Twinkle Toes: 3D-Printing as a Device for Gaming

Robert Panossian
Massachusetts Institute of Technology
Cambridge, MA 02139, USA
rpanos@mit.edu

Abstract
This paper describes an experiment that explores the notion of using the three-dimensional printer as a primary tool in game design and interaction. While fast-paced gaming has traditionally been a popular muse among audiences, nowadays, there seems to be a notable migration towards genres that explore the methodical thought-process coupled with the slowing of pace within gameplay. This project attempts to reimagine these characteristics into a game that undergoes a revealing process, where the game begins and ends when the object in question is constructed and realized. As this paper will discuss, this process triggers interesting social behaviors and interactions as participants grapple with feedback from the 3D-printer, as well as positioning themselves and their thoughts against the actions of their peers.

Author Keywords
Timer; 3D printing; ambiguity; patience; reveal; negotiation; memory; object; identity.

Timekeeping: Typical hour glass used to frame and visualize the passing of time.

Introduction

Timekeeping is one of the most important elements in game design. It can be used to frame the duration of the game, but also dictate the pace at which it is played. For the purposes of functionality, time is often manifested in the form of a user-controlled clock, today, typically in a digital format. Perhaps some of the most fascinating means for timekeeping are clocks which operate in the physical realm, such as the hour glass, where time is measured, and understood, through the transfer of sand between two chambers. This medium poses an interesting inquiry into exploring how time could assume a physical state within game design and embody sensorial and haptic qualities.

The game described in this paper explores the use of a three-dimensional printer to generate an object that through its very fabrication process, facilitates a unique gaming experience bound within the time in which it takes to reach its completion. The three-dimensional printer used in the testing of this game is a Makerbot Replicator 2, which uses a plastic-like filament called PLA that is melted and overlaid, constructing the object layer-by-layer from bottom up. The object that is being printed is randomly selected from a pool of six overall possible options and is imbued with certain visual characteristics that vary slightly from one another, which are incrementally "revealed" through the inherent layer-by-layer building process of the printer. Players (2-6) must quickly recognize and identify these geometric differences and select one of six cards, depicting through silhouette, with what they believe to be the true identity of the object being printing. The sooner this relationship is established, the greater the reward.

Figure 1: Makerbot Replicator 2, three-dimensional printer.

The game design has undergone four total rounds of testing, the two of which are deemed most successful, named *Test A* and *Test B*, will be discussed here in greater detail.

Object Logic

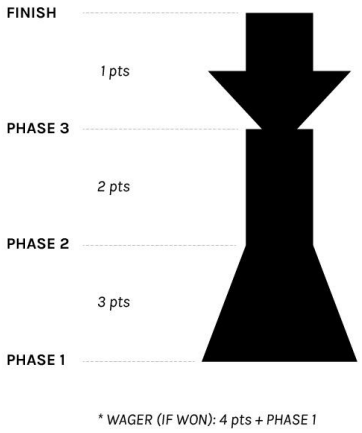

Figure 2: The game employs a point system, where the earlier a player commits to a shape, the larger the reward amount.

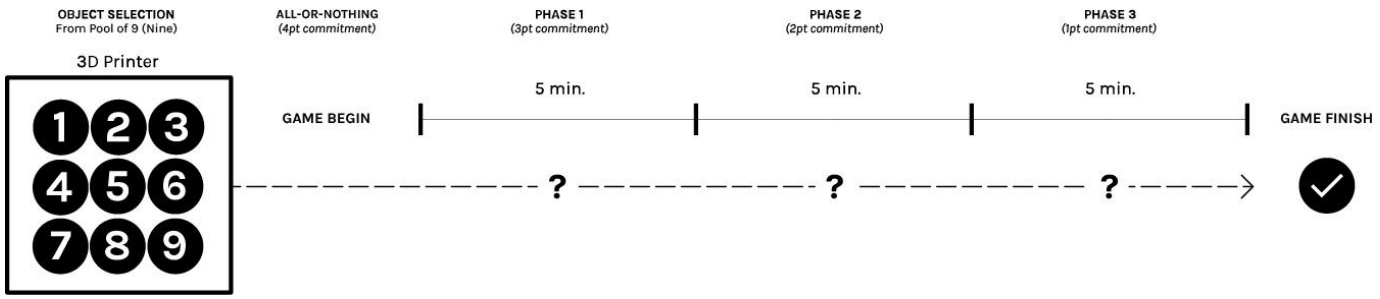

Figure 3: A game map highlighting the duration and progression of the game.

Test Data

Test A

The game begins with three players assessing cards laid in front of them depicting possible printing outcomes. Before an object is randomly selected for printing, players are granted the opportunity to participate in an all-or-nothing wager where, if correct, will be awarded four points in addition to the total points the object would have been worth. If wrong, however, player(s) are awarded no points, nor are they penalized, but only allowed to participate verbally for the duration of the round. This often results in attempts at intimidating and/or sabotaging other players during the card-committing process.

Figure 4: The family of objects (7) used in conducting Test A.

During testing conducted with three players, one player accepted the all-or-nothing wager and subsequently lost as the first phase quickly proved his selection to be incorrect. The other two players continued to discuss aloud the possible trajectory of the form being printed, while the player who committed to a losing wager earlier said things such as, "I know something you don't know…" and continuing with "they are not all the same thickness…." Of course, the objects that they were debating between had no differences in thickness, only form. In the end, one of the players quickly noticed the geometric deviation which only occurred in the last phase of printing and selected the correct card. Because this occurred in the last phase, he was rewarded one point.

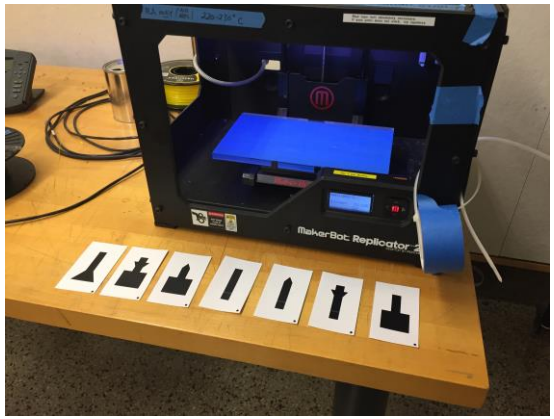

Figure 5: Cards of objects presented at beginning of Test A.

At the conclusion of play, a few player-recommended adjustments included possibly adding "notches" indicating the beginnings and ends of phases, flipping the cards after printing has begun to bring the aspect of memory into play, and to reassign the roles of players who participate in all-or-nothing wagers to take on a villain counterpart.

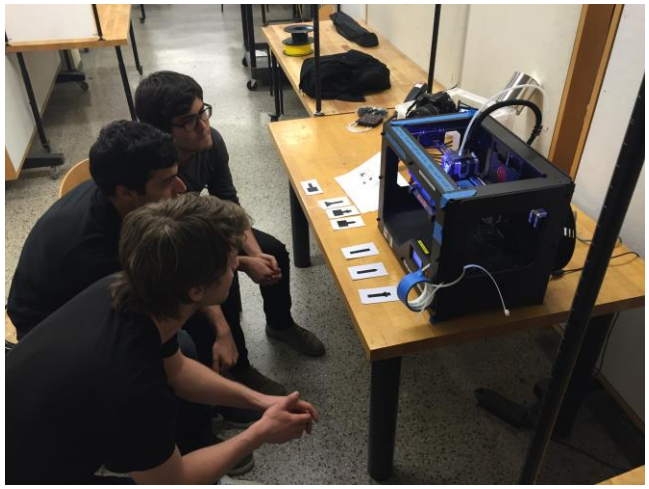

Figure 6: Players assessing the object mid-print and organizing cards accordingly.

Test B

The same mechanics apply from Test A, but with updated forms, the amendment that cards are now flipped over once printing has commenced and that players who lose in all-or-nothing wagers can still participate to choose another single card, but will not be awarded points if they are correct.

Figure 6: The family of objects (increased to 9) used in conducting Test B.

The same three players from Test A once again gathered around the printer to play the new iteration. In this round of testing, the same player from Test A again committed to the all-or-nothing wager before the cards were flipped face-down only to lose again. This did not seem as an inconvenience as the player claimed that he preferred to the game *this* way. As the printing progressed, the other two players exhibited acts of intimidation towards each other, daring one another to commit to a card during the first phase. Neither ended up committing to a card and printing continued into the second phase which saw tensions rise amongst players. While the same two players internally assessed the print, seeming to almost commit to a card, the third player (who lost in the wager) lunged forward to claim a card. The other players were caught off-guard by this action and soon after began to exhibit panic when one claimed, "I think he took the correct card, but I am not entirely sure." Just before the end of the second phase, this player selected a card, soon to be followed by the last player who figured they might still have a chance at winning. At this moment, the object has completed printing and each player has a card with which they hope to win. While all players selected cards in the second phase, only two are playing for two points while the wagerer is playing for no points (whose victory is the only way for the round to end in a draw). The cards are flipped -- it is a draw.

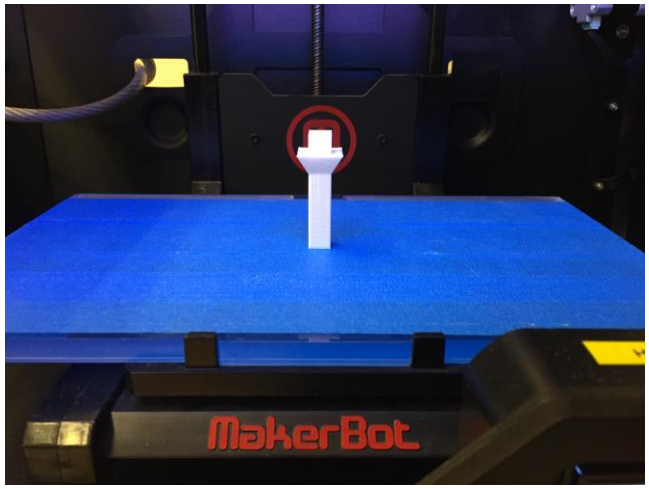

Figure 4: Final object completed at end of Phase 3 (Test A).

Findings

As testing suggests, a game that utilizes the qualities inherent to three-dimensional printer to regulate time and pace can produce interesting results. Players exhibited various emotional responses throughout the duration of gameplay, including moments of excitement, anxiety, grief, and concentration. Going forward, it would be most beneficial to test a single game in numerous rounds and not just one per design iteration. The accumulation of points by players through successive rounds could produce a different array of behaviors and tactics that would significantly alter the way in which the game is played.