Establishing a New Framework to Measure Challenge, Control and Goals in Different Game Genres

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Abstract: For over 40 years, researchers investigated utilizing video games for education. Some of that research focused on the type of pedagogical content to embed in a game and how to integrate it, while others emphasized how to preserve the inherent intrinsic motivation in games. One of the many factors that could affect motivation and learning in video games is the different intrapersonal elements and attributes of games. In order to test those attributes' effects on motivation and learning we need to be able to define them and clearly establish a method for measuring them. The object of this study is to establish a framework for measuring three of these attributes, Challenge, Control and Goals, based on user perception. This framework is an initial step to establish a clear metric for measuring those attributes in five different game genres: First-Person Shooter, Racing, RPG, Arcade and Sports.

Introduction

Understanding video game design and analysis is tough, because of the distinct features of each genre (and each game for that matter). That distinctiveness makes it difficult to assess a standard for game design and evaluation that would apply to all games. A design and analysis strategy that might apply to an *RPG* game might not apply to a *Racing* game, and in some cases might not apply to another *RPG* game. In this study, we used the game player's perception of the game's features and attributes as a measurement to assess and analyze a game.

We started by breaking down intrapersonal game features and attributes into six separate classes based on previous research. We then selected a subset of those classes (Challenge, Control and Goals) and described how each class is present in video games. We generated a set of questions based on those descriptions to define our first survey. The first survey aimed at determining user experience in a generic game and not any particular genre. We used the results from that survey to establish our generic game metric for those classes.

We then used that metric and created a mapping for each of those descriptions to five commonly used game genres: *First-Person Shooter, Racing, RPG, Arcade and Sports* genres. That mapping provided us with the list of questions for our second survey. Similar to the first survey, the second survey asks about user experience but specific to each genre. We analyzed and assessed the results of the second survey to create our CCG Framework, which provides a metric for Challenge, Control and Goals in different game genres based on user perception.

In our conclusion and future works section, we discuss our upcoming studies and their relation to this research. We also recommend a few directions for future studies. For this study we used the terms game and video games interchangeably. We also refer to game attributes (defined in the next section) as attributes, features, elements, dimensions, categories or characteristics.

Game Attributes

Breaking down the game into its primary attributes is essential to analyzing the game design and experience. With respect to motivation, Malone (1980) identified three primary features: Challenge, Curiosity and Fantasy. He branched out each feature into many sub-attributes but maintained that those three are the main categories of attributes. Malone later expanded on his classification in Malone & Lepper (1987) to two categories: Intrapersonal (Challenge, Curiosity,

Control and Fantasy) and Interpersonal (Competition, Cooperation and Recognition). Alternatively, Gredler (1996) considered the Task, User, Goals and Control as the essential elements to a game. Alternatively, de Felix and Johnston (1993) divided the game structurally into Visuals, Interactions, Rules and Goals. Malone & Lepper's (1987) intrapersonal category is later expanded and defined into six different Game Dimensions in Garris et. al. (2002). Garris defined the game dimensions as follows:

- **Fantasy:** Context, themes or characters.
- **Rules/Goals:** Rules, goals and feedback.
- **Sensory Stimuli:** Visual or auditory.
- **Challenge:** Level of difficulty.
- **Mystery:** Information complexity.
- **Control:** Player's control.

While other studies exist and provide their own definitions, the Garris classification of the game attributes seemed to be the most comprehensive when it comes to expanding on previous work and providing a sound break-down of the different game features. In this study we relied on the Garris definition to provide us with a direction in obtaining our own definitions of the different game attributes.

Analyzing the Fantasy, Sensory Stimuli or Mystery elements of a game proved difficult to map into simple survey questions and since there was no existing work done on providing a metric for those dimensions, we decided to select the remaining three attributes only (shown in Table 1). Selecting only Challenge, Control and Goals does not imply that Fantasy, Sensory Stimuli and Mystery are not significant or relevant; rather they proved to be too large for the scope of this study. In fact, we highly recommend future work to tackle those attributes and provide an extension to the CCG Framework.

Attribute	Description
Challenge	The difficulty level of the game, ranging from too easy to too difficult.
Control	Answers the question, how much control does a player perceive they have over the game? Do they have many options for which direction to head or which objective to complete or are they bound to a few?
Goals	Defined by short and long term objectives. Ranging from immediate (jumping a pond, defeating an immediate threat, etc) to longer-term objectives (finishing a chapter, unlocking a weapon, etc).

Table 1: Intrapersonal Game Attributes

Challenge

Challenge is simply defined as the difficulty level of a game. If the game is too difficult, then the players will be frustrated with the game-play which brings down their enjoyment level. If the game is too easy, then the players will be bored with their experience, again bringing down the enjoyment level. Grey et al. (2011) argued that "challenge must be balanced and re-balanced perfectly in order to achieve and maintain flow and the motivation it provides."

That "flow" is often difficult to achieve. Piselli et. al. (2006) argued that his results show that players should only win by a small margin and when that margin becomes larger, their in-game enjoyment levels decrease. Of course setting up a game that is not too difficult and not too easy might not be as simple as it sounds because that depends largely on the player's game experience, abilities, and frequency of playing this particular game.

For this study, we considered the difficulty of a game to be directly proportional to the number of attempts the user makes to finish a task in the game. ("Task" is used here to describe a subset of the game: a level, a fight, a race, a match, or any significant objective.) We deemed a game difficult if users fail to complete the tasks in that game repeatedly and feel frustrated. In contrast, we deemed a game easy if the tasks in a game are finished easily without requiring repeated attempts.

Control
Control has many interpretations. Malone & Lepper (1987) argued Control is synonymous with self-determination and cited DeCharms (1968) that it is "a basic human tendency to seek to control one's environment" and control your "actions and choices." They also argued that it is "the perception of control, rather than the objective level of actual control, that is the important psychological variable of interest." Garris et. al. (2002) defined Control as "the ability to regulate, direct or command something" and he argued that when players are allowed to choose between strategies and directions and make their own decision that will directly affect the outcome of the game, it gives them a sense of "personal control."

For this study we defined control as the choice between directions and objectives presented to the user at any given time. Increased control implies a greater number of choices of directions that could change the flow of the game and of the ordering or prioritizing of objectives to be accomplished in the game.

Goals
We considered Goals in games as the set of objectives required by the game for the user to finish a task. Goals are a bit problematic to clearly distinguish because of overlap with other attributes, primarily Control, Mystery and Challenge. Garris et al. (2002) argued that "clear and specific goals" lead to "greater attention and motivation." For this study we distinguished short-term goals and long-term goals. Short-term goals refer to the more immediate objectives or as in Malone & Lepper's (1987) terminology, "proximal goals."

Short-term goals can be distinguished from Control objectives because they are usually user-defined where Control objectives are often explicitly stated and provide an option to the user to choose from a list. An example of a short-term goal in a *First-Person Shooter* game is "overpower the sleeping guard and do it quietly so I don't alert any other guards and have them raise the alarm." Examples of Control Objectives in *First-Person Shooter* are "kill the guards," "don't get caught" and "detonate an explosive."

Long-term goals are usually defined on a different scale. They are widely considered as the ultimate objectives of a task. In a *First-Person Shooter* genre, a long-term goal could be to finish the level, while in an *RPG* genre the long-term goal could be killing the boss. In this study we considered long-term goals to be the union or result of all the short-term goals and Control Objectives.

First Survey: Providing a Metric for a Generic Game
Using the definitions for the game attributes we listed in the previous section, we formulated a survey questionnaire to determine user perception of those attributes for a generic game. The survey questions (shown in Table 2) were intended to distinguish user experience in good games versus bad games and identify how each experience is translated in terms of Challenge, Control and Goals. It is important to note that terms like "hard," "easy," "good" and "fair" were defined to the participants as their perception of the game. The results here are not intended to be viewed universally, rather they only reflect the perception of experienced gamers.

We also asked the participants some demographic questions to give us data on their age, gender, education, game-play frequency and overall experience. For this study, we only considered results from players who play video games three or more hours a week to ensure

integrity of the data. Players who do not play video games often will have different scales of optimal Challenge, Control and Goals and might lack accuracy of perception if it has been a while since they last played video games. The survey invitation was sent to six mailing lists for video game academics.

Number	Type	Question	Options
1	Challenge	In a "hard" game, how many tries does it take to finish an average level? We understand some levels are harder than others, that is why we want your average.	(1-15+)
2	Challenge	In a "easy" game, how many tries does it take to finish an average level? We understand some levels are harder than others, that is why we want your average.	(1-15+)
3	Challenge	In a "fair" game, how many tries does it take to finish an average level? We understand some levels are harder than others, that is why we want your average.	(1-15+)
4	Control	In a "good" game, what is the ideal number of directions should you be able to choose from in at any given time? Choosing a certain direction means changing the flow of the game, like going down the flowerpot tunnel in Super Mario or choosing one path over another in Zelda.	(1-15+)
5	Control	In a "good" game, what is the ideal number of objectives should you be able to choose from at any given time? Objectives are the list of tasks you need to achieve in order to complete a level or the game like retrieving an item, killing an enemy, winning a race, etc.	(0-15+)
6	Goal	In a "good" game, how many short-term goals should you have at any given time? (like jumping a pond or killing an immediate enemy)?	(0-15+)
7	Goal	In a "good" game, how many long-term goals should you have at any given time? (Like finishing a chapter or unlocking a much sought after weapon)?	(0-15+)

Table 2: First Survey Questions

Results
We published the survey for one week and during that week and we received 87 responses. While there were a number of outliers in our result set, the data was very informative.
Out of the 87 respondents, 94% of survey takers said they play video games three or more hours a week and 100% of them said they have played video games for five or more years. 68% of our survey takers had at least a Bachelor's degree where 100% have finished high school. 72% of the respondents were male and 87% of them were between the ages of 18 and 40. Here are some of our findings:

- Challenge: 86.2% of respondents felt that an optimally challenging game should take a player 2-5 attempts to finish a level of a generic game.
- Control (Directions): 82.8% of respondents felt that a good game allows the user to choose between 2-5 directions at any given time.
- Control (Objectives): 74.7% of respondents felt that a good game allows the user to choose between 3-5 objectives at any given time.
- Goals (Short-Term): 63.2% of respondents felt that a good game provides its users with 2-6 short-term goals at any given time.

- Goals (Long-Term): 49.4% of respondents felt that a good game provides its users with 2-6 long-term goals at any given time.

It is clear that the data is less informative with regards to the Goals attribute but still favors the observations above. It is also important to note that 17.2% of users felt that a good game provides 15 or more long-term goals at any given time. That discrepancy could be attributed to the varying opinions on game experiences.

Based on the result set, we created an initial CCG Framework that is applicable to a generic game and not specific genres (shown in Table 3). Since there was no overwhelming value for any of the attributes based on user perception, we chose a 3 or 4 value range that covers the maximum total value.

Attribute	Questions	Legend
Challenge	1. On average, how many tries does it take you to finish a level?	2-5
Control	1. On average, how many objectives were you able to choose from at a given time?	3-5
	2. On average, how many directions were you able to choose from at a given time?	2-5
Goals	1. On average, how many short-term goals did you have at any given time (like jumping a pond or defeating an immediate enemy)?	2-6
	2. On average, how many long-term goals did you have at any given time (like finishing a chapter, or unlocking a sought-after weapon)?	2-6

Table 3: Generic CCG Framework

Second Survey: Mapping the Metric to Specific Genres

After determining our generic CCG Framework, we formulated the second survey to expand on the CCG Framework for these five genres: *First-Person Shooter, Racing, RPG, Arcade* and *Sports*. There doesn't exist a standard of game genre classification but previous work does have overlapping definitions. Laird & van Lent (2001) used Action, Role Playing, Adventure, Strategy Games, God Games, Team Sports and Individual Sports for their study while Apperley (2006) contended that Simulation, Strategy, Action and Role Playing are the main defining genres.

Our list is not conclusive but does seem to cover a wide variety of the genre spectrum. However, we do not presume that other genres do not exist or are not significant, just that they are outside of the scope of this study. We encourage further study to cover other genres beyond the five we cover here.

For the second survey questions, we mapped our first study questions into the five genres. We also removed the "hard" and "easy" challenge questions, because at this point we are only concerned with optimal games and previous survey data was not very informative for "hard" and "easy" games. The survey invitation was mailed to the same mailing lists as the first survey. We have 25 survey questions for the second study that substitute level for race (in Racing genres), solo boss fight (in RPG genres), a game segment (for Sports genres) and we used level for both First Person Shooter and Arcade genres. We also included the same demographic questions from the first study.

Results

Similar to the first survey, we published the second survey for a week, during which we received 77 responses. For most of the genres, user perception was very similar to the generic game in the first survey, with some small differences.

Out of the 77 respondents, 75.3% were male, 100% between the age of 18-63 and 89.6% with a college degree. Only 1 of the 77 survey takers plays video games less than 3 hours a week and only 3 have been playing video games for less than 5 years. Here are the key observations:

- Challenge: 80.5% of users suggested that *First-Person Shooter* games take 2-5 attempts per an average level. Similarly, 80.5% answered 2-5 attempts to finish in a top 3 of a race in a *Racing* game. 96.1% of the users answered that finishing an average boss fight in an *RPG* game takes 1-5 attempts, while 89.6% say the same about finishing a game segment in a *Sports* game. Finally, 84.4% claim that an average level in an *Arcade* game takes 2-5 attempts.
- Control (Directions): 92.2% say that *First-Person Shooter* games give the option between 1-5 directions at any given time. In a *Racing* game, 84.4% of users suggest that a player always has the choice between 2-5 directions. That number drops to 72.7% for an *RPG* game. 79.2% said the same about *Sports* games. 81.8% also said the same about *Arcade* games.
- Control (Objectives): Having 2-5 objectives at any given time was supported by 93.5% for *First-Person Shooter* games and 85.7% for *RPG* games. However, the percentage of users that claimed 1-5 objectives at any given time for a *Racing* game was 93.5%, a *Sports* game was 89.4%, and an *Arcade* game was 93.5%.
- Goals (Short-term): For *First-Person Shooter* games, 85.7 % of users suggested that a player always has 1-6 short-term goals. That number goes up to 88.3% for *Racing* games. Similarly, 79.2% say the same about *Sports* games and 85.7% about *Arcade* games. 75.1% say 2-5 short-term goals are available to a player at any given time in an *RPG* game.
- Goals (Long-term): 75.3% claim *First-Person Shooter* and *Racing* games provide 1-5 long-term goals at any given time. That number drops to 71.4% for *RPG* games, at 80.5% for *Sports* games and finally at 87.0% for *Arcade* games.

Number of	FPS	Racing	RPG	Sports	Arcade
Attempts	2-5 in a level (80.5%)	2-5 (top 3) in a race (80.5%)	1-5 in a boss fight (96.1%)	1-5 in a segment (89.6%)	2-5 in a level (84.4%)
Objectives	2-5 (93.5%)	1-5 (93.5%)	2-5 (85.7%)	1-5 (89.4%)	1-5 (93.5%)
Directions	1-5 (92.2%)	2-5 (84.4%)	2-5 (72.7%)	2-5 (79.2%)	2-5 (81.8%)
Short-term Goals	1-6 (85.7%)	1-6 (75.1%)	2-5 (80.5%)	1-6 (79.2%)	1-6 (85.7%)
Long-term Goals	1-5 (75.3%)	1-5 (75.3%)	1-5 (71.4%)	1-5 (80.5%)	1-5 (87.0%)

Table 4: Genre-Based CCG Framework

CCG Framework

Using the second survey results, we have compiled our CCG Framework (shown in Table 4). The CCG Framework focuses on a 3-5 value range which maximizes the number of responses. This Framework can be served as a tool to measure experienced gamers perception about Challenge, Control and Goals in an optimal game for those genres.

Future Work

This study is the first of its kind to measure user perception for Challenge, Control and Goals for optimal games. We argued that the end result, the CCG Framework, will help researchers and designers to measure user perception in a quantitative manner but it does not mean there is no room for improvement. One expansion on the CCG Framework could cover the other three attributes we identified from the literature (Fantasy, Mystery and Sensory Stimuli). Another expansion can cover the interpersonal attributes not examined within the scope of this study, like Cooperation, Collaboration and Competition.

Future studies can also test user perception immediately after game-play by comparing the CCG Framework at empirical data from a user study, two such studies are underwa. One study is aimed to test the Challenge parameter of the CCG Framework in an educational game called "Policy World." Another such study is to empirically verify the CCG Framework with data based on user perception immediately after game-play for all five genres.

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