WORD BLASTOFF:
A Physics Word Game for iOS

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Abstract
Word Blastoff *is a single-player word game app in which players are challenged to create 2 to 7 letter words from a pool of randomly-generated letters that enter the screen and gravitate towards a central black hole. With each letter that it zaps, the hole expands in size and ultimately explodes once it is too large for the screen, ending the game.*

Author Keywords
iOS; word game; physics-based game; casual game design; interface design; nonlinear gameplay; dynamic music

ACM Classification Keywords
D.2.10 Software Engineering, Design; D.2.0 Software Engineering, General

Introduction
Word Blastoff aims to capture the casual gamer audience, those who enjoy playing short games on mobile devices. As an additional goal, we strove to make the game appealing for middle school students who can use the game as an educational tool.

Technological Innovations

This application was written in Objective C over the course of three terms for our senior theses at Dartmouth College. Apple's SpriteKit framework provides a basis for drawing, animation, and physics simulation. Although this does much of the heavy lifting, Apple's code is sparsely documented and somewhat buggy. The situation improved as we developed the app; however, seemingly simple features (such as pausing the physics animation) required hacky workarounds.

Because the app was produced over nine months, we designed and programmed rapidly, testing prototypes with playtesters at each stage. Although we had several false starts and major redesigns, the evolved product is far stronger now, having been tested with players at every stage of the process. Prior to app store launch, we used the TestFlight framework to facilitate the distribution of beta versions of our app to users.

We considered performance primarily in areas where inefficiencies affected gameplay. For example, the game preloads textures and sounds to avoid jumping frames when new letters spawn or hit the black hole. We make heavy use of threading to load large resources such as textures, word lists, and sounds. Other practical considerations include giving players a good distribution of letter types, smoothly increasing difficulty (gravitation attraction to the black hole, letter speed, number of letters, etc.), and changing sound as the player's score and health change. In order to perform fast validation of submitted words, we store words in a Trie data structure — a multi-way tree that allows for very fast word lookup.

Although we spent a good deal of time balancing gameplay and creating a strong word list, the game is also designed to be remotely changeable. The major balancing aspects (level difficulty, score thresholds for unlocking new levels, and the word list) are all fetched remotely when there is a new version available on our servers. Thus, we can adjust the game (e.g. by analyzing rejected words to see if some should be added to the dictionary or increasing level difficulties) in response to data about how the app is being used — without users having to download an update from the app store. In the future, some of these adjustments may be automated.

The ability to define words spelled in the game is provided by the Wordnik API. We use this API because the local dictionary does not contain many of the words in our list. In order to provide better definitions through their API, we lemmatized our dictionary (organized it based on root words). This was accomplished through Apple's NSLinguisticTagger library, analysis of "see also" entries in Wordnik definitions, and open source word lists. The word list is organized based on rarity, so that the game can reward players for spelling uncommon words.

Word Blastoff also functions seamlessly without an Internet connection. Without internet, the app will use the local dictionary rather than the Wordnik API.

Gameplay Innovations

Word Blastoff is a new kind of physics-based word game that rejects the grid-based structure of traditional word games like *Scrabble* (and digital equivalents such as *Words With Friends*). It provides a challenging experience to players of many ages and skill levels.

The majority of word games in the App Store are spin-offs of Parker Brothers' *Scrabble* and *Boggle*, both of which have built a historical significance, nostalgia, and fan culture which originate in the physical media of their respective board games. Roughly 150 million sets of Scrabble board games have been sold worldwide and roughly one-third of American homes have a Scrabble set. This cross-media exposure provides a market advantage that allows the app equivalents of these

games to capture the older, less tech-savvy generation segment, in addition to younger tech gurus. Few apps in the word game category have taken risks to break free from these playing norms; the well-ranked spin-offs succeed in capturing the *Scrabble*/*Boggle* audiences by adding to the games features like social media integration that appeal to younger audiences[1].

These traditional apps and their spin-offs follow a gridded, square, rigidly-structured playing board. To this end, the graphics of each of these games are what architecture, art, and design scholars would call "inorganic." Inorganic shapes, such as squares, triangles, rectangles, are rarely found in nature; they are designed by humankind and are often buildings, furniture, and landscape elements, often demonstrating an aura of "control over nature." None of the graphics employed in these games are organic[3]. Organic shapes are shapes found in nature. They are rounded, serpentine; often they are asymmetrical in form. Aside from simply following the example set by Parker Brothers' *Scrabble* and *Boggle*, we could not find a specific reason as to why this design choice has consistently been made. *Word Blastoff*, on the other hand, uses rounded shapes and a circular, "gravity-free" gameplay, in which round letters move in a circular orbit around the black hole. Players have consistently commented positively on the game's design and aesthetic as one of their favorite aspects of the game.

Perhaps the most critical insight lay in the ubiquitous feeling that a good word game has the pleasant surprise of self-satisfaction. It makes the player feel as though they are intelligent as well as able to learn new words with ease. A key playing tactic which differentiates *Words With Friends* / *Scramble With Friends* from *Scrabble* / *Boggle* is the ability to blindly attempt multiple word options without punishment, a quite common and fun strategy; it feels good to discover a new word "by accident." Just as in Words With Friends and other popular word games, we wanted players to experience accidental learning. Employing a similar tactic, players of *Word Blastoff* can attempt words and rearrange letters until a word submits. Additionally, because there is no board or opponents to affect possible words, players can spell any possible word from the available letters without hindrance, thus inciting more "aha!" moments. In this same vein, at the end of the game, the player can view his performance, a list of words submitted and their definitions. Even though the game always ends by losing to the black hole, the post-game experience is one of positivity and recognition of the player's accomplishments. Additionally, from the menu screen, players can access a full analysis of their statistics, including: Best Word (highest scoring), Favorite Word (most used), Vocabulary (variety of words submitted). Players find these features highly encouraging and rewarding; per analytics, many players check their statistics multiple times per day.

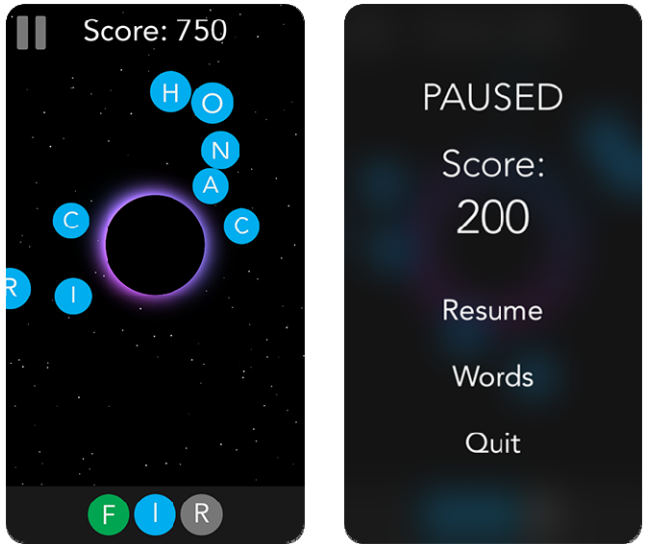

Figure 1: Typical Gameplay.

In designing *Word Blastoff*, we aimed to create a game that takes full advantage of the affordances of the phone. Unlimited by the structure of traditional word games, we can take full advantage of the touch screen — allowing players to form words quickly and efficiently. We also take advantage of several iOS specific features: players can track high scores in Game Center, and shaking the device removes all letters the player has placed on the dock. (This convention of "shaking to clear" is commonly employed by other iOS applications and is familiar to users.)

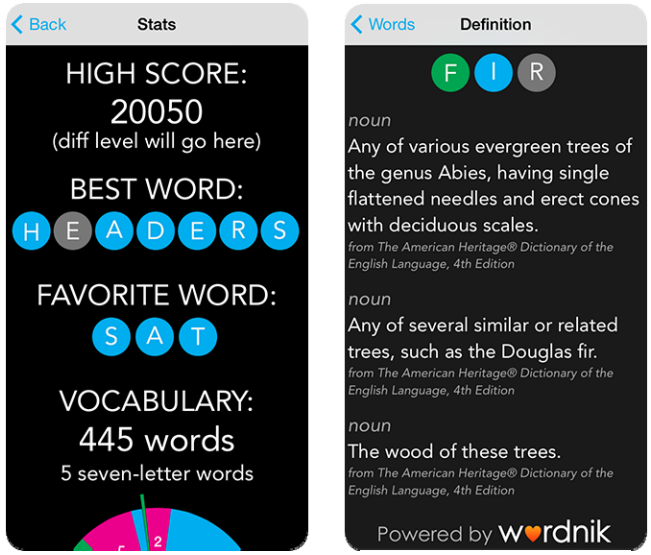

Figure 2: Statistics and Dictionary Views

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Video of Gameplay

http://youtu.be/I74wKAWd-zE

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