Interpreting the Effects of Media Content on Flow Dynamics During Naturalistic Gameplay

Richard Huskey[1], Justin Keene[2], Shelby Wilcox[1], Robyn Adams[3], Natalie Petit[1]

[1]Cognitive Communication Science Lab, School of Communication, The Ohio State University
[2]Cognition and Emotion Lab, College of Media and Communication, Texas Tech University
[3]College of Communication Arts and Sciences, Michigan State University

TEXAS TECH UNIVERSITY COGNITION & EMOTION LAB

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Background

• Flow is a state of high attention and reward directed at and induced by an immersive task.[1]
• Media use is theorized to produce a flow state when there is a balance between task difficulty and an individual's skill at the task.[2]
• Flow results from a dynamic brain-network synchronization between cognitive control and reward networks when task difficulty ≈ individual ability.[3,4,5]
• Our capacity to link flow with moment-by-moment changes media content is limited by conceptual and operational ambiguity.[3,5]
• Validating a flow-inducing experimental paradigm sets a foundation for using fMRI to measure dynamic changes in flow neuromarkers.[5]
• Here, we use naturalistic gameplay to:
  • Validate a procedure for experimentally inducing flow.
  • Replicate flow self-report, behavioral, and neural findings.[4,5]
  • Observe cognitive control dynamics during flow.

Stimulus & Procedure

• Subjects played *Asteroid Impact*
  • Ability > Difficulty
  • Ability < Difficulty
  • Ability ≈ Difficulty
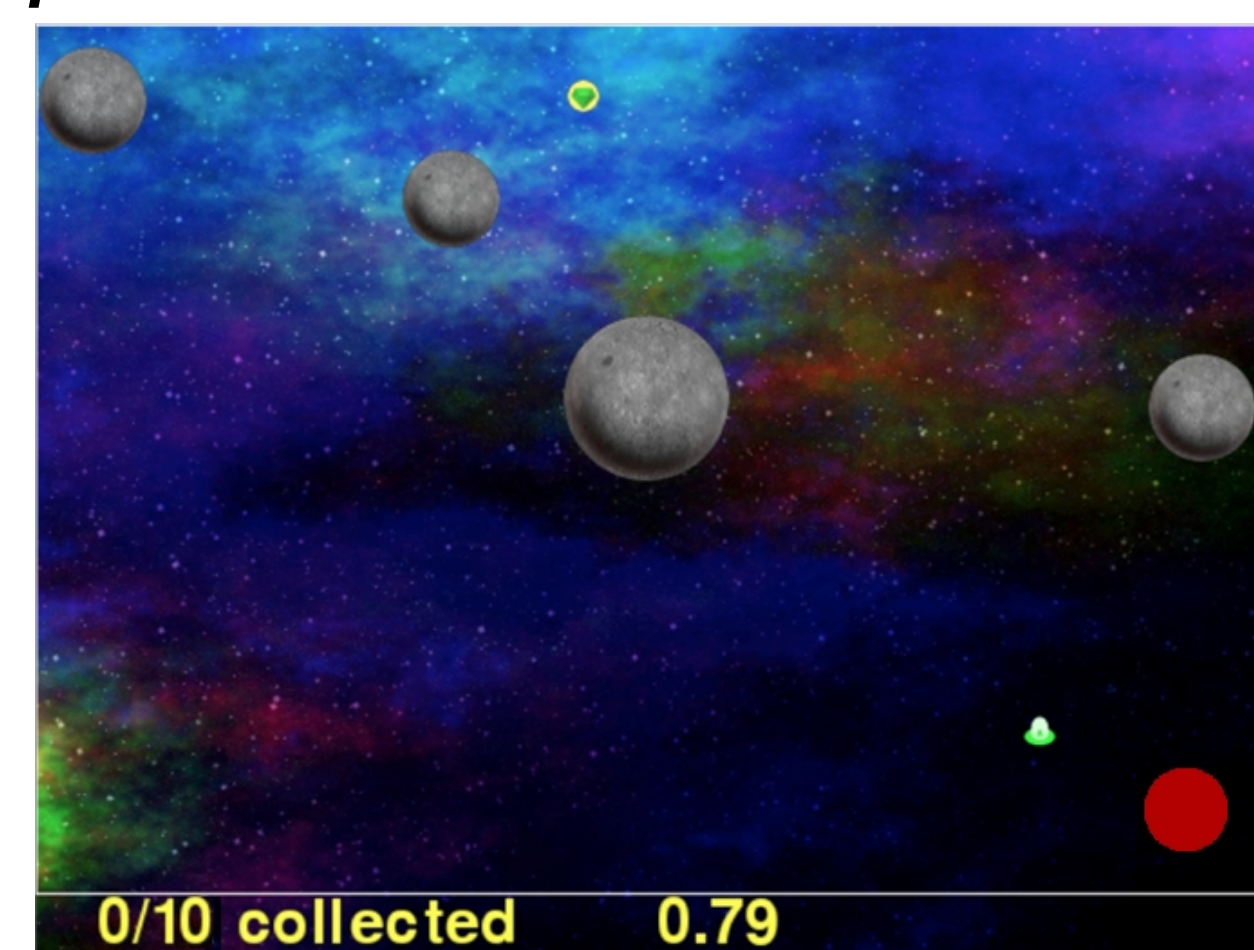• Two experiments
  • *N = 74*
  • fMRI *n = 30*
• Randomized orders
• Dependent Measures:
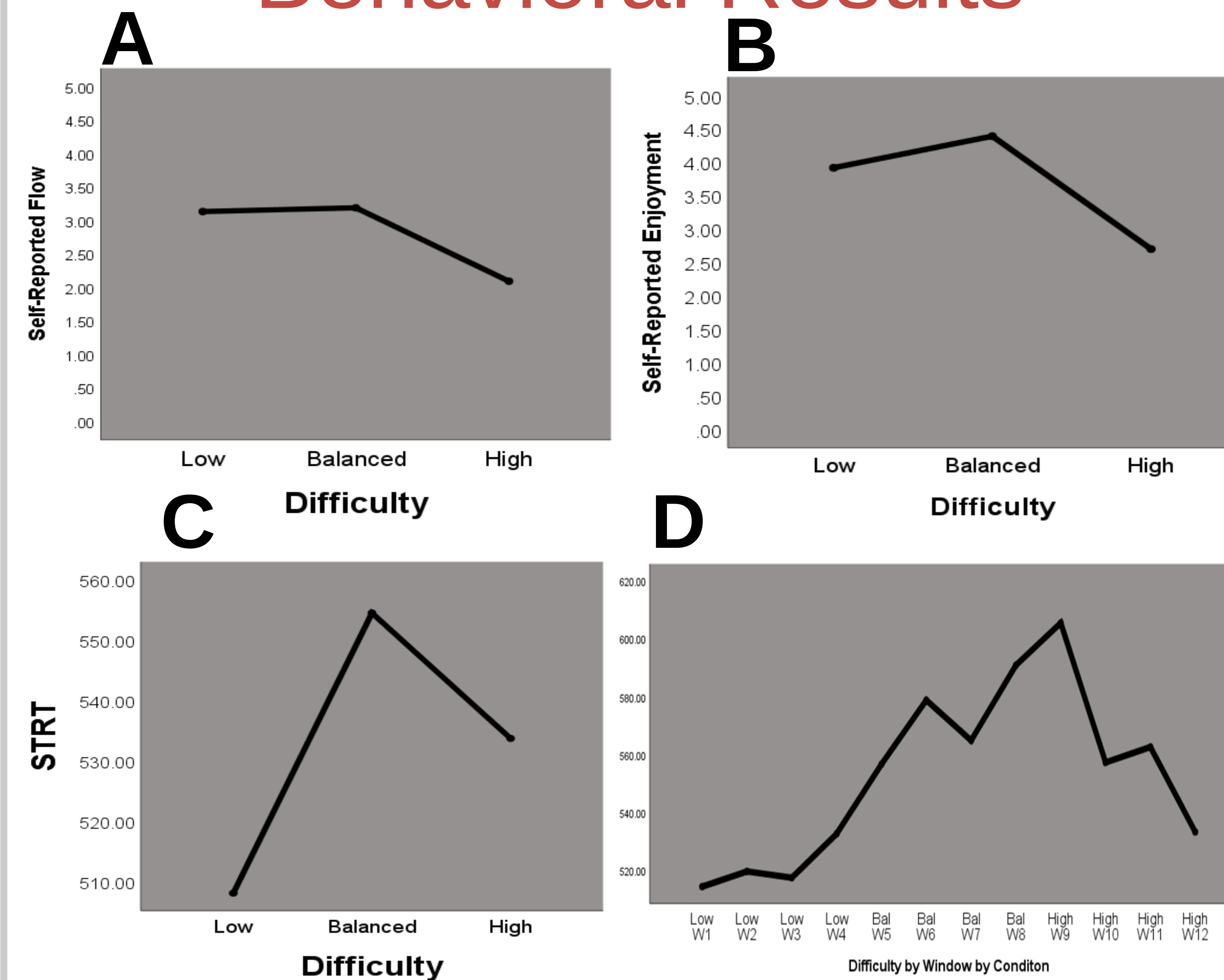 • Self-reported flow
  • Self-reported enjoyment
  • STRT
• GitHub & OSF:
  • https://osf.io/7tgcx/?view_only=fa771af2b2054a89afbb62990d103b57
 • https://github.com/richardhuskey/asteroid_impact

Subjects collected targets while avoiding asteroids that moved around the screen. Difficulty was manipulated by modifying asteroid speed. All other game settings remained the same between conditions. Subjects also responded to a STRT (red circle + auditory tone) during gameplay.

Behavioral Results

(A) Self-reported feelings of flow: Wilk's λ = 0.38, $F(2,67)$ = 53.92, $p < 0.001$
(B) Self-reported enjoyment: Wilk's λ = 0.49, $F(2,67)$= 35.36, $p < 0.001$
(C) Mean reaction time: Wilk's λ = 0.82, $F(2,65)$ = 2.68, $p = 0.076$
(D) STRTs over time: Wilk's λ = .712, $F(11,56)$ = 2.063, $p = .039$

fMRI Results
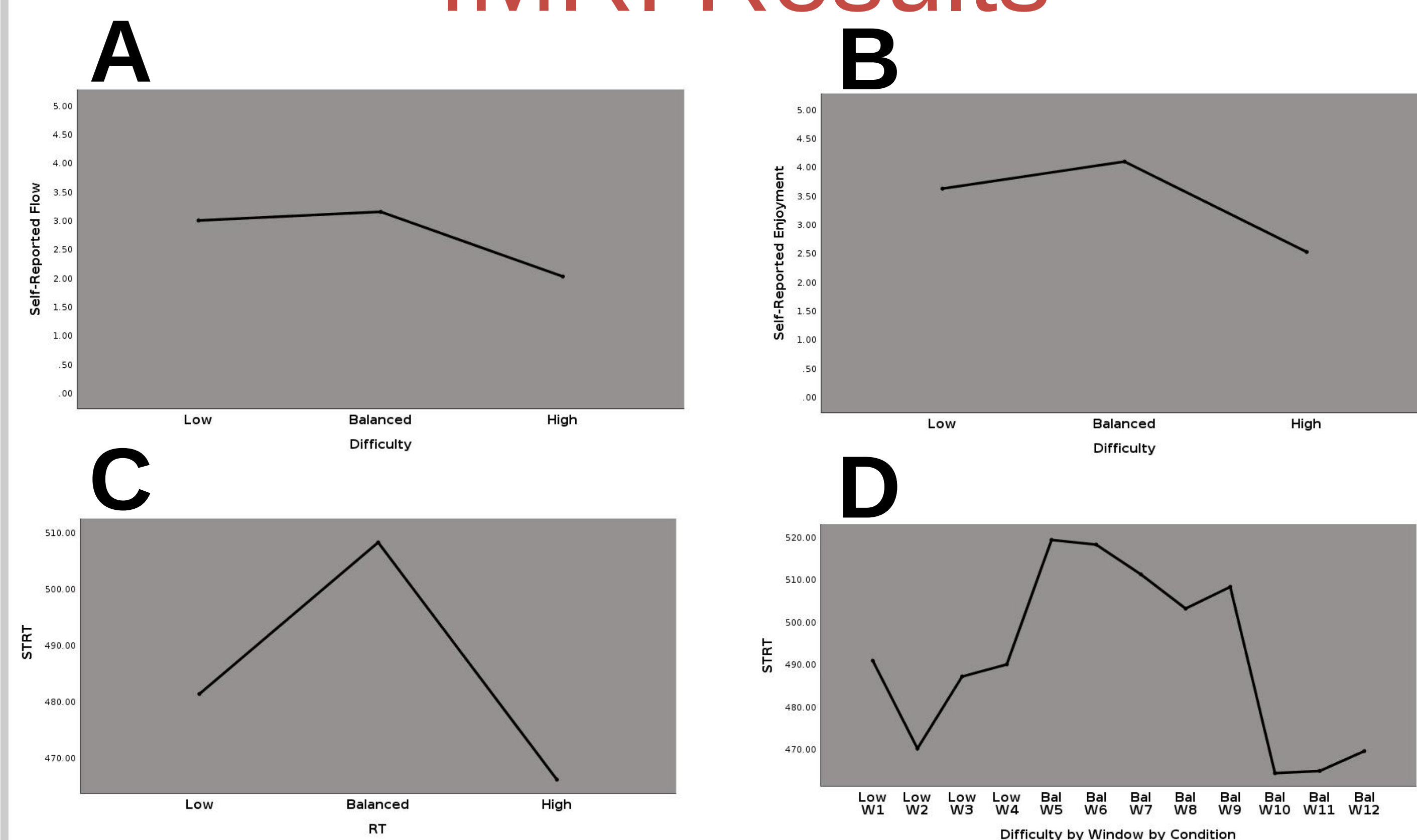
(A) Self-reported feelings of flow: Wilk's λ = 0.36, $F(2,23)$ = 20.72, $p < 0.001$
(B) Self-reported enjoyment: Wilk's λ = 0.43, $F(2,23)$ = 15.40, $p < 0.001$
(C) Mean reaction time: Wilk's λ = 0.87, $F(2,21)$ = 1.58, $p = 0.23$
(D) STRTs over time: Wilk's λ = 0.548, $F(11,12)$ = 0.90, $p = .566$

fMRI Results Cont.

• Replicate a previously published network neuroscience[6] finding.[5]
• The brain-network corresponding to flow had the lowest global efficiency[7] value.
• This indicates that flow is energetically efficient[8] compared to boredom and frustration.
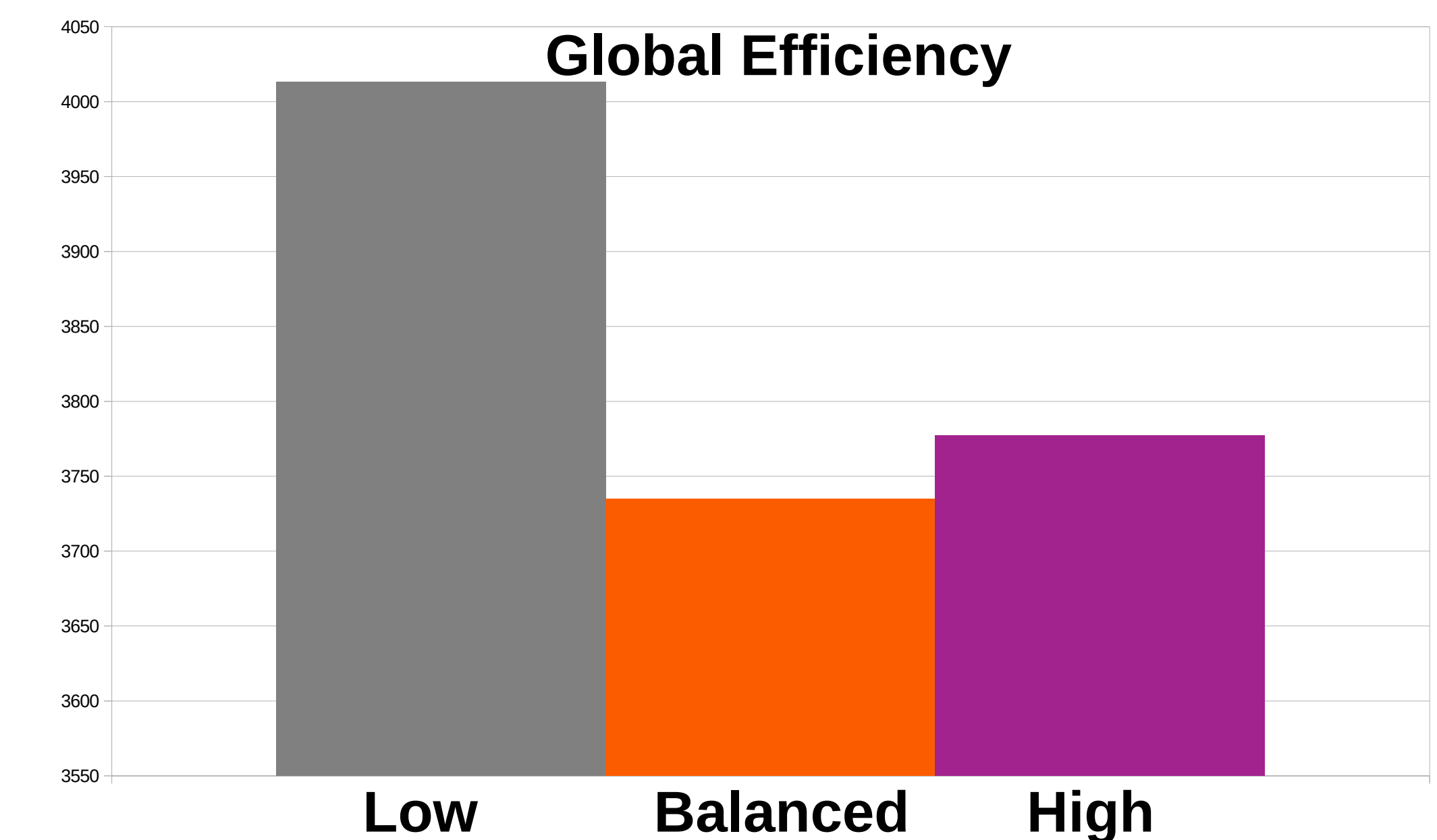
Global Efficiency

Discussion

• Replicate Previous Findings:
  • Highest levels of flow and enjoyment occur in balanced-difficulty conditions.
  • Replicated global efficiency results.
• Extend into windowed analysis
  • STRTs are invariant within condition but vary between conditions.
• Next-step:
  • Dynamic brain-network analysis.

References & Funding

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