Relating Designer Intent and Player Behavior through Data Analysis

Kenneth Hullett
University of Malta
kenneth.hullett@um.edu.mt

CHI'13, April 27 – May 2, 2013, Paris, France.
ACM 978-1-XXXX-XXXX-X/XX/XX.

Abstract
This paper presents a method for understanding the relationship between designer intent and observed gameplay in first-person shooter (FPS) levels. This relies on the underlying design patterns and their intended gameplay effects. Analysis of collected player data has been used to show where these cause-effect relationships hold or not.

Author Keywords
game metrics, level design, design patterns

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

General Terms
Human Factors, Measurement

Introduction
When creating a game level, the designer has an idea of the gameplay they are trying to elicit from the player. One approach to understanding designer intent is through design patterns, recurring arrangements of elements that exist across similar games. By identifying design patterns and the associated designer intent, we can provide tools to explore design space and teach about game and level design. But design patterns may not always create the intended gameplay; this paper

looks at common design patterns in single-player first-person shooter (FPS) levels and presents results from a study that explores these cause-effect relationships. Analysis of data from this study shows the player behavior that resulted, improving our understanding of the design patterns.

User Test

To test the relationships between the level design patterns and player behavior we conducted a series of user tests. For these we constructed levels that were designed explicitly using instances of the previously identified design patterns [1]. For this research we used a version of Valve's Source SDK game engine that had a modified data logging system.

Since the purpose of this study was to understand how FPS players respond to design patterns in the levels, we focused on recruiting experienced players that reflected the general demographic of FPS players. Prior to the study, each participant was asked a series of questions to gauge their experience with FPS games and digital games in general. The purpose of the survey was to justify excluding any participant with a low enough skill level to add noise their data, though all participants proved to be experienced FPS players. On average, they spent 10.4 hours per week playing games, and 47% of that time was spent playing shooter games.

To track the participants' progress through the level, an event reported player state every ½ second, capturing the player's position (X, Y, Z coordinates), their current health and armor levels, and the weapon equipped.

Since combat constitutes a major portion of the gameplay in a FPS game, we tracked all combat actions involving the player. This includes whenever the player fires a weapon, when they do damage to an enemy Non-Player Character (NPC), and when they eliminate an enemy NPC. We also tracked when the player took damage and when the player was killed. When triggered, these events get logged along with the appropriate supporting information, such as player and NPC position, damage, weapon equipped.

Metrics

In order to categorize player behavior we selected pace, tension, and challenge as the primary facets of player behavior. To study how these facets are affected by level design, we first identified what metrics affect each facet, and how the effect increases or decreases the facet.

The metrics considered in this study can be divided into three broad categories: movement, combat, and support. Movement metrics include the speed and distance of movement, as well as the player's use of cover. Combat metrics include frequency of combat actions, the distance at which they occur, accuracy, and damage done. Support metrics include the player's health and armor levels, frequency of item and weapon collection, and weapon preferences. Metrics recorded within a pattern can be compared to the metrics for similar patterns, to other patterns, or to a level overall to determine how player behavior is affected by the pattern being considered.

Pace is on how quickly the player is taking actions. How frequently the player moves, and how far they move are good metrics. For combat actions, the frequency of engagements and preference for high rate of fire weapons such as the sub-machine gun (SMG) and AR2

are indicative of pace. Weapon and Item collection frequency is also tied to pace.

Metric	High	Low
Movement Distance	Larger	Smaller
Movement Percentage	Higher	Lower
Engagement Frequency	Higher	Lower
Preference for High Rate of Fire Weapons	Increased	Decreased
Item Collection Frequency	Higher	Lower
Weapon Collection Frequency	Higher	Lower

Table 1. Metrics Affecting Pace

Tension is about the mental stress the player experiences while playing the game. When tension is high, the player is less able to form long-term strategies. A tendency to "freeze up" and reduce movement percentage is indicative of high tension. In combat engagements, accuracy would be negatively affected by tension, as well as the player's tendency to charge or retreat from enemies. In a low tension situation players are more likely to take advantage of long-range weapons.

Metric	High	Low
Movement Percentage	Lower	Higher
Distance Change During Engagement	Retreating	Closing
Accuracy	Lower	Higher
Preference for Long-Range Weapons	Decreased	Increased

Table 2. Metrics Affecting Tension

When challenge is high, players are more likely to make use of cover, whereas when challenge is lower, players feel freer to move about without fear of consequence. Player deaths, damage, the frequency they are hit by NPCs, and the distance they are hit from are all tied to challenge. In response to a challenging encounter, a player is likely to prefer more powerful weapons.

Metric	High	Low
Movement Distance	Smaller	Larger
Player Deaths	Increased	Decreased
Player Damage	Increased	Decreased
Frequency of Player Hits	Faster	Slower
Distance Player Hit from	Increased	Decreased
Preference for Powerful Weapons	Increased	Decreased

Table 3. Metrics Affecting Challenge

Data Analysis

We analyzed the collected data to draw conclusions about the effect the patterns had on player behavior. This paper summarizes study results for two of these patterns: arena and choke point. For each of these there were at least three instances of each across the four levels. We compared player behavior in a pattern to the level overall to see what deviation from the baseline was apparent.

Arena

Arenas provide a venue for large combat encounters, so the intended effect is often to increase pace, but only one pattern instance showed a clear increase. Contrasted with the other arena instances, this arena was large with light resistance and minimal cover. This suggests that decreasing the size of an arena or increasing enemy resistance will have a decreasing effect on pace. The other two instances showed an indeterminate effect on pace.

Two of the three arena instances exhibited an increase in tension, while the third was indeterminate. This suggests that rapid movement and accuracy are sacrificed in these large combat encounters as players

go on tilt to survive. Arena-2 had an indeterminate effect, and differs from the other two by being the smallest arena, suggesting that the larger the arena, the stronger the increasing effect on tension will be.

None of the three arenas had a clear effect on challenge. In most cases there was no significant increase in the key metrics associated with challenge. Even an instance with heavy resistance had minimal effects on challenge, suggesting arenas are not good patterns for regulating the challenge of a level.

Choke Point
Choke points appear to be highly effective at creating intended effects on pace. The two enemy advantage choke points exhibited a clear increase in pace, as intended, while the one player advantage choke point exhibited the intended decrease. This is consistent with the expected gameplay: in a player advantage choke point, the player must hold their ground and engage enemy NPCs as the pass through the choke point to experience the full benefit of the positional advantage.

Choke points also appear to have a decreasing effect on tension. Two of the instances were intended to increase tension but either decreased or had indeterminate effects. Both featured heavy enemy resistance and no cover, affordances thought to increase tension, but these effects were not shown by the data.

Attempts to use choke points to increase challenge led to indeterminate results in the user test levels. Neither of the two pattern instances intended to increase challenge showed a clear increase, again suggesting that heavy enemy resistance and lack of cover are not useful affordances for overcoming the general effect of choke points to reduce challenge.

Discussion
Design patterns describe common game design idioms, and express cause-effect relationships with gameplay. To further explore these patterns and their effects, this paper presents results from a user study on single player FPS level design by capturing gameplay data from experienced players. Through analysis of this data, we were able to show the actual effects of these patterns on gameplay and compare them to the intended effects

The paper shows a process for validating designer intent through data-driven analysis of player behavior. This could be used to examine different types of patterns in any game genre. The main steps in this process are to identify design patterns and their affordances, identify the key facets of gameplay and related metrics, and compare observed gameplay to the intended effects.

Biography
Kenneth Hullett is a Postdoctoral Researcher at the University of Malta's Institute of Digital Games, having recently defended his Ph.D. at the University of California, Santa Cruz. His research interests include design patterns, data analysis, player modeling, and procedural content generation.

References
[1] Hullett, K. and Whitehead, J. Design Patterns in FPS Levels. In Proceedings of the 5th International Conference on Foundations of Digital Games (FDG 2010). Monterey, California, USA. June 2010.