

**CLINICAL AND NEURAL EFFECTS OF MULTIDOMAIN AUGMENTED REALITY
REHABILITATION IN PERSISTENT POST-CONCUSSION SYNDROME**

Anthony Machula

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Abstract

Persistent post-concussion symptoms (PPCS) cause debilitating impairments lasting months to years and resist conventional rehabilitation. Cognitive-motor integration (CMI) networks are particularly vulnerable following concussion yet remain an unexplored therapeutic target. We investigated whether augmented reality-based multidomain rehabilitation targeting CMI could induce clinical and neural recovery in adults with chronic PPCS. Seven participants (mean age 50.7 years, 71% female, mean 38.1 months post-injury) completed a twice-weekly, 8-week intervention combining visuospatial working memory, visuomotor transformation, and progressive vestibular challenge. Participants demonstrated large effect size improvements ($r = 0.83\text{--}0.90$) in energy, emotional wellbeing, perceived stress, and dizziness, though statistical power was limited by sample size, with seven measures meeting or exceeding estimated minimal clinically important difference (MCID) thresholds. A neuroimaging subset ($n=3$) revealed white matter recovery and limbic-striatal-thalamic functional connectivity reorganization. The concordance between behavioral engagement, white matter plasticity, and functional improvement suggests use-dependent neuroplasticity and positions CMI training as a promising approach warranting controlled trials.

Dedication

The forest disappears.

The trees remain.

We forget the way.

Our feet remember.

Life, in its falling and rising.

林去树留。

道失足识。

起落之间，

生命如是。

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This work would not exist without the participants who trusted me with their recovery journeys. Your courage, persistence, and willingness to show up week after week - even on hard days - is why this research matters. You reminded me constantly why I do this work. Thank you.

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To my past and present lab mates - Miracle, Mariam, Ce Ann, Diana, Nicole, Sara, Kiran, Sonia, and the entire motor control lab crew - thank you for the laughter, joy and brain talk. To the volunteers who made this study possible - Allegra, Hana, Kimer, Oleksii, and Valentina – thank you.

To my mom and dad: I carry you both with me in every aspect of this work. I'll make sure we make so many lives better. Just you wait and see.

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To coffee. I love you coffee.

And finally, to me. For showing up. For not quitting when it would have been easier to quit. For building something meaningful out of grief and uncertainty. This thesis represents not just

research completed, but a commitment kept - to the work, to the people it serves, and to the belief that hard things can still hold joy.

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Conflict of Interest

Anthony Machula is the founder of Path Forward Neurotech (PFN) Limited. PFN is developing AR-based skill training applications that enhance cognitive-motor performance under multisensory challenge (bright, loud, high-pressure environments). The augmented reality intervention protocol evaluated in this thesis forms the technical foundation for Mind Mender's skill training approach.

This potential conflict of interest has been disclosed to and managed by York University in accordance with institutional policies. The research was conducted with oversight from Dr. Lauren Sergio and York University's Research Ethics Board. Data collection, analysis, and interpretation were conducted according to established research protocols with appropriate safeguards to ensure scientific integrity.

Funding for this research was provided by NSERC and CIHR, which had no role in study design, data collection, analysis, interpretation, or manuscript preparation.

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Abbreviations

AR = Augmented Reality

CMI = Cognitive-motor integration

CSF = Cerebrospinal fluid

DHI = Dizziness Handicap Inventory

FA = Fractional Anisotropy

MD = Mean Diffusivity

CST = Corticospinal Tract

SLF = Superior Longitudinal Fasciculus

ILF = Inferior Longitudinal Fasciculus

HMD = Head-Mounted Display

DTI = Diffusion tensor imaging

fMRI = Functional magnetic resonance imaging

mTBI = Mild Traumatic Brain Injury

MRI = Magnetic Resonance Imaging

PPCS = Persisting Post Concussion Symptoms

PSS = Perceived Stress Scale

PSQI = Pittsburgh Sleep Quality Index

QQA = Qualitative and Quantitative Assessment

SCAT-6 = Sport Concussion Assessment Tool 6

SF-36 = Short Form-36 Health Survey

STAI = State-Trait Anxiety Inventory

TBI = Traumatic Brain Injury

1 Chapter 1: Introduction and Literature Review

1.1 Concussion and Persistent Symptoms After Concussion

Concussion has many definitions that vary between clinician, practitioner, athlete and coach. As of 2011, The American Congress of Rehabilitation Medicine has defined concussion as a subcategory of Traumatic Brain Injury (TBI) called mild Traumatic Brain Injury (mTBI). Concussion and mTBI are used interchangeably in the literature and will be referred to in this document as mTBI. The most common causes of mTBI include car crashes, whiplash, slips and falls, or sport-related injuries. Contrary to popular belief, mTBI does not require direct trauma to the head, rather any mechanical force that “shakes” the brain in the skull can result in an mTBI, like a body-check during sport. (McCrory et al., 2017; Miller et al., 2021, 2021; Silverberg et al., 2023). While TBI is obvious to an external party as the patient would have visible head trauma, such as a broken skull, or a brain bleed/swell that can be seen with medical imaging like an MRI, an mTBI is not easy to diagnose and cannot be seen by looking at someone’s head or through medical imaging (Alkhaibary et al., 2021; Silverberg et al., 2023; Thurman, 2016). Instead of diagnosing through overt brain trauma like TBI, mTBI is assessed through physical, cognitive, and emotional symptoms rated by tools like the Sport Concussion Tool 6 (Medicine, 2023; Silverberg et al., 2023). Physical symptoms include headaches, nausea, dizziness, balance problems, vision problems, and sensitivity to light/noise (Silverberg et al., 2023). Cognitive symptoms include “feeling slowed-down”, “mental fog”, difficulty concentrating, and/or memory problems (Silverberg et al., 2023). Emotional symptoms include uncharacteristic emotional lability and/or irritability (Silverberg et al., 2023). Each person experiences mTBI differently, a car accident with side-by-side passengers will result in completely varying mTBI symptom profiles. In some cases,

when the symptoms do not resolve past 14 days, the diagnosis of mTBI changes to Persisting Post Concussion Symptoms (PPCS).

1.2 Epidemiology of mTBI

In 2013, approximately 2.8 million TBI related emergency department visits occurred in the United States (Taylor, 2017) and worldwide, it is estimated that 6 out of every 1000 people experience a TBI every year (Cassidy et al., 2004). Evidence has shown that this rate is likely underrepresenting reality because athletes and employees are not incentivised to report their symptoms of mTBI injury. (Baugh et al., 2019; Gaudet et al., 2019; Miller et al., 2021; Tadmor et al., 2023). In sport, approximately half of all athletes are suspected of hiding their symptoms of mTBI (Baugh et al., 2019; Miller et al., 2021; Tadmor et al., 2023). Common reasons for this include not wanting to miss play time and not wanting to let their teammates or coaches down (Baugh et al., 2019; Miller et al., 2021; Tadmor et al., 2023). Just like athletes, many working-aged adults outside the realm of sport also experience mTBI symptoms and were more likely to return to work early if they were married than divorced or single (Gaudet et al., 2019). Of the 91% of employees that returned to work within 90 days of mTBI, 41% reported PPCS (Gaudet et al., 2019). Although many employees may have returned to work because of monetary pressure, this does not mean that the employees that returned to work with a history of mTBI had their long-term earning potential unscathed. In a longitudinal study, 55 patients with mTBI were followed for 5 years in Denmark, and experienced a long-term socioeconomic impact of their injury: a salary change of 4.2% (Fallesen & Campos, 2020).

It is not just the working aged adults or athletes that experience TBI related emergency department visits (Fu et al., 2016). A retrospective analysis of 0.9 million TBI related emergency department

visits in Ontario between the years of 2002-2010 showed that in 2009, 18% of falls occurred in the ages 55 up and that falls were the leading cause of TBI making up 47% of all TBI-related visits (Fu et al., 2016). Of all fall related TBI visits, patients aged 85+ were responsible for a majority of these falls (Fu et al., 2016). This fall related statistic is especially worrisome as the Canadian population ages because TBIs caused by falls are expected to become one of the most common neurological conditions affecting Canadians by 2031. (Canada, 2014; Saunders, 2022).

As previously touched on, mTBI can occur in a moment and cause immediate symptoms and behavioral concerns causing a person to have a lower quality of life. These events are frequent and impact 6 out of every 1000 people worldwide and a Canadian of every age group is affected, with worse outcomes in the elderly that are only expected to rise. mTBI is a problem for countries like Canada which means that a solution needs to be found. Especially, a solution to persisting symptoms needs to be found to reduce the long-term systemic burden for the average person who is unable to take time off to recover from this injury and continues to experience PPCS.

1.3 Persisting Post Concussion Symptoms

In one of the most cited longitudinal follow-up studies relating to PPCS, Hiploylee et al. (2017) followed participants for 5 years. Of the responding 141 participants, 67% made a full recovery from their symptoms within 1 year post injury, 5% made a full recovery within 2-3 years post injury, and the remaining 22% did not recover. Full recovery was measured using a binary answer at the beginning of the questionnaire set. It was found that no significant difference emerged between those with a single concussion versus multiple in this study. The symptoms that persisted in the not-recovered group were mainly headaches, difficulty concentrating, and fatigue (Hiploylee et al., 2017). Each person with PPCS experience a personal cluster of symptoms that are unique to

themselves. (Signoretti et al., 2011; Silverberg et al., 2023) This symptom heterogeneity has led to inconsistent terminology across the mTBI literature. Different studies employ varying questionnaires, resulting in divergent labels for symptom clusters—some papers use "physical, cognitive, emotional" while others use "somatic, affective, cognitive" to describe essentially equivalent groupings (Hiploylee et al., 2017, 2017; Silverberg et al., 2023) In 2023, the American Congress of Rehabilitation Medicine voted to better define these symptom groupings into physical, cognitive, emotional and acute alterations in mental status for mTBI (Silverberg et al., 2023), these groupings will be used for the remainder of this thesis. All the same symptoms experienced during the initial concussion may persist in any combination, please refer to Table 1 for a categorical breakdown of symptoms.

Table 1: Persistent Post Concussion Symptoms

<i>Symptom Category</i>	<i>Manifestations</i>
Physical Symptoms	Headache, Dizziness, Visual disturbances, Sleeplessness, Noise sensitivity
Cognitive Symptoms	Decreased concentration, Memory problems, Executive dysfunction.
Emotional Symptoms	Irritability, Anxiety, Depression

Note: The presence of two or more new or worsened symptoms from any category (including multiple symptoms within the same category) indicates physiological disruption of brain function. Onset of acute subjective alterations occurs immediately after impact or upon regaining consciousness, while other symptoms may present within 72 hours of injury.

Source: Ryan and Warden (2003)

1.4 PPCS Treatment

Many treatments exist, and have been helpful for PPCS which include; electrotherapy, exercise, homeopathy, manual lymphatic drainage, reiki, repetitive magnetic stimulation, massage, vitamins, yoga, meditation/mindfulness, cranial-sacral therapy, osteopathy, chiropractic manipulation, occupational therapy, and physiotherapy (Hiplylee et al., 2017). While these treatments can work on patients experiencing PPCS within 1 year after injury, it has been found that a large proportion of patients with PPCS do not improve using any of the above treatments (Hiplylee et al., 2017). One correlation found in this study was that the only treatment that helped those who showed no improvement from therapies was medication (Hiplylee et al., 2017).

There is evidence in support of symptom improvement in those individuals who do not respond to the typical treatments listed previously. In a retrospective chart review by Ross et al. (2023), 62 PPCS patients with a mean post injury of 2.2 years completed a 5-day intensive treatment protocol that improved their symptoms. This protocol assessed them across cognitive, physical, emotional and sleep symptom categories. A personalized treatment was formed for the patients based on their symptom burden and they underwent a mix of non-invasive neuromodulation, therapeutic exercises, neuromuscular re-education, and vestibular exercises. This highly personalized approach had the group outcome of moderately reducing physical, cognitive, and affective cluster symptom scores after completion of the 5-day treatment. This is a promising result, showing that after targeted training, late-stage PPCS patients can experience improvements in symptom burden and performance deficits. Another major strength of this study was its multi-modal nature: the combination of both cognitive and physical treatments on the same day suggests that bringing multiple modalities together may be the best way to treat PPCS.

1.5 PPCS Pathophysiology

As previously shown, mTBI is a silent epidemic that cannot be seen on typical medical imaging (Ryan & Warden, 2003; Signoretti et al., 2011). In particular, while participants may experience persisting symptoms or display deficits on standardized assessments such as the SCAT-6 (Medicine, 2023), these injuries were not readily detectable on scans like CT or MRI (Signoretti et al., 2011). The fact that this damage was not discernable on imaging raised questions as to whether any distinct brain damage such as diffuse axonal injury really does occur at all in concussions (Signoretti et al., 2011). Recent work has found that not only is this damage present, but it even persists for years after the initial injury (Gard et al., 2024). A study by Gard et al. (2024) ran an ultra-high field strength (7T) diffusion tensor (DTI), diffusion kurtosis imaging (DKI), and collected cerebrospinal (CSF) biomarkers on participants with a debilitating level of PPCS, defined as an inability to complete daily life activities. It was found that of the 72 white matter tracts investigated, 27% of the tracts were impacted, including the left cingulum (Gard et al., 2024). The left cingulum is one of many tracts implicated in behaviors that are important to daily activities like walking and talking, scrolling on a website using a computer trackpad, or reversing your car into a parking space (Sergio et al., 2020). In addition, the left cingulum is also implicated in the deficits often experienced by those with persisting concussion symptoms (Bubb et al., 2018; Silverberg et al., 2023). These deficits include changes in executive control, emotional lability, and memory – cognitive functions that are tested as soon as a concussion is thought to have occurred on the sports field (Bubb et al., 2018; Medicine, 2023; Silverberg et al., 2023).

The left cingulum is thought to help coordinate and integrate sensory and motor outputs by connecting the parietal and frontal regions of the brain that perform integrative and high order

thought respectively. Frontoparietal connectivity is not only important with respect to traditional concussion symptoms but is also critical for cognitive-motor integration (CMI) and explicit rule integration. In fact, previous work from our laboratory has shown that those with concussion history perform more poorly on tasks that involve thinking and moving at the same time relative to healthy controls, and this can be discriminated by performance alone with 94% accuracy (Brown et al., 2015; Sergio et al., 2020). These behavioural changes have been suggested to arise from alterations in frontoparietal connectivity. However, we have also shown that that among those with neurological dysfunction, CMI ability can be improved following a 16-week, once weekly intervention involving a thinking and moving game (de Boer et al., 2018). The results demonstrated that CMI networks remain amenable to training-induced plasticity even in the context of neurological dysfunction, with early-stage participants showing measurable cognitive improvement (de Boer et al., 2018). Given that PPCS similarly involves frontoparietal network disruption, we hypothesized this intervention approach would extend to concussion rehabilitation. Therefore, an intervention program targeting multiple modalities while addressing CMI deficits may improve functionality among individuals with PPCS.

1.6 Rationale for current approach

A primary goal of rehabilitation is to restore lost function to the affected individual as safely and quickly as possible. To attain this goal, rehabilitation science has begun to examine various forms of augmented neurorehabilitation designed to enhance the ability of the brain to accommodate the impact of damage, something known as neuroplasticity. To this end, this project examined the utility of a multi-domain (sensory-cognitive-motor) augmented reality rehabilitation program. Previously, we had pilot-tested this approach with older adults at-risk for dementia (de Boer et al.,

2018). Here, we tested this approach with working-aged individuals affected by concussion. To this end, we collected pre- and post-intervention mobility, coordination, quality of life measures, and demographic measures for a 16-session program, spanning 8 weeks and analyzed these data using multivariate approaches. We operated through the general theoretical framework of multinodular neuroplasticity (i.e., network versus synaptic level changes), and these data served as pilot data for future larger interventions. In the case that the participant had previously conducted an imaging study with our lab, we offered the participant the option of undergoing a second round of imaging after the completion of the intervention.

2 Purpose and Hypothesis

The present study aimed to determine whether a multimodal neurorehabilitation intervention targeting cognitive-motor integration could reduce symptoms in individuals with PPCS.

We hypothesized that participants would demonstrate reduced symptom burden following the 8-week multidomain intervention compared to baseline. This improvement would be observed at post-intervention assessment relative to baseline.

3 Methods

3.1 Participants

Participants were recruited through our research group's professional network such as vestibular-physiotherapy clinics, from the community using flyers, and through the follow-up of participants who had previously participated in other clinically relevant studies in our laboratory.

Participants completed a repeated Qualitative and Quantitative Assessments (QQA) at 5 timepoints during the intervention, once to define their baseline prior to starting the intervention, on the first

day of the intervention, at two middle timepoints during the intervention, and once more at the end of the intervention.

Participants were asked to complete a daily symptom logbook from their first baseline assessment until the end of the study.

Inclusion Criteria: Participants were ages 18-65 and with persisting post-concussion symptoms more than 3 months since injury who had been stable in their concussion symptoms. PPCS status was determined by participant self-report of a prior concussion and persisting symptoms beyond 3 months post-injury. Symptom stability was confirmed through baseline assessment scores on the QQA battery. Participants were not required to provide clinical documentation of their initial concussion diagnosis, and injury history details (mechanism, severity, number of prior concussions) were collected by self-report.

Exclusion Criteria: Any condition or impairments that may prevent or inhibit the participant's performance on the whole-body intervention task. These include but are not limited to vision and upper-limb impairments, medical conditions such as arthritis, a diagnosis of apraxia, or neurological illnesses such as Parkinson's disease, schizophrenia, alcoholism, epilepsy.

Imaging portion inclusion criteria: Having participated in a previous imaging study with our research group within 3 years of intervention enrollment, during which participants were already experiencing PPCS.

3.2 Ethics

This study was approved by the York University Human Participants Review Committee (Certificate #e2024-244, initial approval October 7, 2024, amendment approval November 9, 2025). All participants provided written informed consent prior to participation. The research was

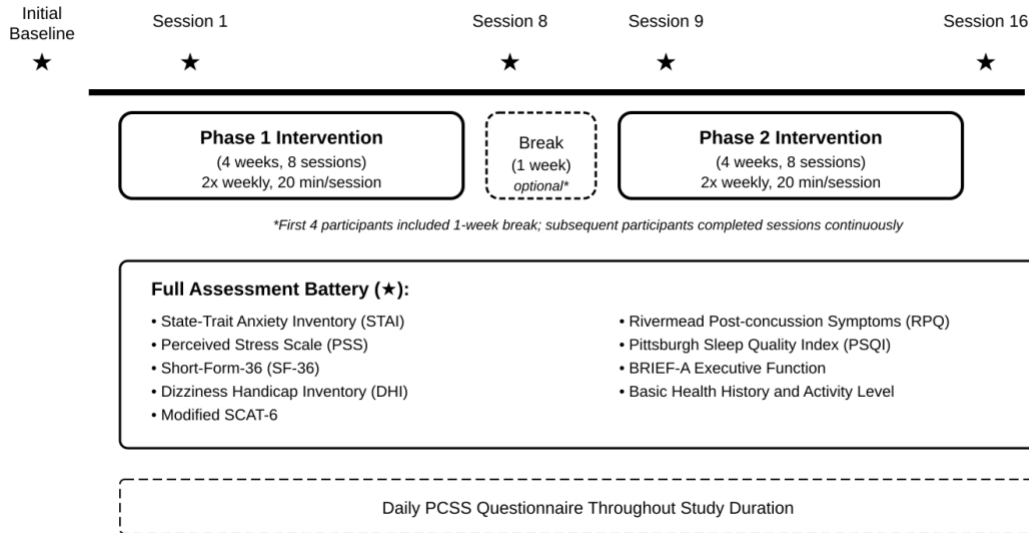
conducted in accordance with the Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans (TCPS2).

3.3 Study Design

This case-series study recruited 8 participants to participate in the multimodal intervention. Because participants recruited were of varying physical capacities and backgrounds, all working age adults, it was unfeasible for these participants to make time for an ideal protocol, for this reason, the periods between participant baseline and beginning of intervention were allowed to vary. Baseline periods varied (minimum 3 days) prior to the start of their twice weekly intervention. This was be done in cases where the participant was able to complete a baseline assessment but not able to commit to a twice weekly intervention right away.

Each participant acted as their own baseline. Each baseline period was defined as the period of 3 days or longer after completion of the first set of QQA but before the start of the intervention. On the first day of the intervention a QQA set was completed, followed by 4 weeks of intervention (8 sessions). The intervention protocol was adapted based on tolerability observations during the study. The first four participants (FAR1, FAR2, FAR3, FAR4) completed the intervention with a 1-week break between the first and second 4-week blocks to monitor tolerability and symptom response. Based on positive tolerability outcomes and participant feedback, subsequent participants (FAR5, FAR6, FAR7, FAR8) completed the 16 sessions continuously over 8 weeks without a scheduled break unless individually needed for symptom management. For a visual description please see Figure 1.

Figure 1: Study Design



3.4 Qualitative and Quantitative Assessments (QQA)

The participants were asked to fill out a form about their basic health history and activity level, the State-Trait Anxiety Inventory (STAI) (Spielberger, 2012a), the Perceived Stress Scale (PSS) (Cohen et al., 2014), the Short-Form-36 (SF-36) (Ware & Sherbourne, 1992), the Dizziness Handicap Inventory (DHI) (Jacobson & Newman, 2016), Rivermead Post-concussion Symptoms Questionnaire (King et al., 1995), Pittsburgh Sleep Quality Index (PSQI) (Buysse et al., 1989). The participant also underwent a series of cognitive, dual task and balance movements that form the basis of a modified form of the SCAT-6 (Medicine, 2023). To assess Executive Function the participants completed a Behavior Rating of Executive Function Adult Version (BRIEF-A) (Roth et al., 2022). The participants were asked to fill out an MRI screening form at the end of their intervention if they meet the imaging inclusion criteria.

A baseline period began with the participant completing a set of qualitative and quantitative metrics at the research facility, they completed a STAI, PSS, SF-36, DHI, Rivermead, PSQ, a modified SCAT-6.

3.5 Intervention Protocol

The intervention took place twice per week, 20 minutes per session with at least a one-day break between sessions.

Apparatus and Software: The AR environment was delivered via the Magic Leap 2 head-mounted display (Magic Leap Inc., Plantation, FL), an optical see-through device providing six degrees of freedom (6DOF) head tracking and binocular display with full visibility of the physical environment, mitigating safety concerns associated with fully immersive virtual reality. The headset weighed 264 grams. Custom prescription lens inserts were available in eight corrections (+1.50, -1.0, -1.5, -2.0, -2.5, -3.0, -4.0, -5.0 diopters) to accommodate participants requiring vision correction. Participants interacted with virtual objects using the Magic Leap 2 handheld controller with 6DOF tracking. Spatial anchoring of the virtual environment was achieved using a fiducial marker (ArUco 5×5, 18cm × 18cm) affixed to a stable surface in the testing space. In pilot work, the gamified task had been well tolerated (universally reported as 'fun').

The application was developed in Unity (2022.3 LTS; Unity Technologies, San Francisco, CA) and deployed natively to the Magic Leap 2. Behavioral data were recorded in real-time using Lab Streaming Layer (LSL; Kothe et al., 2025), an open-source framework for synchronized multi-modal data acquisition. Continuous data streams captured head-mounted display position and rotation, controller kinematics (position, rotation, velocity), and task event markers (trial onsets,

collision events, score updates) at 100 Hz. Post-session data were exported in CSV format for analysis.

Video demonstrations of the AR task environment and gameplay mechanics are provided in Appendix D.

Spatial Configuration: The task environment occupied a $3\text{m} \times 5.2\text{m}$ floor area. Upon application launch, the investigator oriented toward the fiducial marker (see Apparatus) to instantiate the virtual environment in physical space. A central hub—rendered as a short bookshelf topped with a red button—was positioned at the midpoint of the play area (coordinates 0m, 0m, 2.5m). Six stations were arranged around this central hub in a diamond configuration: Station 1 at the origin (0m, 0m, 0m), Stations 2 and 3 positioned laterally at $\pm 1.5\text{m}$ on the x-axis and 1.7m forward (1.5m, 0m, 1.7m and -1.5m, 0m, 1.7m), Stations 4 and 5 at the same lateral displacement but 3.7m forward (-1.5m, 0m, 3.7m and 1.5m, 0m, 3.7m), and Station 6 centered at the far end (0m, 0m, 5.2m). This configuration required participants to navigate approximately 1.5–2m between adjacent stations, with maximum inter-station distance of approximately 5.2m (see Figure 2 for schematic).

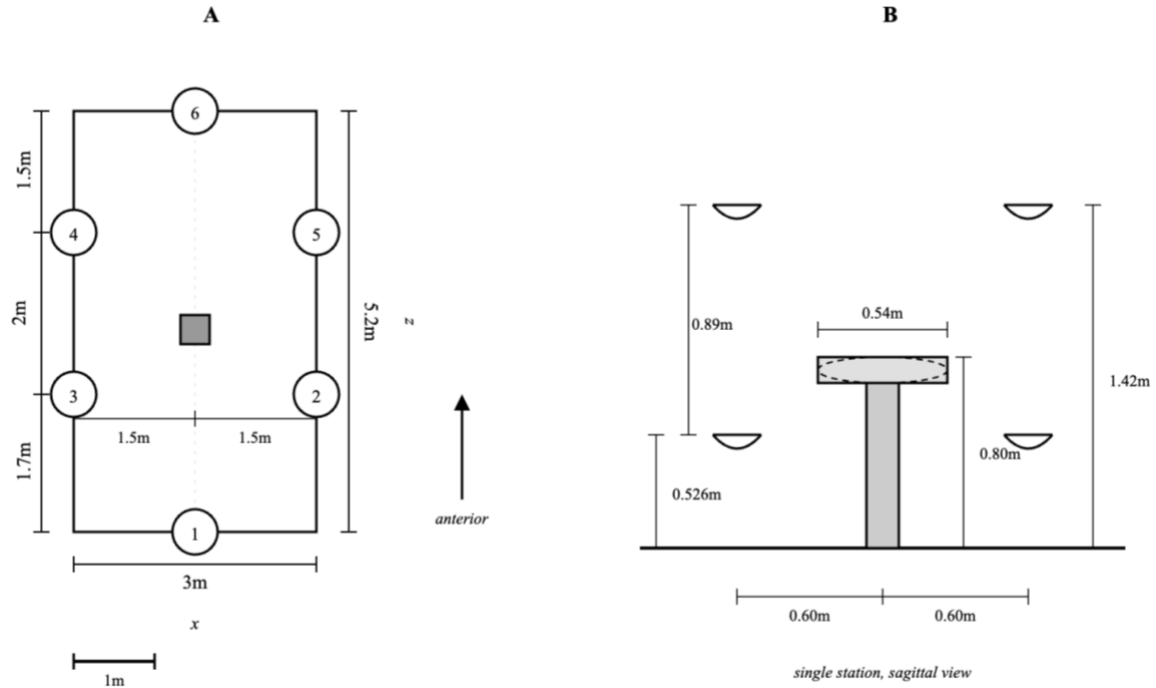


Figure 2. Spatial configuration of the augmented reality task environment. **(A)** Top-down view of play area and station layout. **(B)** Frontal view of a single station as seen from the participant's perspective, showing bird bath, nest positions, and vertical spacing.

Station Task Design: Each station contained a virtual bird bath positioned at 80cm height, filled with rendered blue water. Bird baths were either circular or square in configuration, each 54cm in diameter. Four bird nests (27cm × 9cm × 24cm) surrounded each bath in a rectangular formation. Two nests were positioned laterally at ± 60 cm from the bird bath center at 1.42m height; two additional nests sat at the same lateral displacement but at 0.526m height. This arrangement created a vertically offset target array spanning approximately 89cm. Each station was labeled with a digit (1–6) displayed 1.2m above the floor.

Task Mechanics: One or more colored birds (red, blue, yellow, or combinations thereof) appeared within the bird bath's water area. Each nest contained colored eggs serving as placement targets. The bird bath rim illuminated to match the color of the target bird, while remaining birds served

as distractors. Participants were required to identify the target bird based on the bath rim color, grasp the bird using the handheld controller, and place it into the nest containing color-matched eggs.

Controller Mechanics and Object Interaction: A laser-pointer visualization extended from the controller, enabling participants to align with target birds. When the controller was positioned within 5cm of a bird and the primary trigger was depressed, the bird was "grasped" and subsequently moved in 1:1 correspondence with controller movement (for direct control trials) or in the opposite direction (for mirrored control trials). Releasing the trigger released the bird.

Visuomotor Control Manipulation: Bird bath geometry determined the visuomotor mapping for object manipulation. When the bath was circular, birds moved congruently with controller movement (direct control). When the bath was square, birds moved in the opposite direction of controller movement (mirrored/inverted control), requiring participants to apply a real-time visuomotor transformation. This manipulation imposed cognitive-motor integration demands by dissociating intended movement direction from visual feedback, engaging frontoparietal networks responsible for rule-based sensorimotor remapping.

Sequence Presentation and Working Memory Demands: The task employed a rolling six-digit sequence requiring continuous working memory engagement. To initiate gameplay, participants pressed a secondary trigger, activating the central hub's red button (accompanied by a press-down animation). A six-digit sequence then appeared above the central hub at 0.82m height, oriented toward the participant, specifying the order in which stations must be completed (e.g., 1-4-3-2-6-5). This sequence remained visible for 8 seconds before disappearing, requiring participants to maintain the station order in working memory while navigating and completing station tasks. As

participants successfully completed stations in the correct order, completed digits were removed from the front of the queue and new digits were appended to the back, maintaining a constant six-station lookahead throughout the session.

Recall Cost and Scoring: Participants could review the current sequence at any time by pressing the red button, but doing so reset their score multiplier to 1×. Consecutive correct completions without reviewing increased the multiplier (up to 6×), incentivizing extended working memory maintenance. This design created a strategic trade-off: participants could prioritize accuracy by frequently checking the sequence (accepting lower scores) or challenge their working memory capacity by attempting longer recall streaks (risking sequence errors). The score multiplier was not explicitly displayed; participants experienced its effects through score increments. Time remaining and cumulative score were displayed on the floor surface positioned between the central hub and the posterior station, visible to participants during gameplay.

Performance Feedback: Correct bird-to-nest color matching and correct sequence adherence produced a positive auditory chime. Errors—either incorrect color matching (e.g., placing a red bird in a yellow-egg nest) or completing stations out of sequence—triggered a negative auditory feedback sound. If participants approached an incorrect station (i.e., out of sequence), they could still attempt the bird-matching task but received negative auditory feedback regardless of color-matching accuracy, signaling the sequence error.

Progressive Difficulty: Starting at minute 10 of each session, participants were instructed to walk in tandem gait (heel-to-toe) between stations while continuing to complete all station tasks, introducing a concurrent vestibular and balance challenge. Tandem gait difficulty was adapted to individual tolerance: participants who experienced nausea or instability reduced step proximity

(feet in line but spaced apart) and progressively narrowed their base of support across sessions as tolerated. Gait quality was monitored informally by the investigator through visual observation during sessions but was not systematically recorded or quantified.

Symptom Monitoring: Participants were monitored for symptom exacerbation throughout each session. The investigator conducted verbal check-ins about every 4 minutes, assessing comfort and willingness to continue. Participants could request rest at any time and were encouraged to report any symptom getting worse. Sessions were discontinued if participants reported meaningful symptom exacerbation or wished to stop. One participant (FAR5) withdrew after two sessions due to symptom exacerbation; all other participants tolerated the full intervention protocol.

3.6 Exit Interviews

Upon completion of both the final AR session and the post-intervention assessment battery, participants completed semi-structured exit interviews to capture subjective experiences of symptom change, intervention tolerability, and perceived functional improvements. Interviews ranged from 12.3 to 42.9 minutes in duration (mean = 21.5 minutes, SD = 10.8 minutes) and were audio-recorded with participant consent. Interview questions addressed perceived changes in symptoms, daily function, intervention experience, and suggestions for protocol refinement.

Transcription and Speaker Diarization: Audio recordings were transcribed using OpenAI's Whisper large-v3 model, implemented via the faster-whisper library (v1.2.1). Transcription parameters were optimized for conversational interview content with beam search decoding (beam size=5), voice activity detection, and anti-hallucination safeguards (temperature=0.0, compression ratio threshold=2.4). Speaker diarization was performed using pyannote.audio v4.0.1 (Bredin et

al., 2020; Plaquet & Bredin, 2023) to distinguish interviewer questions from participant responses. Transcripts were generated with timestamps [HH:MM:SS.mmm]. Transcripts were not manually verified against source audio, introducing potential for transcription errors including word substitutions, missed utterances, and speaker misattribution. However, direct quotations included in the manuscript were reviewed for accuracy prior to inclusion, and qualitative themes were derived from convergent patterns across multiple participants rather than individual word-level content, limiting the impact of isolated transcription errors on thematic conclusions.

Qualitative Analysis: Transcripts were analyzed using thematic analysis (Braun & Clarke, 2006). Initial codes were derived from themes identified in the PPCS recovery literature: restoration of cognitive capacity, return to valued activities, and shifts in self-efficacy (Levack et al., 2010; van Ierssel et al., 2021). Additional themes emerged inductively, including domain dissociation and strategic symptom management. Themes were coded as present when participants provided explicit verbal descriptions. Direct quotations are integrated into Results to contextualize quantitative findings; full transcripts are provided in Appendix B.

3.7 NeuroImaging

3.7.1 MRI Data Acquisition

MRI data were acquired using a 3 Tesla (3T) Siemens PrismaFit scanner at York University for three participants (FAR1, FAR3, FAR4) at two timepoints: pre-intervention and post-intervention. T1-weighted anatomical scan: Sagittal volumetric magnetisation-prepared rapid gradient echo (MP-RAGE) sequence with the following parameters: 192 sagittal slices (slice thickness 1mm, no gap), field of view (FOV) 256×256 mm, matrix size 256×256 resulting in voxel resolution of $1 \times 1 \times 1$ mm³, echo time (TE) = 2.26ms, repetition time (TR) = 2300ms, flip angle = 8°.

Diffusion-weighted imaging (DWI): Whole-brain diffusion-weighted images were acquired with 128 directions using diffusion-weighted spin-echo single-shot echo planar imaging (EPI) with multiband acceleration factor 3. The DTI sequence used the following parameters: 60 axial slices (slice thickness 2.6mm, no gap), FOV 220×220 mm, matrix size 146×146 resulting in voxel resolution of $1.5 \times 1.5 \times 2.6$ mm³, TE = 84.0ms, TR = 2700ms, b-value = 1000 s/mm² (including one volume with no diffusion gradient, b = 0 s/mm²). Additionally, we acquired two reversed phase-encoded b=0 images (anterior-posterior/blip-up and posterior-anterior/blip-down) for susceptibility distortion correction using FSL topup.

Resting-state fMRI: Multi-band accelerator factor 4 with multi-echo EPI sequence sensitive to BOLD contrast. Participants lay in the scanner with eyes open, fixating on a white cross with black background for approximately twelve minutes. Acquisition parameters: 52 axial slices (slice thickness 3mm, no gap), FOV 240×240 mm, matrix size 80×80 resulting in voxel resolution $3.0 \times 3.0 \times 3.0$ mm³, TR = 961ms, echo times (TEs) = 12.40, 30.15, 47.90ms, flip angle = 50°. Each TR acquired 3 volumes (one per echo). One resting functional run consisting of 2274 images (758 per echo) was acquired per participant.

3.7.2 MRI Preprocessing

3.7.2.1 Structural Data

All anatomical scans were processed using FreeSurfer 7.4.1 (recon-all -autorecon-all -3T -openmp 10) with T1-weighted MR as input. FreeSurfer 7.4.1 was selected for its validated cortical reconstruction pipeline optimized for 3T acquisition, with the -3T flag applying scanner-specific intensity priors. The Schaefer 200-parcel 7-network parcellation was chosen over anatomical atlases (e.g., Desikan-Killiany) to align parcellation with functional network organization, and the 200-parcel resolution was selected to balance spatial specificity with statistical stability given our

sample size. FreeSurfer's thalamic nuclei segmentation was used to provide anatomically informed priors for tractography seeding, improving reconstruction accuracy in subcortical regions. The standard reconstruction steps included intensity correction, Talairach transformation, intensity normalisation, skull stripping, subcortical segmentation, and cortical parcellation. Skull-stripping was performed on the Talairach transformed, intensity-corrected and normalized image using a deformable template model. Voxels were classified as white matter, grey matter, or cerebrospinal fluid based on intensity values. The white matter/grey matter boundary (white surface) and grey matter/cerebrospinal fluid boundary (pial surface) were then generated. All surfaces were constructed in individual anatomical space, inflated into a sphere, and registered to the FreeSurfer template sphere (fsaverage). Cortical thickness was extracted using the (Schaefer et al., 2018) 7-network parcellation (Schaefer et al., 2018), which subdivides the cortex into 200 functionally defined regions organized into seven large-scale networks: Visual (24 parcels), Somatomotor (30 parcels), Dorsal Attention (22 parcels), Salience/Ventral Attention (22 parcels), Limbic (8 parcels), Frontoparietal Control (34 parcels), and Default Mode (60 parcels). Schaefer 200 thickness values were extracted using FreeSurfer's `mris_anatomical_stats` with the `Schaefer2018_200Parcels_7Networks_order` annotation for each hemisphere separately. For each parcel, average cortical thickness (in mm) was computed as the mean distance between white and pial surfaces across all vertices within the parcel. Thalamic nuclei were segmented using the FreeSurfer thalamic nuclei segmentation tool (version 13; Iglesias et al., 2018) to provide anatomical priors for tractography. All participants' images were visually inspected for artifacts and image quality prior to analysis.

3.7.2.2 DTI Data

Diffusion-weighted images were preprocessed in FSL (Andersson et al., 2003; Andersson & Sotiropoulos, 2016; Smith et al., 2004) MRtrix3 (Tournier et al., 2019), and TRActs Constrained by UnderLying Anatomy (TRACULA; Yendiki et al., 2011). For each participant, DWI images were denoised using Marchenko-Pastur PCA (MRtrix3 dwidenoise), corrected for bias field using ANTs N4 (dwibiascorrect), and corrected for susceptibility distortion, head motion, and eddy currents using FSL topup (total readout time = 0.110s) and eddy tools with outlier slice replacement (eddy --repol). The final corrected DWI was used as input to TRACULA, a global probabilistic automatic tractography algorithm in FreeSurfer 7.4.1 (Maffei et al., 2021; Yendiki et al., 2011). TRACULA was selected over manual or deterministic tractography approaches for its use of anatomical priors from FreeSurfer segmentation, which improves tract reconstruction accuracy in clinical populations where white matter disruption may cause conventional algorithms to fail (Yendiki et al., 2011). The ball-and-stick model with two fiber populations per voxel was chosen to account for crossing fibers, which affect approximately 60-90% of white matter voxels and can bias single-tensor FA estimates. MCMC sampling parameters (200 burn-in, 7500 samples, retaining every 5th) followed validated defaults from the TRACULA pipeline, balancing computational efficiency with stable probability estimates.

TRACULA processing followed established protocols used in our laboratory. Processing steps included: (1) cortical and subcortical segmentation of T1-weighted image using FreeSurfer as described above; (2) within-subject registration of DTI to T1-weighted image using boundary-based registration with 9 degrees of freedom (rigid body + scaling; Greve & Fischl, 2009); (3) between-subject registration using nonlinear FA-to-FA symmetric normalization (SyN) in Advanced Normalization Tool (ANTs; Avants et al., 2008) to map each participant to the MGH35

HCP FA template and to initialize pathway reconstruction with median streamlines from the training data (Maffei et al., 2021); (4) diffusion tensor fitting using FSL DTIFIT and ball-and-stick model estimation using BEDPOSTX (Behrens et al., 2003, 2007), allowing up to 2 fiber populations per voxel; and (5) probabilistic reconstruction of white matter tracts using MCMC sampling (200 burn-in iterations, 7500 samples per voxel, retaining every 5th sample) for pathway probability estimation, combining anatomical priors with diffusion data. Step 3 was used only to initialize tract reconstruction, which was then refined by fitting to the anatomy of each individual participant.

We analyzed all 42 white matter pathways from the TRACULA HCP atlas, including: corpus callosum (genu, rostrum, body sectors [caudal, parietal, prefrontal, premotor, temporal], splenium), anterior commissure, middle cerebellar peduncle, and bilateral arcuate fasciculus, acoustic radiation, anterior thalamic radiation, cingulum (dorsal and ventral bundles), corticospinal tract, extreme capsule, frontal aslant tract, fornix, inferior and middle longitudinal fasciculi, optic radiation, superior longitudinal fasciculi (1, 2, 3), and uncinate fasciculus. For each tract, we extracted mean fractional anisotropy (FA) and mean diffusivity (MD) values averaged over the entire tract. Along-tract profiles of FA and MD were obtained using pointwise assessment of streamline tractography attributes (PASTA), where each measure was averaged at consecutive cross-sections along the tract (Jones et al., 2005). For each tract, a 1D profile was generated by projecting values from every point on every reconstructed streamline to the nearest point on a reference streamline (the mean of training streamlines in template space), resulting in profiles sampled at consistent cross-sections across participants.

Data quality was assessed by examining signal-to-noise ratio in $b=0$ images, motion parameters (translation and rotation per volume), and outlier slice percentage. Registration quality was

verified through visual inspection of T1-to-b0 alignment and anatomical ROI overlap. All three participants' imaging data were deemed acceptable quality for analysis.

3.7.2.3 Resting-State Functional Connectivity

Functional MRI preprocessing was performed using AFNI (Cox, 1996). While multi-echo data were acquired (TEs = 12.40, 30.15, 47.90ms), preprocessing used Echo 1 (TE = 12.40ms) for optimal signal-to-noise ratio in connectivity analysis, following standard single-echo preprocessing approaches validated for resting-state connectivity (Caballero-Gaudes & Reynolds, 2017; Power et al., 2014). Preprocessing steps included: motion correction using rigid-body registration to volume 3 as reference with cubic interpolation (AFNI 3dvolreg), despiking to remove signal transients (3dDespike), slice timing correction with quintic interpolation (3dTshift), skull stripping (3dAutomask), spatial smoothing with 6mm FWHM Gaussian kernel (3dmerge), temporal bandpass filtering (0.01-0.1 Hz, 3dBandpass), and confound regression (3dTproject). Confound regressors included 6 motion parameters, 6 motion derivatives, and mean signals from left and right white matter (FreeSurfer labels 2, 41) and left and right lateral ventricles (labels 4, 43).

Functional images were registered to FreeSurfer anatomical space using boundary-based registration (bbrregister with T2-weighted contrast), and FreeSurfer segmentations were transformed to functional space using mri_label2vol. Visual inspection verified co-registration quality. Mean BOLD timeseries were extracted from 214 regions of interest: 200 cortical parcels from the Schaefer 2018 7-network parcellation (projected to cortical surfaces using mri_vol2surf with 0.2-0.8 fractional depth sampling at 0.1 step intervals), and 14 subcortical regions (bilateral thalamus, caudate, putamen, pallidum, hippocampus, amygdala, nucleus accumbens) using the FreeSurfer aparc+aseg segmentation. Spatial smoothing at 6mm FWHM was selected to match the

spatial scale of the Schaefer parcellation while improving signal-to-noise ratio within parcels. Temporal bandpass filtering (0.01–0.1 Hz) isolated low-frequency BOLD fluctuations characteristic of resting-state neural activity while attenuating respiratory and cardiac physiological noise and low-frequency scanner drift. The confound regression strategy included motion parameters and their derivatives alongside white matter and ventricular signals but excluded global signal regression, which remains controversial due to its introduction of artifactual anticorrelations in connectivity estimates (Murphy & Fox, 2017).

3.7.3 Functional Connectivity Matrix

For each participant, a 214×214 functional connectivity matrix was computed by calculating pairwise Pearson correlations between all ROI timeseries (200 cortical + 14 subcortical). For network-level analyses, only the 200×200 cortical connectivity matrix was used, as cortical parcels are organized into the seven functional networks defined by the Schaefer parcellation. Subcortical regions, while included in preprocessing for completeness, were not assigned to functional networks and were excluded from network-level connectivity analyses.

3.8 Statistical Analysis

3.8.1 Clinical Outcomes

Pre-post intervention changes in clinical outcomes were analyzed using one-tailed Wilcoxon signed-rank tests ($n=7$ participants with complete paired data: FAR1, FAR2, FAR3, FAR4, FAR6, FAR7, FAR8). The Wilcoxon signed-rank test was selected due to the small sample size; while this non-parametric approach avoids distributional assumptions inherent in parametric tests, it also affords less statistical power, increasing the likelihood of Type II errors. One-tailed tests were used based on a priori directional hypotheses: we predicted improvement following intervention,

operationalized as score increases for measures where higher = better (SCAT6, SF-36 domains) and score decreases for measures where lower = better (DHI, PSQI, PSS, STAI, RPQ, BRIEF-A).

Descriptive statistics are reported as median (interquartile range). Effect sizes for non-parametric tests were calculated as $r = |Z| / \sqrt{N}$, where Z is the standardized Wilcoxon test statistic and N is the sample size (Rosenthal, 1991), and interpreted as small ($r = 0.1$), medium ($r = 0.3$), or large ($r = 0.5$) following Cohen's conventions (J, 1992). Clinical meaningfulness was evaluated by comparing observed changes against estimated Minimal Clinically Important Difference (MCID) thresholds. MCIDs were estimated as $0.5 \times$ population normative SD following Norman et al. (2003), whose meta-analysis demonstrated the cross-condition stability of this threshold. This estimation approach was used because validated measure-specific MCIDs are not available for all instruments in PPCS populations; where published MCIDs exist, our estimates were broadly consistent. Statistical significance was set at $\alpha = 0.05$. Given the exploratory nature of this proof-of-concept study and the small sample size, no correction for multiple comparisons was applied across the 16 clinical outcome measures. This increases the risk of Type I error, and statistically significant findings should be interpreted with caution pending replication in larger samples.

3.8.2 AR Task Performance

Seven participants completed the AR intervention (range: 10–16 sessions; see Section 3.5 for full protocol description). FAR1 completed 10 sessions due to an unrelated medical complication; all others completed 16 sessions. Given the small sample size and substantial individual variability typical of persistent post-concussion symptoms, AR task performance data are presented descriptively without inferential statistics. For each participant, performance metrics (task score, path lengths, completion times, peak velocities, movement smoothness) were calculated separately

for direct and mirrored control trials. Session-by-session trajectories and mean values aggregated by participant and control type are displayed to illustrate learning patterns and individual variability.

3.8.3 Imaging Statistical Analysis

Given the small sample size ($n=3$ for neuroimaging), only descriptive statistics and individual-level interpretations are reported. Pre-post changes were quantified as: $\Delta = \text{POST} - \text{PRE}$ and percent change = $((\text{POST} - \text{PRE}) / \text{PRE}) \times 100$. For DTI metrics, FA increases and MD decreases indicate improved white matter integrity, with the "goldilocks pattern" ($\text{FA}\uparrow + \text{MD}\downarrow$) suggesting remyelination and increased axonal organization. FA changes exceeding $|\Delta\text{FA}| > 0.02$ were considered potentially meaningful based on published test-retest reliability and minimal detectable change (MDC) estimates for probabilistic tractography approaches, which report MDC_{95} values ranging from 0.009 to 0.057 depending on methodology (Lewis et al., 2020). The threshold of 0.02 represents a conservative estimate appropriate for automated probabilistic tractography pipelines such as TRACULA. For MD, changes exceeding $|\Delta\text{MD}| > 0.00005 \text{ mm}^2/\text{s}$ ($>7\%$) were considered meaningful. For fornix measurements specifically, test-retest reliability is moderate ($\text{CC} \sim 0.5-0.7$; Cole et al., 2014; Heiervang et al., 2006), reflecting the challenges of measuring this small tract near CSF spaces. Changes exceeding $\sim 15-20\%$ likely reflect genuine biological change rather than measurement artifact (Bach et al., 2014; Maffei et al., 2021). For functional connectivity, connection-level changes were considered meaningful if $|\Delta r| > 0.15$. Effect sizes were characterized as small ($\Delta\text{FA} < 0.02$, $|\Delta r| < 0.10$), moderate ($\Delta\text{FA} 0.02-0.05$, $|\Delta r| 0.10-0.20$), or large ($\Delta\text{FA} > 0.05$, $|\Delta r| > 0.20$).

3.8.4 Software

All statistical analyses were performed using Python 3.9+ with SciPy (v1.7+) for statistical tests, Pandas (v1.3+) for data manipulation, NumPy (v1.21+) for numerical computations, and Matplotlib (v3.4+) and Seaborn (v0.11+) for visualization.

4 Results

4.1 Participant Characteristics

Of the 8 participants recruited, 7 met the minimum completion threshold (≥ 8 sessions) for inclusion in analyses. One participant (FAR5) withdrew after 2 sessions due to symptom burden exacerbated by the intervention and was excluded. Of the 7 included participants, 6 completed all 16 sessions; one (FAR1) completed 10 sessions due to medical complications unrelated to the intervention.

The mean participant age was 50.7 years ($SD = 14.8$), with 71% female. Six participants were right-handed; one (FAR6) was left-handed. Ethnicities included White (57%), Southeast Asian, Black, and mixed race. Education levels ranged from high school to graduate degrees, with 57% having completed at least an undergraduate degree. All participants exhibited comorbidities, with mental health conditions being most common (86%). Six of seven participants (86%) reported prior sports experience.

Mean time from concussion to enrollment was 38.1 months (median = 10.8 months, range = 4.3–129.2 months). This discrepancy reflects a positively skewed distribution, with most participants (5 of 7, 71%) injured within one year of enrollment. Two participants (FAR7, FAR3) sustained additional concussions during the intervention but continued with the protocol, still reporting improved symptoms. One participant (FAR4) experienced worsening of pre-existing cervicogenic pain (per participant report) during the study; this was attributed by the participant to a pre-existing cervicogenic condition and was not associated with intervention activities by either the participant or investigator.

Table 2. Participant demographics

ID	Age	Sex	Ethnicity	Education	Sport Exp	Sessions	Months Since Injury	SCAT6 Δ	DHI Δ	PSS Δ	Energy Δ	Comorbidities
FAR1	58	M	White	Some College	Yes	10	14	7	-24	-4	5	LD
FAR2	23	F	S. Asian	Master	Yes	16	9	5	-14	-7	10	MH
FAR3	58	M	Black	Bachelor	Yes	16	4	10	-6	-3	30	MH, Migr
FAR4	64	F	White	HS	Yes	16	11	5	-4	-1	20	MH, Migr
FAR5	29	F	Mixed	Master	Yes	2	89	—	—	—	—	MH, Migr
FAR6	43	F	Black	Bachelor	No	16	128 (10.7y)	11	2	-2	15	ADHD, LD, MH, Migr
FAR7	46	F	White	Graduate	Yes	16	12	7	-26	-19	45	ADHD, LD, MH, Migr
FAR8	63	F	White	Some College	Yes	16	8	6	-10	-5	25	ADHD, LD, MH, Migr

Note. $n = 7$ (5 female, 2 male) [FAR5 excluded]. Age: $M = 50.7$ years ($SD = 14.8$). Sessions = number of AR intervention sessions completed. Δ = post–Pre change score. Comorbidities: ADHD = attention deficit hyperactivity disorder; LD = learning disorder; MH = mental health treatment; Migr = migraine. DTI neuroimaging available for FAR1, FAR3, FAR4.

4.2 Clinical Measure Results

Participants showed statistically significant improvements in energy/fatigue (+66.7%, $p = .009$, $r = 0.89$), emotional well-being (+23.1%, $p = .013$, $r = 0.84$), perceived stress (–30.4%, $p = .009$, $r = 0.89$), and modified SCAT6 (+35.7%, $p = .009$, $r = 0.90$), all representing large effect sizes. Functional improvements included a 26.3% reduction in dizziness-related disability (DHI, $p = .014$, $r = 0.83$) and modest improvement in executive function (BRIEF-A, –1.4%, $p = .021$, $r = 0.77$).

Near-significant trends were observed for pain (+50.0%, $p = .053$, $r = 0.61$), role limitations due to physical health ($p = .051$, $r = 0.62$), and general health perception ($p = .084$, $r = 0.52$). Notable non-significant improvements included physical functioning (+38.5%, $p = .173$), anxiety symptoms (–14.3%, $p = .154$), and post-concussion symptoms (RPQ-3: –20.0%, $p = .298$).

MCIDs were estimated as $0.5 \times$ population normative SD following Norman et al. (2003) (Norman et al., 2003), whose meta-analysis demonstrated the cross-condition stability of this threshold. Median changes met or exceeded MCIDs for seven measures: perceived stress (−7 points, MCID = 3; Cohen, 1988), state-trait anxiety (−7 points, MCID = 5; Spielberger, 2012b), physical functioning (+25 points, MCID = 14; Ware & Sherbourne, 1992), energy/fatigue (+20 points, MCID = 11; Ware & Sherbourne, 1992), emotional well-being (+12 points, MCID = 11; Ware & Sherbourne, 1992), pain (+22.5 points, MCID = 13; Ware & Sherbourne, 1992), and post-concussion symptoms (RPQ-3: −1 point, MCID = 1; Zakzanis & Yeung, 2011). Overall, 11 of 16 measures showed improvement from baseline, with six reaching nominal statistical significance ($p < .05$, uncorrected) and three approaching significance ($p < .10$). Given the absence of multiple comparison correction, these p-values should be interpreted as exploratory.

Table 3. Intervention Qualitative Outcomes

Outcome Measure	n	Pre Median (IQR)	Post Median (IQR)	Median Change	MCID	p-value	Effect Size (r)
SCAT6 Total Score	7	28.0 (14.5)	38.0 (11.0)	+10.0	—	0.009**	0.898
Dizziness Handicap Inventory	7	38.0 (18.0)	28.0 (23.0)	-10.0	11.0	0.014*	0.831
Pittsburgh Sleep Quality Index	7	15.5 (9.2)	15.0 (13.0)	-0.5	1.0	0.175	0.353
Perceived Stress Scale	7	23.0 (3.0)	16.0 (8.0)	-7.0	3.0*	0.009**	0.894
State-Trait Anxiety Inventory	7	49.0 (10.5)	42.0 (17.0)	-7.0	5.0*	0.154	0.385
Rivermead Post-Concussion (3-item)	7	5.0 (0.5)	4.0 (4.5)	-1.0	1.0*	0.298	0.201
Rivermead Post-Concussion (13-item)	7	23.0 (9.0)	24.0 (28.0)	+1.0	4.0	0.232	0.277
SF-36: Physical Functioning	7	65.0 (27.5)	90.0 (30.0)	+25.0	14.0*	0.173	0.357
SF-36: Role Limitations (Physical)	7	0.0 (0.0)	0.0 (37.5)	+0.0	20.0	0.051	0.617
SF-36: Role Limitations (Emotional)	7	33.3 (16.7)	33.3 (50.0)	+0.0	20.0	0.137	0.414
SF-36: Energy/Fatigue	7	30.0 (12.5)	50.0 (20.0)	+20.0	11.0*	0.009**	0.894
SF-36: Emotional Well-being	7	52.0 (6.0)	64.0 (9.0)	+12.0	11.0*	0.013*	0.837
SF-36: Social Functioning	7	50.0 (43.8)	50.0 (62.5)	+0.0	13.0	0.128	0.429
SF-36: Pain	7	45.0 (16.2)	67.5 (45.0)	+22.5	13.0*	0.053	0.612
SF-36: General Health	7	50.0 (17.5)	50.0 (25.0)	+0.0	11.0	0.084	0.521
BRIEF-A Executive Function	7	142.0 (36.0)	140.0 (42.0)	-2.0	5.0	0.021*	0.767

Note. Median change = Post – Pre. MCID = Minimal Clinically Important Difference estimated as $0.5 \times$ population normative SD (Norman et al., 2003); * indicates change meets or exceeds

MCID threshold. p-values from one-tailed Wilcoxon signed-rank test. Effect size $r = |Z|/\sqrt{N}$ (small: 0.1, medium: 0.3, large: 0.5). * $p < .05$, ** $p < .01$, *** $p < .001$.

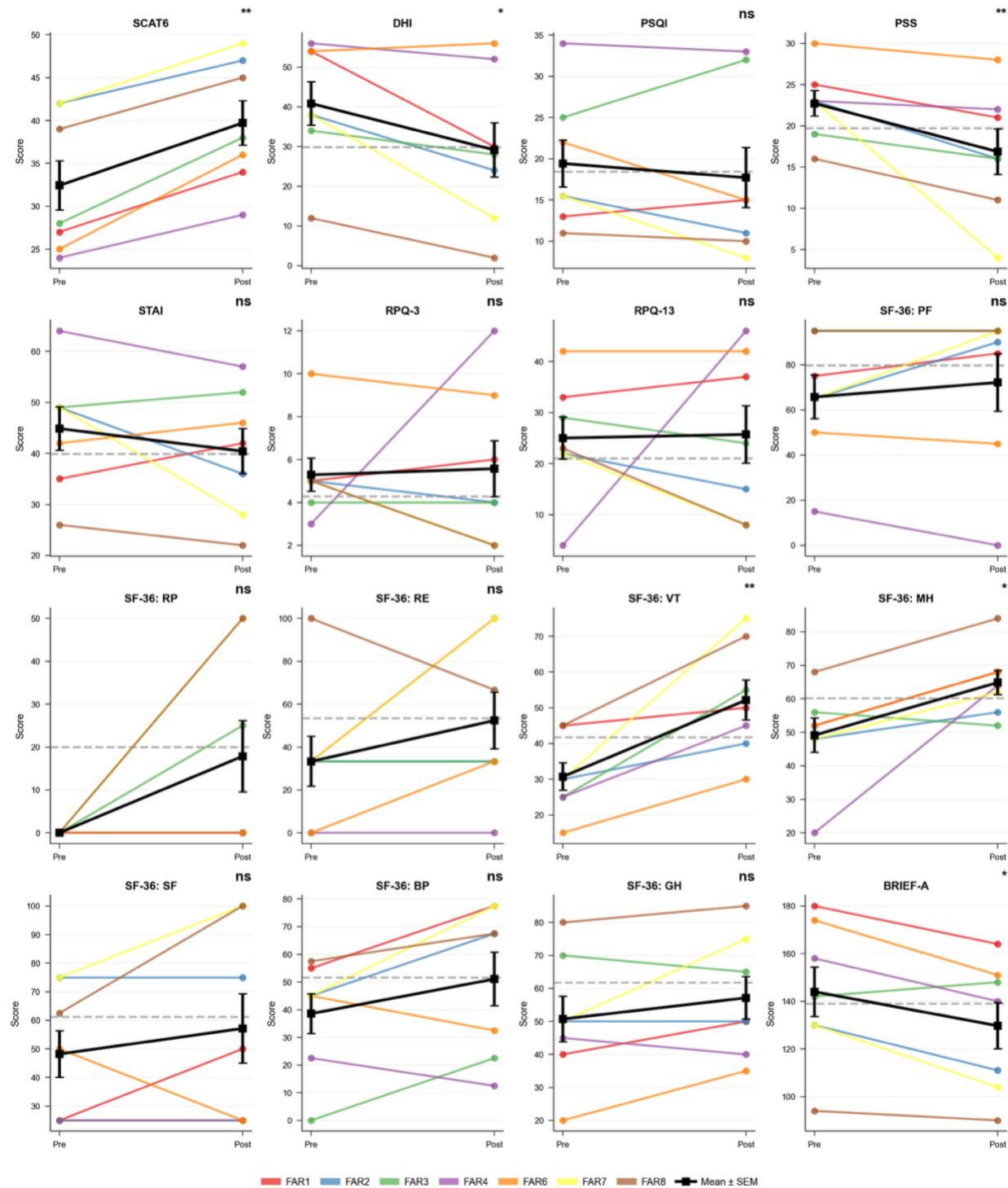


Figure 3. Individual participant trajectories and group mean $\pm$ SEM for clinical outcome measures pre- and post-intervention ($n = 7$). Participant colors are consistent across panels. Gray dashed lines indicate MCIDs where available. *** $p < .001$, ** $p < .01$, * $p < .05$, ns = not

significant (one-tailed Wilcoxon signed-rank tests). See Methods for measure descriptions and scoring directions.

4.3 Behavioral Measures

Behavioral data were collected during each 20-minute intervention session, throughout which participants continuously navigated between stations. Metrics included session scores (primary performance measure), head-mounted display (HMD) path length (navigation efficiency), station sequence reading time (working memory encoding), controller path length and peak velocity (movement kinematics), and completion times for direct versus inverted control trials (visuomotor adaptation).

Participants showed heterogeneous learning trajectories. Session scores increased markedly for FAR2 (418→739 points, +76.8%), FAR7 (317→825, +160.3%), and FAR1 (139→369, +165.5%). FAR3 began with the lowest baseline score (47 points), sustained a mid-intervention re-injury, yet achieved the highest percentage improvement (47→338 points, +619.1%). FAR8 showed modest gains (271→432, +59.4%), while FAR4 (54→125, +131.5%) and FAR6 (38→93, +144.7%) showed limited progression.

HMD path length reflects cumulative three-dimensional distance traveled by the participant's head during each 20-minute session, capturing navigation volume through the 3m × 5.2m play area. This metric indexes two clinically relevant domains: vestibular tolerance (sustained ambulation with frequent directional changes challenges the vestibular system, a primary deficit in PPCS) and spatial working memory efficiency (participants who maintained longer recall streaks completed more stations consecutively, accumulating greater path length before returning to review the sequence). HMD path length is therefore distinct from controller path length, which indexes cognitive-motor integration performance during the bird placement task itself. Together, these metrics dissociate vestibular-navigational and visuomotor components of task performance.

HMD path lengths (cumulative distance traveled per session) showed navigation optimization in successful responders. Most participants showed initial path lengths of 173-549 meters that increased during mid-intervention (reflecting greater sequence complexity) then stabilized or decreased in later sessions despite maintained difficulty. FAR7 progressed from 343 meters early to 849 meters mid-intervention, then stabilized around 700-750 meters in final sessions.

The intervention's mirror control mapping imposed visuomotor transformation demands. Controller path length analysis across all sessions revealed performance stratification among participants. Top performers (FAR2, FAR7) showed efficient movements: mean path lengths of 0.99-1.65 meters with 1.30-1.67 fold increases from direct to inverted control. Intermediate performers (FAR1, FAR8) showed 1.38-1.89 fold increases, while FAR3, FAR4, and FAR6 showed 2.10-2.76 fold increases.

Completion times mirrored path length patterns. Top performers completed direct control stations in 1.19-1.45 seconds and inverted trials in 1.99-3.58 seconds (1.67-2.47 fold increases). FAR3 required 4.81 seconds direct and 10.31 seconds inverted (2.15-fold). FAR4 showed the largest proportional challenge (4.03→13.69 seconds, 3.40-fold). FAR6 showed the longest absolute times (7.23 seconds direct, 17.14 seconds inverted).

Controller peak velocity during bird placement differed across participants. Most showed velocities of 1.90-4.07 m/s. FAR6 showed elevated velocities (10.23 m/s direct, 23.32 m/s inverted)—3-6 times higher than other participants. Combined with long path lengths and completion times, this pattern reflected poorly controlled movements with overshooting and corrections. FAR3 showed lower velocities (1.63-3.31 m/s), reflecting more controlled movement strategies.

Station sequence reading times decreased for successful responders, from early-session means of 2.1-4.9 seconds to late-session means of 0.9-4.1 seconds. FAR2 and FAR7 showed the largest encoding efficiency gains (2.9→1.5s and 2.1→0.9s). FAR6 maintained elevated, stable reading times (5.9→6.1s). FAR6 maintained elevated, stable reading times (5.9→6.1s).

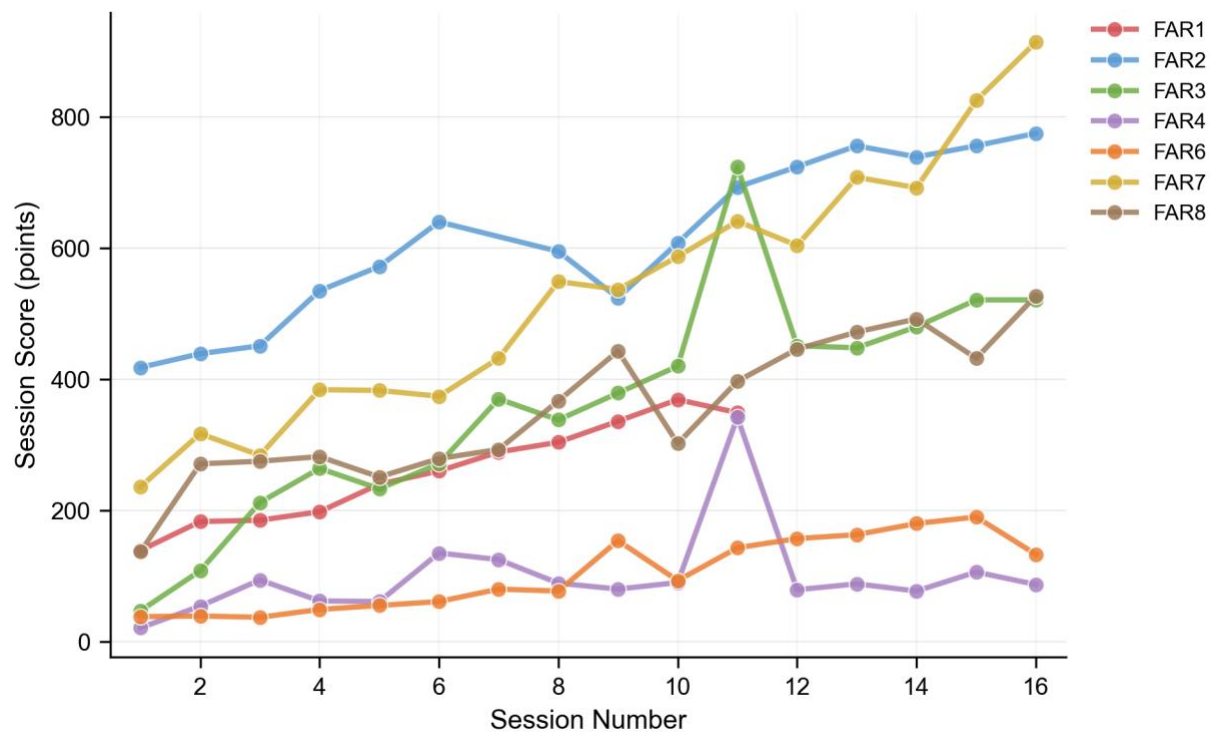


Figure 4. Individual participant session scores across the intervention. X-axis represents session number, with FAR1 completing 10 sessions, FAR4 completing 11, and all other participants completing 16

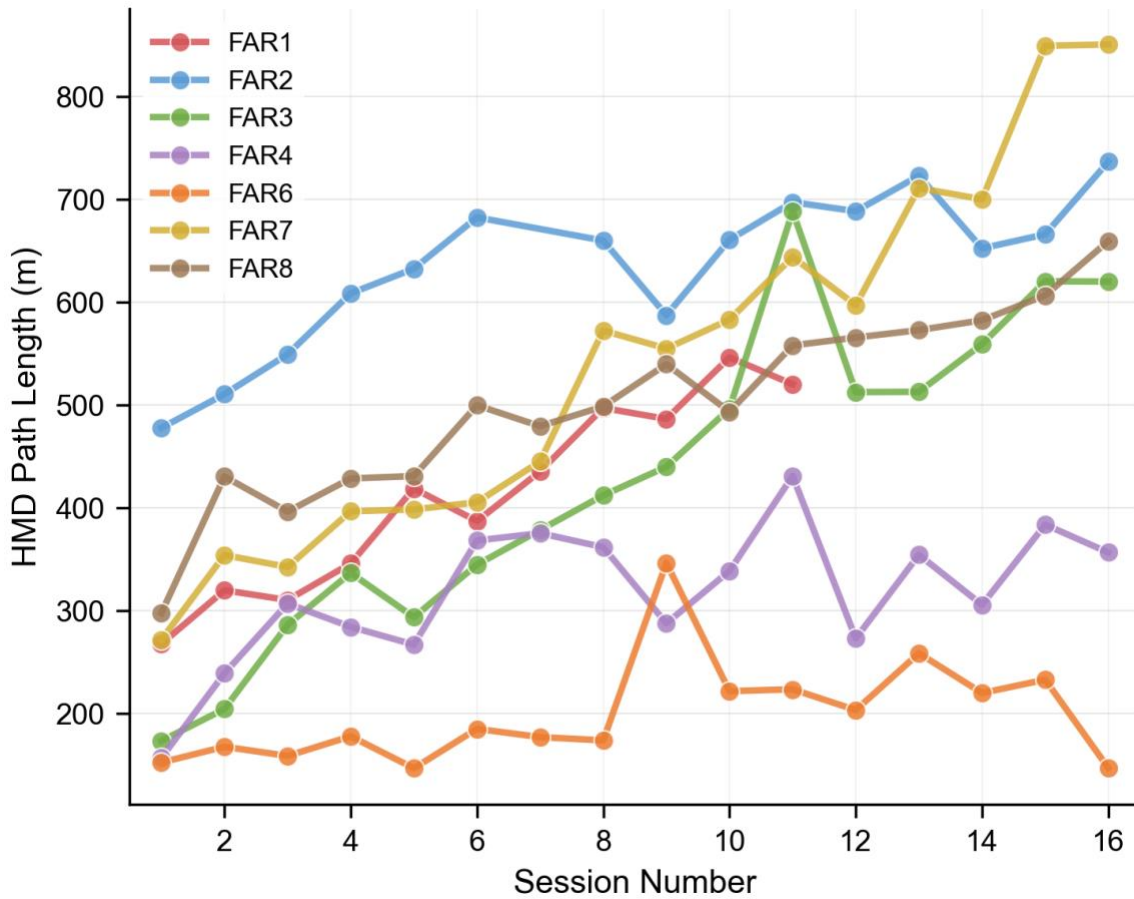


Figure 5. Individual participant head-mounted display (HMD) path length in meters per game session. Greater path length indicates improved working memory capacity, as participants who remembered longer digit sequences completed more stations consecutively, traveling greater distances before needing to review.

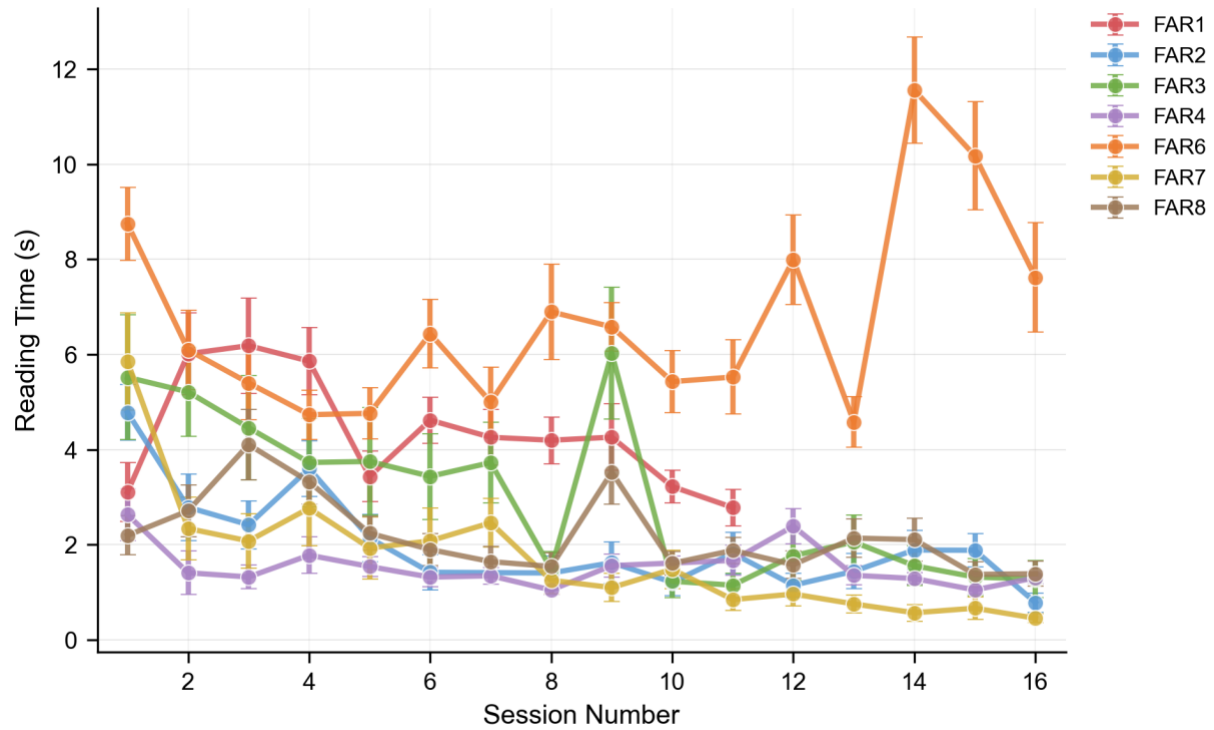


Figure 6. Individual participant reading/memorization time (from sequence display to initiation of head movement $>0.2\text{m}$ or first object pickup) per session.

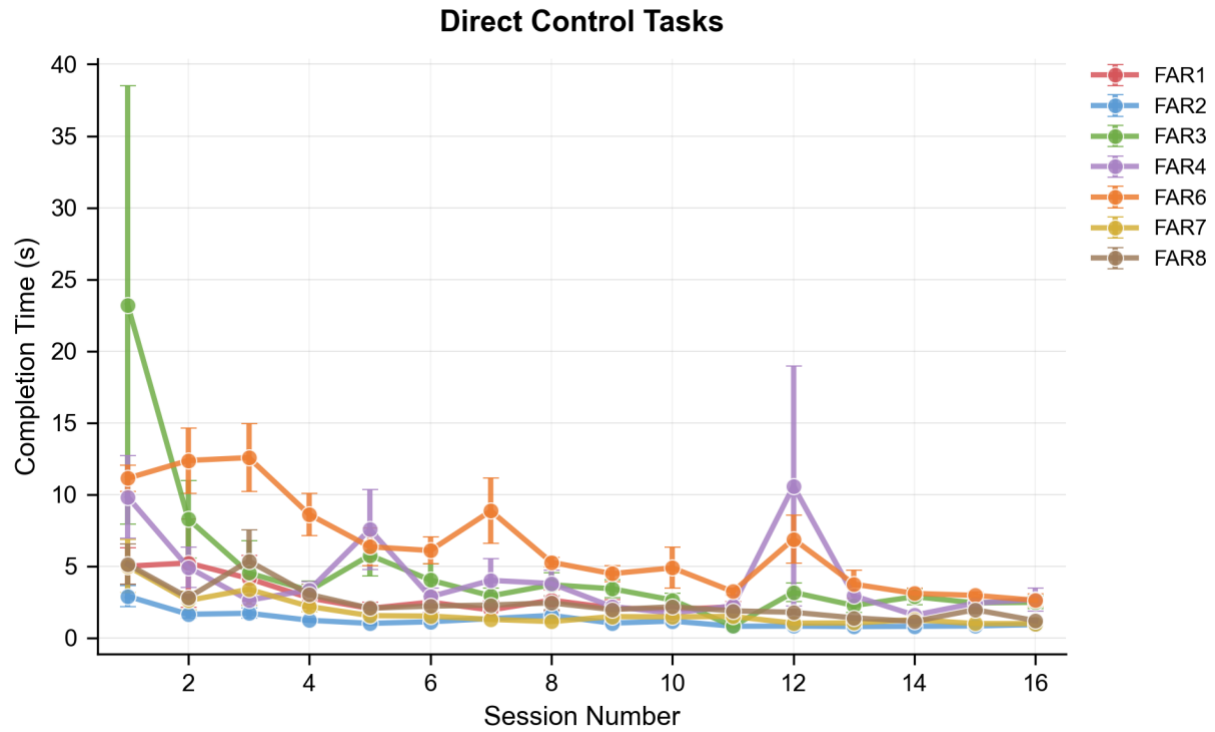


Figure 7. Individual participant average direct control station completion time (from moment of correct bird object pickup to final successful placement) per game session.

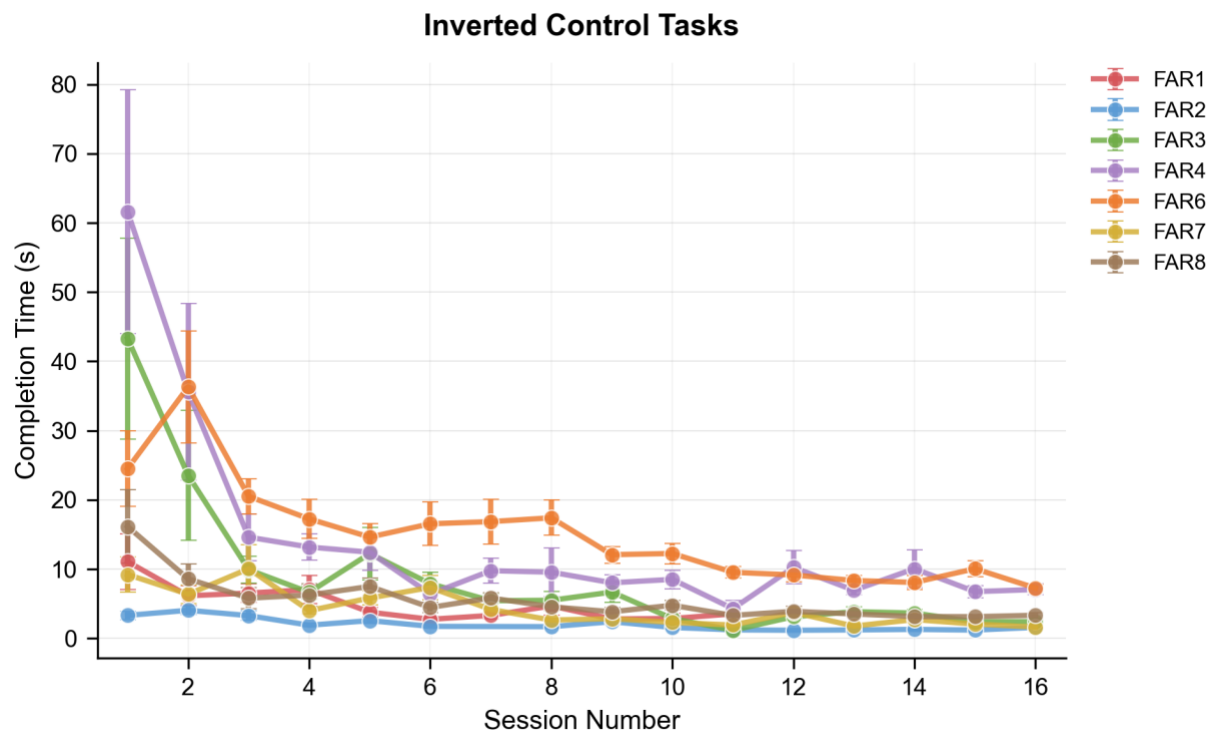


Figure 8. Individual participant average inverted control station completion time (from moment of correct bird object pickup to final successful placement) per game.

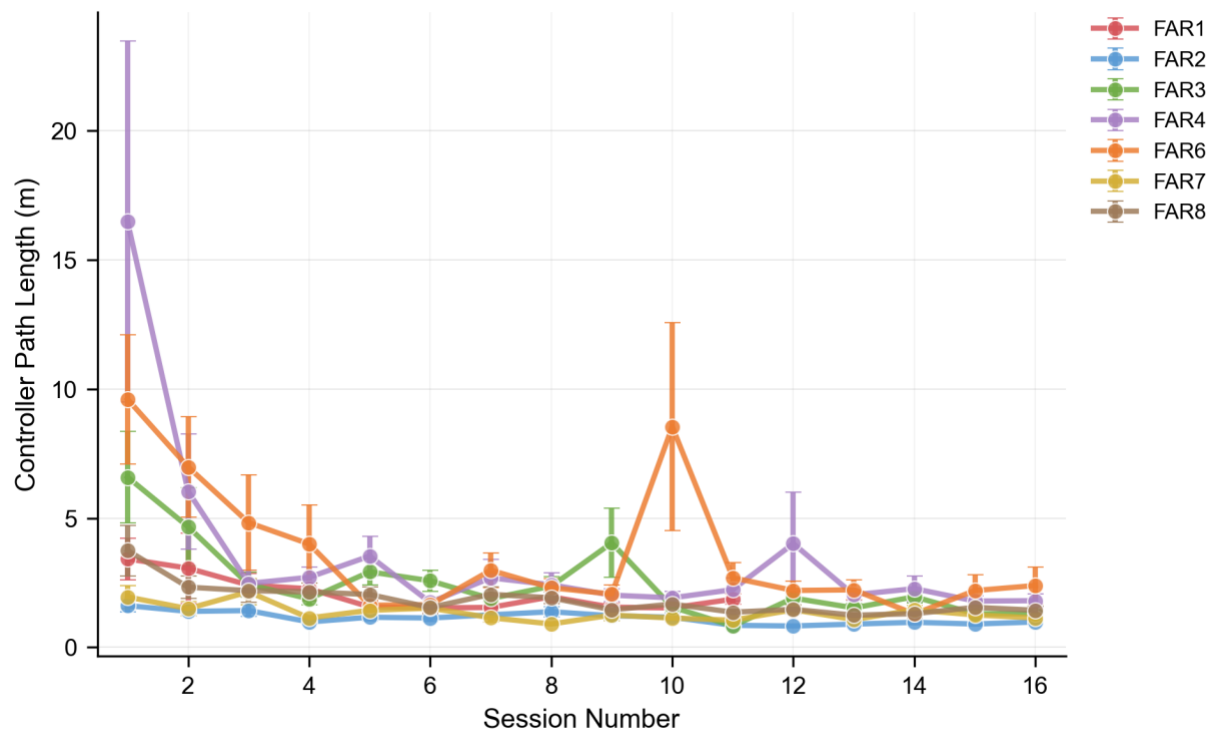


Figure 9. Individual participant controller path length in meters during per game session.

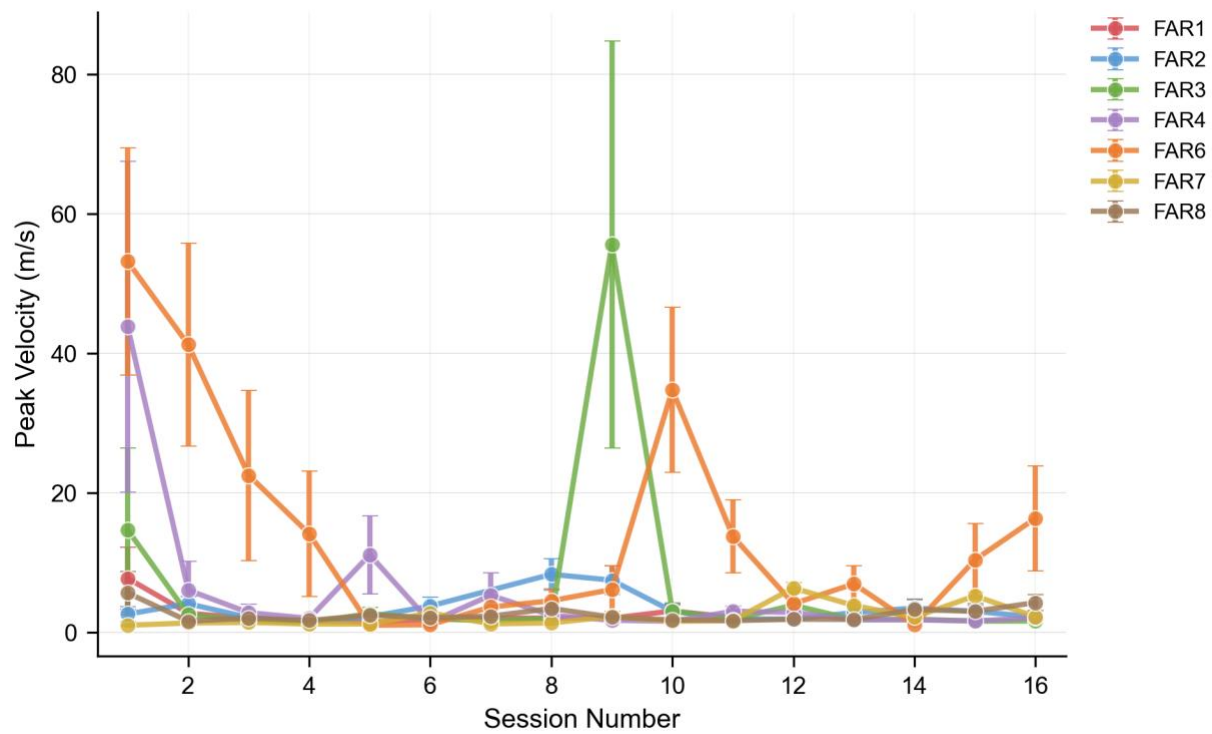


Figure 10. Individual participant controller peak velocity in meters per second during bird placements, averaged per game session.

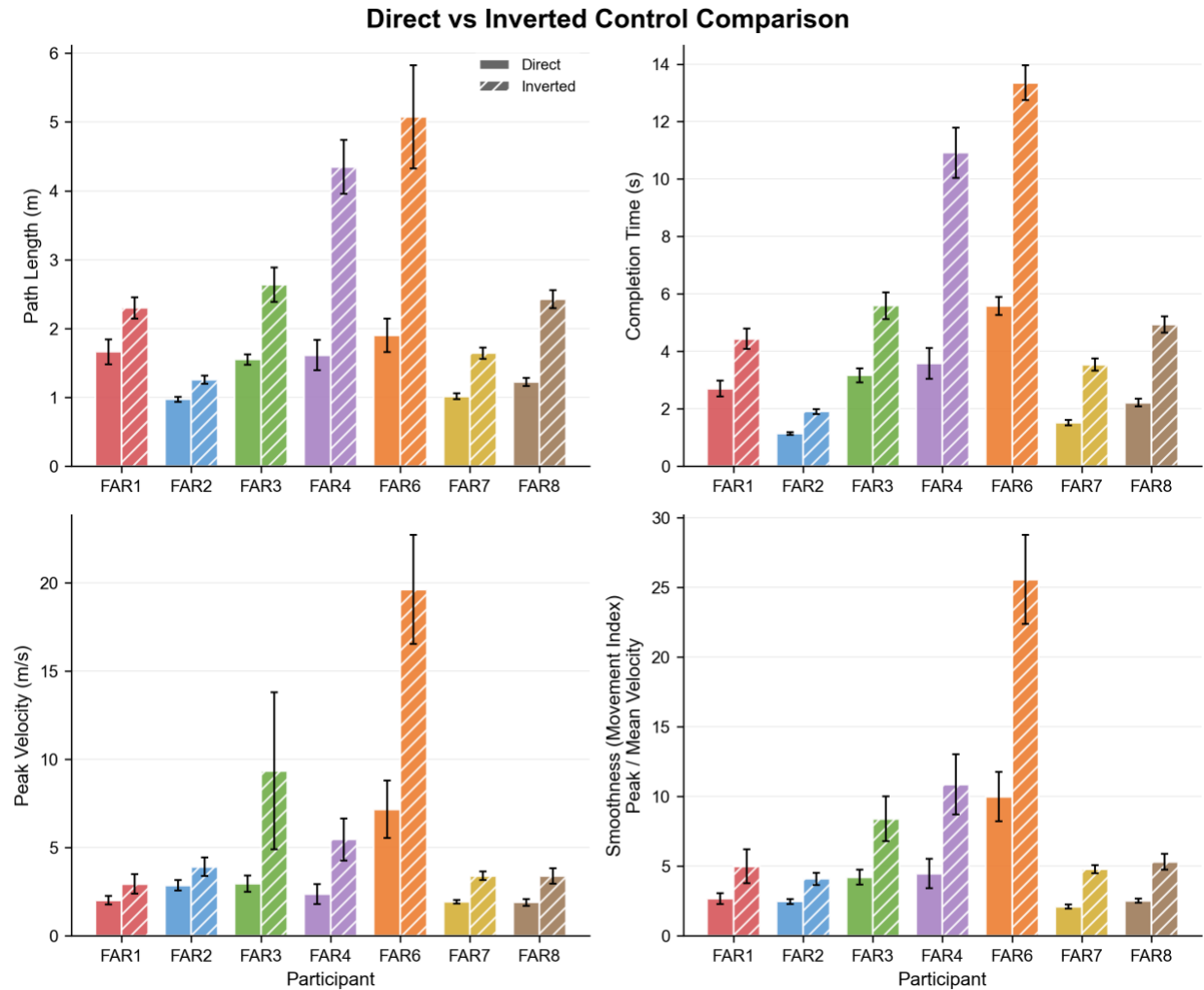


Figure 11. Direct vs inverted control comparison showing mean path length (m), completion time (s), peak velocity (m/s), and movement smoothness (movement index; higher values indicate less smooth/more variable movements) averaged across all bird-to-nest placements for each participant.

4.4 MRI Measure Results

Of the 7 participants who completed the study, 3 (FAR1, FAR3, FAR4) completed pre- and post-intervention DTI and resting-state fMRI. All three were right-handed. Eligibility was based on having completed a prior imaging study using the same protocol. Pre-intervention scans preceded intervention start by 35-91 days (Table 4), at which point participants were already in the chronic PPCS phase (FAR1: ~12 months post-injury; FAR3: ~3 months; FAR4: ~7 months). Observed changes therefore likely reflect intervention effects rather than spontaneous acute recovery.

Table 4. Scan Timeline and Data Quality

Participant	Pre-scan to Intervention (days)	Intervention to Post-scan (days)	Total Timeline (days)	Extenuating Circumstances
FAR1	40	34	74	None
FAR3	35	62	97	Re-injury during intervention
FAR4	91	110	201	Cervicogenic pain

4.4.1 White Matter Structural Changes

Participants showed heterogeneous patterns of white matter change across 42 analyzed tracts. Changes were categorized as optimal (FA↑ AND MD↓), declining (FA↓ AND MD↑), or mixed (discordant FA/MD directions), with the optimal pattern indicating improved white matter microstructural organization (Table 5).

FAR3 demonstrated the strongest white matter plasticity despite sustaining a re-injury mid-intervention. Fifty percent of tracts (21/42) showed the optimal recovery pattern, with only 19.1% showing mixed/discordant changes. The fornix—the primary output tract of the hippocampus and a structure frequently damaged in concussion—demonstrated substantial bilateral recovery, with the right side showing the largest optimal change in the dataset (+60.7% FA with -15.3% MD) and

the left side showing the largest FA increase overall (+76.7%, from 0.196 to 0.345). Additional optimal-pattern improvements were observed in the left corticospinal tract (+41.5% FA), right external capsule (+30.1% FA), and right acoustic radiation (+15.0% FA). However, 31.0% of tracts (13/42) showed the declining pattern, including the corpus callosum rostrum (-13.7% FA) and right corticospinal tract (-9.1% FA), revealing an asymmetric motor profile.

FAR1 showed a more distributed pattern. Only 28.6% of tracts (12/42) demonstrated the optimal pattern, with 31.0% showing decline and 40.5% showing mixed signals. Both corticospinal tracts showed optimal recovery (left: +26.1% FA, right: +7.9% FA), alongside cerebellar pathway improvements (middle cerebellar peduncle: +14.6% FA with -5.3% MD). Fornix changes were mixed, with the left showing FA increase (+19.8%) but concurrent MD increase, and the right showing FA decline (-30.9%).

FAR4 was a clear non-responder. Only one tract (2.4%) showed the optimal recovery pattern, while 71.4% (30/42) demonstrated the declining pattern. Both corticospinal tracts showed decline (left: -7.3% FA; right: -0.5% FA), contrasting with FAR1 and FAR3 who each preserved at least one motor pathway. The largest declines were observed in the right inferior longitudinal fasciculus (-13.0% FA), anterior commissure (-11.5% FA), and corpus callosum body (-11.4% FA).

Motor tract integrity differentiated responders from non-responders: FAR1 showed bilateral corticospinal recovery, FAR3 showed unilateral preservation (left +41.5%, right -9.1%), and FAR4 showed bilateral decline.

Table 5 Summary of DTI Changes by Participant

	FAR1	FAR3	FAR4
FA↑ AND MD↓ (Optimal)	12/42 (28.6%)	21/42 (50.0%)	1/42 (2.4%)
FA↓ AND MD↑ (Decline)	13/42 (31.0%)	13/42 (31.0%)	30/42 (71.4%)
FA↑ AND MD↑ (Mixed)	14/42 (33.3%)	2/42 (4.8%)	9/42 (21.4%)
FA↓ AND MD↓ (Mixed)	3/42 (7.1%)	6/42 (14.3%)	2/42 (4.8%)

White matter tract patterns (n = 42 per participant). Optimal (FA↑ MD↓): both metrics improving in healthy direction. Decline (FA↓ MD↑): both metrics worsening. Mixed: conflicting directional changes between FA and MD.

4.4.2 Cortical thickness

Cortical thickness analysis across 200 Schaefer parcels revealed predominantly stable gray matter with modest network-level changes. FAR1 showed increases in 146 of 200 parcels (73.0%), with largest network-level increases in Visual (+6.89%), Somatomotor (+3.17%), and Frontoparietal Control (+3.90%) networks. FAR3 demonstrated increases in 143 parcels (71.5%) despite mid-intervention re-injury, with largest changes in Control (+5.71%), Visual (+4.13%), and Dorsal Attention (+2.96%) networks, suggesting preserved cortical integrity alongside white matter recovery. FAR4 showed increases in 117 parcels (58.5%), led by Limbic (+2.32%) and Salience/Ventral Attention (+1.46%) networks, despite minimal white matter changes, indicating potential dissociation between gray and white matter recovery timelines. Overall, cortical thickness changes were modest (typically <7% per network), consistent with the relatively short intervention duration (8 weeks) and the slower timescale of cortical morphological changes compared to white matter microstructural plasticity.

4.4.3 Sub Cortical Functional Connectivity Changes

Resting-state functional connectivity analysis revealed reorganization patterns consistent with structural findings. FAR1, who showed improvements in emotional well-being and perceived stress, demonstrated substantial increases in limbic-striatal-thalamic connectivity, with the strongest increases between the left amygdala and left thalamus ($\Delta r = +0.61$) and left putamen to right nucleus accumbens ($\Delta r = +0.49$). FAR3 showed extensive network reorganization with the largest increases in caudate-thalamic ($\Delta r = +0.27$) and caudate-hippocampal ($\Delta r = +0.18$) connectivity alongside decreased hippocampal-pallidum connectivity ($\Delta r = -0.39$), suggesting adaptive circuit reorganization. FAR4 showed modest and diffuse connectivity changes without clear reorganization patterns, consistent with minimal structural change and limited clinical improvement.

Structural and functional brain changes were highly individualized across the three imaged participants. FAR1 showed coordinated structural recovery with favorable tract-cortex concordance and reorganization of emotional regulation networks. FAR3 demonstrated mixed structural patterns with some substantial improvements and extensive functional reorganization despite mid-intervention re-injury. FAR4 showed minimal structural or functional changes, consistent with inability to increase task difficulty and limited clinical improvement.

4.4.4 Network Level Functional Connectivity Changes

To assess coordinated plasticity across imaging modalities, we examined agreement between DTI (optimal pattern: FA $\uparrow$ AND MD $\downarrow$), cortical thickness change, and functional connectivity change within each of the seven Schaefer cortical networks. Full agreement was defined as all three modalities changing in the same direction: partial agreement as two of three.

FAR3 demonstrated the highest multimodal concordance, with full agreement in 4/7 networks (57.1%): Dorsal Attention, Limbic, Control, and Default Mode. These higher-order cognitive networks showed coordinated increases across all three modalities. An additional 2/7 networks showed partial agreement.

FAR1 showed full agreement in 2/7 networks (28.6%): Visual and Somatomotor. In the remaining networks, cortical thickness and functional connectivity generally increased together while white matter showed mixed or declining patterns.

FAR4 showed partial agreement in 6/7 networks (85.7%), but no networks with full agreement. Cortical thickness and functional connectivity increased together across most networks, while white matter showed the declining pattern (FA↓ MD↑) in 6/7 networks.

All three participants showed at least partial agreement in the majority of networks, indicating coordinated brain changes in response to the intervention. However, full trimodal concordance—particularly the participation of white matter in the recovery pattern—distinguished FAR3's robust response from FAR1's more limited concordance and FAR4's structural-functional dissociation.

Table 6. Network Level Multimodal Concordance Table

	FAR1				FAR3				FAR4			
Network	DTI	Thick	Conn	Concord	DTI	Thick	Conn	Concord	DTI	Thick	Conn	Concord
Visual	↑	↑	↑	●●●	~	↑	↓	●○○	↓	↑	↑	●●○
Somatomotor	↑	↑	↑	●●●	↑	↑	↓	●●○	↓	↓	↑	●●○
Dorsal Attention	~	↑	↑	●●○	↑	↑	↑	●●●	↓	↑	↑	●●○
Saliency/Ventral Attention	↓	↑	↑	●●○	↑	↓	↑	●●○	↓	↑	↑	●●○
Limbic	~	↓	↑	●○○	↑	↑	↑	●●●	↓	↑	↑	●●○
Frontoparietal Control	↓	↑	↑	●●○	↑	↑	↑	●●●	↓	↑	↑	●●○
Default Mode	↓	↑	↑	●●○	↑	↑	↑	●●●	~	↑	↑	●●○

Table showing directional agreement across three neuroimaging modalities (DTI white matter, cortical thickness, functional connectivity) for seven Yeo functional networks in three participants. Each network occupies one row, with participants as column groups. DTI direction requires both FA↑ and MD↓ for "Increase" classification. Concordance symbols indicate full agreement (●●●, all 3 modalities), partial agreement (●●○, 2/3 modalities), or mixed (●○○, no agreement). **Key Finding:** FAR3 shows highest concordance (4/7 networks with full agreement: Dorsal Attention, Limbic, Frontoparietal Control, Default Mode), while FAR4 shows complete fragmentation (0/7 full agreement, all partial).

Table 7. Top Multimodal Brain Changes per Participant.

	Brain Region / Connection	Measure	Pre	Post	Change
FAR1 - Improvements (DTI + Connectivity + Thickness)					
1	Right Inferior Longitudinal Fasciculus	FA↑ MD↓	0.242	0.325	+34.2% ↑
2	Left Corticospinal Tract	FA↑ MD↓	0.473	0.597	+26.1% ↑
3	Middle Cerebellar Peduncle	FA↑ MD↓	0.242	0.277	+14.6% ↑
1	Left Thalamus ↔ Right Hippocampus	Connectivity↑	-0.016	0.448	+0.464 ↑
2	Left Amygdala ↔ Left Thalamus	Connectivity↑	-0.039	0.569	+0.607 ↑
3	Right Hippocampus ↔ Right Thalamus	Connectivity↑	0.030	0.491	+0.461 ↑
1	Left Control Network Parcel 2	Thickness↑	0.856	1.706	+99.3% ↑
2	Right Somatomotor Network Parcel 12	Thickness↑	1.692	1.955	+15.5% ↑
3	Left Visual Network Parcel 12	Thickness↑	1.720	1.985	+15.4% ↑
FAR1 - Declines					
1	Right Optic Radiation	FA↓ MD↑	0.435	0.362	-16.7% ↓
2	Right Superior Longitudinal Fasciculus II	FA↓ MD↑	0.388	0.334	-13.8% ↓
3	Right Acoustic Radiation	FA↓ MD↑	0.367	0.326	-11.3% ↓
1	Left Amygdala ↔ Right Pallidum	Connectivity↓	0.055	-0.143	-0.198 ↓
2	Left Hippocampus ↔ Right Pallidum	Connectivity↓	0.090	-0.073	-0.163 ↓
3	Left Hippocampus ↔ Right Nucleus Accumbens	Connectivity↓	0.187	-0.095	-0.282 ↓
1	Left Limbic Network Parcel 3	Thickness↓	3.475	3.150	-9.4% ↓
2	Right Limbic Network Parcel 2	Thickness↓	3.177	2.937	-7.6% ↓
3	Right Limbic Network Parcel 1	Thickness↓	3.715	3.453	-7.1% ↓
FAR3 - Improvements (DTI + Connectivity + Thickness)					
1	Right Fornix	FA↑ MD↓	0.165	0.266	+60.7% ↑
2	Left Corticospinal Tract	FA↑ MD↓	0.316	0.447	+41.5% ↑
3	Right Extreme Capsule	FA↑ MD↓	0.300	0.391	+30.1% ↑
1	Right Default Mode Network Parcel 91	Connectivity↑	0.043	0.183	+0.140 ↑
2	7Networks_LH_Dors_27	Connectivity↑	0.861	1.026	+0.165 ↑
3	Left Control Network Parcel 67	Connectivity↑	0.194	0.618	+0.425 ↑
1	Right Somatomotor Network Parcel 19	Thickness↑	1.524	2.109	+38.4% ↑
2	Right Control Network Parcel 6	Thickness↑	1.914	2.424	+26.6% ↑
3	Right Somatomotor Network Parcel 12	Thickness↑	1.668	2.058	+23.4% ↑
FAR3 - Declines					
1	Corpus Callosum - Rostrum	FA↓ MD↑	0.400	0.345	-13.7% ↓
2	Right Uncinate Fasciculus	FA↓ MD↑	0.374	0.339	-9.3% ↓
3	Right Corticospinal Tract	FA↓ MD↑	0.458	0.416	-9.1% ↓
1	7Networks_RH_Visu_12	Connectivity↓	1.058	0.662	-0.396 ↓
2	7Networks_RH_Visu_5	Connectivity↓	1.012	0.699	-0.312 ↓
3	7Networks_RH_Visu_7	Connectivity↓	1.048	0.728	-0.320 ↓
1	Right Salience/Ventral Attention Network Parcel 1	Thickness↓	2.452	1.694	-30.9% ↓
2	Right Somatomotor Network Parcel 14	Thickness↓	2.887	2.072	-28.2% ↓
3	Right Somatomotor Network Parcel 18	Thickness↓	2.717	2.052	-24.5% ↓
FAR4 - Improvements (DTI + Connectivity + Thickness)					
1	Left Fornix	FA↑ MD↓	0.342	0.365	+6.9% ↑
1	Right Nucleus Accumbens ↔ Right Hippocampus	Connectivity↑	0.053	0.539	+0.486 ↑
2	Right Nucleus Accumbens ↔ Right Amygdala	Connectivity↑	-0.070	0.396	+0.466 ↑
3	Left Default Mode Network Parcel 73	Connectivity↑	0.603	1.023	+0.420 ↑
1	Left Control Network Parcel 2	Thickness↑	1.330	1.702	+28.0% ↑
2	Left Limbic Network Parcel 1	Thickness↑	2.529	2.846	+12.5% ↑
3	Right Somatomotor Network Parcel 16	Thickness↑	2.520	2.750	+9.1% ↑
FAR4 - Declines					
1	Right Inferior Longitudinal Fasciculus	FA↓ MD↑	0.367	0.320	-13.0% ↓
2	Anterior Commissure	FA↓ MD↑	0.366	0.324	-11.5% ↓
3	Corpus Callosum - Body (Central)	FA↓ MD↑	0.576	0.510	-11.4% ↓
1	Left Caudate ↔ Right Amygdala	Connectivity↓	0.182	0.060	-0.122 ↓
2	7Networks_LH_Soma_23	Connectivity↓	1.047	0.971	-0.076 ↓
3	7Networks_LH_Visu_9	Connectivity↓	1.037	0.985	-0.052 ↓
1	Right Control Network Parcel 1	Thickness↓	2.793	2.590	-7.3% ↓
2	Right Control Network Parcel 2	Thickness↓	2.385	2.218	-7.0% ↓
3	Right Somatomotor Network Parcel 11	Thickness↓	2.520	2.363	-6.2% ↓

Pre- and post-intervention neuroimaging metrics showing the three largest improvements and three largest declines for each participant (FAR1, FAR3, FAR4) across three imaging modalities. *White Matter (DTI)*: Improvements = increased FA + decreased MD; Declines = decreased FA + increased MD. Values: FA (fractional anisotropy, 0-1); MD (mean diffusivity, $\times 10^{-3}$ mm²/s). Change reported as percentage. *Functional Connectivity*: Pearson correlation (r, -1 to +1) between ROI pairs using Schaefer 200 cortical parcellation + 14 subcortical structures. Change reported as raw difference (Δr = Post - Pre) due to bounded scale properties of correlations. *Cortical Thickness*: Schaefer 200 parcel thickness (mm). Change reported as percentage.

Calculations: $\Delta = \text{Post} - \text{Pre}$. For DTI and cortical thickness, percentage = $[(\text{Post} - \text{Pre}) / |\text{Pre}|] \times 100$. Case series (n=3); no statistical testing performed.

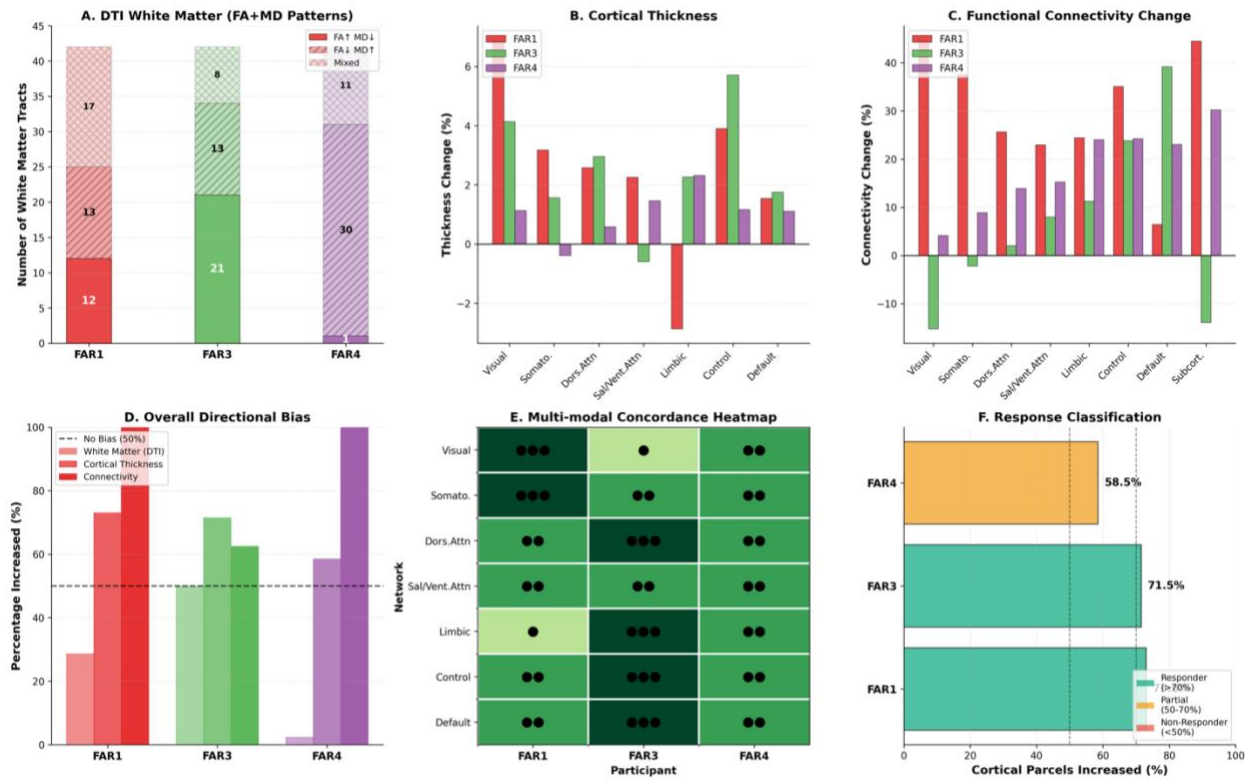


Figure 12. Multi-modal brain plasticity across functional networks. (A) White matter FA changes from 42 tracts mapped to 7 Schaefer networks. Solid bars = concordant FA/MD changes (reliable), hatched = discordant (mixed). Positive concordant change = FA↑ AND MD↓ (true white matter enhancement); negative concordant change = FA↓ AND MD↑ (true white matter decline). (B) Cortical thickness percent change across 200 Schaefer parcels aggregated by network. (C) Within-network functional connectivity changes (mean correlation coefficient change within each of 7 networks). (D) Overall directional bias showing percentage of structures with increases per modality (dashed line = 50% no bias). Lighter bars = DTI, medium = thickness, darker = connectivity. (E) Multi-modal concordance heatmap: ●●● = 3/3 modalities agree, ●● = 2/3, ● = mixed. FAR3 shows highest concordance (4/7 full agreement networks), FAR4 shows structure-function decoupling despite functional gains. (F) Response classification by cortical thickness: >70% parcels increased = Responder. FAR1 (red) and FAR3 (green) = Responders; FAR4 (purple) = Partial Responder.

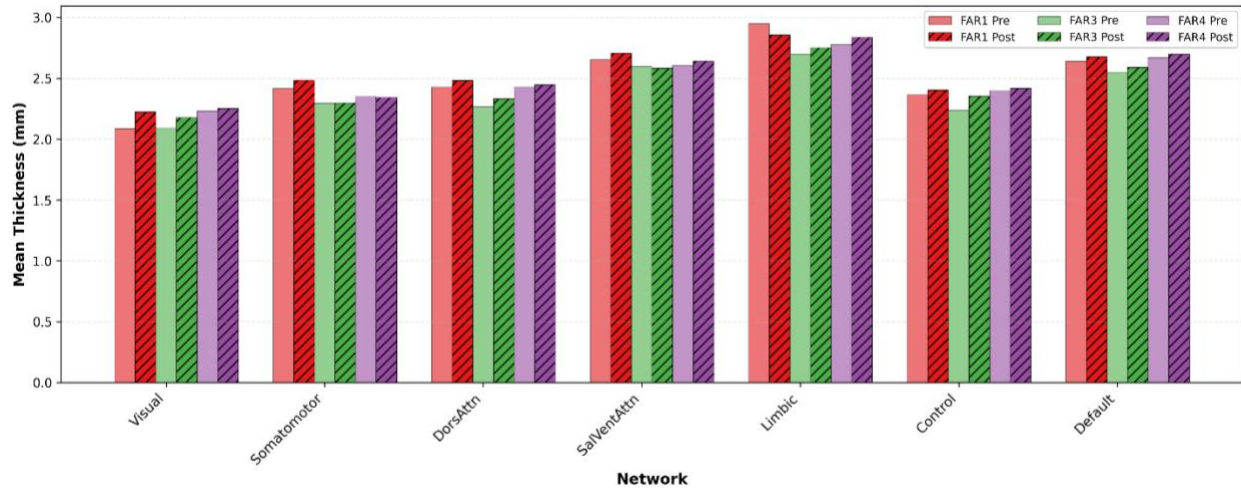


Figure 13. Network-level cortical thickness changes following motor learning intervention. Pre-intervention (solid bars) and post-intervention (hatched bars) mean cortical thickness across seven Schaefer networks for three participants (FAR1=red, FAR3=teal, FAR4=navy blue). All participants show widespread cortical thickening, with FAR3 demonstrating the largest increases across Control (+5.71%), Visual (+4.13%), and Dorsal Attention (+2.96%) networks. FAR1 shows pronounced thickening in Visual (+6.89%) and Control (+3.90%) networks, while FAR4 exhibits more moderate but consistent increases, particularly in Limbic (+2.32%) and Salience/Ventral Attention (+1.46%) networks. Error bars represent standard error across parcels within each network.

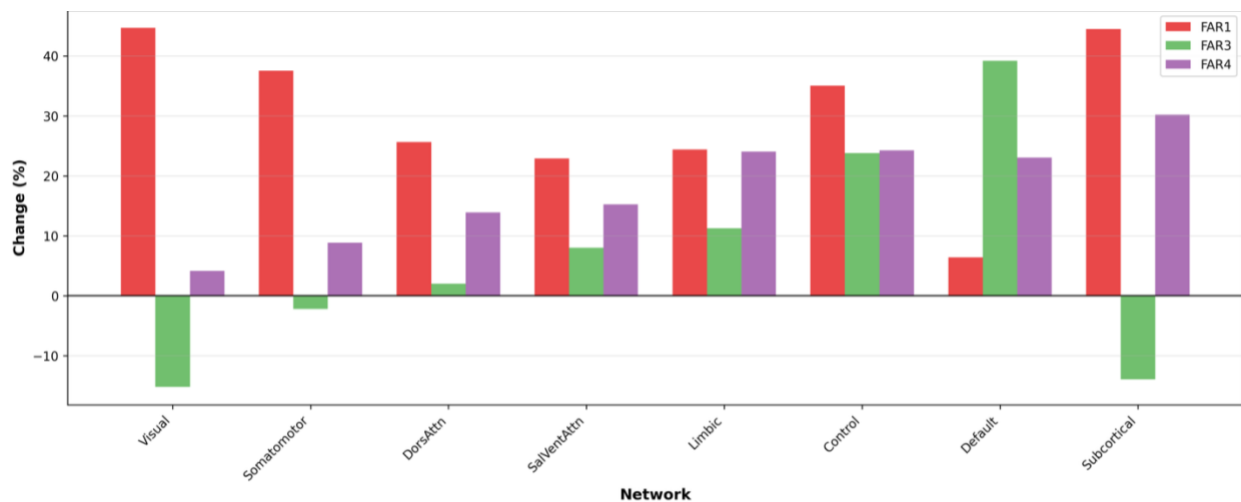


Figure 14. Within-Network Connectivity Changes. Within-network functional connectivity changes (percent) from pre- to post-intervention across eight brain networks for all three participants. Positive values indicate strengthened connectivity; negative values indicate weakened connectivity. All participants showed increased Frontoparietal Control network connectivity

(FAR1: +35.0%, FAR3: +23.8%, FAR4: +24.2%). FAR1 exhibited widespread increases across all networks, with largest gains in Visual (+44.7%) and Subcortical (+44.5%). FAR3 showed Default Mode Network dominance (+39.2%), with Visual and Subcortical networks decreasing. FAR4 demonstrated balanced increases, led by Subcortical (+30.2%) and Limbic (+24.0%) networks.

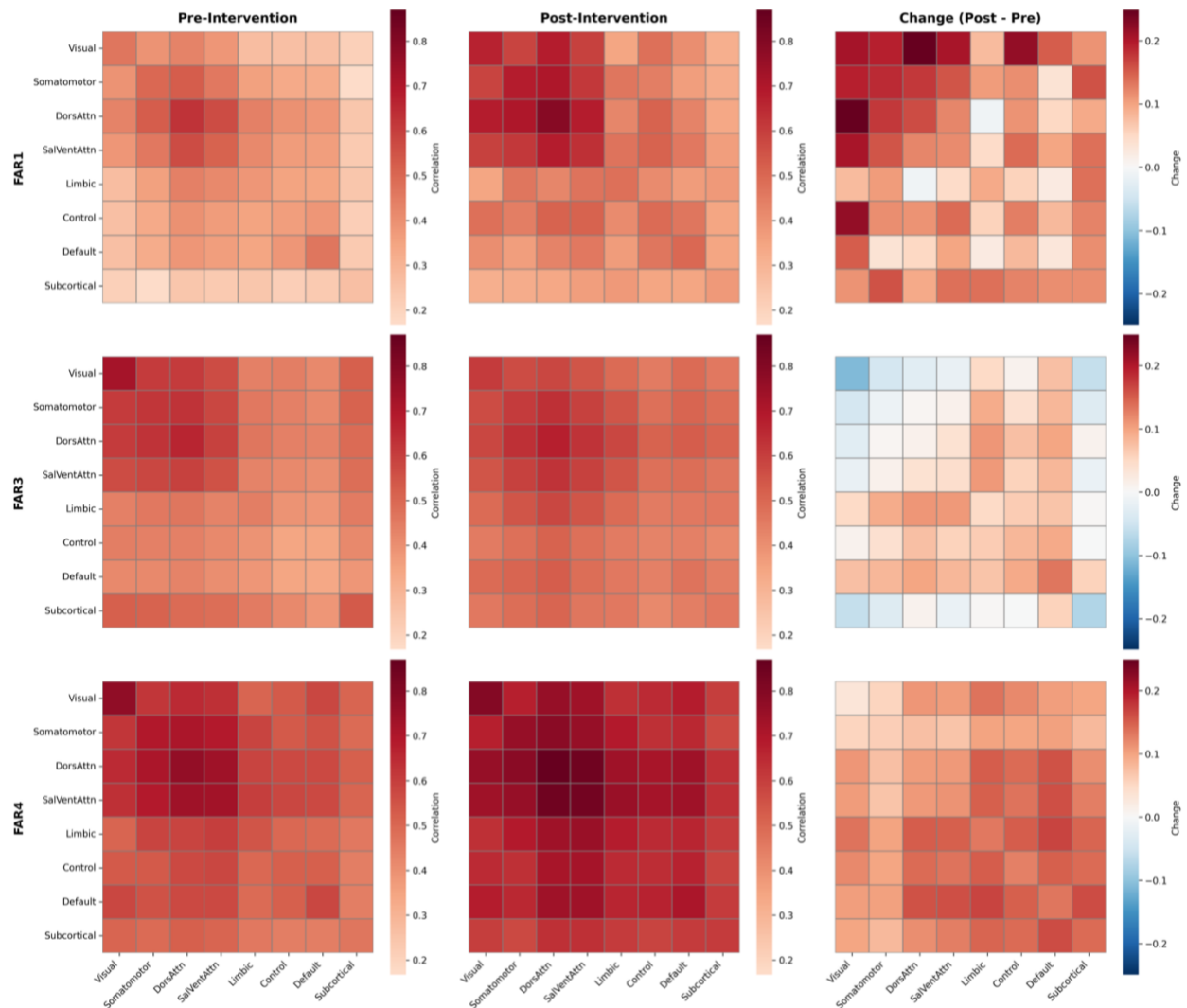


Figure 15. Network-to-Network Connectivity Reorganization. Network-to-network (8×8) functional connectivity matrices showing pre-intervention (left), post-intervention (middle), and change (right) for all three participants. Diagonal elements represent within-network connectivity; off-diagonal elements represent between-network connectivity. Color scale: blue=negative correlation/decrease, red=positive correlation/increase. FAR1 shows widespread strengthening across network pairs. FAR3 displays selective increases in Control and Default Mode connections, with Visual/Subcortical decreases. FAR4 exhibits uniform strengthening across all network pairs.

4.4.5 Participant Narratives: Functional Recovery and Lived Experience

Although work has been done to quantify changes in persistent post-concussion symptoms using both neuroimaging and clinical outcome measures (Gard et al., 2024; Polinder et al., 2018; Ross et al., 2023; Sterr et al., 2006), a fundamental challenge remains in characterizing participant improvement trajectories. Individuals recovering from concussion frequently describe subjective experiences of mental fog, haze, or lack of clarity (Bell et al., 2023; Choudhury et al., 2020) phenomenological states that, while ratable on standardized scales, vary substantially in their subjective meaning across individuals and may precede, lag behind, or occur independently of quantifiable symptom reduction. Further complicating assessment, clinical observations document dissociations between domains: some individuals experience symptom reductions without corresponding behavioral improvements (Sterr et al., 2006), while others demonstrate objective performance gains despite persistent subjective complaints (Fazio et al., 2007; Polinder et al., 2018), with symptom and performance validity proving clinically dissociable. These discordances highlight the limitations of relying solely on standardized outcome measures to capture the multidimensional nature of recovery (Van Ierssel et al., 2020; “Vestibular Dysfunction and Concussion,” 2018), with current assessments systematically missing dimensions patients prioritize such as functional capacity, identity reconstruction, and lived experience of symptom burden (Levack et al., 2010; Van Ierssel et al., 2020).

To address these limitations, we conducted semi-structured exit interviews with all participants upon intervention completion. Interviews were audio-recorded, transcribed, and analyzed using thematic analysis (see Methods 3.6; full transcripts in Appendix B).

Three dominant themes emerged: restoration of cognitive capacity, return to valued activities, and shifts from avoidance to approach. Table 8 summarizes theme prevalence and representative quotations.

Table 8. Qualitative Outcomes table

Theme	n	Representative Quote
Vestibular/dizziness improvement	5	"My ability to ignore visual and vestibular stress, spinning, turning, moving my head in different directions improved." (FAR7)
Cognitive clarity	4	"It feels like the highway is opening again. Things are moving. There's no tolls, and there's no traffic jams." (FAR8)
Avoidance → approach shift	4	"It went from feeling super nervous to move to feeling like excited." (FAR6)
Executive/organizational gains	3	"I do make lists and write things down... I need to organize my day in order to be more productive." (FAR4)
Return to valued activities	3	"I played pickleball and remembered the score almost every single time, which before I remembered maybe 20% of the time." (FAR7)
Sleep restoration	2	"Getting me more tired in the day would help me sleep... it would knock me out for sure." (FAR2)
Social functioning	2	"I could actually follow everything she was saying... despite distractions. That's a huge thing socially." (FAR7)
Strategic symptom management	2	"I now know my triggers... I eliminated them today." (FAR3)
Domain dissociation	2	"Concentration a little bit better... but I don't think it's helped any of my physical pain." (FAR4)

Notable individual patterns: FAR7 demonstrated the most comprehensive improvement trajectory, describing transformation across cognitive, vestibular, occupational, recreational, and social domains: "I actually feel like a completely different person sitting in front of you than the first day." FAR3 developed active mnemonic strategies ("making associations with when I was a wrestler... the weight 335, 314") that facilitated his 619% performance improvement despite sustaining a mid-intervention re-injury.

Two participants exhibited domain dissociation. FAR4 reported cognitive gains ("making better choices") alongside worsening physical symptoms, likely reflecting cervicogenic pathology creating a physiological ceiling for recovery. FAR6 showed substantial cognitive-motor improvement (SCAT6 +44%) while vestibular symptoms remained stable (DHI 54→56), suggesting domain-specific recovery trajectories.

These qualitative findings extend the quantitative results by revealing how measured improvements manifested in daily function—a dimension standardized instruments may systematically underestimate (Levack et al., 2010).

5 Discussion

Beyond the observed improvements in clinical and behavioral measures, participant narratives revealed experiential dimensions of recovery not fully captured by standardized assessments. First, participants described restoration of confidence and self-efficacy—FAR6's shift from "nervous to move" to "excited," FAR7's transformation into feeling like "a completely different person." Second, return to valued activities represented meaningful functional gains: FAR7 attending concerts and maintaining pickleball scoring, FAR8 returning to full work capacity without brain fog, FAR3 anticipating rather than dreading intervention sessions. Third, several participants described enhanced metacognitive awareness—FAR3 identifying and eliminating symptom triggers through strategic memory encoding, FAR2 recognizing the therapeutic value of productive cognitive fatigue, FAR4 implementing organizational strategies despite persistent physical symptoms, FAR6 using executive control to regulate sleep behavior. These qualitative dimensions contextualize the quantitative improvements and suggest that standardized outcome measures may underestimate the intervention's impact on daily functioning and quality of life. Below we explore the neural mechanisms underlying these multidimensional improvements, examining how structural white matter recovery and functional network reorganization corresponded with clinical and behavioral gains.

5.1 Neuroimaging Correlates: Structural and Functional Brain Changes

Multimodal neuroimaging revealed convergent patterns of neural reorganization that mapped directly onto clinical improvements and qualitative descriptions of recovery. Diffusion tensor

imaging (DTI) quantified white matter microstructural changes through fractional anisotropy (FA) and mean diffusivity (MD), while resting-state functional MRI assessed limbic-striatal-thalamic connectivity. Structural T1-weighted imaging measured cortical thickness changes across functional networks supporting motor, sensory, and executive functions. Across participants, the intervention targeted specific neural systems implicated in the task demands: cognitive-motor integration networks for coordinating visual object identification while reaching under mirrored control conditions; memory circuits supporting spatial working memory under motor load; cerebellar pathways mediating adaptive motor learning of the fine motor task; and limbic-striatal-thalamic networks regulating emotional responses to cognitive-motor challenge. Critically, neural changes demonstrated participant-specific patterns that aligned with individual recovery trajectories and qualitative narratives, revealing the mechanisms through which dual-task AR training induced functional improvements.

5.1.1 Cognitive Motor Integration Networks

The intervention's mirror-reversed visuomotor control, combined with concurrent spatial working memory demands and progressive postural challenge, targeted distributed networks spanning ventral and dorsal visual streams, posterior parietal cortex for sensorimotor transformation, cerebellar circuits for adaptive motor control, and prefrontal-striatal systems supporting cognitive flexibility. These networks exhibited striking reorganization patterns that directly corresponded with task performance improvements and symptom reduction, revealing the neural substrates through which cognitive-motor integration training induced functional recovery.

FAR1, right-handed, demonstrated right hemisphere ventral stream dominance, with right inferior longitudinal fasciculus (ILF) fractional anisotropy increasing 34.2% (0.242 to 0.325). The ILF mediates ventral visual stream processing for rapid object identification and visual-motor coordination, connecting occipital and temporal regions essential for recognizing bird colors and

nest locations during reaching-to-grasp movements. This white matter integrity improvement coincided with his 44% reduction in Dizziness Handicap Inventory scores (54 to 30) and qualitative description of movement becoming "more fluid"—specifically noting that "grabbing, dropping, and continuing motion" became easier as he learned to maintain visual-motor flow rather than stopping at each station. His performance trajectory (139 to 369 points, 165% improvement) reflected this enhanced ventral stream efficiency. Interestingly, his dorsal attention pathways showed the opposite pattern: right superior longitudinal fasciculus-II (SLF-II) declined 13.8% and left SLF-I declined 8.3%, suggesting possible pruning after initial learning consolidation or compensatory reorganization favoring ventral over dorsal route strategies.

In contrast, **FAR3** exhibited bilateral dorsal stream strengthening despite stable ventral stream integrity. His right SLF-II increased 16.9% (0.292 to 0.342) while left SLF-II increased 7.0%, with bilateral ILF remaining essentially unchanged (left: -0.3%, right: -1.0%). The SLF connects parietal and frontal regions for attention-guided reaching, visuomotor planning, and egocentric-to-allothetic coordinate transformations—the capacities required when planning movement sequences from hand position to bird location to nest target while compensating for context-specific visuomotor transformation. His interview captured this strategic reorganization: "before I was struggling to move... now I could make a plan," describing how he developed mnemonic associations to wrestling weights (335, 314) that structured his spatial memory encoding. This dorsal stream enhancement may have enabled his remarkable trajectory from lowest baseline performance (47 points) to highest percentage improvement (619%, final score 338), maintained even after sustaining a second sports-related concussion mid-intervention. His energy scores increased 120% (25 to 55) alongside these neural changes, suggesting dorsal attention network strengthening supported both cognitive control and motivational engagement. **FAR4** displayed

declining visuomotor pathways that corresponded with her variable performance pattern. Right ILF decreased 13.0% (0.367 to 0.320), bilateral SLF-II declined (right: -3.2%, left: -10.7%), and her session scores fluctuated without consolidation (54 to 94 to 62 to 61 to 135 to 125). Despite subjective reports that "I think I got a lot faster" and "concentration a little bit better," objective neural and behavioral measures revealed failed visuomotor integration. Her post-concussion symptom burden worsened substantially (RPQ-3: 3 to 12, 300% increase), and she repeatedly emphasized persistent physical limitations: "neck pain... still getting migraines... hard time to sleep" This dissociation between subjective cognitive gains and objective neural-behavioral decline likely reflects her severe cervicogenic pathology and chronic sleep disruption (4-5 hours nightly) preventing her from consolidating motor learning into stable performance improvements despite repeated practice.

Cortical thickness changes provided structural evidence for network-level reorganization supporting multisensory integration and cognitive control. **FAR1** exhibited widespread thickening in Visual (+6.89%), Frontoparietal Control (+3.90%), and Somatomotor (+3.17%) networks that aligned with his 44% DHI reduction and qualitative report of being "more tolerant of unfamiliar environments" with "general dizziness less now." These network-level increases encompassed parietal regions supporting spatial attention, frontal regions mediating executive control, and motor cortex areas coordinating movement execution—systems directly engaged by the intervention's visuospatial working memory demands combined with tandem walking. **FAR3** demonstrated network thickening concentrated in Frontoparietal Control (+5.71%), Visual (+4.13%), and Dorsal Attention (+2.96%) networks alongside his DHI reduction (34 to 28, 18% improvement) and report that "tandem and remembering numbers got a lot easier" with functional transfer to hockey performance, suggesting preserved cortical plasticity in cognitive control and attentional systems

despite mid-intervention re-injury. In contrast, **FAR4** showed modest network changes led by Limbic (+2.32%) and Salience/Ventral Attention (+1.46%) networks, consistent with her persistent physical limitations and inability to consolidate motor-cognitive improvements.

Descending motor pathways demonstrated participant-specific reorganization patterns that coordinated with cortical network changes. **FAR1** exhibited bilateral corticospinal tract (CST) strengthening (left: +26.1%, right: +7.9%) alongside Somatomotor network thickening (+3.17%), supporting his description of movement becoming "more fluid." This tract-cortex concordance suggests coordinated white matter and cortical plasticity in motor systems. **FAR3** showed massive left CST enhancement (41.5%, 0.316 to 0.447) with widespread Somatomotor network reorganization that included both substantial regional increases and decreases, suggesting heterogeneous motor cortex restructuring rather than uniform change—a pattern consistent with left-hemisphere motor dominance and potential right-hemisphere pruning after learning consolidation. **FAR4** displayed declining left CST (7.3% decrease) with modest cortical network changes concentrated in Limbic and Salience networks rather than motor systems, aligning with her inability to consolidate motor performance improvements despite repeated practice.

These cognitive motor findings align with (Churchill et al., 2019) demonstrating spatially heterogeneous DTI effects in sport-related concussion with limited covariation between parameters and extend (Newsome et al., 2016) showing persistent right frontal connectivity abnormalities beyond symptom resolution. The current results reveal that recovery may involve domain-specific pathway reorganization—ventral versus dorsal stream dominance, ipsilateral versus contralateral motor strengthening—rather than uniform bilateral improvement, with individual patterns predicting functional outcomes. These patterns suggest that successful engagement with task complexity may be necessary for inducing neural reorganization: FAR4's

inability to consolidate motor performance despite training exposure coincided with both declining neural pathways and worsening symptoms, highlighting that neuroplastic changes may require functional motor skill acquisition rather than passive task exposure alone.

5.1.2 Memory Network Plasticity

The fornix—a critical white matter tract connecting hippocampal memory systems with diencephalic structures including mammillary bodies and anterior thalamic nuclei—transmits signals essential for episodic memory encoding, contextual binding, and autobiographical elaboration, with fornix microstructure correlating specifically with recollection-based memory ($r=0.43-0.75$) rather than familiarity or working memory processes (Benear et al., 2020; Hodgetts et al., 2017; Rudebeck et al., 2009). FAR3 exhibited the most dramatic fornix recovery, with left fornix FA increasing 76.7% (0.196 to 0.345) and right fornix FA increasing 60.7% (0.165 to 0.266). These bilateral improvements coincided with his SCAT6 score increase from 28 to 38 (36% improvement)—a measure incorporating delayed recall and dual-task thinking-while-walking components that directly tax hippocampal-dependent memory under motor load. His interview revealed an acquired mnemonic strategy: "making associations with when I was a wrestler" describing how he anchored digit sequences to autobiographical memory. This elaborative encoding approach—linking new information to personal episodic context—is precisely the memory process supported by fornix integrity (Hodgetts et al., 2017; Rudebeck et al., 2009). Restored fornix microstructure enabled the contextual binding and autobiographical elaboration necessary for this strategic encoding, as fornix FA correlates specifically with episodic recollection ($r=0.43-0.75$) while showing no relationship with simple familiarity or phonological working memory (Rudebeck et al., 2009). This strategic encoding approach, enabled by restored fornix integrity, allowed him to progress from remembering "two or three numbers" before

"everything goes cloudy" to consistently recalling all six digits while executing complex motor sequences.

(Jang et al., 2018) identified five distinct fornix recovery pathways including recovery through the ipsilateral fornical column to ipsilateral medial temporal lobe, demonstrating neuroplasticity persists in chronic phases. FAR3's bilateral fornix strengthening suggests engagement of multiple compensatory pathways, with his energy score increase (25 to 55, 120% improvement) potentially reflecting reduced cognitive effort as memory retrieval became more efficient.

FAR1 showed asymmetric fornix changes—left fornix FA increased 19.8% (0.271 to 0.325) while right fornix FA decreased 30.9% (0.358 to 0.247)—suggesting left-hemisphere compensation for right-hemisphere reorganization or atrophy. His SCAT6 improved 26% (27 to 34) alongside qualitative reports that "remembering numbers was getting easier" and awareness that "I was able to grab six digits at times." Despite completing only 10 of 16 sessions due to an unrelated medical complication, his partial-dose exposure produced meaningful memory network reorganization. (Jang & Lee, 2017) demonstrated that fornix FA correlates significantly with global memory ($r=0.303$, $p=0.006$) in chronic mTBI patients, with fiber volume also predicting memory performance ($r=0.271$, $p=0.014$). FAR1's left fornix improvement likely contributed to his working memory gains despite incomplete intervention dosing.

FAR4 demonstrated modest bilateral fornix increases (left: 6.9%, right: 12.8%) that aligned with her SCAT6 improvement (24 to 29, 21%) and energy increase (25 to 45, 80%). Her qualitative description captured how even modest memory network improvements enabled functional compensatory strategies: "putting a shopping list together... appointments... organize my day in order for me to be more productive." She emphasized that "concentration a little bit better, making better choices" reflected enhanced organizational capacity rather than raw memory power. This

pattern suggests that fornix integrity supports not only storage and retrieval but also executive control over memory-guided behavior—consistent with fornix projections to anterior thalamic nuclei that connect with prefrontal executive networks.

The fornix findings provide structural validation for Jang & Lee (2017) demonstrating fornix recovery through neural reorganization at 9 months post-mTBI, with new compensatory branches emerging from fornical columns. The current results extend this work by showing that task-specific cognitive-motor training can induce fornix plasticity even in chronic persistent post-concussion symptoms, with recovery magnitude predicting both objective memory performance and subjective functional capacity improvements. Notably, all three participants showed at least one fornix segment improving (left, right, or both), supporting Jang and Lee's (2017) assertion that fornix recovery through multiple pathways represents a viable therapeutic target rather than inevitable chronic degeneration.

5.2 Motor Learning and Emotional Regulation Networks

The intervention simultaneously engaged cerebellar motor learning circuits and limbic-striatal-thalamic emotional regulation networks, producing coordinated changes across these interconnected systems. This pairing is mechanistically coherent: adaptive motor control under cognitive load inherently challenges emotional regulation as individuals manage frustration, effort perception, and motivation during progressively difficult multidomain performance.

5.2.1 Cerebellar Adaptive Control

Bilateral cerebellar vermis white matter integrity improvements reflected motor learning consolidation through error-based adaptation. **FAR1** showed left cerebellar vermis FA increasing 9.4% (0.373 to 0.408) and right cerebellar vermis increasing 7.7% (0.369 to 0.397), with steady performance trajectory (139 to 369 points, 165% improvement) and qualitative description: "I was getting better at just grabbing, dropping, continuing"—capturing the smooth motor sequencing

that cerebellar circuits support. His emotional well-being increased 31% (52 to 68) alongside these cerebellar changes, suggesting reduced frustration as motor execution became more automatic. The cerebellar vermis receives visual, vestibular, and proprioceptive inputs and projects to brainstem and thalamic nuclei that modulate descending motor commands, making it ideally positioned to refine reaching-grasping-placing movements under postural challenge.

FAR3 demonstrated remarkable cerebellar resilience, maintaining motor learning despite sustaining a second concussion mid-intervention. His bilateral cerebellar vermis increased (left: 3.2%, right: 7.2%) with performance trajectory showing initial decline post-concussion (264 to 233 points) followed by full recovery and continued improvement (233 to 271 to 370 to final 338). His energy score increased 120% (25 to 55), potentially reflecting cerebellar contributions to effort perception and fatigue resistance. This adaptive capacity aligns with cerebellar plasticity literature showing that motor learning involves both synaptic strengthening and structural reorganization extending beyond acute training periods.

FAR4 exhibited declining cerebellar integrity (left vermis: -6.4%, right vermis: -1.1%) that directly corresponded with her fluctuating performance pattern (54 to 94 to 62 to 61 to 135 to 125). She reported "sometimes I feel like my performance isn't where it should be" and emphasized that severe insomnia (4-5 hours nightly) left her feeling like "a basket case." Sleep disruption particularly impairs cerebellar-dependent motor memory consolidation, which occurs predominantly during sleep through reactivation of learning-related neural patterns. Her declining cerebellar pathways likely reflect failed consolidation due to inadequate sleep rather than training-induced deterioration—a pattern demonstrating that neuroplasticity requires sufficient physiological support.

5.2.2 Limbic-Striatal-Thalamic Emotional Networks

Resting-state functional connectivity revealed reorganization of emotional regulation circuits that temporally coincided with symptom improvements and qualitative descriptions of enhanced stress tolerance.

FAR1 exhibited substantial increases in amygdala-thalamic connectivity (left amygdala to left thalamus: $r = -0.039$ to 0.569 ; right hippocampus to right thalamus: $r = 0.030$ to 0.491) alongside left putamen to right nucleus accumbens connectivity ($r = 0.181$ to 0.673). These connectivity changes aligned with his emotional well-being increase (52 to 68, 31%) and Dizziness Handicap Inventory reduction (54 to 30, 44%). His qualitative description captured the functional significance: "more able to tolerate things... more tolerant of unfamiliar environments." These patterns align with prior work documenting subcortical emotional network reorganization post-TBI that correlates with clinical recovery (Xu et al., 2018).

FAR3 (4 months post-injury) showed robust caudate-thalamic network strengthening (left caudate to right thalamus: $r = 0.443$ to 0.709 ; left caudate to right hippocampus: $r = 0.271$ to 0.454 ; left caudate to right amygdala: $r = 0.238$ to 0.373 ; right putamen to right thalamus: $r = 0.564$ to 0.717). These connectivity increases corresponded with his energy score increase (25 to 55, 120%) and perceived stress reduction (19 to 16, 16%), alongside qualitative transformation in engagement: "I now know my triggers... looking forward to coming... kind of sad that it's over." This pattern is consistent with Xu et al. (2018) demonstrating that caudate-cingulate connectivity normalizes by 1-month post-injury alongside emotional processing improvements. His maintained learning trajectory despite sustaining a second concussion mid-intervention may reflect emotional-motivational resilience.

FAR4 (11 months post-injury) demonstrated substantial nucleus accumbens network reorganization (nucleus accumbens to amygdala: $r = -0.104$ to 0.423 ; nucleus accumbens to

putamen: $r = 0.123$ to 0.671 ; putamen to nucleus accumbens: $r = 0.135$ to 0.631) that aligned with her striking emotional well-being increase (20 to 64, 220%) despite worsening post-concussion symptom burden (RPQ-3: 3 to 12, 300%). This dissociation is notable: her nucleus accumbens reward network reorganization coincided with subjective improvements in "concentration better, making better choices," supporting functional strategies like "shopping lists... appointments... organize my day." However, persistent cervicogenic pain, migraines, and severe insomnia likely prevented motor-cognitive consolidation, as evidenced by declining visuomotor pathways and cerebellar integrity. This pattern suggests that subcortical emotional-motivational networks can reorganize even when cortical motor-cognitive systems fail to consolidate, potentially due to insufficient physiological support for neuroplasticity.

These patterns across three participants provide preliminary evidence consistent with heterogeneous recovery trajectories documented by Churchill et al. (2019) and the limbic-striatal-thalamic connectivity dynamics mapped by (Xu et al., 2018). The current findings suggest that cognitive-motor integration training may induce participant-specific neural reorganization across emotional regulation networks, with connectivity changes temporally corresponding to distinct functional outcomes and qualitative recovery experiences.

6 Limitations

This proof-of-concept study has many limitations that must be considered when interpreting findings and planning future research.

6.1 Sample Size and Study Design

The clinical sample ($n=7$) and neuroimaging subsample ($n=3$) are sufficient for demonstrating feasibility but limit generalizability and preclude statistical inference. Effect size estimates provide preliminary magnitude information, but confidence intervals remain wide. Individual differences

in imaging data could reflect true biological heterogeneity, measurement noise, or unique circumstances (e.g., FAR3's mid-intervention re-injury). Without a randomized control group, we cannot definitively attribute improvements to the intervention versus natural recovery, regression to the mean, placebo effects, or other life changes. While the magnitude of improvements (66.7% energy increase) and consistency across domains suggests effects beyond placebo, controlled comparison is essential.

Participants varied substantially in age ($M = 50.7$ years, $SD = 14.8$), time since injury (4.3-129.2 months), injury mechanisms, comorbidities (migraine: 71%; ADHD, mental health treatment, learning disorder, cervicogenic pain), sex (71% female), and ethnicity. While this reflects real-world PPCS populations, it increases outcome variability and complicates identification of optimal target populations.

6.2 Measurement and Data Quality

PPCS status was based on self-report rather than clinically verified diagnosis, and injury histories were not corroborated with medical records. While baseline assessments confirmed active symptom burden, this approach may introduce heterogeneity in underlying pathology. Pre-intervention scans were not uniformly timed to intervention start (range: 35-91 days), introducing potential confounding from natural recovery or progression. Fornix FA shows moderate test-retest reliability ($ICC \sim 0.5-0.7$; Cole et al., 2014) due to its small size and CSF proximity. While FAR3's 60-77% improvements substantially exceed reliability thresholds, smaller changes require cautious interpretation. Standard DTI cannot distinguish axonal from myelin integrity and is sensitive to motion artifacts; while we implemented quality control thresholds ($SNR > 10$, motion $< 2mm$

translation/ $<2^\circ$ rotation, outlier slices $<5\%$, visual registration inspection), subtle motion effects may still influence findings.

Primary outcomes relied on self-report questionnaires, which—while appropriate for a symptoms characterized primarily by subjective symptoms—remain subject to response bias and individual interpretation differences. The behavioral metrics captured during intervention may offer objective correlates to complement traditional assessments in future work.

6.3 Protocol and Generalizability

Intervention parameters (16 sessions over 8 weeks, 20 minutes per session, 10 minutes walking/10 standing) were based on feasibility rather than optimization. One participant withdrew after 2 sessions (FAR5, symptom exacerbation) and one completed 10/16 sessions (FAR1, medical complication), yielding 12.5% withdrawal. Participants were predominantly middle-aged (mean 50.7 years), majority female (71%), all with prior sports experience, from the Greater Toronto Area, able to drive to the research center, with English comprehension and ability to tolerate treatment. All had resources for multiple research site visits and 2-hour sessions; feasibility in lower-resourced populations remains unknown.

7 Future Directions

Establishing efficacy requires a randomized controlled trial comparing multidomain AR intervention against active controls (conventional physiotherapy matched for contact time) and AR controls (engaging gameplay without cognitive-motor integration) to isolate therapeutic mechanisms and address placebo and demand effects inherent to unblinded feasibility studies. Embedding neuroimaging within a larger sample ($n=40-50$) would enable statistical inference

impossible with $n=3$. Beyond efficacy, future work should optimize intervention parameters (dose, frequency, task components), extend to other populations (acute concussion, aging, mild cognitive impairment), develop accessible home-based versions, and integrate multimodal biomarkers to predict treatment response.

8 Conclusions

This proof-of-concept study demonstrates that augmented reality-based multidomain neurorehabilitation—integrating sensory (auditory, proprioceptive), cognitive-motor (visuospatial transformation), and vestibular challenges—was associated with clinically meaningful improvements in individuals with persistent post-concussion symptoms, a population that frequently shows limited response to conventional rehabilitation (Hiploylee et al., 2017)

More broadly, these findings contribute to a growing case for behavior-based neurotherapeutics (Merzenich et al., 2014). While pharmacological interventions dominate current approaches to brain dysfunction, no FDA-approved medications exist for PPCS, and available drugs target symptoms rather than underlying neural mechanisms. The convergence of clinical improvement, behavioral learning, and preliminary structural brain changes observed here suggests that precisely designed behavioral challenges—delivered through immersive technology—can drive neuroplastic recovery in ways drugs cannot.

If validated in larger trials, this approach represents more than a novel concussion treatment. It points toward a future where behavior itself becomes medicine: targeted, personalized neural training that leverages the brain's capacity for experience-dependent plasticity to treat dysfunction at its source.

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10 Appendix A: Tables and Figures

11 Appendix B: Supplementary Video Materials

The following videos are included with the digital thesis submission to illustrate the AR intervention protocol described in Section 3.5.

Video	Description
Video B1	First-person view through the head-mounted display showing the AR task environment, station layout, and virtual objects
Video B2	Participant memorizing the six-digit station sequence at the central hub and navigating to the first correct station
Video B3	Participant completing a direct control trial: identifying the target bird and placing it into the color-matched nest
Video B4	Participant completing a mirrored/inverted control trial, demonstrating the dissociation between controller movement and virtual object response

12 Appendix C: Exit Interview Transcripts

12.1 FAR1 Interview

Transcribed: 2025-11-08 17:08:14

Duration: 30.2 minutes

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[00:00:01.140] [SPEAKER_00] So these questions aren't necessarily the most objective, but my goal isn't to push you to say this was good, this was horrible, I want you to be as frank as you possibly can, knowing that you just said you look at things objectively and that makes me happy, so please focus it from there.

[00:00:17.800] [SPEAKER_00] In terms of the game experience, was it what you expected?

[00:00:24.860] [SPEAKER_01] I don't know that I had expectations of what it was going to be.

[00:00:30.380] [SPEAKER_00] Yeah, great.

[00:00:33.160] [SPEAKER_00] And then as you progressed, did you have any expectations of how you felt you would have progressed?

[00:00:37.920] [SPEAKER_00] Let's say through the game or how you would feel?

[00:00:42.460] [SPEAKER_01] I did feel that over the course of time that the movement piece at times became easier

[00:01:03.130] [SPEAKER_01] and I understood more what I needed to do especially with those reversals but

[00:01:11.250] [SPEAKER_01] also things like I think later on especially when you're not doing tandem

[00:01:19.590] [SPEAKER_01] and it's just a conventional movement it's easy to kind of be I was getting

[00:01:25.010] [SPEAKER_01] better at just kind of as I'm moving by grabbing it dropping it and continuing

[00:01:31.110] [SPEAKER_01] the motion as opposed to arrive you know yeah it was there was times when it felt

[00:01:38.290] [SPEAKER_01] more I was that I there was getting more fluid but like today I found that

[00:01:45.970] [SPEAKER_01] especially with the reversals I was feeling it was more awkward than it had

[00:01:53.610] [Unknown] there was a couple times where I was just not going for it wasn't and there's

[00:01:59.190] [SPEAKER_01] also movements that are easier like the the up the the up and out just physically because doing this

[00:02:08.910] [SPEAKER_01] yeah which is maybe like an age thing like that it's easier it's harder to bend over my belly

[00:02:16.710] [SPEAKER_01] you know well i just found that that that going down yeah um well the ones where you just have

[00:02:25.410] [SPEAKER_01] to move the controller up it was easy like physically it was easier yeah than the ones

[00:02:30.430] [SPEAKER_01] where you have to go yeah but there was a time i think it was the not this the last one where

[00:02:37.990] [SPEAKER_01] i found that or maybe it was at the beginning of this one but like there was i was getting a more

[00:02:43.510] [SPEAKER_01] fluid motion for that down one and i think it was using more real estate with my body to move cool

[00:02:52.670] [SPEAKER_01] But that went away with the tandem because you don't have that capacity, you don't have

[00:02:59.870] [SPEAKER_01] the physical strength to do it.

[00:03:03.370] [SPEAKER_01] So I think I was figuring those little things out, which I think would make a difference

[00:03:09.210] [Unknown] in your overall score.

[00:03:12.210] [Unknown] Cool.

[00:03:13.350] [SPEAKER_00] Anything else that you think helped you feel like you performed better?

[00:03:17.890] [SPEAKER_00] The fluidity, the stance, kind of walking into it?

[00:03:21.350] [SPEAKER_01] Yeah. And I mean, I certainly noticed over time that remembering the numbers was getting easier. And I think I was also learning, becoming aware of when I was sort of getting cognitively loaded and not when I was feeling that don't try to go for five.

[00:03:45.680] [SPEAKER_01] yeah I just stick to four because I got I would get caught sometimes where I

[00:03:50.680] [SPEAKER_01] would be feeling cognitive load I would try for five but the act of trying to

[00:03:57.840] [SPEAKER_01] hang on to that five meant that I lost you know the speed to others and only

[00:04:04.240] [SPEAKER_01] had two numbers instead of just yeah just go for the you know yeah just keep

[00:04:10.880] [SPEAKER_00] it in the fair way. That makes sense. Do you feel like you had any techniques for

[00:04:18.160] [SPEAKER_01] remembering numbers or did you just repeat them to yourself? No, I kept thinking about trying to, I think that, I mean I look at them in

[00:04:28.320] [SPEAKER_01] groups of two. Sure. English? Yeah. Okay. I think that's one of the things that I

[00:04:41.840] [Unknown] found has been challenging is like a structure for remembering numbers yeah

[00:04:53.710] [Unknown] and that's where I think like getting from like remember essentially a group

[00:05:00.430] [SPEAKER_01] of four remembering two numbers is pretty good generally reasonable yeah

[00:05:06.250] [SPEAKER_01] But adding that fifth single digit or adding a third double digit is tough.

[00:05:16.360] [SPEAKER_01] That's a lot.

[00:05:17.750] [Unknown] And then it becomes, especially with the, so I would typically be getting, sometimes it would be either the last two numbers had some relevance to something, which helped to imprint it.

[00:05:36.900] [SPEAKER_01] Yep.

[00:05:39.100] [SPEAKER_01] and the other one was and i found over time it's sort of this balance of

[00:05:47.140] [SPEAKER_01] looking at the numbers and then just getting on with it versus looking at it for like there's

[00:05:53.380] [SPEAKER_01] it's kind of like sometimes looking at it longer wasn't actually helpful you're better off just to

[00:06:00.100] [SPEAKER_01] to look and go. So I found that that worked better. That strategy was good especially

[00:06:12.520] [SPEAKER_00] early later on. You got to look at it longer. And it may just be a function of that it takes

[00:06:18.720] [SPEAKER_00] longer to get it to store. Makes sense to me. But those were the things I was sort of

[00:06:25.640] [SPEAKER_01] paying attention to yes okay yeah yeah do you feel like you got back at the

[00:06:32.120] [SPEAKER_00] game by the end I do absolutely yeah yeah I mean I think that's you know I

[00:06:38.240] [Unknown] know I did from yes cool yeah I mean felt like I definitely felt that things

[00:06:45.660] [SPEAKER_01] were moving forward and I was aware that you know I was able to grab you know six

[00:06:54.020] [SPEAKER_01] six digits at times.

[00:06:55.400] [SPEAKER_01] You did.

[00:06:55.980] [SPEAKER_01] I remember last week.

[00:06:57.040] [SPEAKER_01] And, you know,

[00:06:58.860] [SPEAKER_01] I wasn't,

[00:06:59.720] [SPEAKER_01] there was no way

[00:07:00.440] [SPEAKER_01] at the beginning

[00:07:01.800] [SPEAKER_01] that I was going to get

[00:07:03.600] [SPEAKER_01] six digits,

[00:07:04.380] [SPEAKER_01] but it's not going to happen.

[00:07:05.860] [Unknown] Do you remember
[00:07:06.520] [SPEAKER_00] what your first score was
[00:07:07.600] [SPEAKER_00] when we started?
[00:07:09.660] [SPEAKER_01] I think it was just
[00:07:10.880] [SPEAKER_01] a tick under 100
[00:07:11.840] [SPEAKER_01] is my recollection.
[00:07:14.260] [SPEAKER_00] 139.
[00:07:14.920] [SPEAKER_01] Oh, 139 was the first one.
[00:07:16.360] [SPEAKER_01] Okay.
[00:07:16.640] [SPEAKER_00] Yep.
[00:07:18.160] [SPEAKER_00] Do you remember
[00:07:18.820] [SPEAKER_00] how you reacted
[00:07:20.360] [SPEAKER_00] at the beginning
[00:07:21.160] [Unknown] in terms of how you
[00:07:24.420] [SPEAKER_01] felt during the game compared to now oh I think I was very
symptomatic much earlier yeah so one
[00:07:31.180] [SPEAKER_00] of the things that was typical is you do ten minutes you'd be
okay for normal once we get
[00:07:37.200] [SPEAKER_00] to tandem by minute five to 17 we cut the game right so we
didn't cut the game anymore by the
[00:07:41.880] [Unknown] other so that's kind of cool I think yeah yeah it's hard to say like it's
and again where you
[00:07:53.220] [SPEAKER_01] know what's causing what but it does i do feel like since i
started doing it that sort of in
[00:08:03.000] [SPEAKER_01] general things not that it's perfect or yeah there isn't you know
ups and downs but generally i feel
[00:08:10.840] [SPEAKER_01] like i'm i'm more able to tolerate things yeah more than i could
when we started sure and whether
[00:08:21.920] [SPEAKER_01] that's just because time has gone by yeah whichever oh no that
no one can
[00:08:26.580] [SPEAKER_01] tell you yeah yeah and maybe it's you know I don't know if
there's anything

[00:08:31.260] [SPEAKER_01] that's just about having having a tangible quantitative thing so that I

[00:08:46.730] [SPEAKER_01] see that I'm making progress I need yeah and it's like I can't I can't get around

[00:08:53.550] [SPEAKER_01] that reality

[00:08:54.830] [SPEAKER_01] right

[00:08:55.470] [SPEAKER_01] like

[00:08:55.830] [SPEAKER_01] whereas if it's

[00:08:57.150] [SPEAKER_01] you know

[00:08:57.590] [SPEAKER_01] I can

[00:08:57.990] [SPEAKER_01] as my mood

[00:08:59.290] [SPEAKER_01] ebbs and flows

[00:09:00.290] [SPEAKER_01] I can

[00:09:01.070] [SPEAKER_01] it's easy for me

[00:09:02.150] [SPEAKER_01] to lose track

[00:09:02.810] [SPEAKER_01] of

[00:09:04.510] [SPEAKER_01] general progress

[00:09:05.470] [SPEAKER_01] that I've made

[00:09:06.510] [SPEAKER_01] because I'm in a

[00:09:07.390] [SPEAKER_01] low spot

[00:09:08.490] [SPEAKER_01] and I think

[00:09:09.650] [SPEAKER_01] you know

[00:09:10.410] [SPEAKER_01] whereas when it's

[00:09:11.670] [SPEAKER_01] that sort of

[00:09:12.530] [SPEAKER_01] quantitative thing

[00:09:13.530] [SPEAKER_01] I can't

[00:09:15.350] [SPEAKER_00] you can't tell yourself

[00:09:16.290] [SPEAKER_00] you're not doing better

[00:09:16.790] [SPEAKER_00] I can't

[00:09:17.050] [SPEAKER_00] yeah

[00:09:17.210] [SPEAKER_00] it's like
[00:09:17.730] [SPEAKER_00] it's
[00:09:18.070] [SPEAKER_00] no pity party
[00:09:19.230] [SPEAKER_00] yeah
[00:09:19.690] [SPEAKER_00] yeah
[00:09:20.050] [SPEAKER_01] it's just
[00:09:20.450] [SPEAKER_01] you did better
[00:09:21.190] [SPEAKER_01] sorry
[00:09:21.930] [SPEAKER_01] sorry yeah fair enough so i don't know if maybe that is just a helpful metric that just having
[00:09:32.310] [SPEAKER_00] something to track your symptoms and things is beneficial in itself yeah yeah because i know
[00:09:38.750] [SPEAKER_01] that's one of the like and sabrina and i were talking about today because i struggle with
[00:09:42.610] [SPEAKER_01] you know like i know i know that over the last year i've gotten significantly better than i
[00:09:53.490] [SPEAKER_01] was yeah but it's for me just my personality it's really easy for me too
[00:10:00.350] [SPEAKER_01] and it's not that I like I'm aware of the fact that I have made progress but I
[00:10:04.550] [SPEAKER_01] tend to forget about that and focus on how much more I have to go instead of
[00:10:13.110] [SPEAKER_01] celebrating celebrating which is just it's just the way I am yes but if that
[00:10:20.150] [SPEAKER_01] is I think that framework of thinking yeah is not helpful at times yeah in
[00:10:28.770] [SPEAKER_01] terms of recovery I don't think it's a helpful thing when it comes to your own
[00:10:46.470] [SPEAKER_00] symptoms or quality of life comparing to the beginning of this intervention to
[00:10:50.390] [SPEAKER_00] now. Is there anything that you see as different? So let's start with symptoms. Do you feel like
[00:10:55.370] [SPEAKER_01] anything's actually changed? Yeah. I, I feel that my level of, um, sort of general dizziness,

[00:11:05.750] [SPEAKER_01] I think is less now than it was. And it's more like today, mostly because of my, my stuff that

[00:11:16.430] [SPEAKER_01] I went through yesterday yeah really stirred up symptoms but before that I've

[00:11:23.070] [SPEAKER_01] been doing pretty well with that and not feeling nearly as sort of disoriented.

[00:11:33.010] [SPEAKER_00] What moments would you feel disoriented compared to let's say that period that you're referring to?

[00:11:38.150] [SPEAKER_01] like things like you know a good one is like if i'm going into like grocery store but i like i've

[00:11:47.610] [SPEAKER_01] been doing better with my grocery store because i'm familiar with it right but before and i would

[00:11:54.750] [SPEAKER_01] and i've been that's been okay for a while yeah um but if i go into a grocery store that i haven't

[00:12:00.010] [SPEAKER_01] been into before new walmart yeah then it's like whoa um yeah then it becomes a lot because it's

[00:12:06.770] [SPEAKER_01] I think it's because I have to assess

[00:12:08.690] [SPEAKER_01] and I have to get

[00:12:10.310] [SPEAKER_01] too much information

[00:12:11.610] [SPEAKER_01] and

[00:12:15.510] [Unknown] I think

[00:12:16.870] [SPEAKER_01] I'm

[00:12:18.170] [SPEAKER_01] and it's not perfect but I'm

[00:12:20.690] [SPEAKER_01] more tolerant of

[00:12:22.810] [SPEAKER_01] going into those

[00:12:24.770] [SPEAKER_01] unfamiliar environments

[00:12:26.670] [SPEAKER_01] and being

[00:12:27.810] [SPEAKER_00] not perfect but better

[00:12:30.750] [SPEAKER_01] you feel like you can deal with it

[00:12:33.130] [SPEAKER_00] a little better

[00:12:33.550] [Unknown] yeah yeah yeah and is there anything my headaches have also been better but I did a medication

[00:12:42.610] [SPEAKER_00] change oh yeah at what point do you know before we started or in the middle in the middle okay

[00:12:48.530] [Unknown] if I could get a note of that I just I don't think we've ever put that down so yeah oh good

[00:13:14.130] [Unknown] thing i asked you these questions my goodness uh okay all good january or february uh early january

[00:14:34.450] [SPEAKER_01] yeah i did um yeah it must have been early january because i had been with my gabapentin

[00:14:41.350] [SPEAKER_01] i've been doing 600 milligrams in the evening but i was still struggling with headaches and

[00:14:47.270] [SPEAKER_01] And I had been for a while, and I was just sort of dealing with it.

[00:14:50.910] [SPEAKER_01] And then I realized, what am I doing?

[00:14:54.710] [SPEAKER_01] I know that that 600 milligrams is a really low dose.

[00:14:57.910] [SPEAKER_01] So then I switched to taking 300 in the morning and 600 at night.

[00:15:03.970] [SPEAKER_01] So a total of 900.

[00:15:05.910] [SPEAKER_01] But yeah, I think that would have been early January.

[00:15:09.070] [SPEAKER_01] I made that switch.

[00:15:10.270] [SPEAKER_00] If it's okay to bother you for just a minute or two.

[00:15:12.970] [SPEAKER_00] You went looking just a little bit longer to see what went.

[00:15:15.510] [SPEAKER_00] yeah just because depending on when it is in the intervention it yeah would you

[00:15:23.990] [SPEAKER_00] have a note of it on your phone or no yeah I should have it well I should have

[00:15:28.430] [SPEAKER_01] a doctor's appointment okay sounds good I'm only asking because we started on

[00:15:35.850] [Unknown] the 13th of January oh so we started or at least I gave you the booklet on about

[00:15:45.490] [SPEAKER_00] the 13th the official day we started was the 15th i'm trying to get a sense of if that happened

[00:15:51.710] [SPEAKER_01] before or during the 15th at that you know what you might be right yeah so i would that i had the

[00:16:07.440] [SPEAKER_01] yeah i had that appointment with him on january 16th 16th but i i think i actually started that

[00:16:14.920] [SPEAKER_01] did that medication change before I saw him so I think it would have been week

[00:16:25.320] [Unknown] of the 15th or so it would have been before that okay I think it would have

[00:16:32.380] [SPEAKER_01] been early because I I made the I because I remember yeah I made the

[00:16:39.880] [SPEAKER_00] dosage change myself you're like fuck this yeah yeah and I think it was

[00:16:45.500] [SPEAKER_01] was because it was in during the holiday time yep so maybe i had made that change

[00:16:53.620] [SPEAKER_00] because when did we start you say we started on the 15th so january of january yeah oh yeah then

[00:16:59.720] [SPEAKER_01] for sure yeah so i it's been i've been on that dose yeah never mind no it's okay yeah sounds

[00:17:07.240] [SPEAKER_00] good i had to work through that process yeah yes because it would have been i think i'd made

[00:17:12.720] [SPEAKER_01] that decision between like that Christmas New Year's thing okay and I

[00:17:17.700] [Unknown] it's like okay I'm just gonna start sure and then and then I thought because I

[00:17:24.560] [SPEAKER_00] remember feeling bad about you know not talking to the guy yeah yeah I knew

[00:17:32.960] [SPEAKER_01] that these I have other friends that are getting government for other things like

[00:17:37.860] [SPEAKER_00] like i know that that's it just like it's fine yeah it can modulate like candy yeah some people

[00:17:44.960] [SPEAKER_01] are on like 2700 milligrams okay yeah that's pretty good i knew that my 600 milligrams was

[00:17:52.300] [SPEAKER_00] not the end of the world yeah for sure yeah so yeah so that should cool sounds good but i think

[00:18:03.460] [SPEAKER_01] within the even within that our time frame yep that my headaches yeah have like really the last

[00:18:12.800] [SPEAKER_01] little while unless there's something significant happening yep they don't with the doses change

[00:18:20.180] [SPEAKER_01] they don't really bother me okay um it's only if like i had headaches yesterday pretty good but

[00:18:28.140] [SPEAKER_01] it was like a gong show. It was a gong show. It was a lot. Just like today. Yeah, and I'm guessing that I'll probably have it. But again, before I made that dosage change, it would have been way worse.

[00:18:47.240] [SPEAKER_00] Okay, these are more rapid-fire. If there's something you would add to this

[00:18:52.760] [SPEAKER_00] intervention, is there anything you would add? What might it be if you say yes or

[00:18:56.980] [SPEAKER_00] Or remove.

[00:18:58.200] [SPEAKER_00] Either one is great.

[00:19:05.500] [SPEAKER_00] Let's just add it.

[00:19:06.900] [SPEAKER_00] Would you add anything?

[00:19:09.360] [SPEAKER_01] I guess the...

[00:19:10.780] [SPEAKER_01] And again, I have no idea where it fits

[00:19:13.620] [SPEAKER_01] within what you guys are looking at.

[00:19:16.440] [SPEAKER_01] Sure.

[00:19:16.900] [SPEAKER_01] But the things that...

[00:19:17.940] [SPEAKER_01] I think we mentioned this before,

[00:19:19.120] [SPEAKER_01] but whether it could be physically changing

[00:19:28.830] [SPEAKER_01] where the stations are within the game,

[00:19:33.450] [SPEAKER_01] so that they're not static yeah so you have to take in more information sir

[00:19:40.470] [SPEAKER_00] wouldn't be changing the shelf yeah like that wouldn't you know so that three

[00:19:46.430] [Unknown] isn't always there you know I think that would be it would be hard yeah and then

[00:19:57.430] [SPEAKER_01] And sometimes, especially I can notice it with the ball one today, is the field of view is limited.

[00:20:13.230] [Unknown] And it's like, I don't know whether, like with the ball one, if I had taken one step back, I could have had all of them in view.

[00:20:26.690] [SPEAKER_01] you yep but i wasn't sure whether that's what you want or that's what you don't want so that

[00:20:33.970] [SPEAKER_00] was a conscious choice we're limited by the technology yeah i wish we had a larger field

[00:20:38.870] [SPEAKER_00] of view but it physically doesn't exist yes and so the decision there was do we try to

[00:20:44.450] [SPEAKER_00] pretty much replicate the bird task where really if you're standing there you don't see what the

[00:20:49.390] [SPEAKER_00] other ones are yeah yeah or do i make it so it's just this so i think that's where because

[00:20:54.530] [SPEAKER_00] because you can't like just by adjusting where you are so i think it would have been helpful to know

[00:21:02.970] [SPEAKER_01] whether do you want me to be able to see yeah nothing or do you want me to be able to see

[00:21:09.750] [SPEAKER_01] everything everything or yeah yeah like yeah that was the trade-off if you are

[00:21:15.770] [SPEAKER_01] like if you are able to see it you you can be more efficient yeah with how you're moving

[00:21:21.590] [SPEAKER_01] whereas if you can't and it's just about so that the baseline is the same because you could

[00:21:30.130] [SPEAKER_01] like just by a little bit of movement you can get more or less more field of view so if you

[00:21:35.750] [SPEAKER_01] i think if the participant knew what the rules were yeah um yeah it's just yeah someone with

[00:21:45.630] [SPEAKER_01] longer hands would probably do it better yeah yeah and like and it's the same thing with the

[00:21:49.430] [SPEAKER_01] like birds the birds like more of that movement like I wasn't sure whether yeah

[00:21:55.590] [Unknown] it's is it more efficient to try to do it in like one fluid motion or doing I

[00:22:08.800] [SPEAKER_01] didn't know in terms of the data piece yeah is so is that fluid you know yeah

[00:22:17.440] [SPEAKER_01] better and should I be trying to do that or does it matter it's just about

[00:22:22.580] [SPEAKER_00] getting the bird into the basket for the sake of the actual intervention which is

[00:22:25.640] [SPEAKER_00] the overall goal of this technically however you get it is how you get it in

[00:22:28.980] [SPEAKER_00] right part of the reason why it's such a weird way of controlling the birds is in

[00:22:34.280] [SPEAKER_00] a lot of neuroscience if you're starting to use a tool so let's say there was

[00:22:38.060] [SPEAKER_00] distance between you pointing at it and the bird moving that in itself is a

[00:22:42.160] [SPEAKER_00] a whole other spiel right well there's a lot of work on that my goal is to do direct grasp so

[00:22:48.920] [SPEAKER_00] right it's the closest thing we could do to having grabbing it which we i had at one point but

[00:22:53.560] [Unknown] frankly the reality is it didn't work well enough right so another limitation was that yeah right in

[00:22:59.840] [SPEAKER_00] terms of getting it more precisely you know technically you know more precise the movement

[00:23:03.340] [SPEAKER_00] the better the faster it is but also if you do it in a few precise movements well that's the way you

[00:23:09.100] [SPEAKER_00] learn to play yeah yeah there's something to make note of yeah yeah cool if you had to remove

[00:23:15.560] [SPEAKER_00] something you have to remove one thing what would you think that's what i want it's an aesthetic

[00:23:20.020] [SPEAKER_01] thing like i found the the station thing yep in the middle like with the annoying the books and

[00:23:27.920] [SPEAKER_01] at least it's like what does this have to do with everything but that's just yeah you know

[00:23:36.740] [Unknown] You feel like you avoided it? I think I did, yeah. But I think from my perspective, it could just be like a pillow. Like when I look at it, it's the visual guy. It's just like, why is that? What does that have to do with anything?

[00:23:59.260] [SPEAKER_00] it's a vestige of the old version of this so originally there was a chicken in the middle

[00:24:03.640] [SPEAKER_00] of the chicken coop you'd walk around right with like a field of grass i wish i was joking right

[00:24:07.940] [SPEAKER_00] and so you actually had to play with a radio you had to press the button until you'd have to do

[00:24:12.720] [SPEAKER_00] five things do one thing other thing other thing and then you'd continue right and so the button

[00:24:17.800] [SPEAKER_00] you actually used to physically interact with right but then it's kind of like something that

[00:24:22.260] [SPEAKER_00] you kind of have to avoid on purpose right yes future versions we're gonna do is more stuff on

[00:24:28.300] [SPEAKER_00] the floor and garbage and poo and animals and stuff so yeah yeah yeah but no yeah it's it's

[00:24:35.380] [SPEAKER_00] a weird little weird red hat i agree it's odd yeah fair doesn't i don't think it really affects it

[00:24:42.000] [SPEAKER_00] no do you feel like it'd be better if there was more or fewer sessions

[00:24:47.940] [SPEAKER_00] let's say we did three four or five times a week without have been too much

[00:24:51.300] [SPEAKER_01] is that just enough just like for me personally logistically let's say logistics were out

[00:24:57.240] [SPEAKER_00] let's say I came to your house right then how much more do you think you

[00:25:01.660] [SPEAKER_00] could have done I think even length of time obsession either one if you had to

[00:25:06.800] [SPEAKER_00] play around with any of those two variables but nothing the length of time

[00:25:10.480] [SPEAKER_01] like based on how I felt over the course of things I think the time the duration

[00:25:15.380] [SPEAKER_01] sure is actually pretty good for me anyway it's like early on it was like

[00:25:21.920] [Unknown] any young it's still yep you know it's not like I'm getting to the end and

[00:25:26.940] [SPEAKER_01] going to hit I don't know I think the I think two times I think two times a week

[00:25:36.840] [SPEAKER_01] is good I guess I'm looking at it as well and I'm sure that other people that

[00:25:44.280] [Unknown] are dealing with this stuff also have other things going on yeah and i know i've kind of ebbed and

[00:25:54.000] [SPEAKER_01] flowed where it's easy to get overloaded with getting better yeah and i remember having this

[00:26:02.820] [SPEAKER_01] conversation early on with sabrina and she was you know at that point i was you know i was doing

[00:26:08.700] [SPEAKER_01] chiro physio I was doing my sessions with Sonia and Sabrina and Sabrina

[00:26:20.030] [SPEAKER_01] pointed out to me she said you're working so hard at getting better that

[00:26:25.360] [SPEAKER_01] it's impeding your ability to get better and it's like because it's like my I

[00:26:31.520] [SPEAKER_01] want to do everything I can yeah better right sure it's like but you need you

[00:26:38.000] [SPEAKER_01] you need to have an amount of downtime to process it.

[00:26:43.620] [SPEAKER_01] So, I mean, for me,

[00:26:48.080] [SPEAKER_01] I think that the two times was good.

[00:26:52.480] [SPEAKER_00] Twice a week, 20 minutes is okay.

[00:26:54.340] [SPEAKER_00] Yeah.

[00:26:54.560] [SPEAKER_00] It's cool.

[00:26:55.380] [SPEAKER_00] It is.

[00:26:56.660] [SPEAKER_00] Feels like a lot to you.

[00:26:57.820] [SPEAKER_00] It's a lot, like, and it's hard to separate,

[00:27:00.380] [SPEAKER_01] like for me, the reality of the travel.

[00:27:03.360] [SPEAKER_01] No, sure, yeah.

[00:27:04.600] [SPEAKER_01] But I'm also looking at that

[00:27:05.880] [SPEAKER_01] as part of the whole thing yeah but it's you know it's not insignificant no sort

[00:27:14.100] [SPEAKER_01] of investment of a huge time yeah yeah yeah this is essentially two hours twice

[00:27:19.120] [SPEAKER_00] a week yeah at least yeah yeah yeah yeah yeah yeah yeah yeah yeah yeah yeah like

[00:27:24.520] [SPEAKER_01] from my like I would say that that yep twice a week 20 minutes I think is good

[00:27:29.260] [SPEAKER_01] yeah I think realistically I think doing more than that would have been but I

[00:27:36.560] [SPEAKER_01] guess if you had it like if it was self yeah it's like it was something that I

[00:27:42.760] [SPEAKER_01] could just mean anything on my own or like you know Stan like a you know

[00:27:47.280] [SPEAKER_01] standing in my living room and did it on my own

[00:27:51.480] [Unknown] yeah maybe then more frequently yeah yeah yeah sounds good yeah and more or

[00:28:00.920] [SPEAKER_00] less rest in between so I know we had like on average two days in between do

[00:28:04.540] [SPEAKER_00] you feel better typically on the days where you had more time off last time

[00:28:09.780] [SPEAKER_01] off yeah yeah like the like i'm i was still finding that like those sometimes it's like

[00:28:22.580] [SPEAKER_01] especially early on sure it's and with other things that are happening yeah it can be like

[00:28:28.380] [Unknown] it's it's it's it's not an insignificant stressor yeah definitely you have to work a little bit

[00:28:42.700] [Unknown] do you have anything to say about any of it no i think it was good like i really you know i i found

[00:28:49.940] [SPEAKER_01] the like i think that game concept for me was like enjoyable and it's like you know again it

[00:28:56.940] [Unknown] pushed me and we had that conversation like it pushed me to you know to get better and yeah all

[00:29:04.100] [SPEAKER_00] of that so sorry the reason i'm laughing is because i'm remembering you kind of pushing

[00:29:08.380] [SPEAKER_00] and they go, aww, it's just fun, it's fun, that's all it is.

[00:29:11.480] [SPEAKER_01] So no, I think like the, for me anyways,

[00:29:13.760] [SPEAKER_01] I found like the, you know, the game itself was engaging

[00:29:19.060] [SPEAKER_01] and, you know, motivating to do.

[00:29:23.200] [SPEAKER_00] Yeah, for sure.

[00:29:24.180] [SPEAKER_00] Yeah.

[00:29:24.600] [SPEAKER_00] Cool.

[00:29:25.080] [Unknown] Yeah.

[00:29:25.900] [SPEAKER_00] And out of all this stuff, do you have any questions

[00:29:28.780] [SPEAKER_00] about any of the research, anything down the line

[00:29:31.320] [SPEAKER_00] you'd be really curious in seeing?

[00:29:33.020] [SPEAKER_01] I mean, I would just be curious in whatever information

[00:29:35.280] [SPEAKER_01] you can.

[00:29:36.040] [SPEAKER_00] Gleam out?

[00:29:36.820] [SPEAKER_00] You can.

[00:29:37.160] [SPEAKER_01] sure yeah definitely yeah cool yeah awesome i would be curious to know like i know i did the

[00:29:42.540] [SPEAKER_01] yep um the other one the hormone thing yep so i'd be curious like yep i'd be curious about that and

[00:29:49.480] [Unknown] i would also be curious like i know they sent me the brain scan images of the brain scan sure

[00:29:55.300] [SPEAKER_01] but again i would be curious to know what that means to you what it means like it looks cool

[00:30:02.800] [SPEAKER_01] but again I don't know where they can go

[00:30:06.040] [SPEAKER_01] in terms of that research piece

12.2 FAR2 Interview

Transcribed: 2025-11-08 17:22:10

Duration: 13.7 minutes

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[00:00:00.000] [SPEAKER_01] All right. Hiya. I'm here with one of the participants, Far2. How's it going?

[00:00:06.560] [SPEAKER_01] Hello.

[00:00:07.200] [SPEAKER_01] Hello. So pretty much no one's going to hear this. I'm going to transcribe whatever we say using AI to text. That's it.

[00:00:14.220] [SPEAKER_01] Okay.

[00:00:14.360] [SPEAKER_01] So no need to worry. So was the game experience what you expected?

[00:00:19.620] [SPEAKER_00] In terms of what I was prepared for initially with you, yes.

[00:00:24.300] [SPEAKER_01] Okay. And that's because you did it one or two times prior?

[00:00:26.780] [SPEAKER_00] Yes, because we did trials in the beginning. I had a unique experience because I got to see the development of your game.

[00:00:36.400] [SPEAKER_00] I had prior knowledge about it before I started, so yeah, it was what I expected.

[00:00:42.040] [SPEAKER_01] Do you feel like you performed better at the game?

[00:00:45.640] [SPEAKER_00] Throughout the experience, yeah, definitely.

[00:00:48.140] [SPEAKER_01] What do you think changed the most in terms of behavior, like how you move about, what you think about?

[00:00:53.140] [SPEAKER_01] Could you talk walk me through some scenarios that might describe that?

[00:00:58.220] [SPEAKER_00] In regards to doing better in the game, I think I got comfortable with the layout of the game in terms of knowing

[00:01:06.800] [SPEAKER_00] Where each station was because obviously they remain the same every time

[00:01:10.880] [SPEAKER_00] And then I got more comfortable with the flow. I would know where

[00:01:15.320] [SPEAKER_00] Station six is located. Yeah, one two three whatever sure

[00:01:20.740] [SPEAKER_00] Throughout, I obviously noticed that my memory got better because in the beginning I wasn't

[00:01:25.300] [SPEAKER_00] able to fully remember the six together in the sequence.

[00:01:30.960] [SPEAKER_00] I would probably do max maybe four, but obviously towards the end, I would easily be able to

[00:01:38.540] [SPEAKER_00] remember all six with no issues.

[00:01:41.560] [SPEAKER_00] I feel like balance even got better, like I got better at being faster at tandem.

[00:01:48.020] [SPEAKER_00] so that was something else that i noticed throughout the eight weeks did you have any

[00:01:54.280] [SPEAKER_01] strategies that you used like for example some people count chinese other uh kind of remember

[00:02:00.180] [SPEAKER_01] years or when they weighed 63 pounds no joke like i decided to do because at the beginning i was

[00:02:08.780] [SPEAKER_00] comfortable memorizing four so i would memorize the first four and then come up with a different

[00:02:14.060] [SPEAKER_00] strategy and remember the last two digits which I usually had issues with

[00:02:18.940] [SPEAKER_00] so it would be like you know if I knew someone of that age or if a person was

[00:02:24.940] [SPEAKER_00] born in a certain year like 45 my grandma was born in 1945 so I would just

[00:02:29.940] [SPEAKER_00] associate with my grandma yeah and so I would just do that to just help me remember the last two

[00:02:36.980] [Unknown] digits cool yeah do you feel like there was something at the beginning of our

[00:02:41.920] [SPEAKER_01] time together i know it's a while ago but like in your day-to-day life that you couldn't do that now

[00:02:47.900] [SPEAKER_00] you might be more able to do anything i think my sleep was the most prominent issue yeah that got

[00:02:54.740] [SPEAKER_00] resolved i think also like this was obviously the nature of the game it is a little mentally

[00:03:01.300] [SPEAKER_00] fatiguing yeah and i in a weird way getting me more tired in the day would help me sleep sleep

[00:03:10.400] [SPEAKER_00] sleep okay so me exhausting you is the trick here okay cool because i feel like i i used my energy

[00:03:17.520] [Unknown] right so it would make me less active at night okay like i'm done for the day i felt productive

[00:03:26.100] [SPEAKER_00] sure i felt like i mentally worked out my brain yeah plus then being in school after and stuff

[00:03:32.540] [SPEAKER_00] and do other things i would be pretty done by the end of the day yeah and it would knock me out for

[00:03:37.680] [Unknown] sure awesome yeah when you think about let's say your day-to-day symptoms or quality of life

[00:03:43.760] [Unknown] right has anything gotten better has anything gotten worse um i know you said sleep other

[00:03:49.480] [SPEAKER_00] than sleep let's say i think the severity of my headaches went down i wouldn't say they're

[00:03:55.740] [SPEAKER_00] completely gone yeah uh but severity wise i think it's it's lower it's more manageable in my opinion

[00:04:03.300] [SPEAKER_01] I remember you used to take a bunch of Tylenol and then you stopped yeah I stopped did you stop

[00:04:07.940] [SPEAKER_00] and you haven't gone on it since or it's very infrequent okay in terms of if it's like really

[00:04:14.440] [SPEAKER_00] bad headache and it's not going away within you know one two hours and I'll take it okay

[00:04:19.740] [SPEAKER_00] but otherwise I feel like I'm okay with having like a mild headache yeah in the background true

[00:04:26.640] [SPEAKER_01] do you feel like you're less dependent on Tylenol in general yes and has anything gotten worse

[00:04:32.060] [SPEAKER_00] since doing this intervention? No, I don't think so. Okay. If anything comes to mind. It was kind

[00:04:41.400] [SPEAKER_00] of like a temporary onset of symptoms after the task. Yeah. But that's, I feel, expected and

[00:04:50.700] [SPEAKER_01] normal. Sure. Because of what we're asked to do. Like, for example, I think on all the sheets,

[00:04:56.720] [SPEAKER_00] the host activity sheet I always had some sort of a little bit of blurred vision or like a little

[00:05:04.660] [SPEAKER_00] bit of dizziness but I feel like that mostly came from the tandem yeah because that's the last half

[00:05:10.160] [SPEAKER_00] of the game yeah so I would feel a little bit more off balance at that point but it's not like

[00:05:14.960] [SPEAKER_00] prolonged symptoms that it carries into my day yeah it's just like temporary onset will go away

[00:05:21.280] [Unknown] pretty fast. Was there any other than the Tylenol or is there any other medication

[00:05:28.200] [Unknown] change? If there was something you would add to this intervention what might it

[00:05:35.020] [SPEAKER_01] be? So 50 more birds, flipping the numbers, group tasks, like you pick anything that

[00:05:41.900] [SPEAKER_01] you'd want to do that you'd want to see for people like you? Maybe alternating

[00:05:46.240] [SPEAKER_00] alternating starting with tandem and then doing tandem second half because because the game is 20

[00:05:55.280] [SPEAKER_00] minutes long yeah it's fatiguing either way sure so maybe it'd be interesting to see the tandem

[00:06:01.820] [SPEAKER_00] first yeah okay to see like if performance is a fatigue issue or if it's you're naturally just

[00:06:08.160] [SPEAKER_00] slowed down because of yeah um fatigue that's a great question i have absolutely no clue yeah

[00:06:13.440] [SPEAKER_01] Part of the concept with regular then tandem was as much as I wanted to go off the scores,

[00:06:20.040] [SPEAKER_01] I didn't have enough data to figure out at what point the score is high enough

[00:06:23.960] [SPEAKER_01] that people are confident enough that we should force them to do tandem.

[00:06:27.640] [SPEAKER_01] What would you say?

[00:06:28.540] [SPEAKER_01] Is there a number at which point you think you felt good enough that,

[00:06:32.100] [SPEAKER_01] okay, after someone scoring 50 points,

[00:06:35.540] [SPEAKER_01] do you think someone should just switch into tandem permanently?

[00:06:39.180] [SPEAKER_01] permanently or like how good of a score would you need before we put tandem first well i don't know

[00:06:47.990] [SPEAKER_00] what the average score is for your other participants because it varies greatly yeah

[00:06:53.710] [SPEAKER_00] a little bit of an exception you're a big exception yeah for context the one who finished

[00:06:59.630] [SPEAKER_01] for one yeah for one i think he ended in about 460 or so okay because i was gonna say he started

[00:07:06.850] [SPEAKER_00] at a hundred okay so that's a pretty good uh increase yeah i was gonna say around 200 200 or

[00:07:14.350] [SPEAKER_01] so yeah cool that makes sense and in terms of locations anything there would you want to

[00:07:21.930] [SPEAKER_01] no like in terms of this yeah anything like literally imagine you had full of your god

[00:07:26.530] [SPEAKER_00] pray god for us no i think it was okay like well i i also have bias because i'm always in this room

[00:07:32.530] [SPEAKER_01] too that's true i like this room yeah fair enough yeah uh i don't know i personally like it when the

[00:07:38.070] [SPEAKER_00] door is closed it makes me feel like it's more confined yeah rather than just like a

[00:07:43.510] [SPEAKER_00] hole with light coming in it's like with darkness it's easier for me to like see the

[00:07:48.650] [SPEAKER_00] station that makes sense with the technology and stuff so it's it makes it more clear and i'm more

[00:07:54.650] [SPEAKER_00] immersed in the ar rather than seeing stuff around me makes sense um you think if we added more

[00:08:01.250] [SPEAKER_01] more numbers, so seven or eight, you'd be able to work with those, or no?

[00:08:05.230] [SPEAKER_01] Did it get a little dull with six?

[00:08:07.590] [Unknown] No.

[00:08:08.170] [SPEAKER_00] Okay.

[00:08:08.610] [SPEAKER_00] Because then I was focusing on speed.

[00:08:10.810] [Unknown] Okay.

[00:08:12.790] [SPEAKER_00] And, like, accuracy and trying to become more efficient.

[00:08:16.350] [SPEAKER_01] Makes sense.

[00:08:17.110] [SPEAKER_00] I think if you did a longer intervention, then maybe it would be worthwhile adding seven and eight.

[00:08:22.210] [SPEAKER_01] Okay.

[00:08:23.150] [SPEAKER_01] And let's say you had to remove something from this intervention, what would it be?

[00:08:26.910] [SPEAKER_01] One thing you have to.

[00:08:31.310] [SPEAKER_00] Any aspect of it.

[00:08:38.500] [SPEAKER_00] I don't know.

[00:08:39.540] [SPEAKER_01] because i feel like it's all important the log is important yeah the post activity symptom sheet is

[00:08:46.900] [Unknown] important yeah i'm not gonna let you out without you finding one thing you gotta remove

[00:08:53.220] [SPEAKER_01] so one little inefficiency that's what we need to see what's the purpose of the tablet birdie

[00:08:57.860] [SPEAKER_01] uh because it's kind of like doing an fmri in the sense where it's an objective measure that's

[00:09:03.120] [SPEAKER_01] been validated compared to every other cmi measure we have which isn't validated well what's the

[00:09:08.540] [SPEAKER_00] difference between that and the balloon tasks that i do the balloons aren't validated so we

[00:09:13.980] [SPEAKER_01] haven't compared it to other kinematic tasks so but i feel like that's similar in terms of like

[00:09:18.940] [SPEAKER_00] yeah the task yeah it's essentially the same i agree that just until we validate it we can't

[00:09:26.780] [SPEAKER_01] necessarily say oh this you know it shows this yeah i mean if you eventually do yeah then i

[00:09:31.660] [SPEAKER_01] would say cut out the tablet yeah fair do you feel like you'd do better if you had more or fewer

[00:09:38.320] [SPEAKER_00] sessions per week no I think two was good yeah it's not overwhelming yeah

[00:09:45.640] [Unknown] because obviously we have a lot of like repeat bass lines yeah so then like when

[00:09:53.660] [SPEAKER_00] I when I do those like I feel definitely more the long sessions yeah okay so I

[00:09:59.000] [SPEAKER_00] think that having the two small sessions yeah a week is manageable cool because

[00:10:05.340] [SPEAKER_01] Because what I'm thinking of doing for everybody else is essentially, you know how everyone took a week off?

[00:10:10.680] [SPEAKER_01] Yeah.

[00:10:11.480] [SPEAKER_01] For the kind of ANOVA I want to run, I just have three time points, not the middle points.

[00:10:16.140] [SPEAKER_01] So I think I might take out that extra rest week and the two extremes and have it so it's just the first and last and baseline where you do the full batter.

[00:10:23.740] [SPEAKER_01] What do you think about that?

[00:10:26.720] [SPEAKER_01] That'd be okay?

[00:10:28.100] [Unknown] I think so, only if people perform well on the baseline.

[00:10:33.220] [SPEAKER_00] because i know i feel more like my symptoms are triggered more during the long sessions because

[00:10:41.680] [SPEAKER_00] i'm doing so much okay you know what i mean yeah and it's it's longer and it's like i'm asked to

[00:10:49.100] [SPEAKER_00] do so many different tasks that are mentally fatiguing and challenging sure so sometimes i

[00:10:54.020] [SPEAKER_00] feel like my performance isn't where it should be compared to other sessions makes sense yeah

[00:10:59.860] [SPEAKER_01] except today today is an exception for sure yeah yeah would you say it'd be better if there was

[00:11:06.840] [SPEAKER_01] more days in between sessions or fewer so let's say would it be better if it was a tuesday thursday

[00:11:12.080] [SPEAKER_01] or do you think you would do you feel better when it's the thursday to the monday period of time

[00:11:16.580] [SPEAKER_00] like i think for the most part i did mondays thursdays yeah and i liked that okay um so two

[00:11:22.900] [SPEAKER_00] days apart is pretty good yeah because like sometimes if i'm not having a good day already

[00:11:28.140] [SPEAKER_00] ready yeah i don't want to do it like do something like this where it's going to trigger my

[00:11:33.100] [SPEAKER_00] make symptoms even more sure so then having that flexibility allows me to like

[00:11:40.340] [SPEAKER_01] kind of prepare yeah i see that yeah totally so then i'm like okay i'll have a good day

[00:11:44.780] [SPEAKER_00] i'll make sure that i'm having a good day do what i can to control that yeah so i can do my task

[00:11:50.160] [SPEAKER_00] like properly and efficiently give you good data well i mean for yourself more like as a

[00:11:56.120] [SPEAKER_01] as a patient almost yeah because i don't want to yeah feel crappy because i have other things to do

[00:12:01.460] [SPEAKER_00] after this 20 minute session yeah so then i need to also ensure that i can still be efficient you

[00:12:08.100] [SPEAKER_01] don't want to spike your symptoms and feel like crap yes exactly makes sense do you have any

[00:12:12.960] [SPEAKER_01] other thoughts on any part of this intervention on your mind anything at all big small left right

[00:12:18.660] [Unknown] uptown maybe maybe no I think I gave you all like yeah the minor criticism cool

[00:12:28.920] [SPEAKER_01] there anything you'd be curious to see or find out so like for example I have

[00:12:34.520] [SPEAKER_01] access to everything right so like how many recalls you have where you're

[00:12:37.860] [Unknown] looking at it from anything else maybe interesting to see to you my

[00:12:42.500] [SPEAKER_00] percentage of error okay in the birdie task sure yeah I know what you mean yeah

[00:12:51.120] [Unknown] just for the most part I feel like I did really really good pretty well yeah

[00:12:56.020] [SPEAKER_00] remembering sequences sure I'd like to know like my percentage of error true if

[00:13:03.200] [SPEAKER_01] you can yeah no I can do that yeah part of the this question is for myself to

[00:13:06.720] [SPEAKER_01] figure out what to look at yeah because you guys actually play and I think with

[00:13:11.000] [SPEAKER_01] playing you see yourself and you know what might be cool yeah yeah cool percentage error do you

[00:13:18.060] [SPEAKER_01] mean like how many numbers you get wrong before you check like let's say you remember only five

[00:13:22.920] [SPEAKER_01] numbers is what you mean or like like the paths and which ones you go if i put in the wrong do

[00:13:28.620] [SPEAKER_00] you feel like you did that wrong station or wrong nest yeah so you're interested to see the errors

[00:13:34.060] [Unknown] yeah cool awesome that's it that's our spiel

[00:13:37.480] [SPEAKER_00] Okay.

12.3 FAR3 Interview

Transcribed: 2025-11-08 17:37:07

Duration: 12.3 minutes

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[00:00:00.000] [SPEAKER_01] Well, so we're recording. I'm here with Far3. So I'm going to ask you a few questions about this whole thing in general. You just give me honest answers about any aspect of this. To start, what was the game experience and was it what you expected?

[00:00:15.880] [SPEAKER_00] No, it wasn't what I expected because I've never really played games or put on a VR helmet before this. It's my first time putting on a VR helmet. So the first couple weeks was a little bit challenging, but after that it started to flow.

[00:00:28.700] [SPEAKER_00] Good.

[00:00:29.100] [SPEAKER_01] I beat my personal best today yeah you did I did so that kind of plays into the

[00:00:35.740] [SPEAKER_01] next question of whether you feel like you perform better at the game as time

[00:00:38.380] [SPEAKER_01] progress that's a yes and yes what do you think changed over time in terms of

[00:00:42.680] [SPEAKER_01] your strategies in terms of your approach you might walk me through what

[00:00:46.800] [SPEAKER_00] what you know me familiarity and the headaches were less okay today I'm

[00:00:52.840] [SPEAKER_00] feeling little to no symptoms yeah so that was kind of you know an indicator

[00:00:58.320] [SPEAKER_00] to say I performed better because I could memorize the word the numbers yeah

[00:01:02.840] [SPEAKER_00] and move a little bit more efficiently without forgetting and have to start

[00:01:06.620] [SPEAKER_01] over so for you you associate the headache with remembering how come um it

[00:01:12.740] [SPEAKER_00] just everything goes cloudy okay so it's just you know you remember two or three

[00:01:17.760] [Unknown] numbers and then you just forget the next three oh okay so and then with a

[00:01:22.380] [SPEAKER_01] headache kind of come on after the first three usually or no no it's when I come

[00:01:27.200] [SPEAKER_00] here with a headache yeah right okay so and i now know my triggers yeah so sure the two triggers and

[00:01:35.380] [SPEAKER_00] i eliminated them today yeah and i was actually looking forward to coming today good kind of sad

[00:01:40.160] [Unknown] that it's over same yeah fair enough uh do you feel like there was something at the beginning

[00:01:48.080] [SPEAKER_01] of our time working together that you couldn't do let's say personally that you can do now

[00:01:56.720] [SPEAKER_00] walking the tandem and remembering numbers sure it got a lot easier over the period of time that

[00:02:03.440] [SPEAKER_00] we're working through it good so partially you know the knee problem I have yeah and then yeah

[00:02:10.180] [SPEAKER_00] the old saying can you walk and chew gum at the same time yeah you feel like it translated to any

[00:02:15.360] [Unknown] parts of your life outside of this environment is what I mean it helped me with the hockey yeah

[00:02:23.620] [SPEAKER_00] Yeah. And it definitely helped me in trying to organize things, my thoughts in my head before my day.

[00:02:29.800] [SPEAKER_00] Yeah. Because I have insane days or crazy days that I do, you know, 10 different activities.

[00:02:34.660] [SPEAKER_00] Yeah. So I don't write anything down normally.

[00:02:38.500] [SPEAKER_00] Yeah. Because if I write it down, I just forget about it anyway.

[00:02:40.700] [SPEAKER_00] Sure. So I try to keep everything in my head. If it's important to me and the alarm goes off, I know I got to be somewhere.

[00:02:46.660] [SPEAKER_01] Do you still use the same number of alarms? Fewer? More? About the same?

[00:02:52.900] [SPEAKER_00] I've used more since I started well yeah clearly had to add more to it

[00:02:56.980] [SPEAKER_00] sure just so that I knew I knew where to be yeah good but the alarms is just to

[00:03:02.700] [SPEAKER_00] make sure I'm alert to what's going on and yeah but for me if it's important I

[00:03:07.480] [Unknown] will never forget fair enough cool if you think back to your own symptom and

[00:03:13.980] [SPEAKER_01] quality of life has anything gotten better I think you already talked about

[00:03:17.840] [SPEAKER_00] the headache anything else yeah just a memory piece yeah because it was it's i'm still a little

[00:03:24.140] [SPEAKER_00] bit worrisome about the memory piece because because of my age yeah you know i feel it can

[00:03:29.360] [SPEAKER_00] only get worse right sure so but i'm actually it's changing my mind to get a vr helmet and

[00:03:35.540] [SPEAKER_00] you know just practice doing some stuff in there so yeah games or memory stuff in there

[00:03:40.600] [SPEAKER_01] cool in my personal life so yeah yeah neat did anything get worse over the span of us starting

[00:03:47.280] [Unknown] to now no okay has there been any kind of medication changes that I wasn't

[00:03:54.040] [Unknown] aware of okay let's say you had to add at least one thing to this whole

[00:04:00.400] [SPEAKER_01] experience intervention this game what would you add what would you change you

[00:04:04.320] [SPEAKER_01] can make it easier or harder anything at all you have full God mode you know and

[00:04:10.060] [SPEAKER_01] this one I want you to give a little bit of thought let's say somebody else is

[00:04:12.560] [Unknown] gonna go through this right after you how would you improve it the only thing

[00:04:22.060] [SPEAKER_00] thing is the controls yeah there are times when the controls won't won't pick

[00:04:25.500] [SPEAKER_00] up the birds right and to move them and then pick it up again if it's just a

[00:04:30.480] [SPEAKER_00] little bit more efficient sure like when you click when you click on it you just

[00:04:33.540] [SPEAKER_00] grabs it if it grabs the wrong bird you'll release it and then you get to

[00:04:36.940] [SPEAKER_00] the next bird that's the only thing that I had problems with one day yeah it was

[00:04:40.440] [SPEAKER_00] like I couldn't grab the bird again once it was out there I couldn't grab it yeah

[00:04:43.980] [SPEAKER_00] it took a couple clicks yeah get it back okay so maybe just a glitch in the

[00:04:47.880] [SPEAKER_00] in the, you know, ghost in the machine kind of thing.

[00:04:49.780] [SPEAKER_00] Sure, fix the glitches kind of thing, okay.

[00:04:51.960] [SPEAKER_01] But that's the only thing I think

[00:04:53.340] [SPEAKER_00] that needs to be improved.

[00:04:54.340] [SPEAKER_00] You can get access to the birds a lot quicker.

[00:04:56.940] [SPEAKER_01] Would you want more numbers to remember?

[00:04:58.680] [SPEAKER_01] Do you think you could do seven, eight, nine in a row?

[00:05:01.560] [SPEAKER_01] No, the six numbers is perfect.

[00:05:03.420] [SPEAKER_00] Okay.

[00:05:03.940] [SPEAKER_00] Because for somebody who's really struggling,

[00:05:06.480] [SPEAKER_00] that would set you off.

[00:05:08.760] [SPEAKER_00] Sure.

[00:05:09.280] [SPEAKER_00] Because it set me off in the beginning, like,

[00:05:10.760] [SPEAKER_00] you know what I mean?

[00:05:11.980] [SPEAKER_00] It was just like, you get frustrated with yourself

[00:05:13.700] [SPEAKER_00] that six simple numbers, why can't you remember it?

[00:05:16.460] [SPEAKER_00] Yeah.

[00:05:16.640] [SPEAKER_00] and that's where I started making the association with when I was a wrestler

[00:05:20.600] [SPEAKER_00] you know the weight and yeah three three 53 14 yeah time and that's how I started

[00:05:26.520] [SPEAKER_01] you know making the connections yeah would you want more stations or fewer

[00:05:32.380] [SPEAKER_00] stations anything to do with that no the stations are fine yeah yeah how would

[00:05:37.480] [SPEAKER_00] you make this harder um make it wider make it a bigger bigger thing sure all

[00:05:44.420] [SPEAKER_00] right you have to move around in a larger space yeah okay because once

[00:05:48.980] [SPEAKER_00] fatigue goes it sets in that that's a descriptor to say you know whether

[00:05:52.820] [SPEAKER_00] you're gonna remember things and everybody make a mistake when you're

[00:05:55.120] [SPEAKER_00] tired yeah so that's that's one thing I think would make it more challenging

[00:05:59.920] [Unknown] cool yeah anything else more more questions I guess if you ask questions

[00:06:10.860] [SPEAKER_00] while you're doing it yeah that never really throw you up yeah to process you

[00:06:15.760] [SPEAKER_00] know three you know six numbers process what you're saying to give you the answer yeah and

[00:06:19.960] [SPEAKER_00] then continue going that that will make it even more challenging the birds wasn't so much because

[00:06:25.200] [SPEAKER_01] you can tune them out you tuned them out after a while yeah and this generation they're always

[00:06:29.420] [SPEAKER_00] listening to music while they're working anyway true so that's that's not going to affect the

[00:06:33.220] [SPEAKER_01] younger generation what about music or background noise let's say i had speakers playing stuff here

[00:06:38.540] [SPEAKER_01] while you're doing it do you think that will throw you off for them not so much maybe the

[00:06:42.740] [SPEAKER_00] first couple times but yeah I think you'd adapt to it just like I adopted to

[00:06:47.520] [SPEAKER_00] the bird noise in my ears true because at first it was distracting and then all

[00:06:51.700] [SPEAKER_01] of a sudden just like it's not even there anymore makes sense yeah if you

[00:06:55.760] [SPEAKER_01] have to take up one thing or more let's say it's a cut this down a bit what

[00:06:59.060] [SPEAKER_01] would you cut out other than the glitches let's say those are well the

[00:07:03.880] [SPEAKER_00] ones where we're doing the squares or the circles mm-hmm and you have to wait

[00:07:07.940] [SPEAKER_01] 20 seconds okay so that one is a particular one because of the brain

[00:07:12.280] [SPEAKER_01] scanner yeah so that I mean more specifically the game and again what

[00:07:16.540] [SPEAKER_01] would I take out yeah okay I'm not a gamer so no I don't I don't in terms of

[00:07:25.920] [Unknown] anything you hate it sounds good I just find that these questions especially

[00:07:36.540] [SPEAKER_01] from people who've actually experienced the thing over and over and over again

[00:07:39.620] [SPEAKER_01] people get opinionated and I love the opinions sounds good I I liked it so it

[00:07:45.840] [Unknown] was nothing I would change sounds good do you feel like you'd do better if

[00:07:52.750] [SPEAKER_01] there were if you had more sessions per week or fewer sessions per week and I

[00:07:57.090] [SPEAKER_00] think we're just perfect yeah yeah the two days a week spread out was just

[00:08:00.650] [SPEAKER_00] perfect for me because more session sessions would create more of a havoc in

[00:08:05.710] [SPEAKER_01] my life yeah yeah an extra hundred become work like yeah it was kind of

[00:08:11.230] [SPEAKER_00] fun to just come here to early in the morning after after hockey yeah and then coming here

[00:08:15.290] [SPEAKER_00] before hockey sure because i had something to look forward to something to leave you know yeah

[00:08:19.310] [SPEAKER_00] so it made it interesting sure right yeah but if i had to come a third or fourth day then that would

[00:08:25.750] [SPEAKER_01] be like going to work yeah all right and then sure who wants that nobody i don't know if we

[00:08:32.610] [SPEAKER_01] did i think we probably had one session where there was only one day in between and then but

[00:08:37.570] [SPEAKER_01] but frequently we had it so it was more or less

[00:08:39.330] [SPEAKER_01] spread apart by two days or so?

[00:08:40.870] [SPEAKER_01] Yes.

[00:08:41.670] [SPEAKER_01] Do you feel like more spread between these sessions

[00:08:44.710] [SPEAKER_01] is better or worse?

[00:08:46.230] [SPEAKER_00] Better.

[00:08:46.890] [SPEAKER_00] Okay.

[00:08:48.490] [SPEAKER_00] Because, you know, with people going through concussions,

[00:08:50.870] [SPEAKER_00] and if you're having a bad day or a bad two days,

[00:08:53.230] [SPEAKER_00] it gives you time to recover.

[00:08:55.010] [SPEAKER_00] Exactly, okay.

[00:08:55.770] [SPEAKER_00] So, because if you're doing it every other day or whatever,

[00:08:58.290] [SPEAKER_00] because there's some days where I'm just debilitated

[00:09:00.690] [SPEAKER_00] for like two or three days when we first started.

[00:09:02.650] [SPEAKER_01] Sure.

[00:09:03.210] [SPEAKER_00] Right?

[00:09:03.690] [SPEAKER_00] Yeah.

[00:09:04.650] [SPEAKER_00] So it gave me time to recover,

[00:09:05.910] [SPEAKER_00] and he didn't make it an arduous task, he made it something I look forward to coming to do.

[00:09:10.890] [SPEAKER_01] Cool, sounds good.

[00:09:15.240] [SPEAKER_01] Do you have any thoughts on your mind when it comes to any part of this intervention?

[00:09:19.260] [SPEAKER_01] Anything at all, from like walking into the door, to the brain scan, to this,

[00:09:22.960] [SPEAKER_01] to anything you want to add, anything you've been thinking about?

[00:09:26.740] [SPEAKER_00] No, only thing is if you can give me a comparison of the brain scans.

[00:09:30.960] [SPEAKER_00] Sure.

[00:09:31.440] [SPEAKER_01] You know, just my personal, you know, that's the only thing.

[00:09:35.660] [SPEAKER_00] Cool.

[00:09:35.920] [SPEAKER_00] everything was yeah I'm not a fussy guy no you're not you're the opposite of one

[00:09:40.600] [SPEAKER_01] yeah you know I mean it is what it is and true you know I'm not gonna come and

[00:09:44.880] [SPEAKER_00] read in your parade because yeah I think I know more than you this is your name

[00:09:48.740] [Unknown] and I accept it and I respect it okay yeah good job sir good job it was

[00:09:54.820] [SPEAKER_01] awesome thank you I will recommend I have recommended people to and I have

[00:09:59.160] [SPEAKER_00] passed the number onto other people cool to give you guys a call so awesome good

[00:10:03.560] [SPEAKER_01] Good to hear.

[00:10:05.000] [SPEAKER_00] My son just doesn't want to drive from Pickering.

[00:10:11.080] [SPEAKER_01] Other than the brain scan, is there anything else

[00:10:13.020] [SPEAKER_01] that you'd want to know? Anything you'd be curious

[00:10:15.100] [SPEAKER_01] to understand? Because essentially what I can

[00:10:17.000] [SPEAKER_01] collect during the game is how many

[00:10:19.200] [SPEAKER_01] you remember before you check, where you're looking

[00:10:21.060] [SPEAKER_01] from, what your movements are like, so I can look at

[00:10:23.120] [SPEAKER_01] the path of the birds,

[00:10:24.620] [SPEAKER_01] your errors, anything you'd be really curious

[00:10:27.040] [SPEAKER_01] to see? Yes.

[00:10:28.200] [SPEAKER_01] I would love it, once this

[00:10:30.100] [SPEAKER_00] is all wrapped up, if I can get

[00:10:31.800] [SPEAKER_00] you know package at the end of it all just yeah just from like my interest sure all right with

[00:10:37.140] [SPEAKER_01] this with this question i mean like because you've played it you've found methods to kind of get a

[00:10:42.520] [SPEAKER_01] better score are there any strategies you think i should look into for everybody doing this game

[00:10:48.340] [SPEAKER_01] over time do you want me for example one person recommended that i look at the types of errors

[00:10:55.040] [SPEAKER_01] people do and in which situations they do the errors right is there anything like that that

[00:10:59.500] [Unknown] stands out to you that you'd want to see I'm trying to do my research through you

[00:11:05.070] [SPEAKER_00] yeah yeah yeah it's just when when you had an error like they need to get four

[00:11:11.350] [SPEAKER_00] out of six numbers yeah it would give you a new set of numbers yeah I would

[00:11:14.770] [SPEAKER_00] rather to go back because just knowing that I messed up two numbers yeah I'd

[00:11:18.990] [SPEAKER_00] like to continue with those two numbers but yeah it doesn't give you that to

[00:11:22.150] [SPEAKER_00] give you a new set of six numbers if you mess up two or three yeah I'll give you

[00:11:26.770] [SPEAKER_00] of the last three, it'll move it over.

[00:11:29.450] [SPEAKER_00] But it will move over everything,

[00:11:31.130] [SPEAKER_00] even if you made just one mistake or whatever.

[00:11:33.250] [SPEAKER_01] Ah, yeah.

[00:11:34.250] [SPEAKER_01] You know what I'm saying?

[00:11:35.250] [SPEAKER_01] Yeah.

[00:11:36.330] [SPEAKER_00] Because sometimes I'm like, damn, what did I forget?

[00:11:38.970] [SPEAKER_00] But when the numbers came up with something

[00:11:40.550] [SPEAKER_00] totally different, and for that, you know,

[00:11:42.710] [SPEAKER_00] one or two seconds it takes me to, yeah.

[00:11:44.670] [SPEAKER_00] Grab it.

[00:11:45.130] [SPEAKER_00] Yeah.

[00:11:46.990] [SPEAKER_00] Cool.

[00:11:48.530] [SPEAKER_00] Yeah, that's the only thing.

[00:11:50.370] [SPEAKER_01] Sounds good.

[00:11:51.890] [SPEAKER_01] Cool, anything else you wanna add?
[00:11:54.070] [SPEAKER_01] We're good?
[00:11:54.730] [Unknown] No.
[00:11:56.210] [SPEAKER_00] I just
[00:11:58.270] [SPEAKER_00] hope this will help others
[00:12:00.150] [SPEAKER_00] in the future
[00:12:00.770] [SPEAKER_00] that's why I'm doing this
[00:12:04.970] [SPEAKER_00] as I said
[00:12:06.150] [SPEAKER_00] I wanted to donate my brain to science
[00:12:07.870] [SPEAKER_00] when I died because
[00:12:08.690] [Unknown] back in the 70's
[00:12:11.630] [SPEAKER_00] it was a different era of sports
[00:12:13.890] [SPEAKER_00] you know
[00:12:14.790] [SPEAKER_00] you got your bell rung, suck it up

12.4 FAR4 Interview

Transcribed: 2025-11-08 17:51:49

Duration: 13.4 minutes

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[00:00:00.560] [SPEAKER_00] All right, I'm here with Farfour. So when it comes to the game experience, right, this whole thing, was it what you expected?
[00:00:12.200] [Unknown] Yes.
[00:00:13.480] [Unknown] Okay.
[00:00:14.300] [SPEAKER_01] It was what I expected, just, yeah.
[00:00:17.460] [SPEAKER_00] What did you expect, I mean?
[00:00:19.320] [SPEAKER_01] I mean, I didn't expect all this paperwork, but I did enjoy the game aspect of it, like these little games.
[00:00:30.040] [SPEAKER_01] Sure.
[00:00:30.580] [SPEAKER_01] The game with the birds, that was really good for my brain to kind of like match the colors to the fountain and, you know, just that.

[00:00:41.380] [SPEAKER_00] Do you mind if I go over the lights?

[00:00:42.580] [Unknown] Yeah, that would be great.

[00:00:44.140] [Unknown] Yeah, yeah.

[00:00:44.960] [Unknown] How many do you want?

[00:00:47.540] [Unknown] Oh, perfect.

[00:00:48.480] [Unknown] Yeah, right?

[00:00:49.840] [Unknown] Come here.

[00:00:50.720] [SPEAKER_01] Oh my God, I feel like I have clarity now.

[00:00:53.460] [SPEAKER_01] Me too.

[00:00:54.240] [SPEAKER_01] The lights are down, yeah.

[00:00:55.200] [SPEAKER_01] Yeah.

[00:00:56.540] [SPEAKER_01] Yeah, okay.

[00:00:57.260] [SPEAKER_00] Do you feel like you performed better at the game compared to when you started?

[00:01:00.580] [SPEAKER_01] Oh yeah, absolutely. Yeah, I think I got a lot faster. I really feel, not only here but outside, I also feel concentration a little bit better, making better choices and taking the time to concentrate as opposed to making rational choices. So that was really good. I think this helped me a lot.

[00:01:29.120] [SPEAKER_00] But yeah, cool.

[00:01:31.620] [SPEAKER_00] And when it comes to the game,

[00:01:33.540] [SPEAKER_00] is there anything you think you're doing differently

[00:01:35.220] [SPEAKER_00] compared to the beginning?

[00:01:36.900] [SPEAKER_00] Your approach to the birds and all that?

[00:01:42.240] [SPEAKER_01] Yeah, I'm stopping to concentrate a little bit better.

[00:01:45.780] [SPEAKER_01] Okay.

[00:01:46.580] [SPEAKER_01] Like what color?

[00:01:48.440] [SPEAKER_01] Well, yeah, I have to stop.

[00:01:50.260] [SPEAKER_01] So I'm in front of the bird, what's it called?

[00:01:52.880] [SPEAKER_01] The bird bath?

[00:01:53.620] [SPEAKER_01] You got it, yeah.

[00:01:54.420] [SPEAKER_01] Yeah, and I have to look at where the color

[00:01:58.960] [SPEAKER_01] of the nests are.

[00:02:00.340] [SPEAKER_01] are so and then you know match it to the bird and make sure it goes into the right nest so yeah

[00:02:06.040] [SPEAKER_01] take a little bit more time to assess and focus yeah cool that's yeah that's a good word do you

[00:02:13.380] [SPEAKER_00] feel like there's something um at the beginning of our time working together that you're now more

[00:02:19.060] [SPEAKER_00] able to do outside of this like let's say daily activities something that you wasn't didn't feel

[00:02:24.200] [SPEAKER_00] necessarily wasn't possible but was harder than it is now saying that got easier in life i think

[00:02:30.240] [SPEAKER_01] it got easier i think i think um yeah i think my concentration is a little bit better yeah so i'm

[00:02:36.760] [SPEAKER_01] better able to make better choices outside of here are there any examples of these kinds of choices

[00:02:43.460] [SPEAKER_01] yeah like putting a shopping list together and going to buy specific

[00:02:50.760] [SPEAKER_01] specific as opposed to like just like find whatever I want so that's pretty good so I do

[00:02:57.940] [SPEAKER_01] make lists and I do write things down a little bit more often now as to what I need to do for today

[00:03:05.980] [SPEAKER_01] shopping list sure appointments like yeah I just I need to organize my my day in order for me to

[00:03:14.140] [SPEAKER_01] be more productive and to be a little bit more ahead of the game so yeah that's helped me quite

[00:03:19.660] [Unknown] of that too cool sounds good what do you think about your own symptoms and quality of life has

[00:03:26.760] [SPEAKER_00] that changed at all i know you still have your neck and that's not something we could have fixed

[00:03:31.000] [SPEAKER_01] but yeah other than that i don't think i don't think it's helped any of my physical okay pain

[00:03:38.720] [SPEAKER_01] yeah uh you know i mean considering the concussion and the neck pain and i'm still getting

[00:03:47.190] [SPEAKER_01] migraines and hard time to sleep. It's just, you know what, it's just all of that put together

[00:03:53.470] [SPEAKER_01] that makes other things feel even more. So, you know, not sleeping because I have severe

[00:04:01.130] [SPEAKER_01] insomnia. I have restless leg syndrome. And when you don't sleep, like my hours of sleeping

[00:04:08.590] [SPEAKER_01] at night time is like four or five hours. I mean, that's not enough to like re-energize

[00:04:13.610] [SPEAKER_01] my immune system and sometimes I just wake up and I'm just like a basket case like I really need to

[00:04:20.790] [SPEAKER_01] like decompress and just think about what needs to be done for the day so it's yeah it is hard

[00:04:30.510] [SPEAKER_01] it's hard so nothing in that aspect has changed okay by the time I get like finding a doctor you

[00:04:43.230] [SPEAKER_01] know from just you know anyway it's really frustrating dealing with doctors these days

[00:04:49.290] [SPEAKER_01] they don't diagnose properly they don't send you to the proper place it's like it's been a

[00:04:54.030] [SPEAKER_01] year since my accident and you know chiropractor just figured out now that i might have like

[00:04:59.290] [SPEAKER_01] whiplash like you know what i mean so it's kind of like and this is all coming out of my pocket

[00:05:04.830] [SPEAKER_01] so it is draining me financially as well so until that's cleared up and i just wrote a letter to my

[00:05:11.330] [SPEAKER_01] lawyer today actually like hey do you have any better ideas as to what i can do i mean i'm you

[00:05:17.230] [SPEAKER_01] know a lot of money's coming out of my pocket and if there's a better way that we can like deal with

[00:05:22.730] [SPEAKER_01] this issue because you know it's going to cost right but the clinic is going to cost me quite

[00:05:30.610] [SPEAKER_01] a bit so so i haven't heard from her just yet but i hope she does but yeah otherwise i mean

[00:05:38.850] [Unknown] my physical symptoms haven't changed. Has anything gotten worse? My neck has gotten worse.

[00:05:47.290] [SPEAKER_01] That's why she thinks that I may have whiplash. It wasn't diagnosed right up at the beginning.

[00:05:57.110] [Unknown] Have you changed any medication while we were together at all?

[00:06:09.700] [SPEAKER_00] Anything that a doctor prescribed, for example?

[00:06:12.200] [SPEAKER_01] Well, you know, just Sunday night I did, because I haven't slept like three days prior to that, so I had to take, I took something to sleep.

[00:06:21.540] [SPEAKER_01] Sure.

[00:06:22.600] [SPEAKER_01] And I think I wrote that in my book.

[00:06:24.620] [SPEAKER_01] Okay.

[00:06:25.060] [SPEAKER_01] Which is upstairs.

[00:06:26.340] [SPEAKER_01] I haven't slept for like three nights in a row, so I did take.

[00:06:29.400] [SPEAKER_01] Oh, wow.

[00:06:30.480] [SPEAKER_01] I took amitriptyline, which helps you sleep.

[00:06:34.780] [SPEAKER_01] on the bed and it was hard for me to get up the next day anyway so i missed my appointment for

[00:06:39.400] [SPEAKER_01] 11 o'clock because i woke up at 10 30 and so they really like play havoc on my immunity because i'm

[00:06:47.400] [SPEAKER_01] like i'm dead to the world the whole day after that so it was hard for me to deal with yeah

[00:06:54.160] [SPEAKER_01] but what are you gonna do i don't know yeah you know like i just can't do too many drugs i know

[00:07:00.880] [SPEAKER_01] my immunity is very low and very sensitive as well so i can't really be popping drugs here

[00:07:06.560] [SPEAKER_01] and there i'll be like no it's worse to take medication for me anyways that's just the way

[00:07:15.050] [SPEAKER_01] it is when you have a very like sensitive constitution you just can't pop drugs every day

[00:07:20.310] [SPEAKER_01] i mean even even a tylenol bothers me

[00:07:22.870] [SPEAKER_00] me. Anything. Okay. Yeah, I know. It's not easy. And pain

[00:07:31.850] [SPEAKER_01] medication. It's like, Oh, my God. Yeah. Gives me more pain

[00:07:36.450] [SPEAKER_01] and more symptoms than benefit. Exactly. So terrible. Yeah.

[00:07:48.170] [SPEAKER_00] Coming back to the game. Is there anything you would want

[00:07:52.790] [Unknown] it you will that you would want to maybe add to what games like these ones specifically just the

[00:07:59.930] [SPEAKER_00] ar one with the glasses so that one of the birds so you can add let's say you can play god for a

[00:08:06.190] [Unknown] sec yeah how would you change it i like it just the way it is would you remove anything would i

[00:08:14.770] [SPEAKER_01] remove anything no okay i mean it's perfect the way it is there's six little would you do like

[00:08:21.670] [SPEAKER_00] like eight of them instead four of them instead. Things like

[00:08:25.410] [SPEAKER_00] that. I mean, anything at all.

[00:08:26.810] [SPEAKER_01] Okay, no, six is fine with me. I think I could have done better

[00:08:30.210] [Unknown] with four maybe. Okay. I mean, it depends how I'm feeling the

[00:08:35.750] [SPEAKER_01] day before. Yeah. Okay. Four, maybe but six was fine for me.

[00:08:42.310] [SPEAKER_01] I mean, yeah, when I'm tired, I didn't move too fast. And when

[00:08:46.170] [SPEAKER_01] When I slept okay, I mean, I moved a little bit faster.

[00:08:49.630] [SPEAKER_01] I did pretty well.

[00:08:51.030] [SPEAKER_00] True, no?

[00:08:51.670] [SPEAKER_00] Yeah.

[00:08:51.950] [SPEAKER_00] Okay.

[00:08:55.730] [SPEAKER_00] Do you feel like it would be better if we had more sessions?

[00:09:00.110] [SPEAKER_00] Let's say you did this three or four times a week, would that have been better, worse?

[00:09:04.110] [Unknown] No.

[00:09:04.850] [SPEAKER_00] Would you have wanted one session a week instead?

[00:09:07.690] [SPEAKER_01] No, I think two is fine.

[00:09:09.250] [SPEAKER_01] Two is fine?

[00:09:09.710] [SPEAKER_01] Yeah, yeah.

[00:09:11.270] [SPEAKER_00] I know we typically had about a day in between our sessions, right?

[00:09:14.810] [SPEAKER_00] Mm-hmm.

[00:09:15.130] [SPEAKER_00] Did you feel better when you only had a day in between, or did you end up feeling better between your last session and the weekend and the first day?

[00:09:24.270] [SPEAKER_01] I like the one day off, and coming back and doing the other session.

[00:09:28.290] [SPEAKER_01] I mean, because if the Tuesday, which is today, if the Tuesday I didn't sleep the night before, then you can actually, I can feel that, okay, you know, this was useless.

[00:09:39.050] [SPEAKER_01] Yeah, but then if I do get a good night's sleep on a Wednesday night and come back on Thursday, I can see the difference

[00:09:45.430] [SPEAKER_01] Yeah, so I think yeah two days is good

[00:09:52.050] [SPEAKER_01] Well, if you want more days then you're gonna have to start paying my TTC to come up here, yeah

[00:09:58.270] [SPEAKER_01] Yeah, you know, I mean that's the time time and money for sure. Yeah, so

[00:10:04.090] [SPEAKER_00] That makes me

[00:10:04.930] [SPEAKER_01] No, I did. I did. Okay. I mean, considering we did have that week off. Yeah, I did kind of miss it in a way. Yeah. You know, kind of like the brain. Uh huh. Kind of like, you wanted the experience again. I wanted that stimulation in the brain. You wanted the high hormones. Yeah. And so yeah, that week that we took off. Yeah, I was like, my brain was craving it because I felt like I was doing something different with my brain.

[00:10:31.530] [SPEAKER_01] But I'm also thinking that maybe, as much as I'm taking up the language, I do my exercises, I listen to music, I listen to movies, I want to go to the gym, I want to do more things, but sometimes my body doesn't allow me to. It's all like this vicious cycle. You sleep, you're okay. You don't sleep, you're dead to the world. That's pretty much it. I did miss it, though.

[00:11:00.590] [SPEAKER_00] do you have any thoughts on your mind when it comes to the bird part of all this anything at

[00:11:05.950] [SPEAKER_01] all is there anything you'd be curious to find out so I have access to everything you

[00:11:28.010] [SPEAKER_00] you do right from when you pick up the birds where you're looking how you're

[00:11:32.190] [Unknown] moving when you check anything you think I should go back and look at because

[00:11:37.350] [SPEAKER_00] you're the one who played this more than I ever have yeah right anything you'd be

[00:11:41.130] [SPEAKER_00] curious to see any behavior you think would be cool to see between people or

[00:11:46.690] [SPEAKER_01] in yourself right but you're the one doing it that's why I'm asking yeah

[00:12:00.130] [SPEAKER_00] So I have access to everything you do in that game, to where you're standing, to where you're

[00:12:05.830] [SPEAKER_00] looking, to what buttons you're pressing, what the sequence is, where you forget things.

[00:12:11.130] [SPEAKER_00] Is there anything there that you would be curious to see between people?

[00:12:15.550] [SPEAKER_00] Any behavior you'd want to look at?

[00:12:17.650] [Unknown] Like that makes more sense.

[00:12:20.270] [SPEAKER_01] Yeah, it kind of makes sense, but there were times where I would get annoyed and frustrated.

[00:12:25.330] [SPEAKER_01] frustrated and irritable. Like I said, it all depends on whether I slept or not. Otherwise, no, I don't.

[00:12:36.990] [SPEAKER_00] Okay. Sounds good. Do you have any questions for me about any of this game stuff?

[00:12:43.700] [Unknown] No, but will you be able to see the progress from the beginning till now?

[00:12:54.100] [SPEAKER_00] and the changes that you can tell me sure yeah yeah there's something so once we finish off the

[00:13:02.280] [SPEAKER_00] game after I do more a few more things I can give you a sense of what your score was how you're

[00:13:07.860] [SPEAKER_00] performing things like that those are your symptoms and stuff so I need a graph from your

[00:13:13.040] [SPEAKER_01] booklets okay well what was i going to ask you in regards to the mri did you still want me to come

[00:13:22.360] [SPEAKER_01] up

12.5 FAR6 Interview

Transcribed: 2025-11-08 18:15:25

Duration: 19.4 minutes

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[00:00:06.040] [SPEAKER_00] So, there's Anton here with Hannah and Farsix. These are the questions. Go on.

[00:00:12.260] [Unknown] Do you want me to type it down?

[00:00:21.700] [SPEAKER_00] No, you just talk.

[00:00:23.800] [SPEAKER_02] Was the game experience what you expected?

[00:00:27.740] [SPEAKER_01] No, you know what? I had like no expectations so I wasn't sure what it was going to be.

[00:00:32.320] [SPEAKER_00] Yeah. In terms of let's say outcome, did you have anything in mind?

[00:00:36.540] [SPEAKER_01] Yeah, I just wanted to do something better than my start.

[00:00:40.480] [SPEAKER_00] Okay. Before, I think you, did you always know it was going to be a game?

[00:00:44.620] [SPEAKER_01] Yeah, I did because I did have that. I got to try it at the brain injury...

[00:00:49.160] [SPEAKER_01] Oh, you did?

[00:00:50.540] [SPEAKER_01] Yes. And I saw that it was like the VR.

[00:00:53.860] [SPEAKER_00] Yeah. And that got you the most excited almost, okay.

[00:00:56.520] [SPEAKER_02] then i signed up cool do you feel uh like you performed better at the game and if so what do

[00:01:02.740] [SPEAKER_00] you think changed um like let's say we think back to the very beginning right where yeah you just

[00:01:09.960] [SPEAKER_00] played it for that first time compared to now right try to compare okay i think i did so much

[00:01:16.140] [SPEAKER_01] better and i think it's because like before i was like just struggling to move and then like now

[00:01:22.980] [SPEAKER_00] like I could like try to make a plan okay how would that feel like like what

[00:01:29.060] [SPEAKER_01] does that mean I guess no it went from being like feeling super nervous to move

[00:01:33.840] [SPEAKER_00] to feeling like excited okay so you felt the same level of like almost like adrenaline but you shifted what it meant

[00:01:42.820] [SPEAKER_00] yeah okay when it comes to actually playing the game do you feel like it was did you have a big change of approach outside of the nervousness

[00:02:14.080] [SPEAKER_02] I was going to say, if I remember correctly,

[00:02:16.820] [SPEAKER_02] we were talking about this on Monday or last week.

[00:02:20.080] [SPEAKER_02] you said um it came from something to i hope i can reach here i can try to oh let's just see

[00:02:27.880] [SPEAKER_01] how high i can go this time it was like yeah like i was like versing myself yeah

[00:02:34.340] [SPEAKER_02] uh do you feel like there was something at the beginning of our time working together that you

[00:02:38.480] [SPEAKER_00] were more able to do so what i mean is daily things like under sun or paperwork is there

[00:02:45.840] [SPEAKER_00] anything that you think you're actually doing worse on in the middle like in the middle of

[00:02:53.000] [SPEAKER_01] everything i was having like um speech like it was like i was like doing my work finding things

[00:03:00.480] [SPEAKER_01] again yeah for like a little bit i'll tell you for like a week i'll be like what the heck's going

[00:03:04.980] [Unknown] on yeah the idea and then i kind of just randomly resolved there that was was that scary

[00:03:12.240] [SPEAKER_01] Nah, I was just like, you're working a little brain.

[00:03:18.100] [SPEAKER_00] And then, is there anything that you can do now that you couldn't do before?

[00:03:22.440] [SPEAKER_01] You know what? I have more, probably, endurance.

[00:03:26.140] [SPEAKER_01] So it's not like it's easier, but it's like I have more ability to endure and see it through.

[00:03:32.580] [SPEAKER_00] Okay. Is there an example of something that you're referring to that you don't endure?

[00:03:36.720] [SPEAKER_01] Like finishing packing my bag.

[00:03:40.160] [SPEAKER_01] yeah so like i would start with people like finishing it isn't finished okay

[00:03:46.680] [Unknown] like when everything was just miscellaneous i would just be like i'll put it in a box

[00:03:54.480] [SPEAKER_02] that's what i do maybe you should play more i will after this after everybody leaves what do

[00:04:01.060] [SPEAKER_02] you guys think i'm doing what do you think about your own symptoms and quality of life

[00:04:06.000] [SPEAKER_02] Has anything gotten better or anything worse and is there any change of medication? Does that apply to you?

[00:04:36.000] [SPEAKER_01] when I was doing like this last bit

[00:04:37.940] [SPEAKER_01] like even when I'm like 6 in a row

[00:04:39.900] [SPEAKER_01] it's like that 6th one is like tingle tingle tingle

[00:04:42.080] [SPEAKER_01] and I'm like yes

[00:04:43.900] [Unknown] cool

[00:04:47.660] [SPEAKER_02] and then your symptoms and quality

[00:04:49.900] [SPEAKER_02] of life has anything gotten better

[00:04:51.580] [SPEAKER_02] or is there anything that maybe got a little

[00:04:53.940] [SPEAKER_02] worse

[00:04:56.500] [SPEAKER_01] yeah no nothing

[00:04:57.900] [SPEAKER_01] really got worse

[00:05:00.300] [SPEAKER_01] like I said oh sometimes I'll get

[00:05:01.980] [SPEAKER_01] a CPI but it will be like a burst

[00:05:04.020] [SPEAKER_01] of like the day after like the day I'm gonna get all this done and then I like

[00:05:10.000] [SPEAKER_01] get stuff done finish them but then I'm tired the next day yeah yeah like I work

[00:05:20.220] [SPEAKER_01] like I think even using my tools so like do you know where to use my notepads and my

[00:05:31.200] [SPEAKER_01] calendar. I was thinking what are you getting at home on those days. Yeah, like being more like getting things done. Like say being at home and telling the children like okay, you know how to get these things done. Usually I'm just like flat, I don't care. It's not going to get done and I'm not going to tell anybody. I don't care. Yeah. So that like I guess that I don't care. Yeah. There's nothing I can do about it. You feel like you have more control. Yeah. You know what the next steps are. Yeah.

[00:05:59.860] [SPEAKER_00] In terms of your concussion symptoms, let's say, so things like headaches are not stable, do you feel like they have better work?

[00:06:10.360] [SPEAKER_01] It's like, I would say they get better for longer periods, but then when they come, they come, but I have longer periods where it's like not like a three, five day headache.

[00:06:31.240] [SPEAKER_00] Okay.

[00:06:31.760] [SPEAKER_00] Okay.

[00:06:31.900] [Unknown] Like headache, resolve.

[00:06:35.140] [SPEAKER_00] We're talking about like a few days in between or like a week in between now?

[00:06:39.240] [SPEAKER_00] Yeah, exactly.

[00:06:39.560] [SPEAKER_01] So usually when one starts, I don't know, like the whole week I'm going to be out.

[00:06:43.440] [SPEAKER_01] Oh shoot.

[00:06:44.120] [SPEAKER_00] Okay.

[00:06:44.420] [SPEAKER_01] So like I haven't been out for like a whole week.

[00:06:46.960] [Unknown] Cool.

[00:06:47.480] [SPEAKER_00] Yeah.

[00:06:47.960] [SPEAKER_00] That's good.

[00:06:49.020] [SPEAKER_00] What about like vision?

[00:06:50.820] [SPEAKER_00] Did you have any sensitivity when we started?

[00:06:52.700] [SPEAKER_00] I don't know.

[00:06:53.100] [SPEAKER_00] Yeah.

[00:06:53.780] [SPEAKER_01] Like your vision while I was doing it, light sensitivity.

[00:06:58.220] [SPEAKER_01] Is that allowed to say?

[00:06:59.620] [SPEAKER_01] I would say, actually, even with all the hot, hot days, sometimes I can drive and I'm not like, right outside. So I don't know if it, if it matters or if it's related, but.

[00:07:11.020] [SPEAKER_00] Like the fog doesn't affect you as much?

[00:07:13.020] [SPEAKER_01] Yeah, like I don't have to be like, I need to put my sunglasses on. I'm going to die. It's like, I can't see. Like, who are us? Yeah.

[00:07:19.580] [SPEAKER_00] How do you feel emotionally? Do you feel like that's changed?

[00:07:22.160] [SPEAKER_00] Oh, emotionally, I would, yeah, I would, I'm more, what did someone say? You're rambling.

[00:07:27.160] [SPEAKER_01] Yeah.

[00:07:27.700] [SPEAKER_01] So I think I'm like maybe just like more, uh, what's that word again?

[00:07:31.540] [Unknown] I don't know.

[00:07:32.480] [SPEAKER_01] Uh, hyphen?

[00:07:34.560] [SPEAKER_00] Okay.

[00:07:35.840] [SPEAKER_01] Maybe, yeah.

[00:07:37.100] [Unknown] Yeah.

[00:07:38.280] [SPEAKER_01] I don't know if it's bad or good, but.

[00:07:41.040] [SPEAKER_00] No, more excited.

[00:07:41.960] [SPEAKER_00] Yeah.

[00:07:42.380] [SPEAKER_00] Yeah.

[00:07:43.080] [SPEAKER_00] Do you feel like you can control your kind of thoughts better?

[00:07:45.860] [SPEAKER_00] Yeah.

[00:07:46.340] [SPEAKER_00] Okay.

[00:07:47.480] [SPEAKER_01] I'm alright.

[00:07:48.820] [Unknown] Okay.

[00:07:49.220] [SPEAKER_01] But I finished my stuff, so.

[00:07:51.580] [SPEAKER_00] How's your sleep been outside of the 19-year-old birthday party you had?

[00:07:55.540] [SPEAKER_01] It's been back and forth.

[00:07:56.680] [SPEAKER_01] So at the beginning, I felt like I couldn't go to bed.

[00:08:00.540] [SPEAKER_01] Like I could not turn off.

[00:08:03.160] [SPEAKER_01] Then I went through like a period where I was like super sleepy.

[00:08:08.020] [SPEAKER_01] And then I think now it's more like I can go to bed,

[00:08:13.880] [SPEAKER_01] but it's probably because I have more control of like,

[00:08:16.560] [SPEAKER_01] Like, look at your phone, go to bed, because now I know what I need to get done, so there's

[00:08:22.460] [SPEAKER_01] like some perspective of go to bed.

[00:08:24.060] [SPEAKER_01] Like, don't touch your phone, don't worry about that, don't start something new, just

[00:08:29.600] [SPEAKER_01] go to bed, because then you can do better if you just wake up and start your day again.

[00:08:37.430] [SPEAKER_02] If there were something to add to this intervention, what would you add?

[00:08:41.570] [SPEAKER_00] And this interview as well, I know we're talking about literally, let's say you played

[00:08:45.070] [SPEAKER_00] dollar for a second so that's what we get to do we can change the numbers we can change the

[00:08:50.130] [SPEAKER_00] positioning and then our station anyone makes money make it harder easier wow that's definitely

[00:08:56.530] [SPEAKER_00] not harder okay um not harder no okay what else would i do what would i do what did you do

[00:09:04.070] [SPEAKER_01] what's the creative genius okay like the crazy thing is like oh i wish i knew

[00:09:08.620] [Unknown] how i was doing every every how did i do compared to last month maybe i was more competitive

[00:09:20.110] [SPEAKER_02] like a general kind of stats thing

[00:09:22.330] [SPEAKER_01] like am I really doing better

[00:09:24.290] [SPEAKER_01] or

[00:09:24.570] [SPEAKER_00] so you feel like you were told your scores

[00:09:27.550] [SPEAKER_01] no I knew my scores but you know what

[00:09:29.630] [SPEAKER_01] maybe it's just because I'm slow because I don't look at it while I'm doing it

[00:09:32.510] [SPEAKER_01] and then I also don't remember

[00:09:35.290] [SPEAKER_01] last week's score

[00:09:39.670] [SPEAKER_01] so maybe yeah

[00:09:40.730] [SPEAKER_01] I don't know

[00:09:41.550] [SPEAKER_01] but I just like it

[00:09:43.890] [SPEAKER_00] I think it's a little bit

[00:09:48.510] [SPEAKER_02] curious

[00:09:48.910] [SPEAKER_02] you mentioned in the middle of things like you had struggled to look for words

[00:09:53.710] [SPEAKER_02] was that middle of things the time when we had to take about a week off okay

[00:10:10.790] [SPEAKER_02] because I mean I think you'd be curious if you could like take a break and

[00:10:14.950] [SPEAKER_02] halfway through see what would happen if things would consolidate or in regress

[00:10:19.810] [SPEAKER_02] No, that's why we didn't cut it.

[00:10:21.730] [SPEAKER_02] Okay, then never mind.

[00:10:23.930] [SPEAKER_00] Oh no, great idea. Good question.

[00:10:25.530] [SPEAKER_02] If there would be something that you would remove, what would it be?

[00:10:28.830] [Unknown] God, if I didn't have to travel? I don't even know, that's an imaginary thing.

[00:10:40.120] [SPEAKER_00] Yeah, like if you came to your home right at the end of the storm, you couldn't go?

[00:10:43.360] [SPEAKER_00] Yeah.

[00:10:44.440] [SPEAKER_00] How was the drive? Did you like the time? Did you have a typical year?

[00:10:47.120] [SPEAKER_01] Um, because I've been taking the 407, which I shouldn't be, but...

[00:10:53.500] [SPEAKER_01] Um, so I've been having a great, safe break from my house drive here.

[00:10:58.340] [SPEAKER_01] It's actually been a great thing to actually be able to, to be honest, yeah, we didn't want to stay at home.

[00:11:03.880] [SPEAKER_01] Yeah, and then being able to tell everybody, hey, everybody, I'm going to go work on my brain.

[00:11:11.100] [SPEAKER_01] It's like, because do you remember? That's why I'm home, from work.

[00:11:17.260] [Unknown] Like, yeah.

[00:11:18.740] [SPEAKER_00] Like, yeah.

[00:11:23.180] [Unknown] And do you feel that you would do better if you had more or fewer sessions,

[00:11:31.220] [SPEAKER_02] longer ones or shorter ones, or more rest in between or less rest in between of them?

[00:11:37.380] [SPEAKER_00] So kind of like what Hannah was saying when you call for maybe 30-minute gameplays,

[00:11:42.100] [SPEAKER_00] an hour, 10 minutes, do it every single day for 10 minutes versus...

[00:11:47.660] [SPEAKER_01] My personality, I think I like the 20 minutes because it's like fast enough that I can get through it, but not too long that like I get like start floating away or I'm too exhausted to like give up and where I try to start making excuses like, oh, I don't have something to do, I can't come.

[00:12:08.760] [SPEAKER_01] Because that's what I really do.

[00:12:10.100] [SPEAKER_01] But that's what I did do before in the past.

[00:12:12.640] [Unknown] Yeah.

[00:12:13.360] [SPEAKER_00] So you feel like 20 minutes is great.

[00:12:15.460] [SPEAKER_00] Yeah.

[00:12:15.820] [SPEAKER_00] Would you want more sessions in a week?

[00:12:19.340] [SPEAKER_01] If I thought they would be making me smarter.

[00:12:22.320] [SPEAKER_00] Do you feel like you're so tired

[00:12:23.820] [SPEAKER_00] that you can't handle it extra?

[00:12:26.960] [SPEAKER_01] I feel like I would.

[00:12:28.980] [SPEAKER_01] But that's based on my current circumstances.

[00:12:31.700] [SPEAKER_01] My kids are big enough now.

[00:12:33.640] [SPEAKER_01] We're not asking about anybody else.

[00:12:36.880] [SPEAKER_01] Yeah.

[00:12:37.440] [SPEAKER_01] But say it was like five years ago,

[00:12:40.120] [SPEAKER_01] I don't want to go.

[00:12:41.480] [SPEAKER_00] I don't know.

[00:12:45.960] [Unknown] have there been any thoughts on your mind oh is there anything like you think about it

[00:12:52.880] [SPEAKER_01] specifically when you do these sessions um yeah i don't know i just really like the bird

[00:12:58.200] [SPEAKER_01] and usually on a regular day that would drive me crazy but i just oh my little bird friends okay

[00:13:07.520] [SPEAKER_02] how about when you're doing the like six six numbers in a row is there any particular thoughts

[00:13:14.400] [SPEAKER_01] before afterwards yeah so like um at first like it was just like uh it was impossible i was just

[00:13:21.380] [SPEAKER_01] like i'll never get to six like that's literally how i originally thought like that's crazy

[00:13:26.380] [SPEAKER_01] but then when i started to get like through and get through and have more practice and

[00:13:31.080] [SPEAKER_01] And I was able to like make a plan.

[00:13:35.180] [SPEAKER_01] So I was like, map, because I might not remember the numbers,

[00:13:39.960] [SPEAKER_01] but if I like looked at the numbers, I made a physical map.

[00:13:43.440] [SPEAKER_01] Like if I mapped where I had to walk, it was like easier than trying to remember the number.

[00:13:49.720] [SPEAKER_00] Because remembering the number didn't make sense, but the spatial orientation made sense.

[00:13:53.720] [SPEAKER_00] Yeah.

[00:13:54.560] [Unknown] Wow.

[00:13:55.920] [SPEAKER_02] And then how about afterwards, now that you can do it and it's like,

[00:13:59.380] [SPEAKER_02] you get it done in the first five less than five minutes yeah so basically before it was like

[00:14:06.900] [SPEAKER_01] just deciding if i was gonna go left or right was like so hard and then trying not to also you know

[00:14:13.740] [SPEAKER_01] sometimes when i would turn like whatever color i looked at first like that would distract me and

[00:14:19.520] [SPEAKER_01] i would just use that burn like fuck so we're just like just trying to like that's why i always

[00:14:25.140] [SPEAKER_01] be like bloop bloop bloop like stay on track go get distracted because like i would just get

[00:14:31.080] [Unknown] distracted yeah that's my next step and is there anything that you're curious to find out or better

[00:14:39.540] [SPEAKER_00] understand whether it's about yourself or how the game works yeah so the way the way this part of

[00:14:46.720] [SPEAKER_00] the place this question came from is we can we've been tracking everything you do in the game so how

[00:14:51.680] [SPEAKER_00] how you use the controller, what you're looking at,

[00:14:53.980] [SPEAKER_00] how you're walking around.

[00:14:56.180] [SPEAKER_00] Let's say again, you could play golf, what would you wanna,

[00:14:58.220] [SPEAKER_00] what would be the most curative thing for you?

[00:15:01.300] [SPEAKER_00] About any part of how you're acting in a game.

[00:15:03.920] [SPEAKER_00] Yeah.

[00:15:04.500] [SPEAKER_01] Probably a video of my ugly walking

[00:15:06.460] [SPEAKER_01] and the different ways I try to walk to stay in tandem.

[00:15:10.020] [SPEAKER_01] Because honestly, the tandem part and then staying on track,

[00:15:12.760] [SPEAKER_01] I was like, oh lady, get it together.

[00:15:14.920] [SPEAKER_01] Like it's not that hard.

[00:15:16.680] [SPEAKER_01] My kids are proving to me,

[00:15:18.160] [SPEAKER_01] nope, we can walk in a straight line.

[00:15:19.620] [SPEAKER_01] It's like literally not that hard.

[00:15:21.160] [SPEAKER_01] Also, I think even, like I know I have a brain injury, but I know I also think differently.

[00:15:28.220] [SPEAKER_01] So I'm like, I wonder, like how to compare to like other people, like do I, am I better, am I soft?

[00:15:34.080] [SPEAKER_01] Where are you in the leaderboard, yeah?

[00:15:36.680] [Unknown] Like, but that's just a competition.

[00:15:39.240] [SPEAKER_01] Fair enough, yeah.

[00:15:40.160] [SPEAKER_00] I know I keep telling you, but I don't know if you want to know.

[00:15:42.440] [SPEAKER_00] You tell me.

[00:15:43.840] [SPEAKER_00] No, no, no.

[00:15:44.520] [SPEAKER_00] You can tell me.

[00:15:45.280] [Unknown] Huh?

[00:15:45.680] [SPEAKER_01] You can tell me.

[00:15:46.420] [SPEAKER_00] Yeah?

[00:15:47.580] [SPEAKER_00] Right now, I think, you know, let's finish the last one.

[00:15:50.600] [SPEAKER_00] I'll tell you the place where we get and we'll come back.

[00:15:52.840] [SPEAKER_00] Yeah, that's the...

[00:15:54.600] [SPEAKER_02] Yeah, no, it's okay.

[00:15:56.060] [SPEAKER_02] It's okay.

[00:15:58.460] [SPEAKER_02] I live with this thing.

[00:15:59.820] [SPEAKER_02] I mean, if it's anything, I mean, just, like, over the sessions,

[00:16:03.120] [SPEAKER_02] whatever I've seen, it's your tendon walk, like,

[00:16:05.820] [SPEAKER_02] from, like, this robotic, methodical movement

[00:16:08.360] [SPEAKER_02] to a very smooth and organized movement.

[00:16:12.120] [SPEAKER_02] So, like, I think you're doing better,

[00:16:14.220] [SPEAKER_02] but I'm not going to be doctor or something.

[00:16:16.240] [SPEAKER_00] Well, there are no doctors here.

[00:16:18.640] [SPEAKER_00] A PhD?

[00:16:19.800] [SPEAKER_00] No.

[00:16:20.600] [SPEAKER_00] No, but if there were one, there would be a doctor.

[00:16:23.920] [SPEAKER_00] Yeah, but they're not here.

[00:16:27.540] [Unknown] You're in class.

[00:16:28.720] [SPEAKER_02] That's what you said.

[00:16:29.680] [SPEAKER_02] You did great.

[00:16:32.640] [SPEAKER_00] Hannah, do you have any takeaways or anything you want to share just in general?

[00:16:37.060] [SPEAKER_02] It's been an honor getting to watch you get better and see this change in you.

[00:16:42.300] [SPEAKER_02] So thank you both for the opportunity.

[00:16:44.420] [SPEAKER_01] thank you for being here you made it through the whole thing without any

[00:16:57.480] [SPEAKER_00] cancellations we have to cancel on you that's kind of not that's not a bad

[00:17:03.300] [SPEAKER_00] Yeah, it's not you, it's the parking.

[00:17:05.420] [SPEAKER_00] Good.

[00:17:06.420] [SPEAKER_00] Yeah, it happens.

[00:17:07.820] [SPEAKER_00] I didn't.

[00:17:08.520] [SPEAKER_00] Yeah.

[00:17:09.680] [SPEAKER_01] When I called you, I didn't be avoidant.

[00:17:12.300] [Unknown] Yo.

[00:17:13.800] [Unknown] High five?

[00:17:15.400] [SPEAKER_00] Just one.

[00:17:16.640] [SPEAKER_02] Okay, double high five.

[00:17:18.040] [SPEAKER_02] Yeah.

[00:17:18.260] [SPEAKER_02] Me too.

[00:17:19.220] [SPEAKER_00] Thank you.

[00:17:20.100] [SPEAKER_00] When it comes to things you've noticed,

[00:17:21.960] [SPEAKER_00] anything you've noticed in her behavior over time?

[00:17:25.320] [SPEAKER_00] Anything that stands out?

[00:17:26.980] [SPEAKER_02] Anything that I've noticed.

[00:17:29.520] [SPEAKER_02] You've mentioned the tandem and stuff, yeah.

[00:17:31.080] [SPEAKER_02] I wrote it in there.

[00:17:31.920] [SPEAKER_02] Okay.

[00:17:32.120] [SPEAKER_02] But just overall, your demeanor, you seem more alive when you can conquer anything you want to.

[00:17:40.400] [SPEAKER_02] Yeah, I would love that.

[00:17:41.580] [SPEAKER_02] Or do you have more will to live?

[00:17:44.240] [SPEAKER_01] Yes.

[00:17:45.080] [SPEAKER_01] Honestly, I literally had started writing notes when I first had the breathing room.

[00:17:52.500] [SPEAKER_01] Whatever I could sprawl together.

[00:17:54.540] [SPEAKER_01] And then I had started writing a book.

[00:17:58.100] [SPEAKER_00] You started writing a book?

[00:17:59.620] [SPEAKER_00] Yes.

[00:18:00.020] [SPEAKER_01] And then I was like, ah, that's so funny.

[00:18:01.760] [SPEAKER_01] you can't even write

[00:18:02.360] [SPEAKER_01] so like

[00:18:02.860] [SPEAKER_01] you can't write a book

[00:18:03.520] [SPEAKER_01] so that was like

[00:18:04.560] [SPEAKER_01] I just kept going

[00:18:05.320] [SPEAKER_01] like back and forth

[00:18:06.100] [SPEAKER_01] because like

[00:18:06.580] [SPEAKER_01] you can't really write

[00:18:07.600] [SPEAKER_01] but like you're writing a book

[00:18:08.520] [SPEAKER_01] it's like so funny

[00:18:09.320] [SPEAKER_01] but

[00:18:10.700] [SPEAKER_01] then I had like

[00:18:12.360] [SPEAKER_01] obviously life was

[00:18:13.220] [SPEAKER_01] life and long

[00:18:13.720] [SPEAKER_01] so it was like

[00:18:14.360] [SPEAKER_01] I didn't want to look at it

[00:18:15.880] [Unknown] especially because it's like

[00:18:16.640] [Unknown] all the moves from like before

[00:18:17.660] [SPEAKER_01] so when you look back

[00:18:18.680] [SPEAKER_01] you're like

[00:18:18.920] [SPEAKER_01] wow I sucked

[00:18:20.500] [SPEAKER_01] like you know

[00:18:21.560] [SPEAKER_01] so then I just did it

[00:18:22.520] [SPEAKER_01] but I feel like

[00:18:23.320] [SPEAKER_01] I have the power to like

[00:18:25.440] [SPEAKER_01] finish off

[00:18:26.160] [SPEAKER_01] and just

[00:18:26.680] [SPEAKER_01] you send us a copy

[00:18:27.380] [SPEAKER_00] when you have

[00:18:27.800] [SPEAKER_00] and even if I don't do

[00:18:29.020] [SPEAKER_00] ever anything with it

[00:18:30.040] [SPEAKER_00] I'll have it as a record

[00:18:31.540] [SPEAKER_00] Awesome. Please send us a copy, if it's allowed, if you're okay with that.

[00:18:37.480] [SPEAKER_00] And so, from the neuroscience-y point of view, any questions about any part of it?

[00:18:41.480] [SPEAKER_00] Because, I mean, you've done the whole thing now, so I can essentially tell you anything you want to know.

[00:18:46.640] [SPEAKER_00] In short of the ten minutes that we came here.

[00:18:48.920] [SPEAKER_01] So, is the order of the bats and everything randomized?

[00:18:55.000] [SPEAKER_01] Or is it like there's a specific reason, like, let me see if she sucks after doing these three?

[00:19:00.060] [SPEAKER_00] in a row. So it's pseudo-randomized. All that means is we have an equal equilibrium of the

[00:19:05.480] [SPEAKER_00] numbers and the locations and the colors and the situation. How they're spread out, that

[00:19:10.640] [SPEAKER_00] I don't have any control over. And so that's a great question. I'll have to look into what

[00:19:15.080] [SPEAKER_00] the ordering affects in terms of the sequences, but no, we're not fully on purpose.

[00:19:20.000] [SPEAKER_00] That's all.

[00:19:20.420] [SPEAKER_00] Yeah. Cool.

[00:19:21.720] [SPEAKER_02] Great.

[00:19:22.520] [SPEAKER_02] Yeah, that's our spiel then.

[00:19:24.240] [SPEAKER_00] All right.

[00:19:24.900] [SPEAKER_00] Thank you for the spiel.

12.6 FAR7 Interview

Transcribed: 2025-11-08 19:09:02

Duration: 42.9 minutes

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[00:00:00.750] [SPEAKER_02] Yeah, so I'm here with, it's 20, it's full 20 minutes, full 20 minutes, that's actually like going to a fitness class for 20 minutes, so you know, I, before my back concussion that brought me the seizures in like 2016 or whatever it was, I used to salsa dance, and I, that's what I saw, and I, I swear to God, I thought I saw a two-step in there somewhere, and I just wasn't sure, but I couldn't go back, every time I tried to go back, I would have seizures, and, can you go dancing please for me?

[00:00:29.810] [SPEAKER_00] yeah I was gonna say let's do it yeah yeah I've been trying for years it's

[00:00:36.870] [SPEAKER_02] Really? I'm okay. Okay, you let me know when. But Valentin, I'll have to come too. Sure, yeah, totally. Otherwise, it'll just be awkward.

[00:00:42.270] [SPEAKER_02] Definitely, yeah. So, yeah, I used to love, like, not seriously, like, just for fun, like, Lulu Lounge and places like that, right?

[00:00:50.330] [Unknown] Yep. And I couldn't go back. I went for my 40th birthday, because two of my girlfriends planned, you know, a party at Lulu Lounge, and I did a little, like, a little bit of dancing,

[00:01:02.210] [SPEAKER_02] But the spinning was just too hard, so I had to give it up.

[00:01:07.830] [SPEAKER_02] And I would love to be able to one day, not necessarily self-dance,

[00:01:11.130] [SPEAKER_02] maybe like English folk dance or just participate in dancing

[00:01:15.310] [SPEAKER_02] because it's such a healthy activity.

[00:01:20.030] [SPEAKER_02] Aging is an activity you can do the rest of your life to help you feel healthy.

[00:01:25.390] [SPEAKER_02] So, yeah, that's something I would really, now I'm thinking maybe one day I'll be able to do that again.

[00:01:30.450] [Unknown] Good.

[00:01:30.890] [SPEAKER_00] Yeah. Well, see, I was going to ask you these questions, but I'll be honest, I think Valentina knows you better. So I'll leave you guys to it. It's already recording. So all I just want you to roughly ask is these questions in roughly that order. Okay. You guys can go on tangents, do whatever. And if you have anything to add, feel free to just voice it. It's going to be just track them down. Never actually putting your voice out anywhere. Okay. Just going to

put it straight to text. Okay. Just so I get a qualitative assessment. Exactly. And it's already going? It's already going.

[00:02:04.830] [Unknown] Are you coming back later or are you done?

[00:02:07.110] [Unknown] I'm here.

[00:02:07.550] [SPEAKER_00] No, I'm just going to let them know I'm going to be a while and then we'll go away.

[00:02:12.790] [Unknown] Thank you.

[00:02:14.390] [SPEAKER_01] What is this for?

[00:02:16.170] [SPEAKER_02] Don't be promotional.

[00:02:17.890] [SPEAKER_01] Thank you.

[00:02:19.070] [SPEAKER_01] Thank you.

[00:02:21.830] [Unknown] Yeah, so there might be something I might want to refer to, so just let me, in case

[00:02:25.130] [SPEAKER_02] you ask me a question.

[00:02:26.570] [Unknown] Sure.

[00:02:27.870] [Unknown] Sounds good.

[00:02:28.410] [SPEAKER_02] So, like, I would have rated this concept, like, much higher.

[00:02:32.970] [SPEAKER_02] Yeah.

[00:02:33.970] [SPEAKER_02] Yeah, I don't know.

[00:02:35.370] [Unknown] I don't know when I rated it on the – do you remember you started this on a piece of paper?

[00:02:40.150] [Unknown] Yeah, actually, I've got the poster here for you.

[00:02:43.750] [SPEAKER_00] Somewhere.

[00:02:44.350] [SPEAKER_00] Hold on a sec.

[00:02:46.010] [SPEAKER_00] Hmm, where did I go?

[00:02:57.270] [SPEAKER_00] I'll show you, because you asked about the poster, plus there's your data on there, too.

[00:03:00.370] [Unknown] too so work related Sergio cool so when it comes to the poster we're going to take a look at you

[00:03:16.190] [SPEAKER_00] so far so you're far seven you're this one here this is this is back when you did that set of

[00:03:21.150] [Unknown] paperwork so it's probably changed I don't know what are these different lines sure so we have

[00:03:25.210] [SPEAKER_00] your social state is the same your energy is about the same physical improvement is pretty big uh

[00:03:29.890] [SPEAKER_00] Your stress and anxiety has decreased by over 116%.

[00:03:34.490] [SPEAKER_00] Oh, yeah, for sure.

[00:03:36.570] [SPEAKER_00] Sleep's improved by half.

[00:03:37.390] [SPEAKER_02] This is based on the one I filled out with Valentina?

[00:03:39.110] [SPEAKER_02] Yep, the most recent one compared to previous, yeah.

[00:03:41.790] [SPEAKER_02] Okay.

[00:03:42.230] [SPEAKER_02] So it doesn't include today yet, but this is a poster from your last, from your...

[00:03:45.710] [SPEAKER_02] Yeah, that's the concussion poster, yeah.

[00:03:47.710] [SPEAKER_00] Okay, and so what's this?

[00:03:50.030] [SPEAKER_00] So this one is stress, two variations, so one short-term, one long-term.

[00:03:53.930] [SPEAKER_00] I forget which one's which.

[00:03:54.710] [SPEAKER_00] Okay.

[00:03:55.190] [SPEAKER_00] One sleep improved by 50 or so.

[00:03:57.750] [SPEAKER_00] So your executive functioning, 50 or so percent improvement from before.

[00:04:02.090] [SPEAKER_00] These are the subjective things.

[00:04:03.690] [SPEAKER_00] Yeah, the paperwork they did, yeah.

[00:04:05.510] [SPEAKER_00] So most of this is unfortunately subjective because, you know,

[00:04:07.910] [SPEAKER_00] again, potentially, look, but it's really hard to do objective for this.

[00:04:10.810] [SPEAKER_02] Yeah.

[00:04:11.310] [SPEAKER_00] So we have the symptoms, you know, the dizziness handicap down 40%.

[00:04:14.690] [SPEAKER_00] Yeah, definitely.

[00:04:16.670] [SPEAKER_00] The RPQ, another, you know, symptom burden, 25 and 47 respectively.

[00:04:22.590] [SPEAKER_02] Sorry, what is the difference between the Q13 and Q3?

[00:04:25.810] [SPEAKER_00] So these are just extensions of each other.

[00:04:27.750] [SPEAKER_00] we have him and one of the questions we'll take a look at but it's pretty

[00:04:31.010] [SPEAKER_00] much the cross validate that things are going in this like the sanity checks and

[00:04:34.190] [SPEAKER_00] so these are the other people's these are some other yeah no it's not so these

[00:04:41.950] [SPEAKER_02] are different people so what where they're big so this person saw a lot of

[00:04:46.290] [SPEAKER_02] improvement in social yeah this person saw improvement everywhere yeah how

[00:04:51.130] [SPEAKER_02] would you explain the decline tiny though they finished only five weeks

[00:04:57.410] [SPEAKER_00] instead of the eight and it was because they had to take out a full colon or a big portion of the

[00:05:01.970] [SPEAKER_00] colon so the stress and the sleep and the symptoms probably came from there yeah this one is a

[00:05:07.110] [SPEAKER_00] surprise i don't know things got really bad her brain got worse in terms of metrics i honestly i

[00:05:13.430] [SPEAKER_02] did you see that or you think it's so objective so here so your scores here you see how you're

[00:05:19.230] [SPEAKER_00] here your first seven so what's this measuring this is just your score over time oh my score

[00:05:23.470] [SPEAKER_00] So this is you getting better up, you know, now you're here. This is the woman from the car accident. You got it

[00:05:29.690] [SPEAKER_02] So that's chasing. Yeah

[00:05:31.970] [SPEAKER_00] Now you're literally off the graph by the way

[00:05:38.870] [SPEAKER_00] Okay, I read I'm sorry I'll send it to you I'll redo it so we all started pretty

[00:05:45.310] [SPEAKER_02] Was even terrible or so you see the purple so the colors are you know, so the purple from before the one I got all

[00:05:51.590] [SPEAKER_00] worse yeah same thing she never improved in terms of score either and do you think her nutrition and

[00:05:56.490] [SPEAKER_00] her lifestyle she was trying but honestly i wish i could tell you what it was i have no idea yeah

[00:06:00.950] [SPEAKER_00] i mean there's so many factors that play into it it's the last one together is it yeah so in

[00:06:07.990] [SPEAKER_02] general though people yeah this these people actually started worse than me some people start

[00:06:13.110] [SPEAKER_02] at 10 10 for the first session or 20. they're really were they most folk connections or more

[00:06:21.630] [SPEAKER_02] Okay, so I was here so this person started up here. So, I mean the important thing is the percentage of improvement, right?

[00:06:30.430] [SPEAKER_00] So that's... If you're trying to tell me that you're a lot better than everybody else, you are.

[00:06:36.270] [SPEAKER_02] No, I just want to see how much people improved. So other than that one anomaly, everybody made progress.

[00:06:45.390] [SPEAKER_02] grass that this orange person yeah that's enormous yeah enormous totally wow yeah yeah this is very

[00:06:56.210] [SPEAKER_02] very cool to see it in graph form yeah so in terms of your symptoms so this is your daily yeah so

[00:07:02.130] [SPEAKER_00] that number book so the thing is even though that one she still kind of got better now when we're

[00:07:07.230] [SPEAKER_00] looking at you you are just about here so you're like flatline by the way in terms of symptoms on

[00:07:12.030] [SPEAKER_00] average somewhat yeah okay so you had tick tick tick and then give or take a bit that's worse

[00:07:17.950] [SPEAKER_02] or better up is worse down is better down is better so yeah you're just like but i honestly

[00:07:24.290] [SPEAKER_02] am so much better i mean they're better in a lot of things that aren't even in here yeah

[00:07:28.150] [SPEAKER_00] yeah and so those are the biggest ones unfortunately you couldn't get your brain scan

[00:07:31.350] [SPEAKER_00] but oh yeah you mri the other people yeah so in two of them we see 13 brain changes so we're

[00:07:39.430] [SPEAKER_00] talking about like the highways going from single lane to double lane yeah filling in potholes

[00:07:43.390] [SPEAKER_00] legitimately and i think you can feel that yeah well for sure yeah whether you're mri me or not

[00:07:47.650] [SPEAKER_00] i know yeah unfortunately you couldn't but you couldn't actually don't have an mri tech right now

[00:07:51.930] [SPEAKER_00] really yeah what happened oh he um resigned but it would be crazy good because you saw my data

[00:07:58.930] [Unknown] you have my data from a couple years ago if you ever get i mean you might not never we can do a

[00:08:03.770] [SPEAKER_02] late scan with it we'll see what happens but if you ever get the opportunity to do a follow-up

[00:08:07.690] [SPEAKER_02] you let me know so this is um so this is a cool one um pretty much you know how you do that double

[00:08:13.650] [SPEAKER_00] pager every day yeah so on the left you see your symptoms on the right you see some of those so

[00:08:19.270] [SPEAKER_00] like specifically how hard you work and how heavy the workload you think was okay and so this is

[00:08:24.610] [SPEAKER_00] pretty much showing them turquoise you are yeah that's one of my favorite colors okay so pretty

[00:08:30.850] [SPEAKER_02] much you're like in this little grouping here so this is um sorry this is like more effort pretty

[00:08:37.570] [SPEAKER_02] much the more effort you give so you don't tend to get a lot more symptoms

[00:08:41.530] [SPEAKER_00] so even though you're giving I do but not nearly there mark but it's not like

[00:08:47.830] [SPEAKER_00] severe like other people like let's say you look at one the harder they push the

[00:08:52.090] [SPEAKER_00] more severe the symptoms some people seem to be the case some people don't so

[00:08:55.290] [SPEAKER_02] it is but yeah I think I'm an under reporter I think and I think because I

[00:09:00.210] [SPEAKER_02] don't want to seem like I'm worse than I am you know I have this feeling like you

[00:09:05.970] [SPEAKER_02] know there's people who are you know seriously disabled like can't work at all you know and i

[00:09:12.070] [SPEAKER_02] don't want to pick you know moderate on something and feel like you know i'm disrespecting people

[00:09:19.250] [SPEAKER_02] who actually have like can't see the thing is i think i underreported yeah yeah you know oh wait

[00:09:25.030] [SPEAKER_02] but i definitely get worse symptoms when i push harder right like so i think you like this then

[00:09:31.250] [SPEAKER_00] So the one that, you know, got brainwashed, arguably.

[00:09:33.970] [SPEAKER_00] Is that you?

[00:09:34.750] [SPEAKER_00] No, somebody else.

[00:09:35.890] [SPEAKER_00] One of the participants.

[00:09:36.830] [SPEAKER_00] That's cute.

[00:09:37.630] [SPEAKER_02] Yeah, I know, right?

[00:09:38.210] [SPEAKER_02] He's adorable.

[00:09:39.250] [SPEAKER_02] Yeah, I know.

[00:09:39.950] [SPEAKER_02] You should introduce that.

[00:09:42.230] [SPEAKER_00] If he didn't have a wife, I legitimately would.

[00:09:45.070] [SPEAKER_00] Yeah.

[00:09:46.610] [SPEAKER_00] And, you know, I talked to him about all that.

[00:09:48.370] [SPEAKER_00] He's done things, but openly.

[00:09:51.450] [SPEAKER_02] Wait, we don't want to hear about the gossip that happens behind these doors.

[00:09:55.110] [SPEAKER_02] The amount of gossip that happens.

[00:09:56.410] [SPEAKER_02] Or the Sergio's lab gossip.

[00:09:57.710] [SPEAKER_02] Oh, my God.

[00:09:58.530] [SPEAKER_00] You have no idea.

[00:09:59.230] [SPEAKER_00] Even me, right?

[00:09:59.630] [SPEAKER_02] this is a quote from the one who

[00:10:02.730] [SPEAKER_00] so the thing is you know how you under report

[00:10:04.490] [SPEAKER_00] some people over report stupid sex on everything

[00:10:06.330] [SPEAKER_00] even though she started to feel better

[00:10:08.430] [SPEAKER_00] and so in life things did

[00:10:10.470] [SPEAKER_00] improve on her qualitative when she did

[00:10:12.590] [SPEAKER_00] the paperwork she was still pissed off at life

[00:10:14.090] [SPEAKER_02] yeah but the thing is that she also

[00:10:16.810] [SPEAKER_00] benefited her yeah

[00:10:18.330] [SPEAKER_02] and so that's she recognized that to a certain

[00:10:20.570] [Unknown] extent yeah that's great

[00:10:22.350] [SPEAKER_02] what else you got on here that's about it

[00:10:24.270] [SPEAKER_00] for now that's all I'm going to give you that's really
[00:10:26.330] [Unknown] cool you should email it to me
[00:10:28.230] [Unknown] Yeah, I'll text you everything.
[00:10:30.190] [Unknown] Yeah, it's really cool.
[00:10:34.070] [Unknown] That's really wild.
[00:10:35.370] [Unknown] I mean, it's great to see those numbers
[00:10:37.150] [SPEAKER_02] and see how well other people did as well.
[00:10:39.670] [SPEAKER_02] Yeah, yeah.
[00:10:40.150] [SPEAKER_02] And when Anthony first presented this,
[00:10:43.430] [SPEAKER_02] what he's doing to me,
[00:10:45.150] [SPEAKER_02] I didn't really think I was coming in here.
[00:10:47.450] [SPEAKER_02] Like, I knew inherently that I needed to participate
[00:10:50.030] [SPEAKER_02] and, like, respond to the email
[00:10:52.190] [SPEAKER_02] and not give up that opportunity
[00:10:54.250] [SPEAKER_02] to be part of something like this.
[00:10:55.550] [SPEAKER_02] I had no idea what exactly he was doing.
[00:10:57.950] [SPEAKER_02] and the potential.
[00:10:59.130] [SPEAKER_02] And I remember I said to you...
[00:10:59.790] [SPEAKER_02] That's a good eye, to be fair.
[00:11:01.010] [SPEAKER_00] That's why we're starting a business here.
[00:11:02.370] [SPEAKER_00] And I remember saying to you,
[00:11:04.210] [SPEAKER_02] two times a week for 20 minutes,
[00:11:06.110] [SPEAKER_02] you must be joking because, you know,
[00:11:08.810] [SPEAKER_02] my line of work is creating neuroplasticity,
[00:11:11.810] [SPEAKER_02] helping people get out of pain,
[00:11:13.130] [SPEAKER_02] helping people feel better.
[00:11:14.270] [SPEAKER_02] And, you know, sometimes we'll give someone an exercise.
[00:11:16.830] [SPEAKER_02] They have to do one rep 10 times a day
[00:11:18.690] [SPEAKER_02] to really push their brain enough
[00:11:20.670] [SPEAKER_02] to create a lasting change.

[00:11:22.770] [SPEAKER_02] And I was like to Anthony,
[00:11:23.990] [SPEAKER_02] are you kidding me?
[00:11:25.350] [SPEAKER_02] like 20 minutes twice a week and he's like you know it's because
you're pushing because you're
[00:11:31.070] [SPEAKER_02] pushing so much you're challenging so many areas to work
together you know at once and i couldn't
[00:11:38.370] [SPEAKER_02] believe it yeah and when he told me you know he's seen people
really improve on their minds i was
[00:11:42.470] [SPEAKER_02] like wow i have a huge potential here to actually have you know
improvements and yeah um it's
[00:11:48.770] [SPEAKER_00] incredible i'm going to have to delete that recording i think some
of the things i showed
[00:11:53.130] [SPEAKER_02] to you are ethics approved so do not worry don't worry yeah
yeah i have a good objective yeah i
[00:12:01.710] [Unknown] know i look at things so totally yeah yeah wow well thanks for
sharing sure she actually has
[00:12:06.670] [SPEAKER_02] questions okay i will do my best to answer them and i might
refer to this game yeah i just want
[00:12:11.770] [SPEAKER_02] to i started writing a couple notes later on sure and i just want to
just make sure i can just
[00:12:18.410] [SPEAKER_02] or do anything that was really...
[00:12:19.950] [SPEAKER_02] Yeah, totally, welcome to, yeah.
[00:12:22.030] [Unknown] Yeah?
[00:12:24.230] [SPEAKER_02] Okay, I think I'm ready.
[00:12:25.710] [SPEAKER_02] Yeah?
[00:12:26.130] [SPEAKER_00] Yeah, I think the questions aren't that serious.
[00:12:28.570] [SPEAKER_00] No, they are.
[00:12:29.290] [SPEAKER_02] I'm going to do an accurate job for you.
[00:12:31.890] [SPEAKER_02] Thank you.
[00:12:33.290] [SPEAKER_01] Yeah, first one?
[00:12:34.630] [SPEAKER_01] Yeah, go ahead.
[00:12:35.310] [SPEAKER_01] Was the game experience what you expected?
[00:12:37.370] [SPEAKER_02] It was better.

[00:12:38.550] [SPEAKER_02] Yeah?

[00:12:39.130] [SPEAKER_02] In what way?

[00:12:40.830] [SPEAKER_02] It challenged me in a way I never expected.

[00:12:44.370] [SPEAKER_02] What did you expect?

[00:12:46.330] [SPEAKER_02] I expected...

[00:12:50.330] [SPEAKER_02] i don't know what i expected but i didn't expect it to be so challenging oh yeah it was really

[00:12:55.610] [SPEAKER_02] challenging and um that's what pushed me did you expect anything about the result would be

[00:13:05.570] [SPEAKER_01] result wise did you have any expectations i'm realistic in the fact that i

[00:13:10.210] [SPEAKER_02] know my brain has a you know just like everyone has a great capacity for neuroplasticity

[00:13:15.890] [SPEAKER_02] and that if i eat well and i sleep well and i keep a good mindset about this and i actually push and

[00:13:21.330] [SPEAKER_02] actually make the effort I knew I would make a movement it was dismal when I

[00:13:26.770] [SPEAKER_02] started it was so overwhelming even just following Anthony's instructions was so

[00:13:32.750] [SPEAKER_02] overwhelming I actually feel like a completely different person sitting in

[00:13:35.830] [SPEAKER_02] front of you than the first day I sat in front of Anthony and I was like am I can I even

[00:13:40.270] [SPEAKER_02] he speaks so fast and I thought can I even and he's just like oh you just do this and you move it sideways and you move it this way and you put it in the

[00:13:48.410] [SPEAKER_02] verb the next and you know and just following the instructions cognitively was so challenging

[00:13:55.810] [SPEAKER_02] for me and then doing the task correctly yeah you know am i and you you feel stupid you know

[00:14:02.010] [SPEAKER_02] like when you can't do it right i did my job so well and you know it's so difficult yeah um

[00:14:10.430] [SPEAKER_02] but yeah i knew there was a good potential and i did not realize i would improve as much

[00:14:16.810] [SPEAKER_02] as I did.

[00:14:18.310] [SPEAKER_00] Did that answer your question?

[00:14:23.450] [SPEAKER_02] Yes.

[00:14:23.850] [SPEAKER_02] Yes.

[00:14:24.210] [SPEAKER_02] Yes, it does.

[00:14:25.550] [SPEAKER_02] Okay.

[00:14:26.690] [SPEAKER_02] Yeah.

[00:14:27.050] [SPEAKER_02] Yeah.

[00:14:27.390] [SPEAKER_01] Whatever you want to contribute or not contribute.

[00:14:29.250] [SPEAKER_01] Okay.

[00:14:29.730] [SPEAKER_01] That's all up to you.

[00:14:30.530] [SPEAKER_01] Okay.

[00:14:30.890] [SPEAKER_01] Do you feel like you performed better at the game?

[00:14:32.610] [SPEAKER_01] If so, what do you think changed?

[00:14:35.750] [SPEAKER_02] Do I feel like I performed better?

[00:14:37.150] [SPEAKER_00] Well, I know it's an obvious question, but we can ask everybody the standard questions,

[00:14:40.570] [SPEAKER_00] so.

[00:14:41.350] [SPEAKER_02] Yes, I performed better.

[00:14:43.030] [SPEAKER_02] Yes.

[00:14:43.390] [SPEAKER_02] At the game.

[00:14:43.950] [SPEAKER_00] What do you think changed?

[00:14:44.930] [Unknown] Yeah.

[00:14:45.610] [SPEAKER_01] What do you think changed?

[00:14:46.790] [SPEAKER_01] directly caused you to get a higher score physically because in the end physically it's

[00:14:50.930] [SPEAKER_01] you moving faster with less mistakes and moving it was able to tolerate the challenges better

[00:14:57.490] [SPEAKER_02] it was my cognitive processing was faster my reaction times are faster my short-term memory

[00:15:04.590] [SPEAKER_02] improved my ability to ignore visual and vestibular stress spinning turning yeah moving

[00:15:16.310] [SPEAKER_02] and moving my head in different directions improved.

[00:15:20.890] [SPEAKER_02] Everything improved, don't you?

[00:15:22.770] [SPEAKER_02] Good.

[00:15:23.930] [SPEAKER_01] Do you feel like there was something at the beginning of our time

[00:15:26.250] [SPEAKER_01] working together that you were more able to do?

[00:15:28.890] [SPEAKER_00] So where is it in the game, in life?

[00:15:32.270] [SPEAKER_00] Oh, is there something that is more difficult now?

[00:15:35.410] [SPEAKER_00] No, let's say at the beginning of this intervention,

[00:15:38.750] [SPEAKER_00] let's say you were terrified of playing volleyball or dancing,

[00:15:41.370] [SPEAKER_00] do you feel like now you can play volleyball or dance?

[00:15:43.410] [SPEAKER_00] So what's changed?

[00:15:43.990] [SPEAKER_02] activities yeah um so in terms of sports um i'm less intimidated by the ball so i play sports

[00:15:51.950] [SPEAKER_02] where the ball's moving very fast pocket sports uh volleyball with a lot of you know young people

[00:15:57.830] [SPEAKER_02] who are quite aggressive spiking the ball um softball etc yeah and i definitely have a lot

[00:16:05.070] [SPEAKER_02] more confidence going into those situations um in my ability to react quickly um to track the ball

[00:16:14.190] [SPEAKER_02] I just have a lot more confidence in my visual and vestibular skills yeah my stability and moving

[00:16:19.430] [SPEAKER_02] quickly there's a lot of different areas in my life that are different now my driving has

[00:16:27.790] [SPEAKER_02] improved my reaction time braking has improved my ability to navigate when traffic all of a sudden

[00:16:35.210] [SPEAKER_02] stalls on the highway and I have to swerve around them yeah or all of that is much faster it's

[00:16:42.050] [SPEAKER_02] important for your life and your work too. My hand-eye coordination has improved. My foot-eye coordination. My reaction time has improved. My confidence in that reaction time. Even if I'm going through the grocery store. So before I used to get really overwhelmed with shopping. Recently I got a Costco membership.

[00:17:04.430] [SPEAKER_02] Oh, thank you. It's saving me a lot of money. So I had a Costco membership a long time ago, and now I've bought it again just to save money on groceries. But, you know, just navigating the grocery store with those shelves and a million products,

everybody's moving around with those huge carts, you know, it's like driving kind of, you know, and even that is less stressful.

[00:17:31.770] [SPEAKER_02] So when I come out of the grocery store, I'm not exhausted.

[00:17:35.730] [SPEAKER_02] I can do more things with my day.

[00:17:38.010] [SPEAKER_02] I can schedule more things without going,

[00:17:40.930] [SPEAKER_02] okay, I'm going to need this much break in between.

[00:17:43.930] [SPEAKER_02] One of the biggest things is it's practical

[00:17:47.010] [SPEAKER_02] that it has encouraged my ability to work on Zoom.

[00:17:51.850] [SPEAKER_02] So I had to start working on Zoom during the pandemic,

[00:17:56.350] [SPEAKER_02] which was a few years after the major concussion.

[00:18:00.190] [SPEAKER_02] and it was horrible experience yeah the past two weeks i've been able to work on zoom

[00:18:09.170] [SPEAKER_02] there's so much less fatigue yeah usually i give myself 15 minutes to half an hour between clients

[00:18:17.470] [SPEAKER_02] if i have that opportunity yeah and it's too it's too dark i know see that's how much better my life

[00:18:24.710] [SPEAKER_02] and um thank you and i the other day i was on zoom and i saw you know two people pretty much

[00:18:33.130] [SPEAKER_02] back to back and my eyes weren't burning yeah and i wasn't feeling exhausted so it's directly

[00:18:40.410] [SPEAKER_02] affecting my ability to make a living yeah without being exhausted

[00:18:47.190] [SPEAKER_02] this is like probably exhausting for you to listen to no no i'm more than happy i'm more

[00:18:51.930] [SPEAKER_02] than happy those are a few examples i could give you more examples it's up to you so i'm

[00:18:59.510] [SPEAKER_00] just going to check my book here sure um so one of the things i will just tell you guys it'll

[00:19:04.630] [SPEAKER_00] probably turn off yeah okay okay so i'm just gonna take care of that okay thank you so one

[00:19:10.230] [SPEAKER_02] of the things so i started playing pickleball in the last few weeks like actually once a week and

[00:19:15.810] [SPEAKER_02] drop in yes and I have played pickleball a few times before I'm pretty decent at

[00:19:22.950] [SPEAKER_02] rocket sports but this pickleball scoring system is fire ladies yeah it's

[00:19:29.250] [SPEAKER_02] it's so crazy every time before you serve you have to yell out the score for

[00:19:35.010] [SPEAKER_02] everybody that's playing so it has three numbers so it's how many points do you

[00:19:41.170] [SPEAKER_02] have how many points they have and then if you're the first server or the second

[00:19:44.910] [SPEAKER_02] server like 7 15 1 or whatever keeping track of every single point was so

[00:19:53.970] [SPEAKER_02] difficult for me yeah and I played on Monday night and I remembered the score

[00:19:59.050] [SPEAKER_02] almost every single time which before I remember it maybe 20% of the time and I would feel so

[00:20:05.250] [SPEAKER_02] embarrassed yeah because I couldn't keep up with the score the way that other people played and that

[00:20:12.550] [SPEAKER_02] discourages you from playing because you feel embarrassed yep so this was huge I

[00:20:18.990] [SPEAKER_02] was also you know we have when we have family dinners sometimes I'm totally

[00:20:24.550] [SPEAKER_02] burned out yeah and I cannot concentrate when there's you know more than one

[00:20:29.890] [SPEAKER_02] conversation going on yeah and the neurological fatigue is overwhelming so

[00:20:35.670] [SPEAKER_02] we had a Father's Day lunch and there was two conversations at the table I was

[00:20:41.630] [SPEAKER_02] talking to my sister-in-law and I could actually follow everything she was saying I was still

[00:20:46.450] [SPEAKER_02] annoyed that there was these men chattering and it was loud but I could keep in with the

[00:20:53.150] [SPEAKER_02] conversation with her without feeling like I'm sorry I can't yeah participate so that's a huge

[00:20:59.310] [SPEAKER_02] thing socially right to go into a situation and be able to have a conversation with someone

[00:21:04.610] [SPEAKER_02] despite distractions yeah because you know normally I won't want to go to dinners anymore

[00:21:10.550] [SPEAKER_02] more where there's a whole bunch of women chit-chatting about everything because i just

[00:21:14.030] [SPEAKER_02] feel so burned out yeah and then and then it affects the rest of my day and affects my next

[00:21:20.450] [SPEAKER_02] day yeah there's only so much energy in the bank and now my brain is able to tolerate a lot more

[00:21:25.670] [SPEAKER_02] yep so that's you know very practical improvement um the visual light sensitivity has improved quite

[00:21:37.450] [SPEAKER_02] quite a bit. So I'm not so exhausted driving. Often, you know, I drive to clients' houses

[00:21:45.070] [SPEAKER_02] for work, and by the time I get there, I'm already tired. And I have to kind of like

[00:21:50.050] [SPEAKER_02] wake myself up to get ready. Like I've already feel like I've expended myself in traffic

[00:21:54.830] [SPEAKER_02] from the light and the visual stimulation. So I definitely have a lot more to give and

[00:22:00.590] [SPEAKER_02] share with other people. My energy, I have more energy to share with other people. And

[00:22:05.790] [SPEAKER_02] I'm giving people more of the best.

[00:22:08.370] [SPEAKER_02] Are you starting to have more love to give?

[00:22:09.750] [SPEAKER_02] I have more love to give.

[00:22:11.050] [SPEAKER_02] Love?

[00:22:11.630] [SPEAKER_00] Love, yeah.

[00:22:12.510] [SPEAKER_00] Oh, I don't have a lot.

[00:22:13.770] [SPEAKER_02] Yeah.

[00:22:15.050] [SPEAKER_02] I don't even have a lot of love.

[00:22:16.590] [SPEAKER_00] Do you feel like there's more joy in your day?

[00:22:19.210] [SPEAKER_00] We're about the same.

[00:22:22.280] [SPEAKER_02] Yeah, because I have more energy to enjoy things.

[00:22:25.560] [SPEAKER_02] Yeah.

[00:22:27.020] [SPEAKER_02] Yeah.

[00:22:28.640] [SPEAKER_02] I mean, it's like you're starting with your tank more full.

[00:22:32.720] [SPEAKER_02] Yeah.

[00:22:33.380] [SPEAKER_02] Instead of feeling like you're one empty all the time.

[00:22:36.700] [SPEAKER_02] I've also reduced some of the brain supplements I was taking.

[00:22:40.060] [SPEAKER_02] And I don't feel like I have to take so much to get through the day.

[00:22:43.280] [SPEAKER_02] I was taking citricoline in the morning on my work days.

[00:22:47.020] [SPEAKER_02] I haven't been taking any citricoline for the past month.

[00:22:49.800] [SPEAKER_02] I ran out and I didn't put it in.

[00:22:52.280] [SPEAKER_02] And I'm only taking by using 3 and 8 once per day.

[00:22:55.300] [SPEAKER_02] I used to have to take it twice a day.

[00:22:58.900] [SPEAKER_02] That's a big improvement.

[00:23:00.640] [SPEAKER_01] Would you say you have more of a capacity to have a better quality of life?

[00:23:05.740] [SPEAKER_02] or two yeah my quality of life has dramatically improved over the last three weeks yeah yeah so

[00:23:12.160] [SPEAKER_00] especially these last few sessions i've really really pushed yeah i think after you broke like

[00:23:17.840] [Unknown] six 650 things really really improved yeah other than the score so you feel like the more you put

[00:23:24.560] [Unknown] in the more you got out of it the more i put in i mean i've only put in so much at the beginning

[00:23:29.160] [SPEAKER_02] because i was learning yeah and it would make me nauseous and i would go home and have a hard time

[00:23:34.700] [SPEAKER_02] during the rest of the day so it would take me a little bit of recovery the past few weeks i

[00:23:39.860] [SPEAKER_02] haven't needed as much recovery after the game but i told them i went straight to work on the

[00:23:44.380] [SPEAKER_02] natural occasions or it came straight after a busy work day and i still was able to put even after

[00:23:49.160] [SPEAKER_02] a funeral and i was able to push yeah yeah yeah um it's much faster for me to schedule my clients

[00:23:56.720] [SPEAKER_02] so my life since the pandemic is very complicated because i'm working half on zoom and half doing

[00:24:04.000] [SPEAKER_02] home visits and with the cognitive difficulties I was having trying to plan

[00:24:10.440] [SPEAKER_02] those sessions and make sure I have enough breaks between the online clients

[00:24:16.320] [SPEAKER_02] and make sure I have enough driving time and also wiggle room to not you know

[00:24:21.180] [SPEAKER_02] you have to deal with traffic accidents and things like that to plan and do the

[00:24:25.520] [SPEAKER_02] sequence of how where I'm gonna be when I'm gonna eat it was really time

[00:24:30.120] [SPEAKER_02] I'm consuming. I think I was sharing with you about, you know, it used to take me a few hours

[00:24:34.000] [SPEAKER_02] a week to do my scheduling. And I'm trying to, you know, I'm self-employed, but I have

[00:24:38.100] [SPEAKER_02] to fit around when the clients can do it. So you're trying to help them, and you're trying to make that work for everybody.

[00:24:43.860] [SPEAKER_02] It's so much faster for

[00:24:46.080] [SPEAKER_02] me to do my scheduling now. Like, there's just, like,

[00:24:49.860] [SPEAKER_02] it's easier for me to predict my driving and my,

[00:24:53.940] [SPEAKER_02] and also it's easier for me to prioritize

[00:24:59.580] [SPEAKER_02] prioritize my activities, like I can't describe it, I'm not sure how to verbalize it properly.

[00:25:06.400] [SPEAKER_02] Okay, so the other thing is, and I haven't tested it quantitatively, but my word finding

[00:25:12.120] [SPEAKER_02] has really improved. Like my brain, so since I came to Cushion in around the 2016 one,

[00:25:22.980] [SPEAKER_02] I've had a lot of trouble with word-binding and a lot of trouble speaking.

[00:25:27.480] [SPEAKER_02] So when I get neurologically tired, I cannot pronounce my words.

[00:25:31.140] [SPEAKER_02] I'm a little neurologically tired right now.

[00:25:33.480] [SPEAKER_02] It can feel like my tongue is not...

[00:25:35.500] [SPEAKER_00] So it's hard to find a particular word or phrase you're looking for?

[00:25:38.480] [SPEAKER_02] Yes, but actually speaking, the act of speaking.

[00:25:42.120] [SPEAKER_02] Like I have brainstem damage on the right side.

[00:25:45.100] [SPEAKER_02] So my shoulder would drop, my tongue goes to the right when I get tired.

[00:25:49.280] [SPEAKER_02] um it's you know there's several brainstem deficiencies on the right side um after that

[00:25:57.940] [SPEAKER_02] big concussion i had problems swallowing problems eating like dribbling yeah um almost choked a few

[00:26:04.740] [SPEAKER_02] times like my whole right side of my brainstem was affected and my blood flow and my speech

[00:26:12.000] [SPEAKER_02] speech has been so much better the past 2-3 weeks. So I'm pronouncing my words easier,

[00:26:20.000] [SPEAKER_02] I don't hear my mother going, you're mumbling again, all the time. Like my speech is a tiny

[00:26:25.060] [SPEAKER_02] bit off-putting, it's a tiny minute list.

[00:26:28.240] [SPEAKER_00] Something that you can only notice, frankly.

[00:26:30.200] [SPEAKER_00] Yeah.

[00:26:30.620] [SPEAKER_02] No, no, no, it's obvious. Like when I'm starting to mumble, and I start losing the ability,

[00:26:37.620] [SPEAKER_02] And it's not just losing the ability, it feels extremely straining to speak.

[00:26:43.660] [SPEAKER_02] I feel it a little bit right now, like I'm working.

[00:26:47.020] [SPEAKER_02] I can pronounce my T's better now.

[00:26:49.680] [SPEAKER_02] I always had a lot of difficulty since this concussion with T's.

[00:26:53.680] [SPEAKER_02] And I'm actually enunciating my words better now.

[00:26:59.180] [SPEAKER_02] So that's huge. My tongue is actually a little straighter as well.

[00:27:02.840] [SPEAKER_02] It's aligning, like the whole right side is working better.

[00:27:06.420] [SPEAKER_02] so yeah that's big I mean it's a huge big deal yeah for sure for socializing because when you're

[00:27:14.140] [SPEAKER_02] embarrassed that you're gonna all of it I'm not be able to find your words yeah or you're not

[00:27:19.320] [SPEAKER_02] gonna be able to speak yeah nice nice although I mean it's still I was still I'll do it I can

[00:27:33.340] [SPEAKER_02] tolerate fluorescent lights a lot easier yeah um first time i played pickleball under really

[00:27:39.220] [SPEAKER_02] bad fluorescent lights at cloverdale mall i had seizures the next day

[00:27:43.600] [SPEAKER_00] what's that the seizures um yeah so i went the longest i've been without a seizure

[00:27:50.420] [SPEAKER_02] which was 66 days until when i had the one i marked in here which was um

[00:27:55.340] [SPEAKER_02] at the end of May.

[00:27:57.000] [SPEAKER_00] The pickleball without her head?

[00:27:58.600] [SPEAKER_00] Pardon?

[00:27:59.180] [SPEAKER_01] Was that the volleyball or the pickleball?

[00:28:01.440] [SPEAKER_00] The bird.

[00:28:02.480] [SPEAKER_01] The bird.

[00:28:03.400] [SPEAKER_01] Which one?

[00:28:04.100] [SPEAKER_02] May 31st, I had seizures.

[00:28:06.200] [SPEAKER_02] Okay.

[00:28:06.800] [SPEAKER_02] And June 1st.

[00:28:07.700] [SPEAKER_02] And I had one, I think, the other day that week.

[00:28:09.540] [SPEAKER_02] It was weird.

[00:28:10.260] [SPEAKER_02] But the seizures were less serious.

[00:28:13.880] [SPEAKER_02] Yep.

[00:28:16.300] [SPEAKER_01] Wasn't it volleyball, then bird, then pickleball?

[00:28:19.420] [Unknown] Oh, yeah.

[00:28:19.980] [SPEAKER_02] Volleyball, and then bird, and then pickleball.

[00:28:22.080] [SPEAKER_02] That's what I was going to say.

[00:28:22.720] [SPEAKER_02] That was the order.

[00:28:23.440] [SPEAKER_02] It's unbelievable.

[00:28:23.640] [SPEAKER_02] You know, but if I wasn't feeling better, I wouldn't have been running so fast in pickleball.

[00:28:30.740] [SPEAKER_00] You're opening yourself to more risk because you're more capable of it.

[00:28:34.660] [SPEAKER_00] And that's why you're still alive against the general population, if anything.

[00:28:38.420] [SPEAKER_02] Yeah. So, my brother got me a gift certificate for that pretend skydiving place in Oakville.

[00:28:45.460] [SPEAKER_02] Oh yeah, sure.

[00:28:46.400] [SPEAKER_02] What's it called? Sky...something?

[00:28:48.080] [SPEAKER_00] I know you mean the two of us, right?

[00:28:51.020] [SPEAKER_00] Oh, where it flowed at the end.

[00:28:53.300] [SPEAKER_02] And I haven't used a kid's certificate because I was too scared.

[00:28:59.200] [SPEAKER_02] But I'm like, yeah.

[00:29:00.680] [SPEAKER_00] Do it.

[00:29:01.280] [SPEAKER_00] Actually, that's okay.

[00:29:02.440] [SPEAKER_00] Don't worry about it.

[00:29:03.200] [Unknown] Yeah.

[00:29:04.740] [SPEAKER_02] So the seizures were interesting because I had less tachycardia and I had less sweat.

[00:29:10.220] [SPEAKER_02] So my nervous system somehow was less stressed.

[00:29:15.560] [SPEAKER_02] I actually had those a little bit after I got diagnosed by the Blackbird.

[00:29:18.900] [SPEAKER_02] But yeah, so the longest I've ever gone without a seizure, before was 56, and then this one was 66.

[00:29:26.700] [SPEAKER_02] So this is the longest since like 2016 or whatever that I have gone, that I went without a seizure.

[00:29:32.700] [SPEAKER_02] Wow.

[00:29:33.740] [SPEAKER_01] Would you say there's anything that's gotten worse?

[00:29:36.120] [SPEAKER_02] What has gotten worse?

[00:29:37.640] [SPEAKER_01] If your shirt has gotten worse or just a part of your life.

[00:29:41.380] [SPEAKER_02] So the actual, you know, dizziness, because it gets flared by the game, sometimes I feel off.

[00:29:47.480] [SPEAKER_02] you know that day or next day I feel like my vestibular system is recovering but it's once I

[00:29:57.580] [SPEAKER_02] started to see the result of improving I was motivated to go through it no matter what because

[00:30:03.920] [SPEAKER_02] I knew the outcome was more important than the short-term suffering so when you would feel the

[00:30:09.040] [SPEAKER_01] dizziness from the Wednesday to the Friday would it last from the Wednesday to the Friday not after

[00:30:14.600] [SPEAKER_02] i got used to the game the first time i was sick for about four days um and then things just

[00:30:21.760] [SPEAKER_02] continually improved the harder i flush the more i'm going to get dizzy because i'm spinning a lot

[00:30:27.880] [SPEAKER_02] in the visual that's around yeah i wish i had i wish i i told you not enough watching the video

[00:30:34.560] [SPEAKER_02] but i should have it's funny it's hard to believe that it was like that it was legitimately dancing

[00:30:39.500] [SPEAKER_02] yeah yeah okay I've been sleeping in the guy yeah we haven't just done one yeah

[00:30:53.800] [SPEAKER_01] don't don't worry so from I was curious from the Wednesday from the Friday to

[00:30:58.280] [SPEAKER_01] the next Wednesday yeah how long would the symptoms triggered by the game last

[00:31:03.020] [SPEAKER_00] what's the longest thing with lasting okay yeah yeah I'm Friday night for the

[00:31:20.780] [SPEAKER_02] last month I'm then doing going to an Aldo across right

[00:31:24.240] [SPEAKER_02] Although it is a system created by an osteopath where there's different movements and poses where you hold that do

[00:31:33.280] [SPEAKER_02] detractors specific

[00:31:35.060] [SPEAKER_02] Spinal segment like if you want I'll find us mine or yeah, you know Oxford c1

[00:31:40.440] [SPEAKER_02] So you get in these weird positions where you're externally rotating creating a lot of fascial tension

[00:31:45.140] [SPEAKER_02] Yeah, there was cord your legs are up and there's different positions. Yeah, so you can target whichever spinal cord

[00:31:51.240] [SPEAKER_02] part you want but she does a lot of general nice therapeutic movement she makes each class really

[00:31:56.880] [SPEAKER_02] fun so i've been doing that on friday nights just to like have some self-care to wind down

[00:32:03.040] [SPEAKER_01] and that's been really really helpful so the symptoms wouldn't reach past the weekend no

[00:32:08.500] [SPEAKER_02] not at all i'd be completely fine on sunday yeah there's a few times i've avoided night

[00:32:14.100] [SPEAKER_02] noisy environments on sunday yeah um where i like for instance the church i go to is really loud

[00:32:21.100] [SPEAKER_02] it's like a party and it's a really really loud yeah so you get out of there and you feel like

[00:32:26.920] [SPEAKER_02] you just came out of a rave yeah you know and you're like overly stimulated um there's a few

[00:32:33.760] [SPEAKER_02] times where i'm like okay i need to just go to like a more traditional church yeah like you know

[00:32:39.080] [SPEAKER_02] quiet the silence you can hear a pin drop you know like just to have a worship period that was

[00:32:46.020] [SPEAKER_02] was like you know peaceful for me but now I've lost my train of thought oh yeah so there's a

[00:32:57.680] [SPEAKER_02] few times I found it again I found the path I found the path forward so there's a few times

[00:33:04.320] [SPEAKER_02] where I said okay I need um a quieter place to be on my day off but most of the time I've been

[00:33:13.420] [SPEAKER_02] able to tolerate okay noise and yeah and i haven't i haven't used my ear like i have these new

[00:33:22.580] [SPEAKER_02] ear things yeah which have been like my saving grace for the past six months yeah and i haven't

[00:33:28.780] [SPEAKER_02] used them well i haven't used them in over a month wow and i went to a concert i don't know if that

[00:33:35.460] [SPEAKER_00] was before maybe when we first started yeah i went to a concert did you wait whoa and i had

[00:33:42.900] [SPEAKER_02] It had no seizures triggering.

[00:33:44.980] [SPEAKER_02] Oh, wow.

[00:33:45.660] [SPEAKER_02] And before, I would never go to a loud concert.

[00:33:48.620] [SPEAKER_02] No.

[00:33:49.200] [SPEAKER_02] And I went to a loud concert.

[00:33:50.960] [SPEAKER_02] Yeah.

[00:33:51.200] [SPEAKER_02] And I, like, danced the whole time and sang, and I was okay the next day.

[00:33:56.540] [SPEAKER_02] You're singing with a mosh pit.

[00:33:57.660] [SPEAKER_02] Yeah, wow.

[00:33:58.460] [SPEAKER_02] There's no mosh pit coming.

[00:34:00.120] [SPEAKER_02] Sure.

[00:34:00.820] [SPEAKER_02] So, okay.

[00:34:01.560] [SPEAKER_02] So, any more questions?

[00:34:03.260] [SPEAKER_01] Yes, if there's anything that you would add.

[00:34:05.740] [SPEAKER_01] To this?

[00:34:06.540] [SPEAKER_00] Actually, I think one of the questions there, I don't know if it's coming up, but there's

[00:34:11.040] [SPEAKER_00] One that I'm curious about is, in terms of the spacing, right, so you have one that's kind of closer together, one that's farther apart, right?

[00:34:18.040] [SPEAKER_00] Like the Wednesday-Friday?

[00:34:19.320] [SPEAKER_00] The sessions. Would you increase the number of sessions, reduce the number of sessions, increase the time for a session?

[00:34:24.580] [SPEAKER_02] Like if it was being used as a training program?

[00:34:26.920] [SPEAKER_00] No, for yourself, for clinical.

[00:34:29.440] [SPEAKER_02] Yeah, like for a clinical training program?

[00:34:33.080] [SPEAKER_02] So I would prefer to do another maybe...

[00:34:37.120] [SPEAKER_00] Three times a week?

[00:34:38.300] [SPEAKER_02] No, I think that two times a week is perfect.

[00:34:40.160] [SPEAKER_02] If it was Tuesday and Friday, it probably would have been better for recovery.

[00:34:43.920] [SPEAKER_02] But I know we chose that based on my own schedule.

[00:34:47.720] [SPEAKER_02] But I would have put two days in between instead of one day.

[00:34:58.320] [SPEAKER_02] And I would lengthen, if it was being used clinically, I would lengthen them out a week.

[00:35:05.080] [SPEAKER_02] okay because right now I'm almost peaking no I mean peak in terms of my

[00:35:14.560] [Unknown] performance oh I don't think it will I think I don't think I'm peaked after

[00:35:19.060] [SPEAKER_02] eight weeks yeah I think there's so like a few more yeah and I think I would

[00:35:25.960] [SPEAKER_02] a peak yeah two three weeks i think like if i was doing this for max benefit yeah i would say

[00:35:34.440] [SPEAKER_02] i would go three more weeks okay yeah good to know yeah great and then you know for you it's

[00:35:40.300] [SPEAKER_02] hard because there's so many variables with progress and nutrition is huge for sure you know

[00:35:47.160] [SPEAKER_02] and it's like you have no control over what these people are eating what environment they're sleeping

[00:35:52.820] [SPEAKER_02] in and that you're giving them a tool but it can only work based on what

[00:35:56.540] [SPEAKER_02] they're doing on their own yeah so I would if you're using it as a serious

[00:36:01.440] [SPEAKER_02] training program I would put together some sort of supportive booklet more

[00:36:08.680] [SPEAKER_02] holistic care like hydration yeah sleep hygiene totally you know proper

[00:36:14.780] [SPEAKER_02] nutrition so that people can learn because there's a lot of people who have

[00:36:19.780] [SPEAKER_02] have no idea when I got this major concussion I couldn't cook for myself

[00:36:24.660] [SPEAKER_02] like I have to cook for me yeah but I literally my diet became so limited

[00:36:30.660] [SPEAKER_02] yeah because I had no energy I would literally go to the grocery store and I

[00:36:37.040] [SPEAKER_02] feel overwhelmed like what like you lose I lost myself yeah what do I buy like

[00:36:43.180] [SPEAKER_02] what did I eat? I used to love cooking and recipes and things and it wasn't a burden and all of a

[00:36:53.180] [SPEAKER_02] sudden it was like I don't even know what to buy at the grocery store like it's just so incapacitated

[00:36:59.260] [SPEAKER_02] my friends like do good food do hello fresh and I'll go warehouse for dinner I couldn't even read

[00:37:07.140] [SPEAKER_02] the instructions yes yeah exhausting people who've been concussed unless they

[00:37:15.340] [SPEAKER_02] have a caregiver they really need like do this yeah sure you're hydrated make

[00:37:20.900] [SPEAKER_02] sure you eat you need the fats for your brain to heal like they need sometimes

[00:37:27.840] [SPEAKER_02] like just a basic self-care and I'm a self-care queen I teach self-care yeah

[00:37:35.200] [SPEAKER_02] And, you know, I'm very educated in nutrition and things, and I struggle.

[00:37:41.540] [SPEAKER_02] Everybody does.

[00:37:43.780] [SPEAKER_02] So I think this would, if you're using it for a training program, some holistic support.

[00:37:50.240] [SPEAKER_00] Or a holistic approach would be nicer, yeah.

[00:37:52.340] [SPEAKER_02] Just to make sure that you can maximize the results.

[00:37:55.140] [SPEAKER_02] Definitely.

[00:37:55.780] [SPEAKER_00] And that actually means, what was the question you were going to ask before I cut you off?

[00:38:00.080] [SPEAKER_01] I don't think, well, this is, it was what would you add,

[00:38:04.680] [SPEAKER_01] but is there anything, is there anything that's in the back of your mind?

[00:38:07.680] [SPEAKER_00] When you say add or remove, you mean specifically clicking, like the words, the numbers, things like that?

[00:38:11.340] [Unknown] Um, no, I mean there is a few errors.

[00:38:15.320] [SPEAKER_00] Sure, so that error where it's a double, yes?

[00:38:17.760] [SPEAKER_02] A few here and there.

[00:38:18.880] [SPEAKER_02] Yeah.

[00:38:19.220] [SPEAKER_02] Do you want . . .

[00:38:19.760] [SPEAKER_02] Or once the heater didn't work well.

[00:38:21.480] [SPEAKER_02] Yeah.

[00:38:21.740] [SPEAKER_02] And not just tech, not just tech needs, that's nothing to do with that.

[00:38:24.820] [SPEAKER_02] Is six enough? Do you want eight?

[00:38:26.900] [SPEAKER_02] Six and . . .

[00:38:28.040] [SPEAKER_02] Okay.

[00:38:28.300] [SPEAKER_00] Yeah.

[00:38:29.140] [SPEAKER_02] So most people should be able to, the healthy brain should be able to sequence six to eight.

[00:38:34.040] [SPEAKER_02] so I wouldn't put more than 6

[00:38:36.740] [SPEAKER_02] and because it
[00:38:38.880] [SPEAKER_02] makes a nice shape
[00:38:40.600] [SPEAKER_02] for moving smoothly
[00:38:43.100] [SPEAKER_02] if you had 8
[00:38:44.600] [SPEAKER_02] it would be 1, 2, 3, 4, 5, 6, 7
[00:38:46.680] [SPEAKER_02] too big
[00:38:48.560] [SPEAKER_02] what about the tandem portion halfway through
[00:38:50.800] [SPEAKER_00] is that good?
[00:38:51.560] [SPEAKER_00] it's so hard but it pushed me
[00:38:53.800] [SPEAKER_00] my balance is better now
[00:38:55.120] [SPEAKER_01] what do you think about the 20 minutes?
[00:38:57.120] [SPEAKER_01] because I know sometimes it goes by so fast
[00:38:58.680] [SPEAKER_01] it's enough
[00:38:59.500] [SPEAKER_02] when I'm pushing I'm sweating like crazy
[00:39:02.000] [SPEAKER_02] using my heart rate like we checked my heart before it was like
90 something after the game
[00:39:06.860] [SPEAKER_00] you know it was my heart rate was so i would say no i think six
stations is perfect what do you
[00:39:16.300] [SPEAKER_00] think we'll see you know i think it's so overwhelming i imagine
how overwhelmed it
[00:39:24.680] [SPEAKER_02] was at the beginning i can't imagine eight stations i would have
given up yeah yeah i
[00:39:29.400] [SPEAKER_01] I guess I didn't mention it to Christine, it was my own fault, but
when did we figure this out?
[00:39:34.920] [SPEAKER_01] Like four weeks, maybe not even, like three weeks ago when I
told you it was water in the fountain?
[00:39:40.540] [SPEAKER_01] Because there was one time she asked, she was like, what's the
blue?
[00:39:45.760] [SPEAKER_01] And I'm like, oh, it's literally a fountain, like that's meant to be
water.
[00:39:50.520] [SPEAKER_00] No, it was just, I was just, that made me, yeah, honestly, I do, I
don't think people process it.

[00:39:59.400] [SPEAKER_01] Yeah, because she was like, does the blue contribute to the white of the thing?

[00:40:04.440] [SPEAKER_01] She's like, is it blue?

[00:40:05.100] [SPEAKER_01] I was like, no, it's water.

[00:40:07.300] [SPEAKER_00] No, I do think a lot of people don't.

[00:40:08.960] [SPEAKER_00] No, everyone has.

[00:40:10.260] [SPEAKER_01] Because they're also just like, they're floating up there.

[00:40:12.080] [SPEAKER_02] I know, but it was so obvious when she said it to me.

[00:40:13.800] [SPEAKER_02] Oh, it's okay.

[00:40:14.740] [SPEAKER_02] And I was like, I should have.

[00:40:16.220] [SPEAKER_00] It's part of my instructions.

[00:40:17.680] [SPEAKER_00] I was misspoken.

[00:40:18.680] [SPEAKER_00] I was so confused a couple times.

[00:40:21.880] [SPEAKER_02] Sometimes the bird is like in a different area.

[00:40:24.900] [SPEAKER_02] Yeah.

[00:40:25.860] [SPEAKER_01] Remember when it's like, if you can't find it, look in the mask.

[00:40:28.380] [SPEAKER_00] yeah so just make sure you tell people yeah yeah i didn't feel like those three out of the loop

[00:40:33.740] [SPEAKER_00] or yeah in a good way or a bad way like i just like i just got lost no not angry like angry

[00:40:41.560] [SPEAKER_02] but i i lost my train of thought right yeah it's frustrating you're always already working

[00:40:49.680] [SPEAKER_02] so hard that tandem thing is so hard it is a lot yeah um did the bird noise annoy you

[00:40:56.520] [SPEAKER_02] At the beginning, for the first month, they drove me crazy.

[00:41:00.820] [SPEAKER_02] Like, they were so hard.

[00:41:02.940] [SPEAKER_02] But now I'm at the dinner table, and I can listen to my sister-in-law.

[00:41:06.840] [SPEAKER_02] Yeah, with the birds.

[00:41:08.100] [SPEAKER_02] When these guys were talking beside us.

[00:41:10.480] [SPEAKER_02] And so if it wasn't for forcing through this, I probably wouldn't have that ability to.

[00:41:15.380] [SPEAKER_00] Would you believe me if I said, originally, like last minute, I was intending to put on music after week four,

[00:41:21.500] [SPEAKER_00] and then also bother you halfway through every 30 or 45 seconds asking you questions?

[00:41:25.960] [SPEAKER_00] is that like why you guys started talking yeah it's actually part of it like for some of the

[00:41:29.560] [SPEAKER_00] first we've done it yeah that was so mean yeah you feel like that would be too much

[00:41:35.200] [SPEAKER_02] i think the bird distracting sometimes i wake up at night when i hear the birds

[00:41:41.540] [SPEAKER_01] i'm in the game better get to that nest that fountain like that's what we do with bruises

[00:41:46.600] [SPEAKER_02] on me i'm probably like in my sleep like yeah that's weird bruises i'm probably like

[00:41:55.060] [SPEAKER_01] Any lingering thoughts about the intervention?

[00:41:59.500] [SPEAKER_02] Any lingering thoughts? No, I just feel so grateful that I was able to participate in this and what an amazing convention.

[00:42:10.720] [SPEAKER_00] We all just got lucky for it when we walked into the world.

[00:42:15.020] [SPEAKER_00] No one was actually expecting the results to be extreme.

[00:42:18.500] [SPEAKER_00] So, you know, I started 236. Yeah, you did. Yeah, you only went up by 700 points. Yeah, it's a lot. It's a lot. It's a lot. I worked hard. Yeah. Thank you. Anything you're curious about?

[00:42:40.540] [Unknown] How would this be available to people to use in the future?

Exit Interview Transcript

12.7 FAR8 Interview

Transcribed: 2025-11-08 19:41:53

Duration: 27.5 minutes

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[00:00:00.000] [Unknown] You know, thank you. Sorry!

[00:00:03.040] [SPEAKER_01] All right, so we're on, we're here with part eight, and then we got me, Anthony, and we've got Alexei.

[00:00:10.200] [SPEAKER_01] So those are the questions, roughly. So, again, you're welcome to talk about anything, preferably just on the subject while it's recording, after the fact, you know.

[00:00:18.920] [SPEAKER_02] Okay, so we do one recording for all the questions.

[00:00:20.880] [SPEAKER_02] You got it, yeah.

[00:00:21.940] [SPEAKER_02] Okay, cool.

[00:00:22.400] [SPEAKER_02] Where's it going, yeah.

[00:00:23.440] [SPEAKER_02] Wonderful. Okay.

[00:00:26.780] [SPEAKER_00] You actually relate to him better, that's why he's doing it.

[00:00:30.000] [Unknown] not because i don't want to talk i'll jump in a bunch sure yeah but again you're welcome to talk

[00:00:34.780] [SPEAKER_00] about whatever you like i didn't relate to you i mean i do relate to alexi but i also relate

[00:00:40.500] [SPEAKER_02] to you of course yeah yeah we're all like a little study family here now and yeah and speaking of

[00:00:47.280] [SPEAKER_02] that was the game experience what you expected it to be uh so when i first came in yeah like

[00:00:55.760] [SPEAKER_01] Like, we said intervention for concussion.

[00:00:59.320] [SPEAKER_01] Was this what you were thinking about?

[00:01:00.800] [SPEAKER_01] Is this what you thought it was going to be?

[00:01:03.260] [SPEAKER_00] No.

[00:01:03.780] [SPEAKER_00] I mean, I thought there was a virtual reality component to it.

[00:01:08.160] [SPEAKER_00] Right.

[00:01:08.600] [SPEAKER_00] But exactly what that was going to look like, I had zero idea.

[00:01:12.700] [SPEAKER_01] Okay.

[00:01:13.660] [SPEAKER_01] And when it comes to the frequency, did you think the frequency was enough, not enough?

[00:01:19.600] [SPEAKER_01] What was your honest expectations, if any?

[00:01:23.260] [SPEAKER_00] In terms of the frequency?

[00:01:28.080] [SPEAKER_01] Or anything related to this. I mean, like, thinking back to when you started, right?

[00:01:32.240] [SPEAKER_01] What were your thoughts, if any, about this?

[00:01:36.540] [SPEAKER_00] I mean, I knew that Lauren did a lot of work around concussions.

[00:01:42.660] [SPEAKER_00] And she did use virtual reality.

[00:01:45.780] [SPEAKER_00] And I had done a previous study with one of her Ph.D. students for Alzheimer's and dementia

[00:01:53.920] [SPEAKER_00] using sort of a similar original idea, I guess, because it was like put your finger on the screen and go like this.

[00:02:03.860] [SPEAKER_00] So we were doing that within that study as one of the things.

[00:02:09.700] [SPEAKER_00] So I guess my expectations, if I had any, were sort of based on that.

[00:02:15.400] [SPEAKER_00] prior work right so I thought it would be something potentially similar but not

[00:02:21.820] [SPEAKER_00] similar because yeah we weren't doing virtual reality yeah cool the VR was the

[00:02:29.060] [SPEAKER_01] biggest expectation there so now the fact that it's not virtual reality was

[00:02:34.120] [SPEAKER_01] the biggest expectation that it was broken someone okay well so what would

[00:02:39.580] [Unknown] what would you call this if not oh if i had to be big you know i'm calling it augmented reality

[00:02:45.350] [SPEAKER_01] augmented reality yeah you can see the world around you but there's more overload right okay

[00:02:50.050] [SPEAKER_00] so i think i'm just using the wrong terminology then yeah so augmented reality just sub that word

[00:02:55.090] [SPEAKER_00] in for where it's a virtual reality sounds good okay because i get the two of them matched together

[00:03:00.390] [Unknown] yeah but that okay sounds good do you feel like you performed better at the game and if so what

[00:03:09.290] [SPEAKER_02] What do you think changed?

[00:03:11.350] [SPEAKER_00] Over time, right?

[00:03:12.810] [SPEAKER_00] So yes, I definitely performed better in the game over time.

[00:03:19.310] [SPEAKER_00] Some of it was just, you know, if I had one of my kids

[00:03:24.030] [SPEAKER_00] doing this, I probably wouldn't have

[00:03:26.010] [SPEAKER_00] had any issue from the beginning.

[00:03:27.410] [SPEAKER_00] But because I've never used any kind of an augmented reality,

[00:03:30.550] [SPEAKER_00] I'm not a game player, so that's, you know, that is, yeah.

[00:03:37.190] [SPEAKER_00] Yeah, so I think there is a bit of a learning curve

[00:03:41.050] [SPEAKER_00] for that part, but then also,
[00:03:43.190] [SPEAKER_00] you know I was struggling with brain fog,
[00:03:46.510] [SPEAKER_00] and so that didn't help, and there were some times
[00:03:49.570] [SPEAKER_00] when, yeah, I just didn't feel on my game,
[00:03:54.770] [SPEAKER_00] but that started dissipating,
[00:03:57.290] [SPEAKER_00] and the brain fog became a lot less
[00:04:00.530] [SPEAKER_00] from start to finish of the game.
[00:04:03.650] [SPEAKER_01] I guess it's the end, but if you put it in like that,
[00:04:06.330] [SPEAKER_01] it breaks the cables and it breaks the you can't you gotta leave it
like that
[00:04:11.290] [SPEAKER_02] otherwise no problem yeah because there's no repair it breaks oh
no you don't want you want
[00:04:17.390] [Unknown] to do that and then you work there's a big for um insurance oh my
god all right well do you feel
[00:04:25.920] [SPEAKER_02] like there was something at the beginning of our time working
together that you are more able to do
[00:04:31.660] [SPEAKER_01] do now. So we're not talking about the game context? Yeah, like
quality of life-wise.
[00:04:37.560] [SPEAKER_01] Suddenly shooting people in the back, Batman at night, Batman
at night, Batgirl is going
[00:04:44.740] [SPEAKER_02] to shut us up. Covering people's faces. Yeah, so that doesn't
perfectly relate to things
[00:04:54.980] [SPEAKER_00] that I'm doing, but I think it has helped with balance and focus,
concentration, memory.
[00:05:06.840] [SPEAKER_00] Somehow it's helped with brain fog as well.
[00:05:10.940] [SPEAKER_00] So that's the most substantial one for you, isn't it?
[00:05:13.820] [SPEAKER_01] Brain fog, you keep referring to that one.
[00:05:15.840] [SPEAKER_00] Yeah, brain fog and headaches, migraines.
[00:05:21.760] [SPEAKER_00] Those two were probably the biggest things for me.
[00:05:25.580] [SPEAKER_01] If we walk through your day, what's something that at the
beginning of this was debilitating due to the brain fog?
[00:05:32.620] [SPEAKER_01] Could you give us an example?

[00:05:33.680] [SPEAKER_01] Because at least your brain fog might be different from other people's brain fog, from my conception of it.

[00:05:39.900] [SPEAKER_00] So in my work, I have to read sometimes research papers and then make sense of them and write a media release that the media and then public will understand from this research.

[00:05:52.380] [SPEAKER_00] that have zero science background so I'm trying to understand sometimes like a

[00:05:58.560] [SPEAKER_00] chemistry paper or biology paper and make sense of things and have to

[00:06:04.240] [SPEAKER_00] sometimes Google terms because I don't have any formal education in science so

[00:06:11.020] [SPEAKER_00] that kind of thing yeah would definite I would be slower and it would take me

[00:06:14.880] [SPEAKER_00] longer and be harder for me to absorb what I was reading and make sense of it

[00:06:22.460] [SPEAKER_01] And you would consider that to be brain fog?

[00:06:24.540] [SPEAKER_01] Yes.

[00:06:25.400] [SPEAKER_00] Okay.

[00:06:26.360] [SPEAKER_00] Yes.

[00:06:26.860] [SPEAKER_00] I mean, that's not the only thing, but that's an example of where I noticed it in work,

[00:06:32.500] [SPEAKER_00] but that's one of the examples.

[00:06:37.280] [SPEAKER_00] Now you're going, that's not really brain fog, Sandra.

[00:06:40.220] [SPEAKER_00] No, it's okay.

[00:06:40.820] [SPEAKER_00] But that's one last thing.

[00:06:42.180] [SPEAKER_01] It's a part of my own family.

[00:06:45.220] [SPEAKER_00] It's just, that was like the most extreme example.

[00:06:48.660] [SPEAKER_00] Sure.

[00:06:49.060] [SPEAKER_01] of what so it's kind of like is it bringing is it kind of trying to bring it down to actions kind of

[00:06:56.880] [SPEAKER_01] and so you're reading this research paper about chemistry of some sort where they modified this

[00:07:02.660] [SPEAKER_01] or that and you're just staring at it blankly would that be considered brain fog comparative

[00:07:07.640] [SPEAKER_00] to more recently or like what i think it just was like my brain was fuzzy okay it was like

[00:07:15.480] [SPEAKER_00] cotton balls okay and it was just like a hangover or yeah I'm like that so it's

[00:07:23.920] [SPEAKER_00] just more difficult to understand things it was more difficult to understand

[00:07:32.380] [SPEAKER_00] things as quickly and that translated not just into like work yeah and

[00:07:41.160] [SPEAKER_00] research papers, but everything. So everything was just felt like I wasn't doing things as quickly,

[00:07:49.240] [SPEAKER_00] or there wasn't the same motivation as well, because I just wasn't feeling sharp.

[00:07:58.060] [SPEAKER_00] Is that a better way? Yeah, so you feel sharper.

[00:08:00.920] [SPEAKER_02] It's interesting. Yeah, physical exercise made you feel sharper,

[00:08:04.760] [SPEAKER_02] intellectually. It's really cool. I like Alexa.

[00:08:10.020] [SPEAKER_00] But then I've also been able to do physical exercise more, too, which I wasn't able to do.

[00:08:18.520] [SPEAKER_00] I mean, I was exercising, but I wasn't exercising as much, or it would be triggering, you know, headaches, or it would just, you know, the motivation wasn't as right.

[00:08:48.200] [SPEAKER_02] has anything gotten worse since you started the study with us any medication changes okay then

[00:09:02.900] [SPEAKER_02] then if there were also that's a change positive change yeah yeah but I do know

[00:09:13.260] [SPEAKER_00] bottles would expire and I had to buy a whole new bottle so I was definitely

[00:09:22.480] [SPEAKER_00] taking way more time than I've ever taken in my entire life

[00:09:25.860] [SPEAKER_00] and that is definitely tapering off.

[00:09:30.880] [SPEAKER_02] Wow. If there was something you would add

[00:09:33.560] [SPEAKER_02] to this intervention, meaning this study, what might it be?

[00:09:38.140] [SPEAKER_01] So we're going to start with different aspects of it.

[00:09:41.440] [SPEAKER_01] When it comes to, let's say, even the paperwork, do you feel like we missed

[00:09:45.640] [SPEAKER_01] anything in terms of questions?

[00:09:52.210] [SPEAKER_01] It's okay to say no, it's just more so... Yeah, nothing jumps

[00:09:58.210] [SPEAKER_01] Cool. About the experience, let's say, with me, Alexi, the way we run the session, anything you change there?

[00:10:06.350] [SPEAKER_01] No. No, it's great. You guys are great.

[00:10:08.810] [SPEAKER_01] Cool. And let's say the game, right? So we have six stations, you want more stations, fewer stations, bigger space, smaller space.

[00:10:18.210] [SPEAKER_01] Let's say you have godlike powers all of a sudden. What might you do?

[00:10:23.930] [SPEAKER_00] Well, I mean, remembering three numbers and three stations would be easier, however, that's not challenging.

[00:10:30.530] [SPEAKER_00] Totally not.

[00:10:32.150] [SPEAKER_00] So, I don't think I would want to see more because I don't think I would be able to remember, well, I mean, I'm talking personally now, other people, maybe they would have better, right?

[00:10:42.490] [SPEAKER_00] But, yeah, no, I think six is a good number.

[00:10:45.010] [SPEAKER_00] Okay.

[00:10:48.050] [SPEAKER_00] Yeah, I don't think it needs to be any closer or further apart.

[00:10:52.350] [SPEAKER_00] I mean, if you're doing tandem and then really close, you're not really doing tandem anymore.

[00:10:57.250] [SPEAKER_00] True enough, yeah.

[00:11:01.490] [SPEAKER_02] Well, if there is nothing to add, is there anything you would remove from the study procedures that we did?

[00:11:07.450] [SPEAKER_02] Any aspect of the study that felt extra?

[00:11:10.510] [SPEAKER_00] No, it would have been nice to get an MRI.

[00:11:15.740] [SPEAKER_00] right no but but yeah we didn't do a pre-scan did we remember the reasons for it i forgot

[00:11:41.320] [SPEAKER_00] There wasn't a technician back then either.

[00:11:44.060] [SPEAKER_02] Oh, there we go.

[00:11:45.600] [SPEAKER_00] Okay, there you go.

[00:11:46.660] [SPEAKER_00] No technician.

[00:11:48.300] [SPEAKER_00] Did you have an appointment set up?

[00:11:49.980] [Unknown] Yeah, okay.

[00:11:51.160] [Unknown] And then you told me that they were sick.

[00:11:53.600] [Unknown] Oh, they were sick, yeah.

[00:11:55.880] [Unknown] And then that person maybe left or something.

[00:11:59.400] [SPEAKER_00] It's very difficult.

[00:12:00.840] [SPEAKER_01] Not enough for a while, yeah.

[00:12:02.220] [SPEAKER_00] Yeah, let's do that.

[00:12:04.780] [SPEAKER_00] For her or him.

[00:12:06.500] [SPEAKER_00] For them, yeah.

[00:12:07.180] [SPEAKER_00] That's what I'm talking about.

[00:12:07.960] [SPEAKER_00] Not for me.

[00:12:08.600] [SPEAKER_00] For them.

[00:12:11.460] [SPEAKER_00] yeah but that so that would have been obviously interesting because it would

[00:12:15.560] [SPEAKER_00] be another way of physically seeing change yeah for sure do you feel that

[00:12:26.360] [SPEAKER_02] you would do better if you had more or fewer sessions maybe longer sessions

[00:12:31.200] [SPEAKER_02] more rest in between or less rest in between the sessions how was the timing

[00:12:41.900] [SPEAKER_01] Because you guys did like Mondays, Wednesdays, is that right?

[00:12:45.100] [SPEAKER_02] No, we did Mondays and Thursdays or Fridays.

[00:12:48.040] [SPEAKER_01] So you did it like evenly apart pretty much, huh?

[00:12:50.540] [SPEAKER_01] Yep, yep.

[00:12:51.220] [SPEAKER_01] And that's been good, huh?

[00:12:52.360] [SPEAKER_02] Yeah, 20 minutes per session.

[00:12:54.140] [SPEAKER_01] Would you do 30 minutes a session?

[00:12:57.700] [SPEAKER_00] I mean, I would, yeah.

[00:13:00.720] [SPEAKER_00] I think as you do it more and more, because it gets easier, then you also are like,

[00:13:08.680] [SPEAKER_01] like okay are we done yet you get a little bored don't you yeah yes even though yeah but but then

[00:13:15.880] [SPEAKER_00] also i would start my mind would start to wander and then some of the forewords yes and then then

[00:13:22.420] [SPEAKER_00] i would have explosion sometime right because i think okay i've got the numbers and i've got

[00:13:26.880] [Unknown] spatially what i need and then i'd be like oh yeah yeah um but i mean that's probably

[00:13:36.280] [Unknown] hopefully a good thing is close to a bad thing, right?

[00:13:39.360] [SPEAKER_00] Hopefully that means that you're getting better at it.

[00:13:42.800] [SPEAKER_02] Yeah, I remember when you started,

[00:13:44.460] [SPEAKER_02] you would make more mistakes in the beginning

[00:13:46.540] [SPEAKER_02] and then you would dial in

[00:13:47.800] [SPEAKER_02] and in the end you would have a streak.

[00:13:49.920] [SPEAKER_02] And then now you start perfectly

[00:13:52.440] [SPEAKER_02] and closer to the end you get bored

[00:13:54.160] [SPEAKER_02] and I hear explosions in the last couple of minutes.

[00:13:56.820] [SPEAKER_02] So it's switched.

[00:13:58.140] [SPEAKER_02] I noticed that.

[00:13:59.240] [SPEAKER_02] Yeah, see, so there you go.

[00:14:00.900] [SPEAKER_00] It's true, because either we start talking

[00:14:04.500] [Unknown] or exert. Have there been any other thoughts on your mind about the

[00:14:13.080] [SPEAKER_02] intervention in general? Is there anything else you want to share?

[00:14:17.140] [SPEAKER_00] I think it's really cool. It's an interesting design to use birds and numbers and all the different elements that are there that are done in this way.

[00:14:34.500] [SPEAKER_00] you know kind of a fun game yeah right right um totally yeah so and i think that it's very

[00:14:41.780] [SPEAKER_00] accessible for people yeah to get into and and do that and they don't necessarily i mean you

[00:14:47.560] [SPEAKER_00] have to remember the numbers but it it's also a game so it's not like it's not like with the

[00:14:52.780] [SPEAKER_00] questionnaires remember and repeat these numbers back it's like more of a you know more fun way of

[00:14:58.540] [SPEAKER_00] sort of doing that and testing that and then seeing if someone's responding to that so

[00:15:06.180] [SPEAKER_01] cool and they chirp i mean hey did the chirping annoy you or no no i liked the chirping

[00:15:18.500] [SPEAKER_01] cool do you have anything to add lexi anything at all no no just even sitting and watching you

[00:15:24.300] [SPEAKER_02] play was really enjoyable because of all the chirping and the sound of success,

[00:15:28.680] [SPEAKER_02] the sound of failure. It felt like a video game which makes it more

[00:15:31.640] [SPEAKER_02] interacting and interesting than just doing some blank mental exercises with

[00:15:37.000] [SPEAKER_02] words or repeating numbers or whatnot. For sure, for sure.

[00:15:41.120] [SPEAKER_00] And it's motivating because when you do it wrong you get the explosion.

[00:15:44.740] [SPEAKER_00] No one wants the explosion!

[00:15:46.760] [SPEAKER_00] Yeah, it's really cool.

[00:15:49.160] [SPEAKER_00] Yeah, and you guys are great, so I really like that.

[00:15:54.760] [SPEAKER_01] It was all you, Lexi.

[00:15:58.560] [SPEAKER_02] Well, I'm just sitting in a chair, like here we have the master of the game.

[00:16:02.400] [SPEAKER_02] Is there anything you would be curious to find out and better understand

[00:16:06.780] [SPEAKER_02] about the intervention, about its purposes, anything?

[00:16:09.640] [SPEAKER_00] Yeah, all of it, actually.

[00:16:12.260] [SPEAKER_00] I'd love to know, does it stay the same?

[00:16:15.940] [SPEAKER_00] because this is a pilot right? Will this stay the same going into, are you going to change things?

[00:16:22.880] [SPEAKER_00] What exactly is it tapping into that you're trying to tap into?

[00:16:29.360] [SPEAKER_01] Beautiful. We'll keep it going, but they just started cutting. What did they cut? A cake, that's what they're cutting, a cake.

[00:16:39.320] [SPEAKER_01] So I think, you know what we'll do is we'll first talk through Lauren's work broadly,

[00:16:44.100] [SPEAKER_01] then i'll show you the poster with some of your data other people's data all that where we're

[00:16:48.360] [SPEAKER_01] going things like that so all right so i think you know you know more longer than i ever have

[00:16:54.540] [SPEAKER_01] you know i think you know more longer than i've been alive probably i don't know about that i've

[00:17:00.840] [SPEAKER_00] only been here 17 years you're older than 17. i know how old alexi is he's the same age as my

[00:17:09.320] [SPEAKER_01] little one okay well we'll learn to do this for a long time funny enough it actually came from a

[00:17:16.760] [SPEAKER_01] quirk from animal work where for whatever reason when you dissociate what you're controlling and

[00:17:24.360] [SPEAKER_01] how you're controlling it and it's an instantaneous rule-based interaction and suddenly your brain

[00:17:30.640] [SPEAKER_01] gets really angry and it becomes really hard and different parts of your brain light up relative to

[00:17:36.100] [SPEAKER_01] to other regions that would just typically not light up.

[00:17:39.220] [Unknown] Reason being is, sure, you can think,

[00:17:43.880] [SPEAKER_01] you could do the questionnaires,

[00:17:45.140] [SPEAKER_01] that uses simpler surface level functionality.

[00:17:50.600] [SPEAKER_01] Or let's say you can go for a walk,

[00:17:52.580] [SPEAKER_01] you can do some physical movement,

[00:17:54.020] [SPEAKER_01] you can do some exercise,

[00:17:55.180] [SPEAKER_01] that's another somewhat simple portion

[00:17:58.520] [SPEAKER_01] of your brain, somewhat.

[00:18:00.760] [SPEAKER_01] But to put those two together,

[00:18:03.520] [SPEAKER_01] your brain has systems to make that happen,

[00:18:05.340] [SPEAKER_01] but they're very atypical.

[00:18:06.960] [SPEAKER_01] like let's say we're talking about back when we were hunter-gatherers the few times when you might

[00:18:13.300] [SPEAKER_01] experience this is when let's say you made a boat or you're trying to stab a fish in the water and

[00:18:19.660] [SPEAKER_01] because of the light refraction you got to aim at a particularly different location and so that

[00:18:24.060] [SPEAKER_01] integration of instantaneous rule instantaneous reality in an almost otherwise way leads to a lot

[00:18:32.660] [SPEAKER_01] of interesting things in the brain specifically in more parietal regions so back here so movements

[00:18:38.300] [SPEAKER_01] up here more higher order functions here emotions and sound is here visions back here but up here is

[00:18:45.740] [SPEAKER_01] roughly where everything kind of comes together the reason why we think this works slightly

[00:18:51.020] [SPEAKER_01] differently than just exercise or just other things is because when it came to the monkeys

[00:18:57.180] [SPEAKER_01] to start they just have to just a little bit off when we start to separate things they could still

[00:19:03.660] [SPEAKER_01] do it but it would take some of the concussion take someone who had early late middle dementia

[00:19:09.020] [SPEAKER_01] or let's say someone who's high on weed take an nhl draft pick because she did over 100 of those

[00:19:15.400] [SPEAKER_01] right people's performance in these kinds of tasks post injury is about 94 accurate simple

[00:19:24.060] [SPEAKER_01] simple statistics. In short, it's the integrative hubs that really show us how well your brain

[00:19:30.500] [SPEAKER_01] can talk, how well it can kind of function, and in the process, correlates with a lot

[00:19:36.380] [SPEAKER_01] of quality of life, a lot of symptoms, a lot of performance metrics, in short. And so the

[00:19:41.940] [SPEAKER_01] idea was, well, we can assess it with really good accuracy, and we can bring it to a dementia

[00:19:48.300] [SPEAKER_01] long-term care home in a pilot and give them the equivalent of fruit ninja but on the split screen

[00:19:53.880] [SPEAKER_01] in reverse 30 minutes once a week for 16 weeks and have people with early dementia not have

[00:19:59.720] [SPEAKER_01] dementia based off of dementia rating scores moderate dementia improved and city are not

[00:20:05.360] [SPEAKER_00] falling off a cliff wow and so super cool we would have kept going with that but then

[00:20:09.920] [SPEAKER_01] you know partly great partly horrible covid happened yeah somebody can't touch that

[00:20:15.080] [SPEAKER_01] population anymore those grants expired and so when i came in before our whole spiel here was

[00:20:21.340] [SPEAKER_01] well we know 2d pretty much works in a pilot like dimension we have a grant for concussion

[00:20:26.180] [SPEAKER_01] and we care about concussion quite a bit plus it's a very interesting condition respectfully

[00:20:31.280] [SPEAKER_01] speaking because we're both sitting in the same car we won't get hit from behind we both walk

[00:20:36.420] [SPEAKER_01] with different symptoms and sensations yeah part of the reason why we think is the integration

[00:20:41.220] [SPEAKER_01] the parietal stuff, it puts all that information in the communication hubs.

[00:20:46.340] [SPEAKER_01] Well, when we look at athletes, the reason why they perform better,

[00:20:49.440] [SPEAKER_01] even though they have more hits, because you'd expect them to kind of go,

[00:20:51.920] [SPEAKER_01] whoa, whoa, whoa, I know, they're actually surprising,

[00:20:54.080] [SPEAKER_01] is because there are networks, those communication channels,

[00:20:59.060] [SPEAKER_01] and more specifically the highways between, let's say, the Sudoku part of you

[00:21:03.060] [SPEAKER_01] and the vision and the movement, instead of it being a single-lane highway,

[00:21:07.180] [SPEAKER_01] it's multi-lane, no potholes.

[00:21:09.120] [SPEAKER_01] or if there is a problem you swerve and it's okay right me you the typical

[00:21:14.040] [SPEAKER_01] we've got like a single lane highway uh we don't collect taxes for it there's a bunch of cracks

[00:21:20.620] [SPEAKER_01] it's this spring it's horrible right and so you get one impact suddenly you're out for the count

[00:21:25.920] [SPEAKER_01] because things just don't come together road is broken you got it somewhat like and the brain's

[00:21:30.740] [SPEAKER_01] really good at compensating so it'll go around the pothole but it'll slow things down and then

[00:21:35.740] [SPEAKER_01] suddenly you're supposed to bring information together one of them arrives late and while

[00:21:39.680] [SPEAKER_01] the brain's really good it's not perfect it definitely works better when things kind of

[00:21:45.480] [SPEAKER_01] have fewer potholes and the roads are more direct right right you got it yeah and so the theory

[00:21:52.180] [SPEAKER_01] here right that if we could create a task specifically high cognitive load so we have

[00:21:59.260] [SPEAKER_01] the funnel we have to stick with the balance right you have the auditory verse right then on top of

[00:22:06.060] [SPEAKER_01] that you add that attention of figuring out what you're supposed to do next right what kind of task

[00:22:11.140] [SPEAKER_01] are you doing paired with the mirror which is technically the secret sauce here we could engage

[00:22:18.540] [SPEAKER_01] more networks in a unique way that re as cheesy sounds like get the neuroplasticity to reoccur

[00:22:26.900] [SPEAKER_01] and get those highways fixed, fill in the potholes,

[00:22:30.260] [SPEAKER_01] maybe even open up a highway or two, open up a lane.

[00:22:32.960] [SPEAKER_01] That's very cool.

[00:22:33.860] [SPEAKER_01] Yeah, and so that's the postulate here.

[00:22:36.460] [SPEAKER_01] That's what we've somewhat, I can't, it's a voice memo,

[00:22:40.060] [SPEAKER_01] so admit this part, I guess, but that's part of the idea

[00:22:44.100] [SPEAKER_01] as to why we're thinking you're feeling so much better

[00:22:47.120] [SPEAKER_01] because suddenly things are clicking, right?

[00:22:49.180] [SPEAKER_01] Right.

[00:22:49.780] [SPEAKER_01] Like you said, cotton balls, less cotton balls, right?

[00:22:53.240] [SPEAKER_00] Yeah, definitely less cotton balls, way less cotton balls.

[00:22:56.700] [SPEAKER_00] Yeah, it feels like the highway is opening again.

[00:22:58.940] [SPEAKER_00] Yeah, exactly, right?

[00:22:59.900] [SPEAKER_00] Things are moving.

[00:23:00.720] [SPEAKER_00] There's no tolls, and there's no traffic jams.

[00:23:05.160] [SPEAKER_01] You know, yeah, you're not being hijacked in Mexico, right?

[00:23:08.320] [SPEAKER_01] Exactly.

[00:23:08.780] [SPEAKER_01] The hotel's not quite there anymore, at least.

[00:23:10.860] [SPEAKER_01] Nope, nope, they're leaving me alone now.

[00:23:12.820] [SPEAKER_00] Exactly, right?

[00:23:13.860] [SPEAKER_01] And so part of the reason, or at least, like, yes, my direction.

[00:23:17.860] [SPEAKER_01] On the one hand, I want to fix the bugs.

[00:23:19.980] [SPEAKER_01] On the other hand, I might actually add in more bugs by accident.

[00:23:23.880] [SPEAKER_01] Right.

[00:23:24.320] [SPEAKER_01] So we'll see how the data says.

[00:23:26.220] [SPEAKER_01] Can I track how your head moves, what you're looking at?

[00:23:29.140] [SPEAKER_01] So we have some eye tracking in there.

[00:23:30.420] [SPEAKER_01] Oh, very cool.

[00:23:31.560] [SPEAKER_01] Yeah, and we keep track of where the birds are, how many recalls, pretty much everything.

[00:23:35.640] [SPEAKER_01] Yeah.

[00:23:36.200] [SPEAKER_01] Literally, like, I play God a little bit, you know?

[00:23:39.000] [SPEAKER_01] The original idea was to track your body movement as well using these cameras.

[00:23:42.260] [SPEAKER_01] Yeah.

[00:23:42.640] [SPEAKER_01] We didn't get the ethics in our time for me to do the mastering, but ideally we were

[00:23:47.380] [SPEAKER_01] going to try to make a comprehensive model of what changes over time and see which behaviors

[00:23:52.500] [SPEAKER_01] may be most correlated with improvement and improvement so we'll see what

[00:23:59.320] [SPEAKER_01] happened there yeah but ultimately the goal let's say or this man next year I

[00:24:06.020] [SPEAKER_01] think I told you about my personal circumstance and so I thought about this

[00:24:10.540] [SPEAKER_01] for a while and as much as I don't want to work in there I find that if you

[00:24:15.520] [SPEAKER_01] harness the negative emotions you know and use them to do good you make a lot

[00:24:19.840] [SPEAKER_01] more could happen than you experiencing those negative emotions and so my goal is to help

[00:24:24.420] [SPEAKER_01] brain injury concussion dementia and unfortunately high performers so over the span of the past few

[00:24:31.780] [SPEAKER_01] weeks i think i've told you i've been pitching this to provincial bodies going for funding so

[00:24:37.000] [SPEAKER_01] everything from the ontario brain institute to baycrest and cabi us in a meeting to get some

[00:24:42.940] [SPEAKER_01] funding from CAVI. And so pretty much the goal is to get this into as many hands as possible,

[00:24:50.260] [SPEAKER_01] add scale in a way that helps more people open up their highways again,

[00:24:55.580] [SPEAKER_01] essentially pulling out the cotton balls, you know? Yeah. Yeah. There's going to be more

[00:25:00.800] [SPEAKER_01] studies done. Lauren's part of the business that we started, now we have a neuroscience startup,

[00:25:05.960] [SPEAKER_01] ridiculous, you know? It's officially called Path Forward. Okay. Because we're trying to

[00:25:10.700] [SPEAKER_01] cardboard for everybody you know but the cotton balls and unfortunately we're not

[00:25:16.440] [SPEAKER_01] starting with clinical even though I want to it turns out that I was born in

[00:25:23.060] [SPEAKER_01] Russia you know socialism you know Canada's semi-socialistic but even here

[00:25:28.460] [SPEAKER_01] you do need money to create change whether you like it or not and to help

[00:25:34.180] [SPEAKER_01] the public you get a lot of money so you could go through all the avenues to do

[00:25:38.400] [SPEAKER_01] it correctly which is great safeguards but in the process it slows down helping people like me

[00:25:44.800] [SPEAKER_01] like you like anybody else who you want to help and so over the next year i'm going to become

[00:25:51.580] [SPEAKER_01] the professional snake oil field i'm officially working on it already frankly um so we're gonna

[00:25:58.960] [SPEAKER_01] sell this as actually after i turn off the voicemail i'm like maybe run through this

[00:26:03.700] [SPEAKER_01] with you that essentially you're going to sell it as a one-week high impact intervention for people

[00:26:10.600] [SPEAKER_01] who are already high performers and are starting to feel the cotton balls and are sick of the

[00:26:14.840] [SPEAKER_01] cotton balls and are willing to pay pretty penny to get cutting engineering science top to line

[00:26:19.400] [SPEAKER_01] feel better fast right and get enough money there to fuel the clinical side so we can actually

[00:26:25.200] [Unknown] report that right now though we have a study that's studying for dementia in september that

[00:26:32.000] [SPEAKER_01] I'm certain of. I think we'll be doing this exact game or slightly modified for athletes

[00:26:39.820] [SPEAKER_01] underserved populations

[00:26:44.640] [SPEAKER_01] So the direction is to push this up there even more. So athletes with concussions? Not necessarily

[00:26:50.920] [SPEAKER_00] We just have a concussion data

[00:27:04.420] [SPEAKER_00] it's like playing guitar driving riding a bicycle and counting numbers all at

[00:27:13.020] [SPEAKER_02] the same time it's a good exit it's amazing exercise for the brain I mean

[00:27:18.380] [SPEAKER_01] I mean, ideally, here's my mitt and I'm going to turn off the voicemail because at this point it's getting a little personal, but there we go.

13 Appendix D: Participant Assessment Forms

Standardized Assessment Battery

The following instruments were administered at baseline and post-intervention timepoints:

- State-Trait Anxiety Inventory (STAI)
- Perceived Stress Scale (PSS)
- Short Form-36 Health Survey (SF-36)
- Dizziness Handicap Inventory (DHI)
- Rivermead Post-Concussion Symptoms Questionnaire
- Pittsburgh Sleep Quality Index (PSQI)
- Sport Concussion Assessment Tool 6 (SCAT-6; modified)
- Behavior Rating Inventory of Executive Function – Adult Version (BRIEF-A) *

**The BRIEF-A is a proprietary instrument (Roth et al., 2005) and cannot be reproduced. See citation in References.*

Daily Symptom Tracker

Participants completed a daily symptom logbook from their first baseline assessment through intervention completion. The tracker captured day-to-day symptom fluctuations and potential triggers.

Complete assessment forms and daily tracker are provided as supplementary material: [Machula_AppendixC_AssessmentMaterials.pdf](#)