Leveraging Mobile Health Technology to Identify Neurobehavioral Symptom Patterns in the First Year after Discharge from Inpatient Rehabilitation for Traumatic Brain Injury

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Background

Traumatic Brain Injury (TBI) as a chronic condition [1-3]

1. Regular and systematic evaluation of known and anticipate symptoms and conditions
2. Requires more focus on effective self-management
3. Self-management may be more challenging in the context of TBI, as many skills necessary for self-management are directly affected by the injury

National Academies of Sciences, Engineering, & Medicine (2022) Report [4]

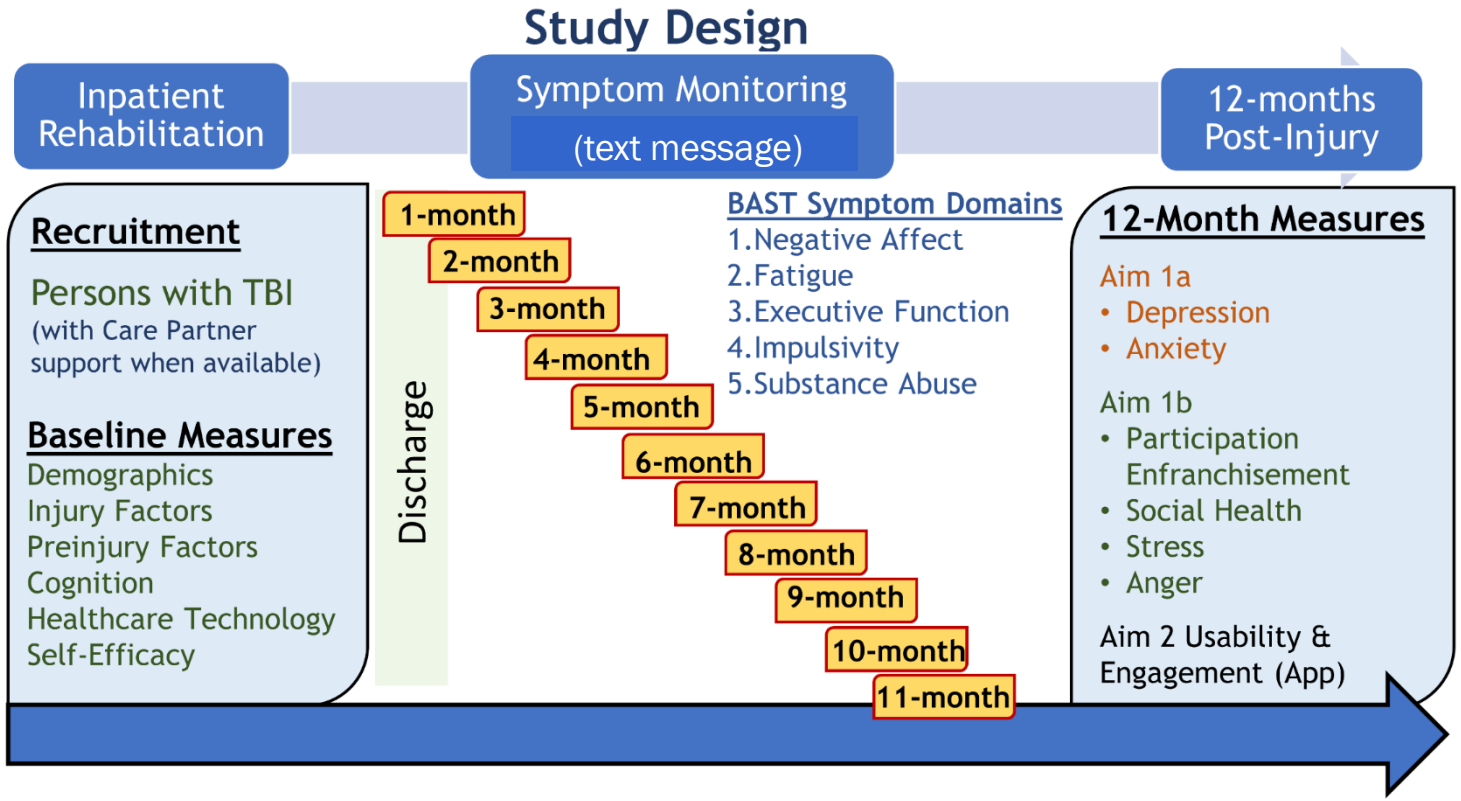
- Maintaining stable mood during the first year following TBI
- Prevention as necessary for an optimal system of care for TBI
- Clinical communities ensure that all persons with TBI and their care partners receive guidance in advance of development of symptoms and complications to ensure timely intervention and optimal recovery

Objective

- mHealth offers a promising, state-of-the-art, and efficient solution for monitoring and intervention after TBI [5,6]
- Evidence-based algorithms based on symptom patterns are needed to trigger just-in-time interventions or follow-up by a healthcare provider.
- Requires detailed and serial data on prodromal symptoms that evolve into mental health conditions
- Supports self-management, through self-monitoring, of symptoms

Specific Aims and Study Design

1. To **identify trajectories** in neurobehavioral symptom domains over the first 12 months post-injury that **predict depression and anxiety** at 12-months.
2. To **determine the feasibility** of using mHealth (text messaging a link to an electronic survey) for self-monitoring symptoms in the first 12 months after TBI.



Inclusion criteria (n=90 enrolled)

1. Admitted to TIRR inpatient rehabilitation
2. Medically-documented TBI
3. Fluent in English
4. ≥18 years old
5. Capacity to self-consent
6. Access to smartphone/mobile device/computer with internet

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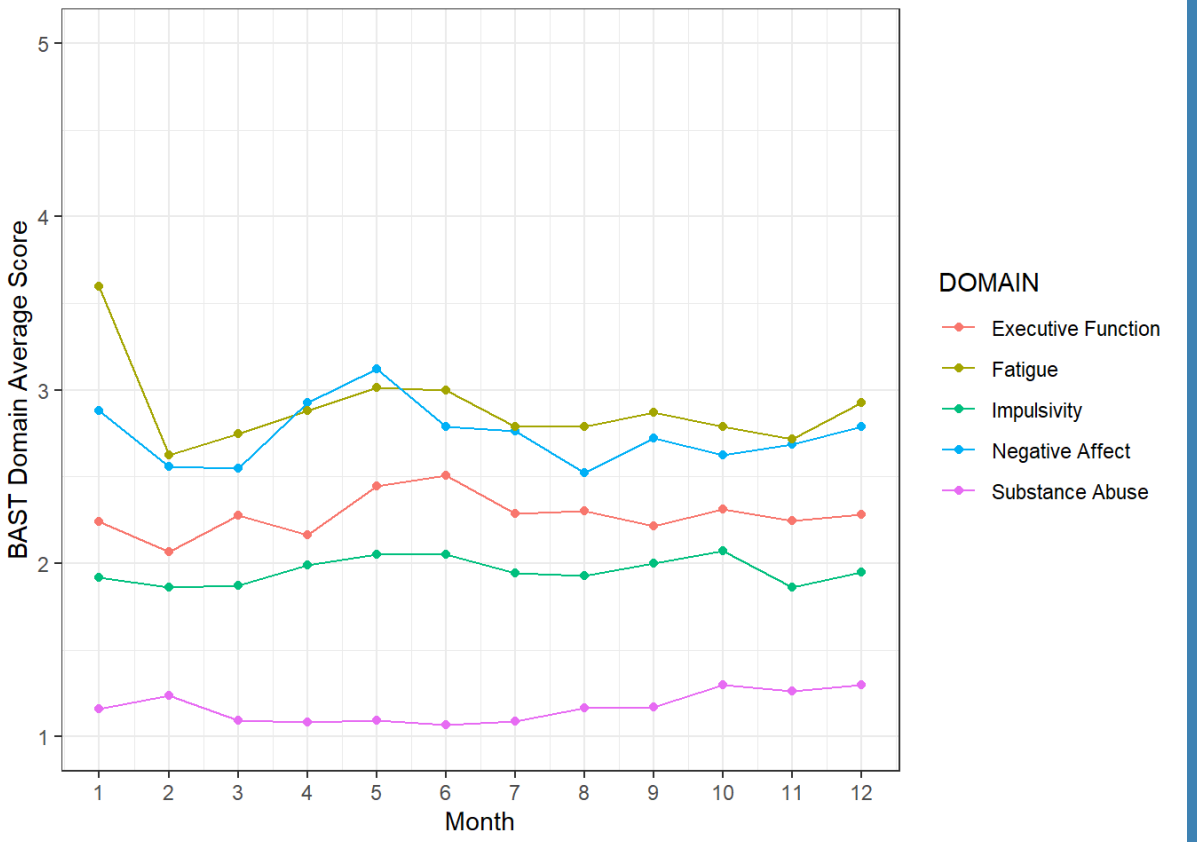
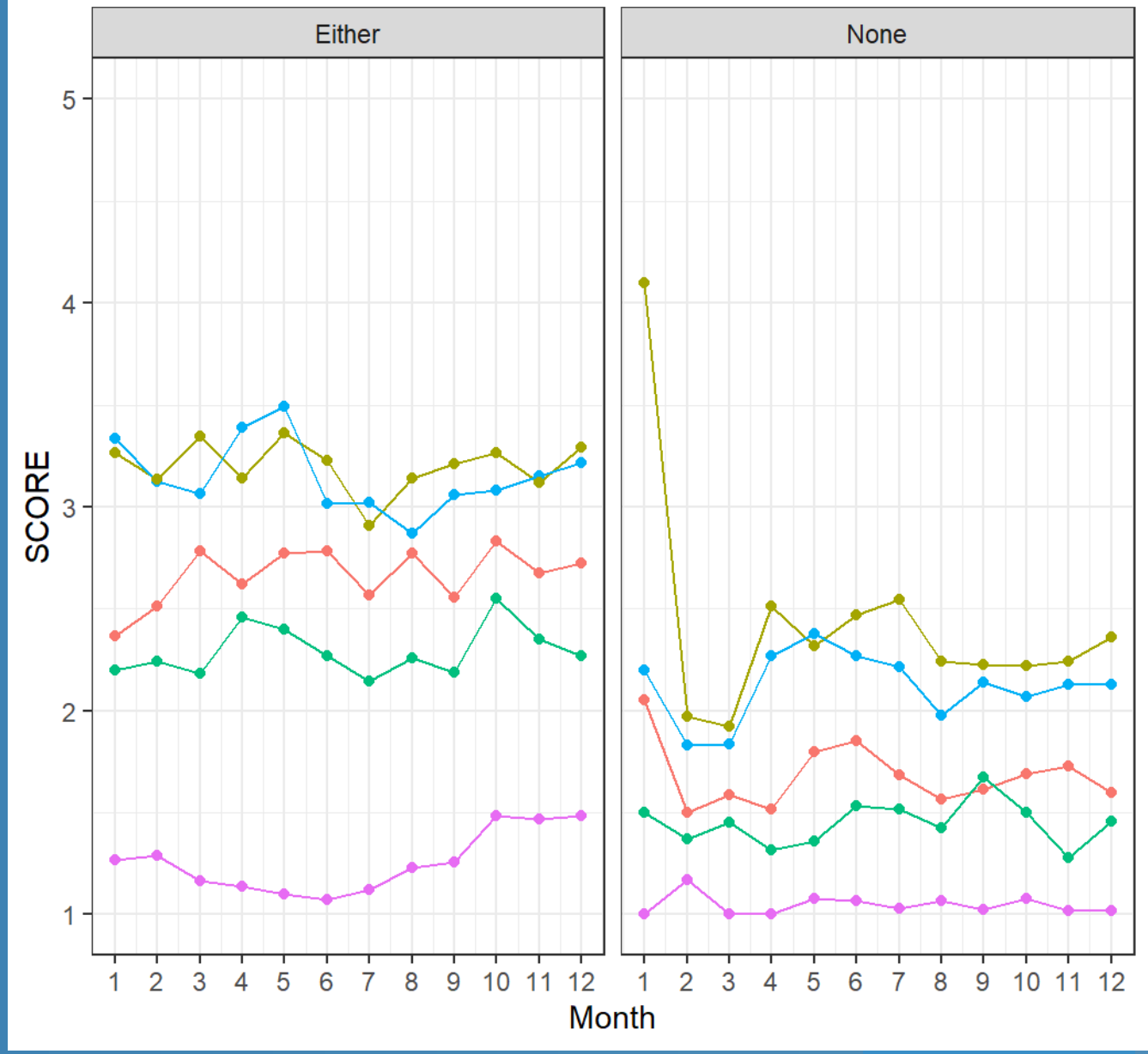
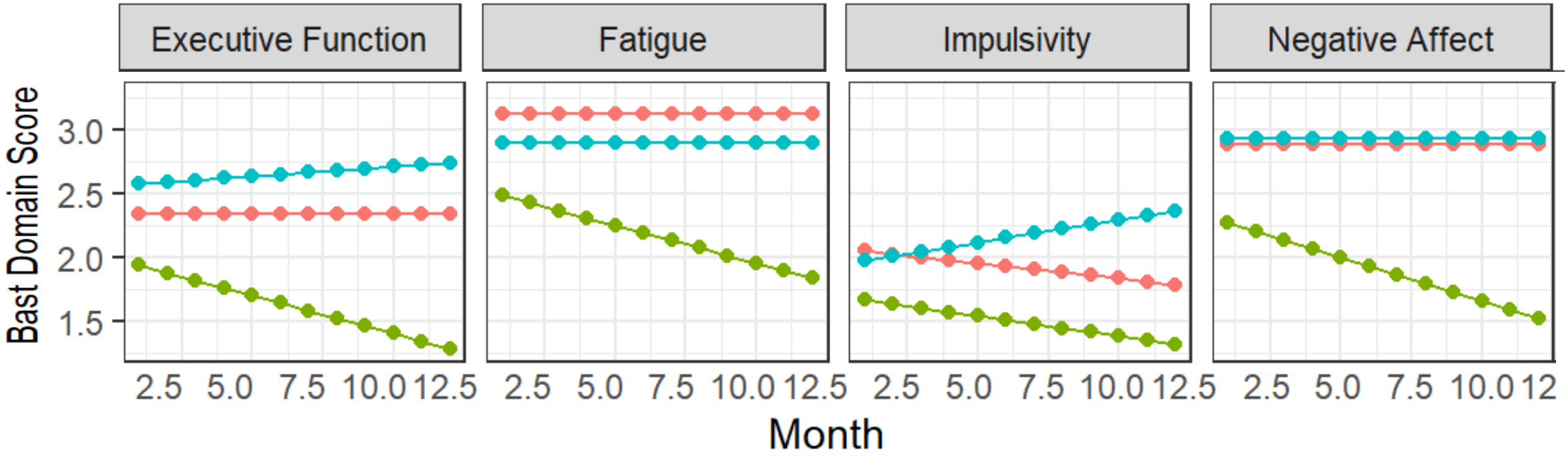
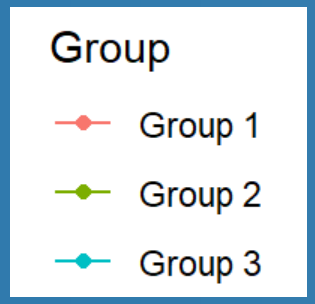
Average BAST Subscale scores for all participants over 12-months post-injury



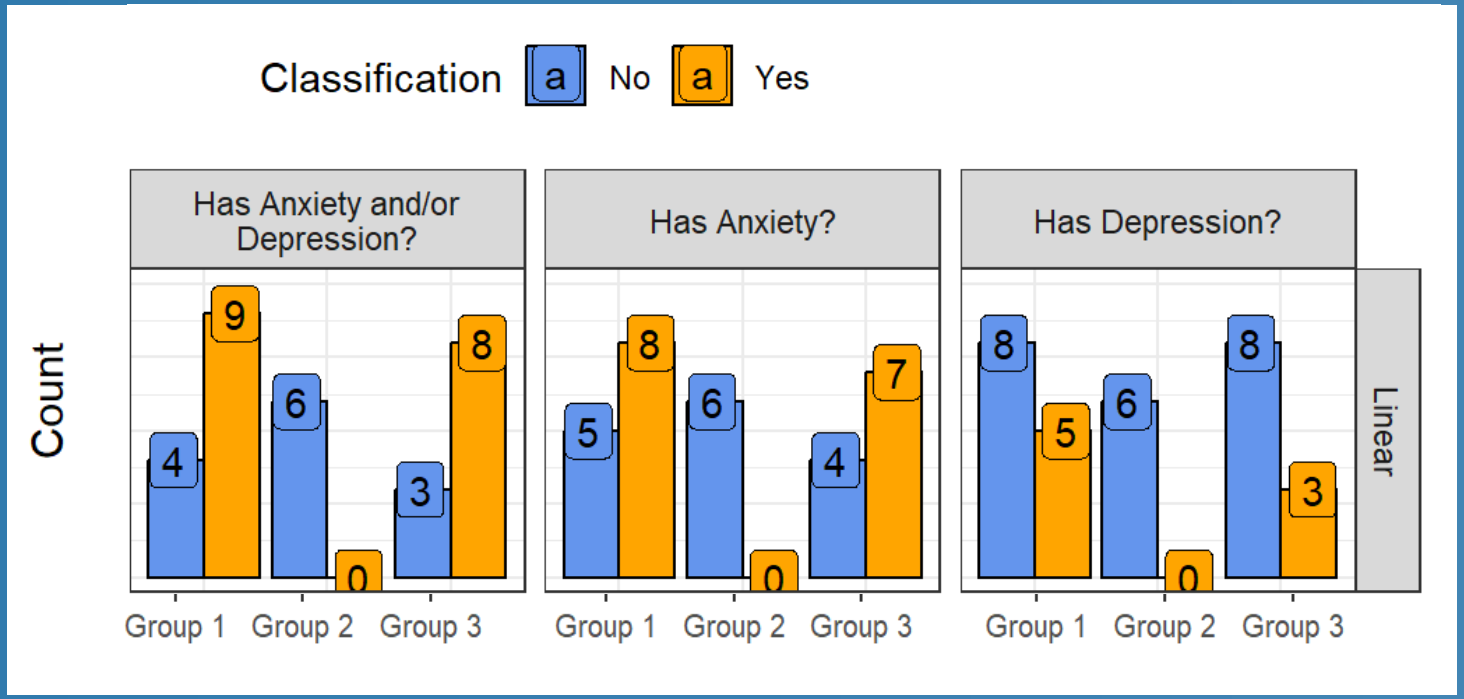
Average BAST Subscale scores over 12-months post-injury by depression/anxiety status

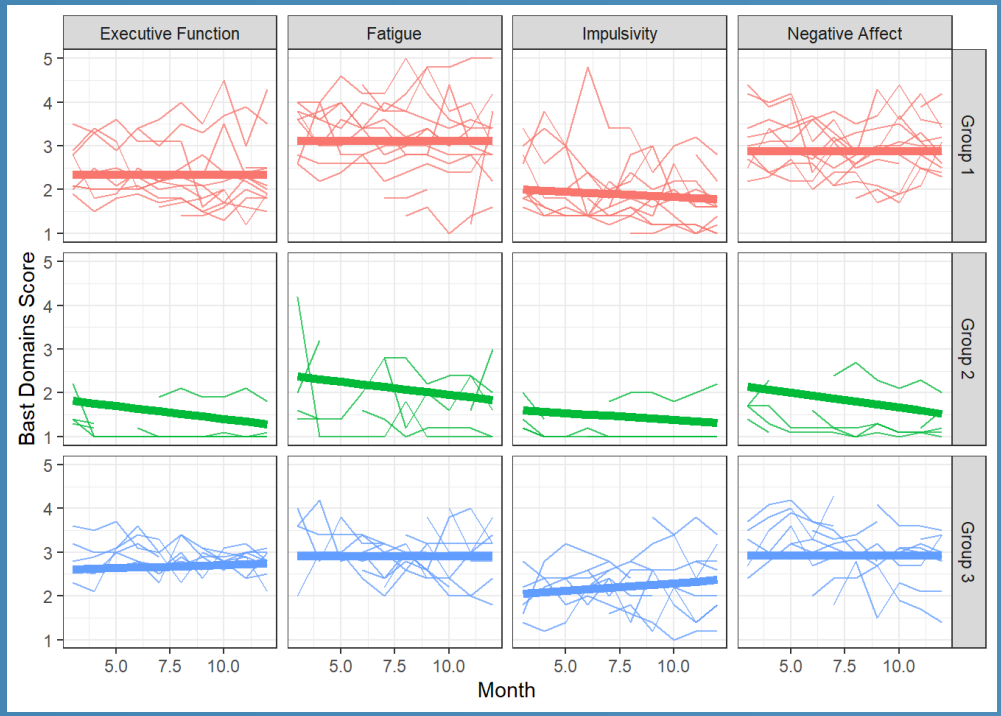






Group-Based Trajectory Modeling (GBMT)


Classification a No a Yes
Has Anxiety and/or Depression?
Has Anxiety?
Has Depression?
Count
Linear
Group 1 Group 2 Group 3


Executive Function
Fatigue
Impulsivity
Negative Affect
Group 1
Group 2
Group 3
Bast Domains Score
Month

Conclusions

Characterizing multidomain symptom trajectory groups over the first year post-TBI:

- High variability (within and between persons)
- Potential patterns indicative of later mental health challenges
- Potential opportunities for proactive intervention
- Consistent with prior research but should be validated across different clinical settings and institutions

References

[1] Corrigan JD, Hammond FM, Sander A, Kroenke K. Recognition of Traumatic Brain Injury as a Chronic Condition: A Commentary. J Neurotrauma. 2024 Sep 14. doi:10.1089/neu.2024.0356 PubMed PMID: 39276117.

[2] Sander AM, Pappadis MR, Bushnik T, Chiaravalloti ND, Driver S, Hanks R, et al. An Umbrella Review of Self-Management Interventions for Health Conditions With Symptom Overlap With Traumatic Brain Injury. J Head Trauma Rehabil. 2023 Jun 1. doi:10.1097/htr.0000000000000863 PubMed PMID: 37294622.

[3] Corrigan JD, Hammond FM, Sander AM, Kroenke K. Model of Care for Chronic Brain Injury. Arch Phys Med Rehabil. 2025 Jan;106(1):145–9. doi:10.1016/j.apmr.2024.08.001 PubMed PMID: 39154926; PubMed Central PMCID: PMC12182749.

[4] National Academies of Sciences, Engineering, and Medicine. Traumatic Brain Injury: A Roadmap for Accelerating Progress [Internet]. Berwick D, Bowman K, Matney C, editors. Washington, DC: The National Academies Press; 2022 [cited 2022 Mar 25]. 244 p. Available from: https://www.nap.edu/catalog/25394/traumatic-brain-injury-a-roadmap-for-accelerating-progress doi:10.17226/25394

[5] Juengst SB, Hart T, Sander AM, Nalder EJ, Pappadis MR. Mobile Health Interventions for Traumatic Brain Injuries. Curr Phys Med Rehabil Rep. 2019 Dec 1;7(4):341–56. doi:10.1007/s40141-019-00240-9

[6] Juengst SB, Terhorst L, Nabasny A, Wallace T, Weaver JA, Osborne CL, et al. Use of mHealth Technology for Patient-Reported Outcomes in Community-Dwelling Adults with Acquired Brain Injuries: A Scoping Review. Int J Environ Res Public Health. 2021 Feb 23;18(4). doi:10.3390/ijerph18042173 PubMed PMID: 33672183; PubMed Central PMCID: PMC7926536.