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Occupational Therapy and Artificial Intelligence: A Collaborative Approach to Improve Quality of Life While Recovering from Concussion

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A Doctoral Experiential Capstone Project Final Report

Presented to the Faculty of Western New England University

In Partial Fulfillment of the Requirements for the

Entry-Level Doctorate

in

Occupational Therapy

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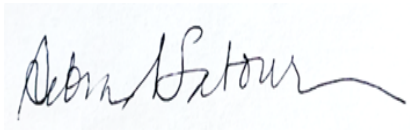

7/31/24

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Abstract

Literature surrounding occupational therapy's role with concussion management is sparse. This study aims to examine the effectiveness of occupational therapy (OT) in combination with Brainbot, an Artificial Intelligence (AI) phone application for tracking and managing post-concussive symptoms. This study is composed of qualitative and quantitative data on five individuals ages 18+ who have sustained one or multiple concussions within the past five years. The researcher administered the following through pre and post assessments: The Quality of Life Inventory (QOLI), the Sport Concussion Office Assessment Tool (SCOAT-6), and the Positive and Negative Affect Schedule (PANAS). In addition, the researcher conducted the researcher-developed Occupational Therapy Concussion Evaluation Form to assess performance skills across a variety of areas. The student also used the BEAR PAW Center (BPC) Discharge Satisfaction survey to assess the services provided post-treatment. Through pre and post assessments, weekly sessions, and utilization of Brainbot, clients were able to improve their quality of life (QOL) and develop strategies to implement into their everyday life after concussion. This study helps to describe how occupational therapy practitioners can aid individuals in returning to meaningful activities after concussion(s).

Introduction and Background

Introduction

After a person experiences a concussion, one of the most important priorities is to regain previous level of occupational engagement (Boone, Henderson, & Zenoozi, 2024).

Post-concussion, individuals may be required to significantly limit their participation in activities that once had no restrictions. According to Sheldrake et al. (2022), reduced activities associated with post-concussive state have psychosocial implications that could lead to poor mental health and well-being. Occupational therapists (OTs) have skilled expertise to to support the engagement of individuals in purposeful and meaningful activities. They play a unique role on the concussion management team to maximize and adjust to life after concussion. OTs can provide individualized and holistic treatment to address client barriers to facilitate re-engagement and participation in meaningful activities. In turn, this can increase overall well-being and optimize perceived quality of life (Andreas, Molitor, & Dubisar, 2021).

Based on the literature, it is hypothesized that those who are seeking various, consistent services in support of their concussion recovery, will report a decrease in preexisting concussion symptoms (Cottle et al., 2017). According to its website, Brainbot is a phone application that offers "innovative, safe, and effective digital tools that support concussion recovery" while using Artificial Intelligence (AI) generated insights to help people manage symptom triggers and "make informed choices about daily activities and routines" ("About Us", 2022).

The researcher held services through the BEAR PAW Center. After opening in the fall of 2022, the BPC is one of the first student-run occupational therapy pro bono clinics in the country that provides free, hands-on services under the direct supervision of licensed occupational therapists (*BEAR PAW Center,* 2024). At Western New England (WNE) University, the BPC is an essential part of the Doctor of Occupational Therapy (OTD) curriculum that allows students to apply classroom knowledge in real-world settings. All services are offered on the University's campus or virtually on Zoom to community members of the Greater Springfield community.

Background

A concussion (also referred to as a mild traumatic brain injury) is a complex pathophysiological process caused by direct or indirect impact to the head (Dolbec, 2019). Some common signs and symptoms include: headache, slowed reactions, decreased attention, irritability, sensitivity to light or noise, and difficulty with sleep. Post-concussion syndrome (PCS) is a set of symptoms that persist and do not resolve within the expected fourteen days recovery period (Finn, 2019).

Occupational therapists offer holistic, client-centered, and evidence-based approaches targeted to maximize client function. OTs provide a unique perspective on assessing, intervening, and re-evaluating functional impact to support individuals' return to daily activities and prior level of function. According to recent studies, graded, active rehabilitation is more effective than prolonged rest and isolation (Wheeler, 2021). OTs can fit into this role of recovery as they are skilled at activity analysis to facilitate graded progression (Wheeler, 2021). OT services for concussion management may include: Education to clients and families, fatigue management and relaxation strategies, sleep hygiene coaching, balance or visual exercises, and symptom tracking support (i.e. applications such as Brainbot).

AI is technology that enables computers or machines to simulate human intelligence (Xu et al., 2021). Modern advances, including healthcare, are progressively increasing. As practitioners, it is important to stay updated on the latest technology and treatments to better patients’ care and their quality of life. QOL refers to an individual’s perception of position in life in relation to their goals, expectations, and cultural context (World Health Organization. 2012). The Centers for Disease Control and Prevention (CDC) estimates that ~5.3 million Americans

experience long-term or lifelong difficulties with activities of daily living following concussion (Wheeler, 2021). Persons who experience post-concussion symptoms are at an increased risk for anxiety and depression, leading to negative implications for functioning (Finn, 2019). In addition to assessing cognition, memory, balance, and vestibular concerns, it is crucial to screen for mood disorders.

Theoretical Frameworks

Two theoretical frameworks were utilized for this study: Trauma-informed approach and Person-Environment-Occupation-Performance (PEOP) Model. A trauma-informed approach is focused on understanding and applying an appropriate response to the impact of trauma in relation to treatment. Trauma is known to have profound effects on health and may influence how one engages with healthcare services (Grossman et al., 2021). As trauma-informed providers, it is important to approach each individual with mutual respect in aims of building trustworthiness throughout sessions. This approach was the foundation for gathering past and present information for a complete and accurate picture of the individual in this study.

The PEOP Model was used for this study as it describes the transactional nature of person, environment, and occupation factors that support performance, participation, and well-being (Bass et al., 2024). This model helps to support populations and life circumstances that pertain to overall engagement. For this study, the client was the center of care in relation to their symptoms and goals. It was emphasized that each treatment session was unique and client-centered based on the individualized data provided.

Program Evaluation & Design: Logic Model

A logic model was created to communicate the evaluation and intervention process (Roelke, Jewell, & Radomski, 2022). The study's evaluation design was based on the logic model that served as a "roadmap" for inputs (ie. technology and partnership with Brainbot), outputs (ie. interventions), and outcomes (ie. client's individual goals) are conducted. This graphic depiction helped the researcher understand the connections between the program's activities and its intended effects.

Doctoral Experiential Project Overview

Methods

Five individuals, 20 to 71 years of age, with a history of concussion, participated in a mixed methods design to examine client quality of life prior to and following OT treatment while using Brainbot to track post-concussive symptoms. Assessments utilized were: Quality of Life Inventory (QOLI), Sport Concussion Office Assessment Tool (SCOAT-6), Positive and Negative Affect Schedule (PANAS), and researcher-developed Concussion Evaluation Form. The QOLI, SCOAT-6, and PANAS were structured as a pre and post model where the researcher conducted these three assessments at the beginning and end of sessions to compare effectiveness of interventions. Scores were analyzed and compared amongst individual and group outcomes.

The QOLI assesses positive mental health and happiness and yields an overall score based on the areas (ie. love, work, play) that make up quality of life. The SCOAT-6 is an extensive tool for evaluating concussion that assesses various categories including balance, memory, gait, and anxiety and sleep screenings. The PANAS is a self-report measure to assess positive and negative affect and helps to track positive and negative emotions for clients as they engage in day-to-day life. The researcher-developed Concussion Evaluation Form is a form

formulated from Amanda Hill's 2023 Driver Risk-Assessment Form that assesses history, general cognition, and alertness. The Occupational Profile was referenced throughout this form to probe questions of greater insight. The BEAR PAW Center Discharge Survey was conducted at the end of sessions to evaluate satisfaction of services. The BEAR PAW Center uses this survey for all clients regarding services provided. To ensure safety and ethical practice, the Western New England University Institutional Review Board (IRB) reviewed and approved this study (see Appendix A).

Recruitment

Participants were recruited using convenience and snowball sampling. Clients were either pre-existing clients of the BEAR PAW Center or in the Western Massachusetts area. Inclusion criteria were as follows: Age 18 years or older, fluent in English reading and writing (due to lack of an interpreter), history of a diagnosed concussion within 5 years, own or have daily access to an Android or Google phone for daily use with Brainbot application, and receive services at the BEAR PAW Center. Exclusion criteria were: Age 17 years and younger, not fluent in English reading, not owning an Android or Google smartphone, and concussion history exceeding 5+ years.

To initiate recruitment, communication flyers were dispersed on various platforms of social media, in the local community at select healthcare facilities and gyms, email, WNE University Posts, and word-of-mouth. Once contact was made, an initial evaluation was scheduled to go over history and complete assessment measures.

Table 1

Individual Participant Data

Participant	Participant Information
A	About: Female; 20 years old Goals: Improving cognition, focus, and attention; Return to higher level of activity (noncontact sports) Number of treatment sessions: 5 Utilized Brainbot: Yes
B	About: Male; 42 years old Goals: Improve quality of sleep; Discontinue sleep medication Number of treatment sessions: 6 Utilized Brainbot: Yes
C	About: Female; 29 years old Goals: Improve QOL and focus; Increase concussion knowledge; Manage symptoms Number of treatment sessions: 5 Utilized Brainbot: No
D	About: Female; 30 years old Goals: Improve activity tolerance at work; Manage vertigo symptoms Number of treatment sessions: 4 Utilized Brainbot: Yes
E	About: Female; 71 years old Goals: Increase concussion knowledge; Develop strategies for vestibular symptoms Number of treatment sessions: 6

	Utilized Brainbot: Yes

Assessment Tools

During the initial evaluation and discharge, individuals participated in quantitative and qualitative measures to collect baseline data for comparison. The QOLI, SCOAT-6, and PANAS were assessments that were completed prior to treatment (pre) and after treatment (post). Data was analyzed and scored. The researcher-developed Concussion Evaluation Form was developed by the researcher, supported by existing evidence. Clients were encouraged to respond in detail through some open-ended questions on the concussion history and expected goals. The BEAR PAW Center Discharge Satisfaction Survey was another tool utilized that BEAR PAW Center uses for all clients to gather insight to improve future services and the overall clinic. Questions were asked to gather data on overall experience, satisfaction with services and Brainbot, and how confident one feels with concussion knowledge and treatment after receiving services.

Experiential Component

The Doctoral Experiential Capstone ("DEx") involves completing fourteen weeks at a community organization that allows students to apply occupational therapy education in traditional and non-traditional settings to further the OT profession. The DEx is devised of two components: community experiential and scholarly project. The experiential component includes planned activities and daily participation that works with the population and provides services for the student's partner organization. It includes areas of the process that the student researcher created, learned, and experienced within their involvement with the site and topic.

The researcher enhanced expertise and preparedness in treating clients by completing a concussion management course through *ImPACT Applications, Inc*. Throughout this 6.5-hour course, the researcher increased knowledge with various topics including concussion clinical trajectories, vision therapy, and vestibular therapy. OT sessions were structured off of these evidence-based interventions.

The researcher provided services weekly for over a month. The researcher completed a therapy note after each client's session to summarize that date's treatment. The researcher used these records as reference to better plan and prepare for future interventions.

Depending on the client, interventions varied to accommodate each individual's goals and barriers. Interventions included: Gradual return to exercises with analysis, sleep hygiene coaching, sleep diary creation, relaxation techniques, mental health functional support, overall concussion education, strategies for gradual return to work tasks, Brainbot symptom tracking, balance exercises, and visual scanning activities.

Scholarly Component

The scholarly component involves plans for ongoing review of the literature and planned strategies for data collection and analysis. It involves the developmental process and dissemination of the research for formal advocacy to reduce gaps in care and advance the sustainability of implemented programs.

This study was submitted to the Massachusetts Association for Occupational Therapy (MAOT) Annual Conference, the American Occupational Therapy Association (AOTA) Inspire

2025 Conference, and the Toronto ABI Network Conference. The MAOT and AOTA submissions are currently pending as the Toronto ABI Network submission was recently denied.

Discussion and Recommendations

Results

The findings of this research study reveal that occupational therapy services in combination with the use of Brainbot was beneficial to all participants' mood and quality of life. Specifics are redacted due to submission for publication.

Based on the BEAR PAW Center Discharge Satisfaction Survey, 100% of the participants stated they felt more informed about their concussion status and ways to improve mental health and well-being. One participant wrote, "Lindsey really cared about improving my sleep. She worked really hard to find a solution and her personal experience with a concussion helped achieve all my personal goals." Another participant added, "Lindsey was able to use her knowledge as well as external tools to help provide me with individualized therapy sessions that helped me get back to day-to-day life without experiencing symptoms…"

Strengths

The strengths of this study included the researcher-developed Concussion Evaluation Form. As mentioned in the *Methods* section, this form gathers an extensive amount of data that can be accessed for all occupational therapists to use as reference. Individualized sessions ensured confidential, client-centered treatment to meet participant goals and needs. The student developed strong rapport each session to meet the client where they were at and to discuss what

needs to be done in order to accomplish their short-term and long-term goals. Lastly, the strengths seeked an opportunity to successfully collaborate with the Canadian-based phone app, Brainbot. Both parties benefited from this partnership to mutually collect data and treat clients affected.

Limitations

The study limitations include a small sample; thus these findings cannot be generalized to the entire population that are affected by concussions. Additional limitations include some elements that trigger current post-concussive symptoms (ie. headache or dizziness when completing visual assessments). Observed when conducting the SCOAT-6, there were sections that participants had to stop due to an adverse reaction to the assessments. Depending on sensitivity of experienced symptoms, this delayed and impacted the process.

The recruitment window was limited and possibly impacted turnout of those interested. Future research should follow up with the participants to determine long-term implication.

Recommendations

After completion of this study and seeing its effectiveness, recommendations include OT practitioners performing therapeutic services coupled with daily tracking tools (ie. Brainbot). This combination may improve PCS even years later as shown in the results. Evaluating and focusing on QOL are integral parts of an individual's recovery plan and should be included in initial evaluation and reassessed throughout sessions upon discharge. Lastly, OT curricula should

include concussion topics to spread awareness on this invisible injury. OT students should be educated on their potential role with concussions to serve future clients.

Learning Outcomes

Learning Objectives

Below are four final learning objectives related to the student's personal and professional growth throughout this project:

1. *Student will further their knowledge in concussions by investigating research-based articles to become a more competent generalist practitioner.*

   The student read and dissected various research-based articles to increase their base knowledge on concussions and OT's role. The student created an annotated bibliography with five research articles to show the comparisons and differences between the practitioners that are on the concussion management team. The student also completed an online course through ImPACT Applications Incorporation: *ImPACT Trained Occupational Therapist.*

2. *Student will enhance their time management by creating a weekly work plan and following through.*

   The student printed and created individualized forms of weekly calendars to increase time management and organization of the University's criteria. The student also took the lead of the secretary for group meetings by typing detailed notes that were shared and easily accessed through Google Drive for reference. The student additionally

was consistent with the University's time sheets that provided information on productivity for each hour of the day for the duration of fourteen weeks.

3. *Student will leverage interprofessional collaboration skills to develop relationships with all stakeholders to better inform the scope of this project and the potential impact.*

The student was in close contact with the University's Health and Well-Being Center for recruitment on clients and OT's involvement in the current concussion protocol. Unfortunately, the student was unable to establish a permanent role within the protocol at this time, however added insight and created the connection for future students taking on this study. Additionally, the student educated each client on the role of occupational therapy in relation to concussions to increase awareness and advocacy.

4. *Student will strengthen advocacy skills by disseminating doctoral work focused on concussions and quality of life to bring global change and spread awareness on this topic.*

The student's research proposal was submitted to the Massachusetts Association for Occupational Therapy Annual Conference, the American Occupational Therapy Association Inspire 2025 Conference, and the Toronto ABI Network Conference. During sessions, the student provided clients various resources (ie. holistic treatments, podcasts, etc.) tailored to that individual's concussion needs to target goals.

Additional Information

E-Portfolio

To access the student's e-portfolio please use this link:

https://sites.google.com/view/lindsey-kiltonic/home

Appendix A

IRB Approval Form

WESTERN NEW ENGLAND UNIVERSITY | WNE
COLLEGE of PHARMACY and HEALTH SCIENCES

Subgroup of the IRB & Human Subjects Committee
FWA00010736 Approval Form&

Responsible Director: _____Dr. Levine _____

Title of Project: Occupational Therapy and Artificial Intelligence: A Collaborative Approach to Improve Quality of Life Recovering from Concusion

College Proposal Number: ___COP-IRB#221

_X____ This research proposal is exempt under Federal Regulation _____*45 CFR 46.104.d.1*

It is deemed acceptable according to the Belmont Principles and the American Psychological Association's Ethical Guidelines for the Use of Human Participants for a period of one year.*

_____ This research proposal has undergone an expedited review under Federal Regulation _____. It is deemed acceptable according to the Belmont Principles and the American Psychological Association's Ethical Guidelines for the Use of Human Participants for a period of one year.*

_____ This research does not qualify for exemption or expedited review and will need to be reviewed by the entire board.

Signature__ Minna Levine
_____Date_____4/30/2024_____

Renewal requests due before ___4/30/2025_____

&Note: Authority to approve exempt or expedited research originating within the College of Pharmacy.

* Note: It is your responsibility to notify the IRB of any adverse events that occur during your research. You must also request an additional review before you introduce changes to the proposed protocol. Maintain a copy of your original application, any requested changes, and this signed approval form. You will need to submit these if you apply for a renewal.

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