Ravenous

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Think you are a smart biped at the top of your food chain? Re-skin yourself in black feathers and see if you've got what it takes to survive and fly the farthest in *Ravenous*. Get from here to there, find what you need to survive, avoid predators, and show you've got the feathers to hook up with that special "somebird." *Ravenous* encourages you to engage in the virtual to uncover how the real world interplay between adaptation, natural selection, and energy influence survival. Play like a bird, be the bird.

Introduction

Think life is tough? *Ravenous* portrays "nature red in tooth and claw," through a Raven trying to find and use energy efficiently, prove its fitness, and pass on its genes to the next generation. As you look out from your starting perch (see Figure 1a), how will you take advantage of the Raven's adaptations, honed over millions of years, which allow it to meet the challenges of its environment? Can you find the sweet speed spot where flying is most efficient? Will you make the right decision when to fly versus bide your time on the ground or perch? Will you replenish your energy stores by finding and eating food that meets your needs? The game, like life, can be unforgiving if you make the wrong decisions. As George Carlin said: *"Life is tough, then you die."*

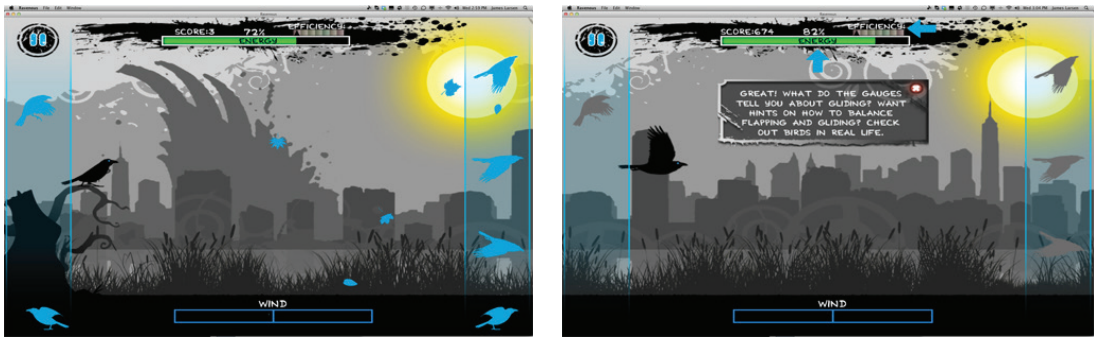

Figure 1: *Ravenous* a) Start of game and, b) Tutorial with efficiency and energy gauges

Ravenous is part of a larger suite of *Leveling Up* games—including *Quantum Spectre (QS)* and *Impulse*—being developed with support from the National Science Foundation. The focus of the work is to develop games that teens (and the general public) like to play in their free-choice time on mobile devices and the Web. They are also designed to show empirical evidence of fundamental high-school STEM content learning. The research around these games focuses on the development and validation of a set of game-based assessments using an indwelling model of tacit learning that emerges through game play (Polanyi, 1966; Thomas & Brown, 2011). Since their release, over 10,000 players have played *QS* and *Impulse*, and our research has shown that these games can improve science learning. In an implementation study with hundreds of high school students, learners who played the game *Impulse* and also had teachers who used examples from the game in class, showed higher gains on a pre/post test of Newton's laws of motion (Rowe et al., 2014).

About *Ravenous*

Ravenous is a side-scroller game, modeled after real world Ravens and specific adaptations that help them cope with the challenges of their local environment. Game play provides opportunities to uncover how these adaptations influence survival. The player controls various aspects of flight that include flying speed, gliding, ascending, descending, and landing. As the bird moves from left to right, the player must make decisions that influence the amount of energy used and available. For example, flying into a headwind or landing requires the player to realize there is a "best" strategy, just like in real life, that is based on energy cost that will impact their ability to survive and, subsequently, increase their score. As the game progresses, opportunities for replenishing energy, in the form of food, are presented that, depending on various conditions—current energy levels, difficulty of getting the food, or presence of predators—the player may or may not choose to utilize. Factors like predators, wind, thermals, or physical obstacles to avoid, which are part of the game environment, reflect real world environmental biotic and abiotic factors. The game challenges the player to uncover how the Raven's adaptations help it to use the available energy in the most efficient manner. Success is measured by earning points through distance flown before

running out of energy and dying. An added score multiplier is earned if the player has enough energy to find and mate with another bird.

The game, through a tutorial and in-game billboard "advertisements," provides hints to players on how to improve play by going outside and observing birds. In addition, bridge activities (currently under development with input from teachers) will help players extend and apply their understanding of science concepts in the game. These activities will link the game to activities and observations of birds and their energy needs as they relate to survival in the real world.

Balancing Science and Learning with Game Play

The basic design of *Ravenous* started with attempting to model in great detail actual bird flight in a 3D game with the player having precise control of the bird and its behavior. Working with experts in the field of bird flight and behavior, and studying high-speed videos of Ravens and other birds in flight, it soon became clear that a Raven flight simulator was not possible for a variety of reasons. The development shifted to something more attainable given time and money considerations, a side-scroller, and efforts centered on staying true to the science of flight and bird behavior balanced with making the game fun to play. For example, it was important to the science for the game to include the understanding that Ravens, like most birds, have adaptations that define an optimal speed where they are most efficient for long distance flight. Balancing this with fun required us to keep the focus on flying, surviving, and interacting with the more engaging challenges of the game and include unobtrusive opportunities to link learning and game play. As such, the game has an efficiency gauge that appears only when appropriate to provide a hint to help the player make the connection between actions and energy use (see Figure 1b).

Developing the game, like in nature, resulted in many tooth and claw moments. But we survived to deliver *Ravenous* for testing in the classroom—a bit bloodied but excited about releasing it in the wild!

Ravenous Research

We are using *Ravenous* to test our assumption that we will be able to measure the development of players' tacit understanding of the science concepts infused into successful game play. We expect to see that as a player hones in-game play strategies we will see improvements in understanding how the interplay of adaptations and efficient energy use are crucial to survival in Ravens, and by extension, all living things. For example, successful players, as measured by high scores for surviving longer and traveling farther, should show that they learned to take advantage of gliding rather than constant flapping, just as birds do in real life when they exhibit flap and glide strategies to minimize energy use. Data should show that the player takes advantage of flying with a tail wind or lift opportunities to save energy or avoid obstacles, and to land without crashing by positioning their wings to slow descent through stalling. We also hope to look at how connecting the game to outdoor observations improve game play as well as demonstrate application of in-game learning to understanding adaptations of birds other than Ravens.

Get Your Bird On

Ravenous extends our research, begun with the physics games *Impulse* and *Quantum Spectre*, to a more Biology infused side-scrolling game. To study players' understanding of the concepts built into *Ravenous*, we are collecting and analyzing click-data as well as screen-capture video of game play and audio and video of players' faces as they play the game as we did with other *Leveling Up* games. In addition, *Ravenous* offers an opportunity to connect the virtual to the physical world, through bridge activities, to see how observing real birds influences game play. Come play *Ravenous* to learn more!

References

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