Games for Mindfulness and Pro-Social Behavior: The Tenacity Project Collaboration

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Abstract: Educators have long been concerned with not only the development and transmission of knowledge in the classroom, but also in the social and moral development of children (c.f. Noddings, 2002). To this end, the Games+Learning+Society Center has joined in collaboration with the Center for Investigating Healthy Minds in a project called Tenacity. The work pivots around the development of two iPad games: *Tenacity*, a game cultivating the self-regulation of focused attention using breath counting; and *Crystals of Kaydor*, an RPG designed to cultivate the development of pro-social behavior through collaborative, cooperative and kind social interactions. Creating both of these games was a wonderfully rich collaborative process of connecting the practice of breath awareness & pro-social content to data-driven iterative game design. This paper provides an account of the cross-disciplinary work done in the Tenacity project to connect the power of attention, learning, and games.

Introduction

The Tenacity project is a collaboration between the Games+Learning+Society Center and the Center for Investigating Healthy Minds. With similar research interests around constructive cognition and social behavior (c.f. Steinkuehler 2006, 2008; Davidson 2003, 2012), Dr. Richard Davidson and Dr. Constance Steinkuehler led the effort to create two new videogames centered around the development of mindfulness and pro-social skills. The team engaged in iterative game design, ongoing collaboration, and frequent, early user testing, allowing for optimization of data-driven design practices throughout the project.

Tenacity's core focus was on developing and researching iPad-based tools to cultivate tenacity in 8th grade students to prepare them for high school and college success. The project supports the development of two specific games, each within a different skill domain. One game is intended to cultivate the self-regulation of attention and the other is intended to cultivate the development of pro-social behavior, particularly sensitivity to the non-verbal communication of others and skill at collaborative, cooperative and kind social interactions.

Games and Content

Mindfulness is based on the contemplative practice of breath counting. In *Tenacity*, the first game developed in the project, you practice awareness of the breath by being challenged to count a set number of breaths (five by default), again and again, for 5, 10, 15, or 20 minutes. As you play, you can choose from two different visual styles. In the first style, you casually follow a path through ancient Egypt or Ancient Greece**.** As you count your breaths, flowers will begin to grow along the path. In the second scene you can ascend into the heavens on a spiral stairway. Following the spiral stairway as it rises above the treetops, ducks and geese begin flying by. Rising higher and higher, the stairs ascend into the clouds and then into space where you can see the moon, spaceships and even other planets. As an additional motivator for accurate mindfulness practices, *Tenacity* also features an achievement system that rewards players for successfully counting their breaths without making errors, as well as resuming accurate counting after making an error.

Figure 1: Egyptian Ruins in the *Tenacity* mindfulness game

The second half of the Tenacity project is the role-playing game *Crystals of Kaydor*. The goal of *Crystals* is to support cooperative and kind social behaviors. In the game, this is primarily achieved through the interpretation and response to non-verbal emotional cues of other game characters (designed based on Ekman's facial action coding system, 2002).

In *Crystals*, the player controls a robot who has crash-landed on an alien planet. Consequently, many of its parts have been scattered across the landscape of the planet. In trying to recover the missing parts, the player encounters several different types of alien life (see Figure 4). These aliens display a range of emotions upon meeting the player, which he or she must then accurately identify (select the emotion from a number of different options) and calibrate (indicate when the emotion is high vs. low in intensity). If the player successfully accomplishes both of these tasks, they may receive quests from the alien to help them with subsequent missions. If the player is unsuccessful at either step, the alien becomes unresponsive, and the user must attempt to successfully complete both tasks again in order to receive the alien's mission. The interactions with these aliens are key to collecting all of the missing parts and returning your robot home.

Additionally, in order to progress further in the game, the player must find and destroy red crystals, which make the local flora and fauna angry and hostile. Destroying red crystals restores balance to the alien planet; gathering blue crystals powers the robot's ability to pacify aggressive animals in the environment.

Figure 2: Early level map in *Crystals of Kaydor*.

Data Collection

One advantage of working closely with game designers and programmers on a project is the ability to implement robust data tracking and collecting systems into the game itself. In the Tenacity project, this was accomplished through the use of the Assessment Data Aggregator for Gaming Environments, or ADAGE. ADAGE works through collecting clickstream data such as player input (button presses), character states (player attacked or low on energy), and cumulative experiences (overall game progression). These data can be used to identify patterns in play within and across players (using data mining and learning analytic techniques) as well as statistical methods for testing hypotheses that compare play to content models (cf. Loh, 2013; Halverson & Owen, in press). ADAGE processes can be integrated into any video game to allow for comparison of play across games and across learning environments (such as learning management systems or other forms of assessments). Design efforts like ADAGE model technology standards for transforming click-steam data into evidence for learning.

Both *Tenacity* and *Crystals of Kaydor* feature ADAGE integration, with a standardized set of data tags that capture a user's gameplay experience. The data tagging, or telemetry, system was tested extensively using groups of students attending the GLS Center or the Wisconsin Institutes for Discovery next door. An example of the telemetry system for *Tenacity* is below (see Figure 3).

Data-Driven Design

The use of ADAGE click-stream data is not limited to post-play analysis of player learning. Telemetry data acquired early on, and throughout the design process, was a vital component of user feedback and data-driven design. Jesse Schell, an iconic game designer, dedicates an entire chapter of *The Art of Game Design* to the maxim that "The Game Improves Through Iteration" (2008, p.75). Throughout the Tenacity project, player feedback and click-stream interaction data fueled informed, meaningful iterative design.

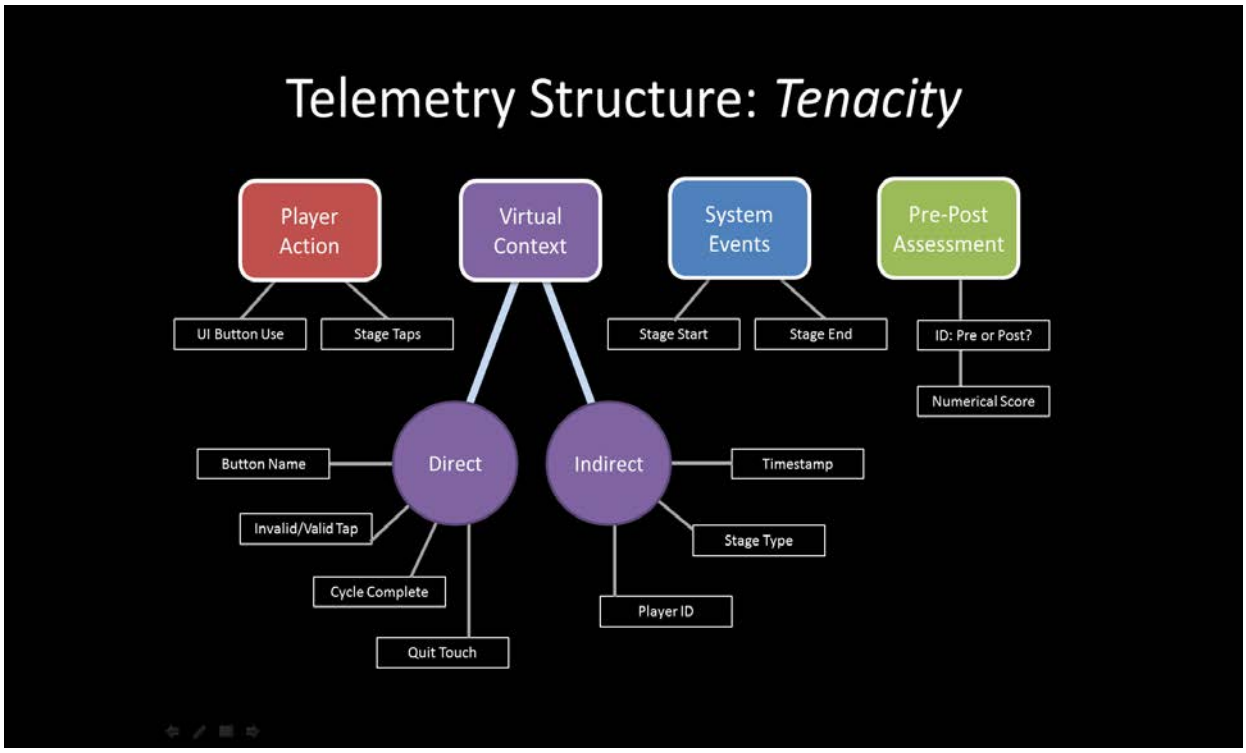

Figure 3: The structure of data tags in *Tenacity*.

One example of data-driven design centered on the non-hierarchical UI layout in *Crystals of Kaydor*. When a players first encounter an alien, they must correctly identify which emotion that alien is currently displaying. Initially, these emotion options were laid out in a 2 x 3 grid on the screen (see Figure 4). This layout was first tested with observation of user interaction, interviews with players about the matrix, and consultation with AI scholar and game designer Dr. Simon McCallum. Based on user interaction and feedback, development team members Mike Beall and Greg Vaughan set to streamlining the UI in a way that presented the choice buttons less hierarchically. The result was a radial design that served as a recurring motif in the game.

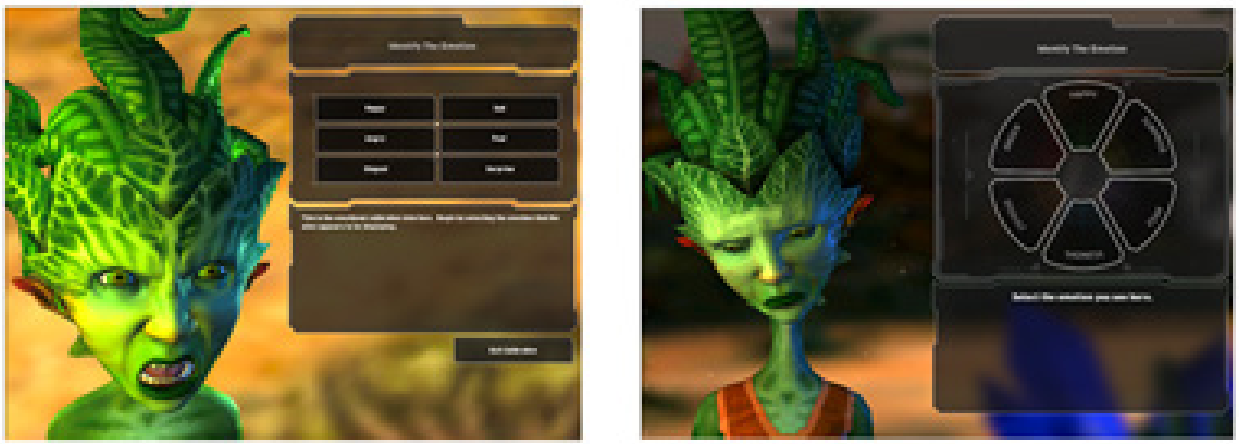

Figure 4: Emotion selection screen in *Crystals*. Left panel shows the first matrix version; the right panel shows the updated radial version.

Additionally, using data retrieved during play allows developers to tweak core game mechanics by using player feedback. For example, after selecting an emotion from the display, players then 'calibrate' that emotion using a slider. When the emotion is intense, players are instructed to move the slider up. When the emotion is not intense, players are instructed to move the slider down. A player who calibrates the emotion accurately enough can move on, but a player who does not must try again. However, for this mechanic to work, the game needs a "correct" calibration to compare player calibrations too. By having players play the game at playsquads and field trips, game developers were able to collect data on what player calibrations looked like and build a model off of those to use as the template for a "good" calibration. In this way, player calibrations were compared to those of their peers, instead

of some pre-existing and pre-defined norm of what the emotion tends to look like.

Another interesting insight from early, frequent data collection involved player interaction with the pre-post self-evaluation meter in the *Tenacity* app. Some players rated themselves on extreme parts of the spectrum, while others remained perfectly in the middle. Too perfectly – at precisely .5000 out of 1, recurring consecutively. Thinking it was more than a coincidence that over half the players repeatedly shared this perfectly balanced score, we began to think about the mechanics involved. We hypothesized that players were, in fact, not moving the slider at all -- and just hitting the continue button to skip to the next session. Observations from the next playsquad corroborated this hunch. Informed by the data, we then implemented a mechanic that required movement of the slider before continuation of the game was possible.

A similar issue was found with the tutorial level in *Tenacity*. During playsquads, many students appeared confused and lost when attempting to use the *Tenacity* app, complaining that they didn't understand what to do, or how the app worked. We used ADAGE to confirm that many players skipped the tutorial level entirely in *Tenacity*, leading to their confusion. By making the tutorial level mandatory on a player's first play-through, this issue was resolved.

Similar patterns of map selection were also detected through early data analysis. Looking into a Markov-style progression of early play in the *Tenacity* app, we discovered that the majority of players were starting on one particular map (the Greek Ruins), when all maps were possible to play. We also discovered that if players did start the Stairway map, they tended to stay on that map rather than shift to a new one (Figure 5).

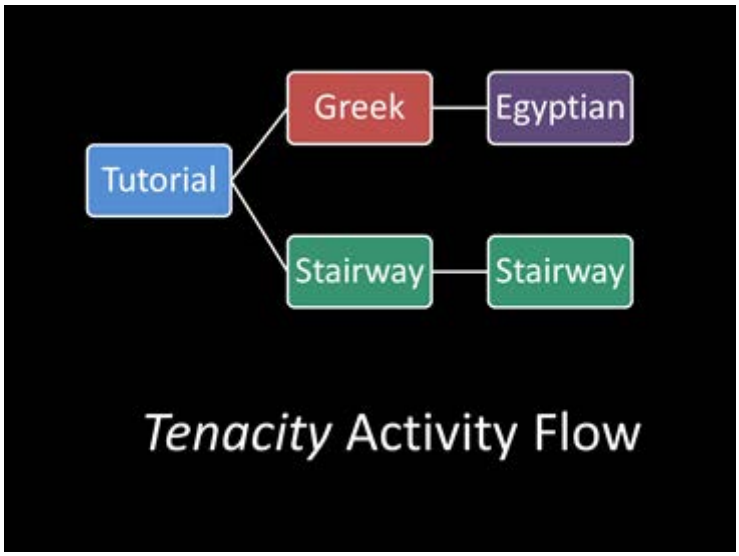

Figure 5: Activity flow for *Tenacity* level selection

We then set out to observe, in the next playsquad, why this particular pattern was happening. What we found was that there were two distinct groups in map choosing: those who figured out that there was a sidescrolling menu of map choices, and those who did not realize they had more options than the first one presented from left to right. Thus, this data led to a re-design of the map selection UI to display more of the maps at once, and in a matrix formation (rather than one horizontal sidescroll) (Figure 6).

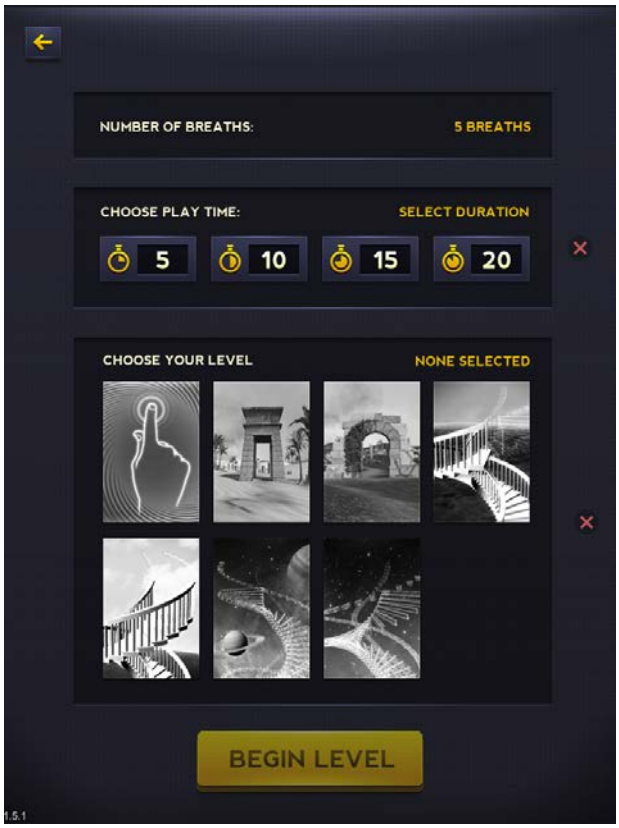

Figure 6: *Tenacity* map selection - final matrix design.

Conclusion

Overall, collaborative efforts with Dr. Steinkuehler and Dr. Davidson are supporting integrated research in the domains of digital media, learning, and neuroscience. In the successful building of the mindfulness and pro-social games, frequent team dialogue, ongoing playtesting, and data-driven design proved vital. Given extended support, we hope to build on this collaboration with future versions of *Tenacity* and *Crystals of Kaydor* for use with varying experimental design and research collaboration between GLS and CIHM.

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