Brains & Brawn: A Strategy Card Game for Muscle-Strengthening Exercises

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Abstract
Participation rates in muscle-strengthening programs are low. Exergames show promise in encouraging people to exercise, but it is difficult to build compelling games around resistance training. Games involve players making meaningful choices, but workout programs are rigidly structured, making it difficult to find opportunities for such choices. As such, most muscle-strengthening exergames have chosen between engaging gameplay and high quality exercise. To solve this issue, we have developed a muscle-strengthening card game — Brains & Brawn — that exploits and enhances player agency.

Author Keywords
Game design; agency; repetitive exercises; exergames; physical rehabilitation; muscle-strengthening; strength training; resistance training.

ACM Classification Keywords
K.8.0 [Personal Computing]: Games.

Introduction
Despite important health benefits [5], participation rates in strength training are woefully low [2]. Exergames have been proposed as a way of motivating people to perform physical exercise. There has been considerable success in the design of exergames for

Figure 1: Brains & Brawn user interface. The player has just played an AOE card on the enemy's acrobat.

cardiorespiratory exercise [1, 3, 4], in part due to a straightforward mapping of activities, such as cycling or jumping, to avatar movement in a game [3].

Developing exergames for muscle-strengthening exercises — exercises characterized by many repetitions of the same movement and typically following a workout plan or exercise prescription — has proven more challenging. Because exercise plans are rigid and players are expected to follow them as written, there is little opportunity for meaningful gameplay where players can choose between different courses of action. Consequently, designers of strength training exergames have had to choose between providing engaging and meaningful gameplay and providing quality exercise following a prescribed plan.

To resolve this tension between meaningful gameplay and quality exercise, we have developed a muscle-strengthening card game that exploits player agency. Initial playtesting with eight participants yielded encouraging results. P3 said of the game, "It's good because it integrates exercise with a game. This would be something cool that people could put in the gym."

Brains & Brawn

Brains & Brawn is a strategy card game in the genre of Hearthstone, Magic: The Gathering, or Pokémon. This genre was selected in order to match the slow and controlled pace of muscle-strengthening exercises. The player controls a team of characters with distinct abilities, playing against a similar team of AI-controlled characters. Each turn, the player plays a single card

Figure 2a: Player controlling game using gesture controls during strategy mode.

Figure 3b: Player engaged in combat (arrows flying to enemy) while exercising.

Figure 2: Example of a melee attack card in Brains & Brawn.

from their hand, allowing them to attack one or more opponents or heal one or more allies (see Figure 1). Players have a fixed number of turns to defeat their opponent by reducing all enemy characters' health to zero. The player has a hand of three face-up cards from which they can choose each turn. At the beginning of the turn, if the player has fewer than three cards in their hand, they select cards from their choice of decks of cards associated with each of their team characters. Themed around a circus, each of the player's characters specializes in a particular form of combat — e.g., the "strongman" specializes in melee combat, the "clown" specializes in spells, and the "acrobat" in healing.

In strategy card games, combat is typically resolved automatically when a card is played. In Brains and Brawn, play of a card requires the player to perform a set of exercises as displayed on the card (see Figure 2).

Brains & Brawn demonstrates four key design decisions which allow the player to make interesting choices and follow a rigidly defined workout plan.

Division into Strategy and Combat Modes
Brains & Brawn is divided into two modes of play, a strategy mode (the card game) and a combat mode (where the player attacks, heals, or casts a spell). In strategy mode, players have full agency to choose from the decks associated with their team members, and then choose a card to play (see Figure 3a). This mode allows the player to make interesting decisions in both choice of cards drawn and choice of card played.

Gameplay then enters combat mode, where the player either fights enemies or heals allies (see Figure 3b). Strategy game elements are hidden and replaced with a mirror image of the player captured from the Kinect camera (see Figure 3b). This allows the player to track their exercise performance, aiding in adjustment of form. The player carries out the exercise listed on the card they played (e.g., a set of shoulder press exercises with dumbbells.). Once the exercise set is complete, the AI team takes a turn, following which the player returns to strategy mode.

Rigged Decks Fulfill Exercise Prescription
When performing muscle-strengthening exercises under the guidance of a personal trainer or rehabilitation therapist, people are typically provided with an exercise prescription (or workout plan) that specifies the type and number of exercises to be performed. Despite their random appearance to players, the exercises associated with the cards in Brains & Brawn are predetermined to ensure that the prescription is met, necessarily limiting player agency. For example, if the player is due to

receive a "bicep curl" exercise, then no matter which deck the player draws from (strongman, tiger, etc.), the card will have "bicep curl" as its associated exercise. But, players are unaware that exercises are predetermined. This gives players an illusion of agency, while ensuring the correct number of sets of each exercise is performed over the course of the game. Players retain agency in the choice of the next exercise performed, since they may still choose which of the three cards in their hand to play next.

Combat Outcome Is Tied to Exercise Form
After playing a card, players perform the exercise that is shown on the card. The quality with which the exercise is performed determines the effectiveness of the card. Each repetition of the exercise during the set does damage or healing based on the player's form; in the card of Figure 2, poor form earns 5 points of damage versus the target enemy, while excellent form leads to 20 points of damage. Exercise form is evaluated using a Wizard of Oz design. The players are led to believe that a Microsoft Kinect sensor is evaluating form, but in fact, a kinesiologist is monitoring the player and has a separate application that sends exercise form evaluations to the game.

Damage/healing is applied after each repetition of the exercise, and visual and audio effects show the result of the action in real time. This closely binds the exercise to its gameplay consequences. Players have agency in how well they perform the exercise (players could perform the exercise quickly and poorly simply to get the exercise out of the way). But, binding the damage/healing power of each repetition of the exercise to the quality of the player's exercise form incents the player to perform it correctly.

Game Ends after a Set Number of Turns
Brains & Brawn is designed to end exactly and naturally when a prescribed set of exercises have been performed. The goal of the game is to defeat the enemy team. If the player defeats all enemies before all exercise sets are complete, players fight against a game boss, the opponent team's leader. If, instead, the AI opponent defeats the player's characters early, the player's team leader emerges, and the opponent fights against player's leader until the exercise prescription is met. If neither team has been defeated within twelve rounds, the player with the most characters remaining wins; if the players have the same number of characters remaining, the player with the highest overall health remaining wins.

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