

# Symptoms associated with concussion in adolescents are alleviated through use of a gamified health app.



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## Introduction

Following concussion, if cognitive rest, physical rest, and/or medication do not resolve symptoms within 3 weeks, the window for spontaneous recovery is believed to close. Persistent post-concussion symptoms pose long term implications for education, physical activity, depression, social isolation, and suicide risk<sup>1</sup>, yet medical care for resolving persistent symptoms remains relatively under-developed.



**Research Objective:** Determine the effect of using a smart phone-based application called SuperBetter (app) on persistent symptoms and depression more than 3 weeks after concussion among adolescents.

The app we studied was created by a game designer to recover from concussion (co-author McGonigal). It's interactive design incorporates:

**Positive Health** principles, under the guidance of Dr. Martin Seligman and colleagues. Positive Psychology is "the scientific study of human flourishing, and an applied approach to optimal functioning"<sup>2,3</sup>. By reframing the recovery journey as a heroic narrative, this app seeks to help individuals maintain/increase positivity in the face of life-changing health challenges such as concussion<sup>4,5</sup>.

**Gameful design** principles that seek to promote intrinsic motivation in real life through game play. By reframing recovery as a personal and "epic" win, the app utilizes gameful strategy to attempt to shift players from a threat mindset to a growth/challenge mindset<sup>5</sup>. Key to gameful designs are intangible rewards that the player chooses to assign value to.

**Social game mechanics** that invert the traditional social network approach by focusing on the quality of a small number of social connections rather than the quantity of connections. Social game mechanics require interaction between two or more people (e.g., assign a health quest in SuperBetter, share armor with a fellow player in order to jointly battle Mobzilla in Minecraft™). Social connectivity has been shown to impact human health<sup>6</sup> but has yet to be effectively incorporated within standard medical care. Social game mechanics might provide an avenue to involve the patient's existing asset (i.e., friends and family) in the recovery journey in a semi-structured, positive way.<sup>4,5</sup>

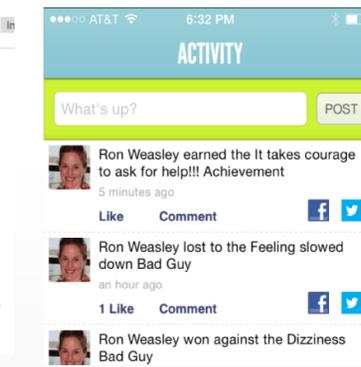
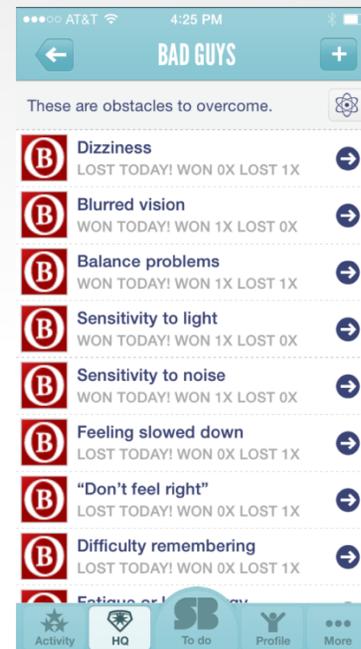
The app had been play tested by individuals without neurological injury prior to this study. Sample testimony from play testing follows: "It's HARD to ask for help when you're sick, especially if you are used to being able to take care of yourself. You fear becoming a burden, of sounding like you are constantly complaining, of running out of goodwill from your friends and family. The SuperBetter game provides a framework, through missions, that allows friends and family to have concrete, actionable ways to help me, and provides me with a way to focus on what I CAN do, instead of what I CAN'T. It lets me see, and lets loved ones see, exactly what I go through on a daily basis, and to recognize that those are, in fact, epic wins. It allows me to participate in my life and healing instead of just sitting around waiting to get better."



1. Participants loaded the app on their phones, and selected their personal goal (i.e., their *Epic Win*) while in the doctor's office. Creating a secret identity was an option but not mandatory.

2. Symptoms were represented as *bad guys* (e.g., headaches, dizziness) and things that help were represented as *power ups* (e.g., sleep, sunglasses). Participants invited *allies*, meaning their closest friends and family who were giving them support during recovery. Our research coordinator was always an ally.

3. Participants logged activity in the game *once a weekday for at least 3 weeks*. Activity consisted of any in-app action, such as reporting that a bad guy was battled (and how severe the battle was), reporting that a power up was completed, "liking" a comment from an ally, or posting a status update in the activity feed. Participants achieve *resilience points, achievements and emails* for their activity and from their allies.



## Methods

**Design:** Controlled intervention trial.

**Setting:** Outpatient concussion clinic.

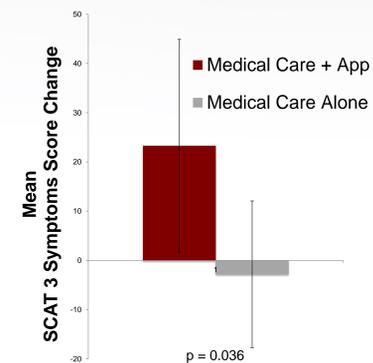
**Participants:** Sixteen adolescents (11 female/5 male; ages 13-18 years) with persistent, unresolved symptoms 3+ weeks post-concussion. Those with neurologic involvement other than concussion were excluded (e.g. chiari malformation; ADHD). The first 10 participants underwent the experimental intervention; the last 6 served as active control.

**Intervention:** All participants received standard of care for persistent concussion symptoms, including prescription medication when indicated. In addition, the experimental group interacted with the app once per weekday for at least 3 weeks and no longer than 6 weeks. Players interacted with content designed by the authors to deliver a gamefully redesigned symptoms journal.

**Outcome Measure(s):** Sports Concussion Assessment Tool-3 Symptoms score, Center for Epidemiology Studies Depression Scale for Children (CES-DC).

**Analysis:** Repeated Measures One-way MANOVA, with days elapsed between pre- and post-test as covariate.

## Results



Groups were equivalent in baseline symptoms, duration of study participation, gender distribution, and incidence of medication use. All members of the experimental group showed a positive response in symptoms while only half of the active control group improved (symptoms improvement mean±SD = 23.3±21.6 exp; -2.8±14.9 control). A group effect was evident for both symptoms and depression (p=0.036 and p= 0.012 respectively).

## Summary

- Smart phone based applications promoting health management through *social game mechanics, positivity theory, and gameful design* are feasible for use by youth with concussion to complement medical treatment.
- Standard medical management material can be delivered in gameful form through such apps.

**Author(s) Disclosures:** SuperBetter was developed under the auspices of SuperBetter, LLC and is now owned by Cherry Street Studios, both for-profit organizations. J.M. founded SuperBetter LLC and is Chief Scientific Officer of Cherry Street Studios. LWC has served as a Science Advisor to SuperBetter Labs, LLC, on a strictly *pro bono* basis. No other authors have any conflict to report. Funding was provided by NIH-NICHD SBIR grant 1R43HD075638-01A1. Thank you to Dr. Marcia Bockbrader for assistance with statistics and to Drs Jennifer A Bogner and Chelsea M. Kane for providing feedback on initial drafts of this poster.

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