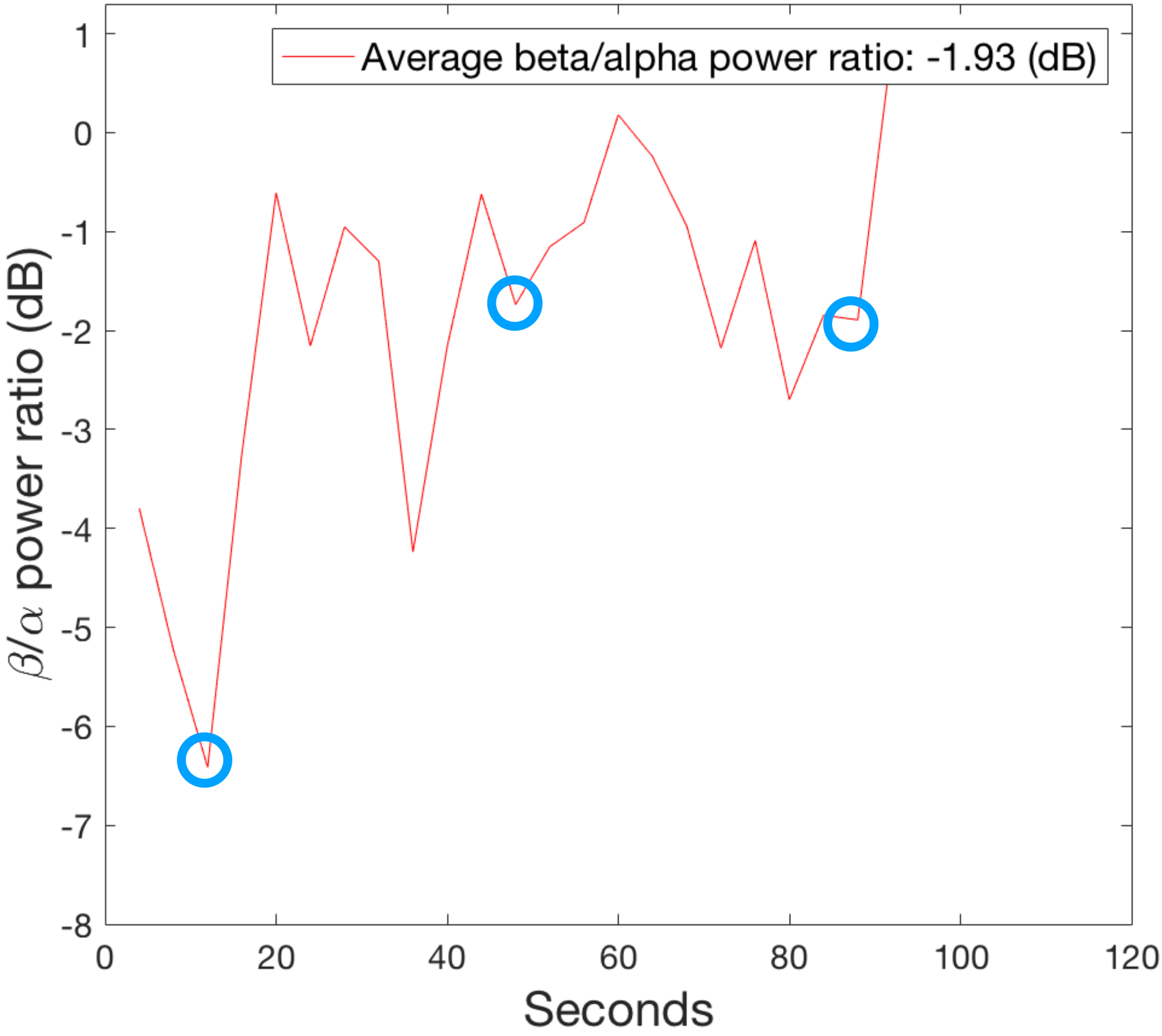
Experiment Design

Scenario 1 - Positive	Scenario 2 - Negative
Drove smoothly on the highway	Drove erratically around a residential neighborhood
Followed all rules of the road	Violated common rules of the road
Maintained a comfortable amount of distance from other vehicles	Ran through a stop sign and nearly collided with another vehicle

Scenario 1


Average beta/alpha power ratio: -4.05 (dB)
β/α power ratio (dB)
1
0
-1
-2
-3
-4
-5
-6
-7
-8
0
20
40
60
80
100
120
Seconds

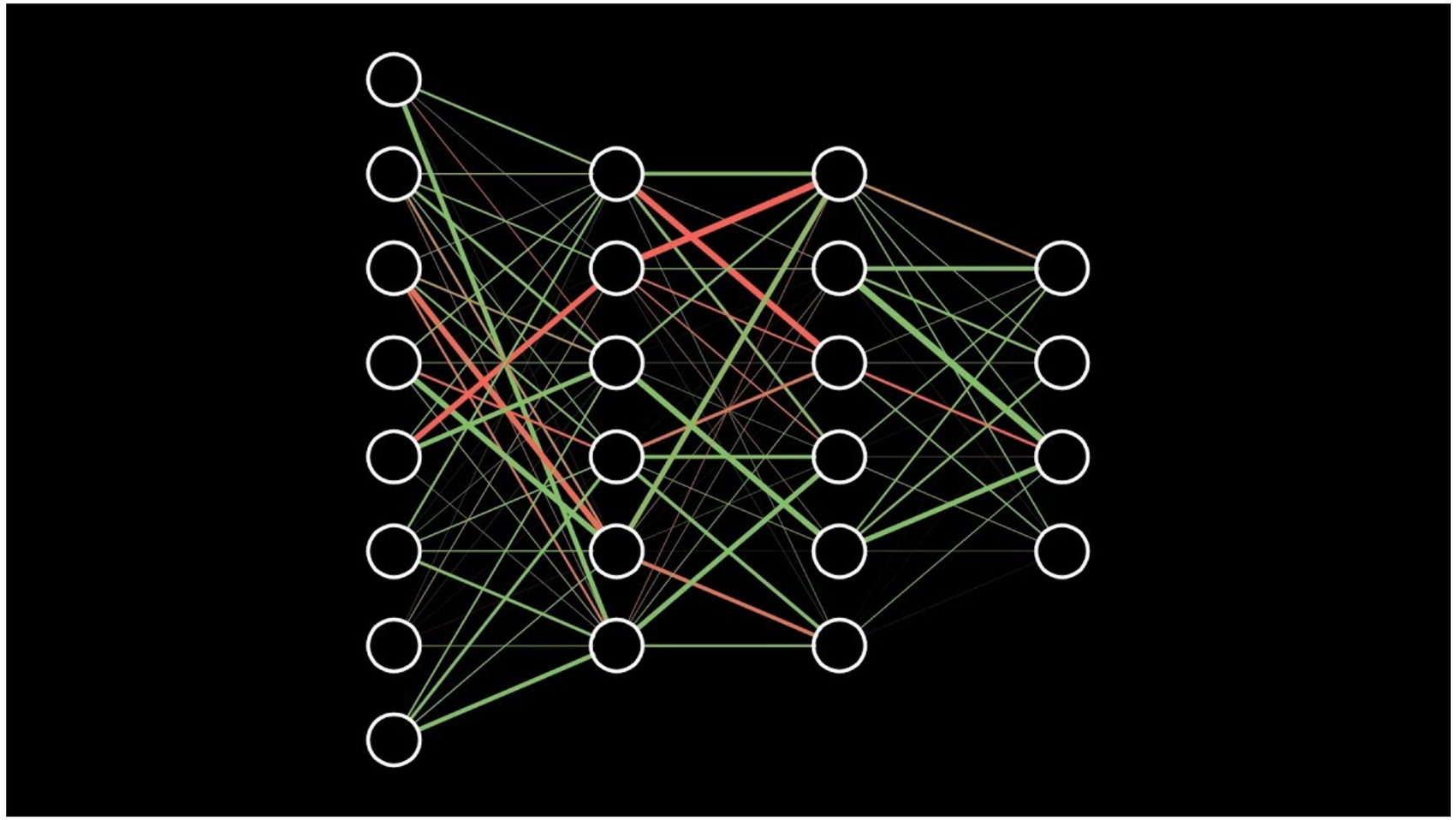
Scenario 2


Average beta/alpha power ratio: -1.93 (dB)
β/α power ratio (dB)
1
0
-1
-2
-3
-4
-5
-6
-7
-8
0
20
40
60
80
100
120
Seconds

Future Work

- Currently running full trial with 50 participants across different scenarios.

- Build Neural Network for automatic classification of data.



Car Behavior

Control System

Acknowledgments

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