

Personalized Neuromodulation Strategies for Cognitive Rehabilitation

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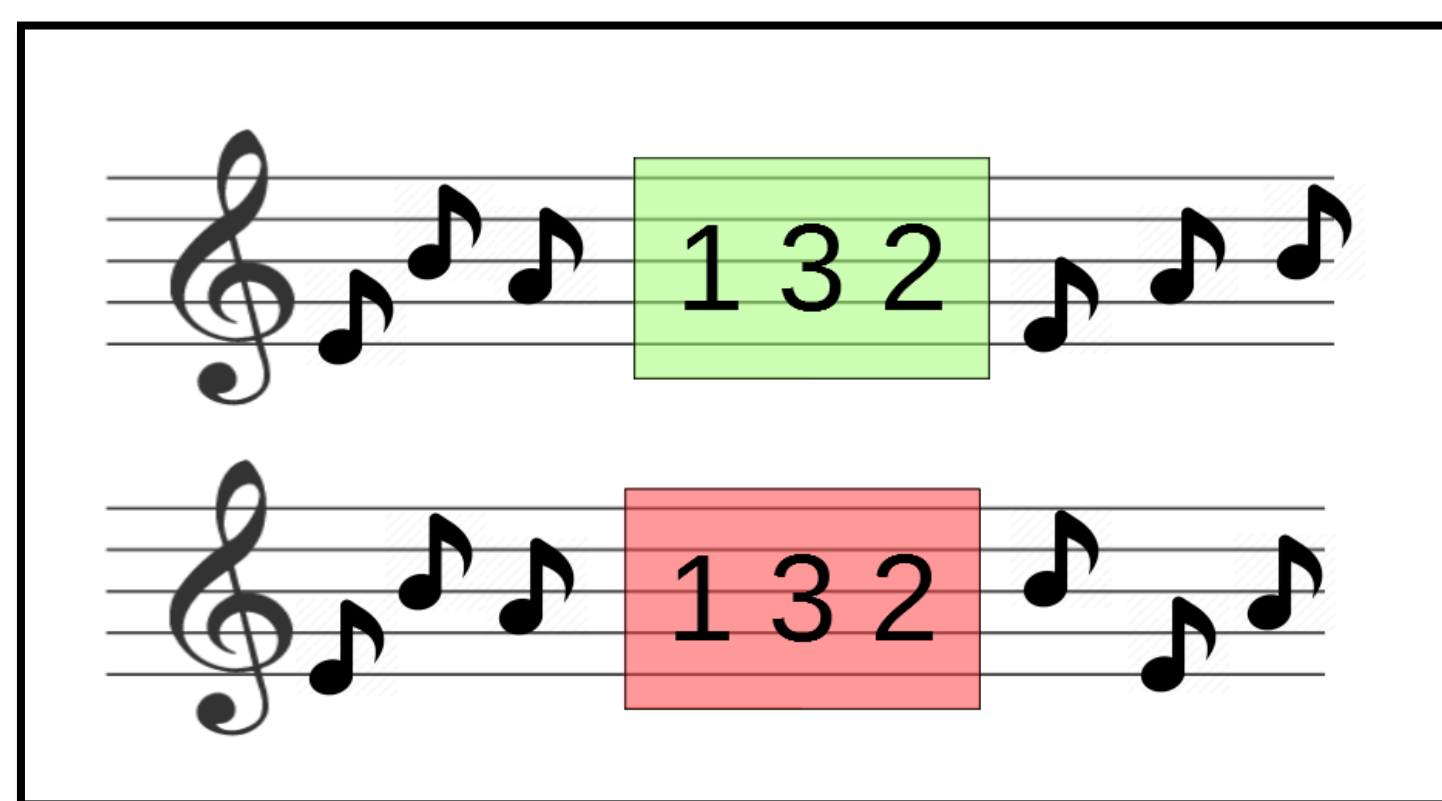
Integrated Program in Neuroscience, McGill University



Introduction

No Effective Treatments for Cognitive Decline
Rising Popularity of **Brain Training** Software

Albouy et al¹: **TMS Theta IPS**
Stimulation = Increased Performance



NF Studies: **Visual Perceptual Learning**

Perceptual Learning Incepted by Decoded fMRI Neurofeedback Without Stimulus Presentation

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Design

Task-based NF for Cognitive Training^{2,3,4}

3 Groups:

1) **Visual NF:**
Early Visual Gamma, Alpha

2) **Auditory NF:**
IPS Theta

3) **Control:**
Sham
No Task-Based NF

2 Main Tasks: (+ Transfer Tasks)

1) **Ventral Visual**
Gabor Orientation Identification

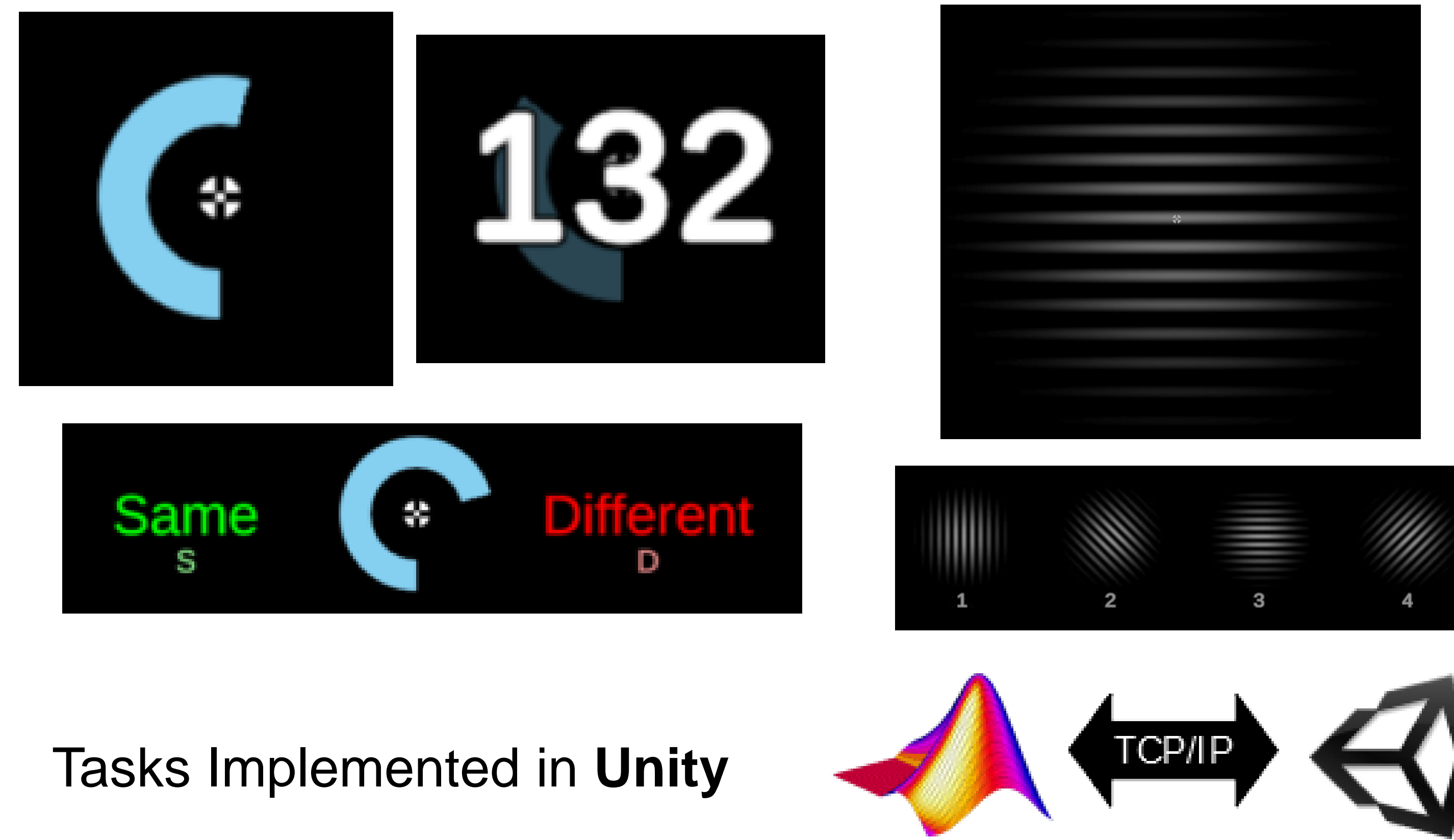
2) **Dorsal Auditory**
Auditory Working Memory

Primary Outcome = Task Performance

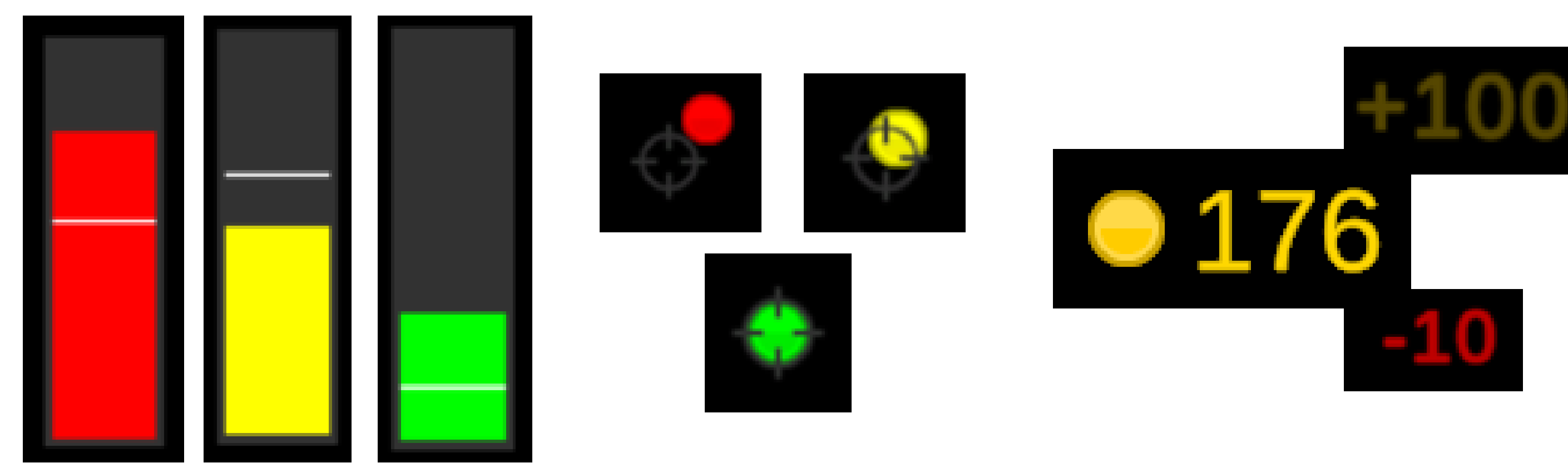
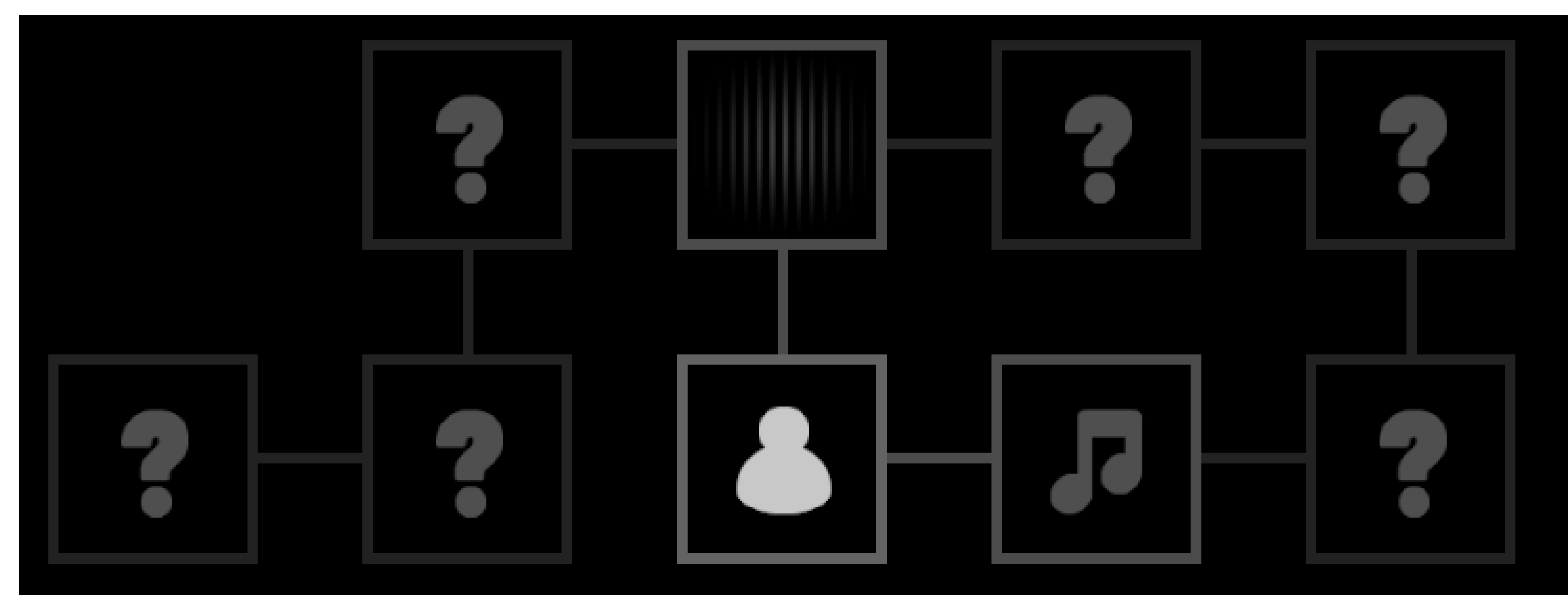
1) **Visual Contrast Threshold:**
Visual NF \geq Control $>$ Auditory NF

2) **Auditory Task Performance**
Auditory NF \geq Control $>$ Visual NF

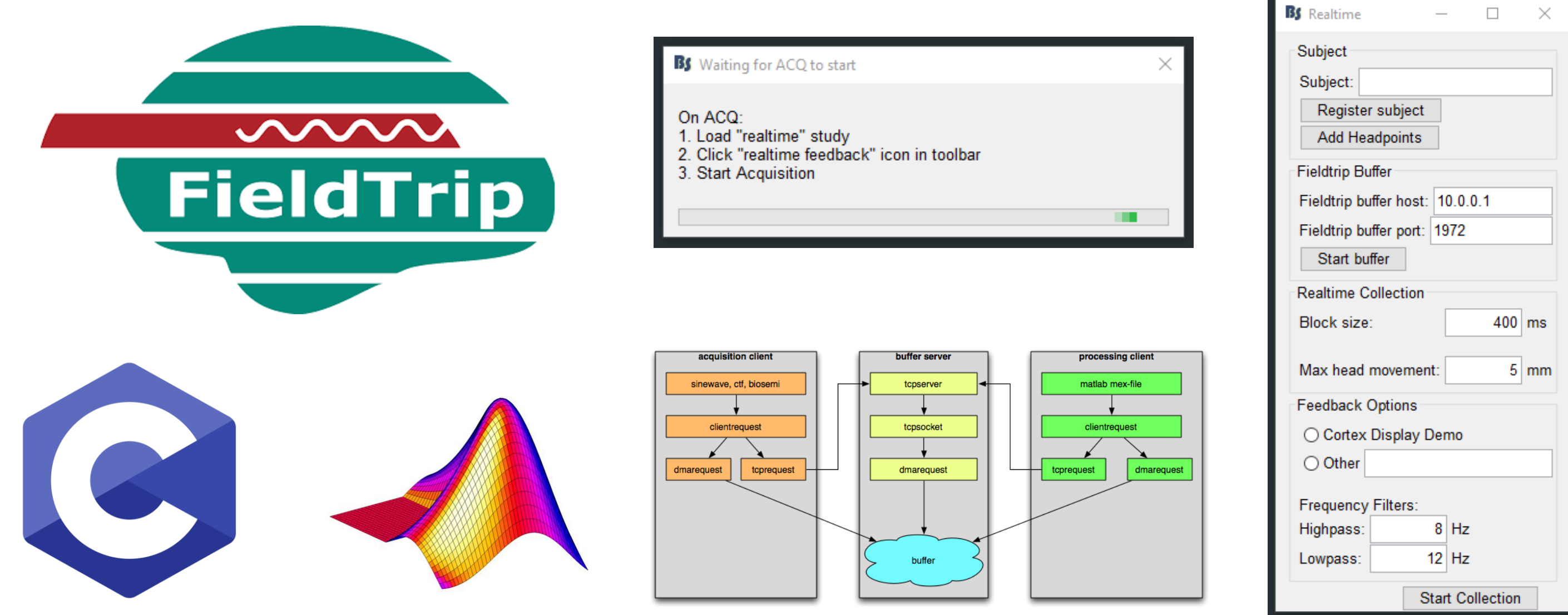
Implementation



Tasks Implemented in **Unity**



Gamified, Adaptive Feedback & Artifact Control



Realtime Feedback Loop: **Brainstorm**^{5,6} & **Fieldtrip**

Discussion

Feedback Classifiers:

1) **Predict Correct Trials**
Parameterized Spectral & Time Series Features

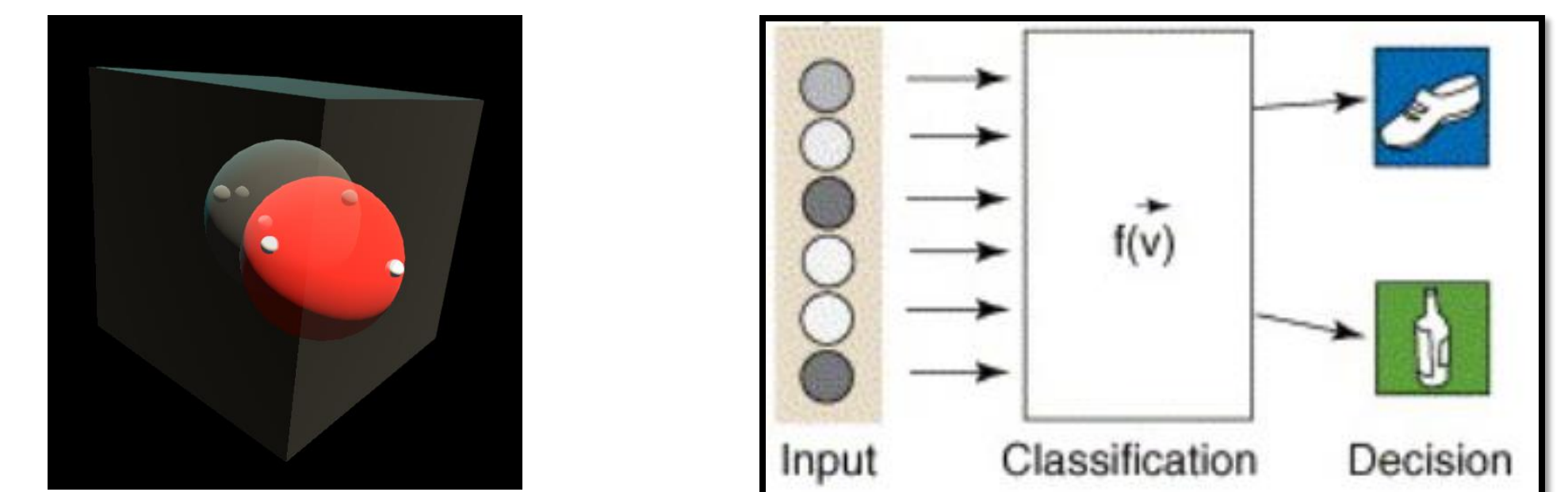
2) **Feedback Predicted Confidence**
Positive Matched Feedback Off-Task



Next Step: MEG Pilot

1) **Pre-Pilot**
Stable Realtime Implementation
Real-time Artifact/Headtracking Feedback

2) **Training Pilot**
Real-time Artifact Correction
Feature Extraction, Classifier Design
Assess Blinding



Normal et al. Beyond mind-reading: multi-voxel pattern analysis of fMRI data

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Acknowledgments



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