Revisiting the GameFlow Model with Detailed Heuristics

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Abstract

The GameFlow model strives to be a general model of player enjoyment, applicable to all game genres and platforms. Derived from a general set of heuristics for creating enjoyable player experiences, the GameFlow model has been widely used in evaluating many types of games, as well as non-game applications. However, we recognize that more specific, low-level, and implementable criteria are potentially more useful for designing and evaluating video games. Consequently, the research reported in this paper aims to provide detailed heuristics for designing and evaluating one specific game genre, real-time strategy games. In order to develop these heuristics, we conducted a grounded theoretical analysis on a set of professional game reviews and structured the resulting heuristics using the GameFlow model. A selection of the resulting 165 heuristics are presented in this paper and discussed with respect to key evaluations of the GameFlow model.

Introduction

GameFlow (Sweetser & Wyeth, 2005) is a model of player enjoyment, comprised of a set of criteria derived from games user experience literature and structured into eight elements that can be mapped to Csikszentmihalyi's (1990) concept of flow. Since the original publication of the GameFlow model (Sweetser & Wyeth, 2005), it has seen extensive use throughout the games research and development communities, as well as a number of related areas. Several additional models have been derived from the original GameFlow model, such as EGameFlow (Fu, Su & Yu, 2009) and Pervasive GameFlow (Jegers, 2007). The GameFlow model has been used to evaluate a variety of games and applications, including mobile games (e.g., Omar & Ali, 2011), educational games (e.g., Brown, Ceccarini & Eisenhower, 2007), virtual/augmented/mixed reality games (e.g., Khoo, Cheok, Nguyen & Pan, 2008), as well as non-game applications (e.g., Faber & van den Hoven, 2011).

The GameFlow model has been extensively evaluated in the literature. Researchers have discussed and examined the GameFlow model's connection to flow (Cowley, Charles, Black & Hickey, 2008; Poels, de Kort & Ijsselsteijn, 2007), the inclusion of the Social Interaction element (Cowley et al., 2008), and the conceptualisation and measurement of immersion (Bleumers, Jacobs & Lier, 2010; Ijsselsteijn, de Kort, Poels, Jurgelionis & Bellotti, 2007; Tijs, 2006). Previous research has also suggested that it would be useful to indicate what could promote or inhibit the various GameFlow elements, particularly immersion, in video games (Bleumers, Jacobs & Lier, 2010).

In a preliminary application of the GameFlow model (Sweetser & Wyeth, 2005), two real-time strategy (RTS) games, one high-rating and one low-rating, were evaluated with the GameFlow criteria, to provide insight into how the criteria manifest in RTS games, what makes RTS games enjoyable, and the relative importance of each GameFlow element to RTS games. The result was a set of insights into how GameFlow presents in RTS games. However, in order to provide actionable heuristics for design and evaluation, a more detailed and specific set of guidelines need to be created. Consequently, in this study, we have aimed to generate a detailed set of heuristics specifically for designing and evaluating RTS games. In order to do this, we conducted a grounded theoretical analysis on a set of professional game reviews and structured the resulting heuristics using the GameFlow elements. A selection of the resulting 165 heuristics are presented in this paper and discussed with respect to key evaluations of the GameFlow model, including social interaction, immersion, group versus individual experience, and challenge versus player skills.

GameFlow

Sweetser and Wyeth (2005) conducted a comprehensive review of the literature on usability and user-experience in games to determine the key elements of player enjoyment in video games. The result was the identification of eight core elements of player enjoyment in games – concentration, challenge, skills, control, clear goals, feedback, immersion, and social interaction. It was observed that these core elements overlapped closely with the elements of flow (Csikszentmihalyi, 1990) and

subsequently the core elements of player enjoyment were mapped to the elements of flow. The resulting structure, based on flow, formed the foundation of Sweetser and Wyeth's (2005) model of player enjoyment in games, called GameFlow.

The first element of flow, a task that can be completed, is not represented directly in the GameFlow elements, since it is the game itself. The remaining GameFlow elements are all closely interrelated and interdependent. In summary, games must keep the player's concentration through a high workload, with tasks that are sufficiently challenging to be enjoyable. The challenging tasks must match the player's skill level, the tasks must have clear goals so that the player can complete the tasks, and the player must receive feedback on progress towards completing the tasks. If the tasks match the player's skill level and have clear goals and feedback, then the player will feel a sense of control over the task. The resulting feeling for the player is total immersion or absorption in the game, which causes the player to lose awareness of everyday life, concern for themselves, and alters their sense of time. The final element of player enjoyment, social interaction, does not map to the elements of flow, but is highly featured in the literature on user-experience in games. People play games to interact with other people, regardless of the task, and will even play games they do not like or even when they don't like games at all (Sweetser & Wyeth, 2005; de Kort & Ijsselsteijn, 2008; Bond & Beale, 2009). Recent research conducted with a large Australian sample shows that 70% of people who play games enjoy doing so with others (Brand, 2012).

Each element of the GameFlow model consists of an overall goal and a set of central criteria that can be used to design and evaluate games with respect to player enjoyment (see Sweetser and Wyeth (2005) for the full model). In the original research, expert reviews of two RTS games were conducted with the GameFlow criteria to investigate the utility and validity of the GameFlow model in designing and evaluating games with respect to player enjoyment (Sweetser & Wyeth, 2005). From these expert reviews, it was concluded that some of the criteria are more relevant to different types of games and that some of the criteria are difficult to evaluate via expert review and require player testing. It was also suggested that the GameFlow model, in its original form, was suitable as a set of heuristics for conducting expert reviews, but that it would require further development to be used as an evaluation tool.

Social Interaction

It has been suggested that the Social Interaction element does not belong in a model of flow, as it is implicit in "the task" that is undertaken, as well as not being desirable in every game (Cowley et al., 2008). While GameFlow is often referred to as a model of flow in games (Cowley et al., 2008; Poels et al., 2007; Tychsen, 2008), strictly speaking, it is a model of enjoyment in games that incorporates flow. Though the concepts of flow and enjoyment are similar, and often used interchangeably in the games literature, we believe that this is an important distinction to make. The GameFlow model is based on the assumption that enjoyment is a broader concept than flow, which is an assumption that is supported in the player experience literature (Poels et al., 2007).

There is substantial support in the literature for the centrality of Social Interaction as an element of player enjoyment (de Kort & Ijsselsteijn, 2008; Bond & Beale, 2009). Players will engage in and enjoy games socially, even if they would not play or enjoy the same games as a solo experience (Sweetser & Wyeth, 2005). Additionally, not all of the GameFlow criteria need to be achieved for a game to be enjoyable and not all of the criteria are appropriate to all games or players. Consequently, Social Interaction remains a GameFlow element, despite the fact that it is unlikely to be experienced by every player during every play session for all games.

Evaluation Immersion

One key issue with the GameFlow model in its current form is that some criteria in the Immersion element are difficult to assess (Sweetser & Wyeth, 2005; Bleumers et al., 2010), as they are attributes of the player experience, rather than the game. The definition and classification of the Immersion element and criteria have also been brought into question. Criticism include that the Immersion element is defined as the characteristic flow experience (Ijsselsteijn et al., 2007), that the GameFlow model considers Immersion to be on the same level as the other elements (Tijs, 2006), and that it would be more useful to show how the elements are related (Bleumers et al., 2010).

From a design and evaluation perspective it might be more useful to identify game elements that promote or inhibit Immersion, rather than describing what the player should experience (Bleumers et al., 2010). While Sweetser and Wyeth (2005) suggested that immersive games draw players into the game through elements such as audio and narrative, there are many ways in which games can create an immersive experience. The effect of game elements on a player's state seem likely to vary by game type. Identifying these elements and the influence that they have on the player experience is a focus of our current research.

Groups versus Individual Experience

The GameFlow model focuses on the individual experience, as opposed to the group experience. However, elements such as Challenge and Control can vary considerably in a group situation. In particular, it has been suggested that the Challenge criteria do not accommodate cooperative situations and that GameFlow focuses on individual, rather than group, control (Bleumers et al., 2010). The GameFlow model is designed to model an individual player's enjoyment. However, we agree with the suggestions made by Bleumers et al. (2010) and intend that the majority of the criteria should be flexible enough to support individual or multiplayer games.

Player Skills and Challenge

Bleumers et al. (2010) suggested the division between the Player Skills and Challenge criteria in the GameFlow model is artificial. These elements are tightly intertwined and interrelated, as one of the key precursors to an enjoyable (and flow) experience is a match between skills and challenge. While the self-report flow scale used by Csikszentmihalyi (1990) measures perceived skills and challenge with single items, recent research has highlighted the need to consider these concepts

separately. This distinction is important as the extent to which challenge and skill are related to each other differs from person to person (Engeser & Rheinberg, 2008). The division between these elements in the GameFlow model is that the Player Skills criteria relate to supporting the player in developing skills, whereas the Challenge criteria relate to providing the player with appropriate challenges.

Detailed Heuristics for RTS Games

In order to validate and further extend the findings of the original paper (Sweetser & Wyeth, 2005), we conducted a grounded theoretical analysis on a set of professional game reviews and structured the resulting heuristics using the GameFlow elements. Previous research has involved conducting grounded theoretical analyses on game reviews to develop models of the play experience of video games. A grounded theoretical analysis of game reviews was conducted to characterise good and bad games (Bond & Beale, 2009), using reviews from GameSpot UK (2011). Similarly, grounded theory was used to analyse game reviews as data, alongside interviews, to construct the Core Elements of the Gaming Experience (CEGE) model (Calvillo-Gámez, Cairns & Cox, 2010). According to Calvillo-Gámez et al., game reviews are appropriate for analysing as data to capture the play experience because:

Game reviews are aimed at telling the general player the reasons that certain games should be played. They do not tell the ending of the game, but just try to describe what it is like to be playing. Game reviews, in some sense, convey the experience of playing video-games. (p. 54)

In our study, four RTS games, which were comparable in platform (PC), genre (fantasy), and technology/year of release (2002-2003), were selected for analysis. The main difference between the selected games was their review scores, as indicated by their aggregate professional review scores on the website Metacritic (2011). Two high scoring and two lower scoring games were selected for analysis. The selected games, along with year of release and Metacritic (2011) aggregate review score were:

- WarCraft III: released 2002, aggregate score 92% based on 40 professional reviews;
- Age of Mythology: released 2002, aggregate score 89% based on 31 professional reviews;
- The Lord of the Rings: War of the Ring: released 2003, aggregate score 67% based on 25 professional reviews.
- Lords of EverQuest: released 2003, aggregate score 62% based on 25 professional reviews.

For each game, 10 professional reviews were analysed, drawn from key game critic websites and magazines (see Table 1). Each distinct comment in each review was coded into content categories (e.g., campaign, missions, races) using grounded theoretic analysis. An initial set of heuristics was extracted for each content category. Each heuristic was then coded into GameFlow elements (e.g., Control, Challenge, Immersion). Both positive and negative comments were coded and incorporated into the heuristics. Positive comments (i.e., game strengths) were added as a heuristic and negative comments (i.e., game weaknesses) were reversed and added. The

resulting initial set of heuristics for all games was compiled into a single list, sorted by GameFlow element and then content category. A second iteration was then conducted on the combined list of heuristics, in which redundancies were removed and remaining heuristics were combined and refined. Finally, the list was examined by three games design and evaluation experts and further refined. The full list of 165 heuristics can be found in Sweetser, Johnson, Wyeth, and Ozdowska (2012).

Table 1.
Professional Review Sources for Selected Games

Professional Review Sources by Game	
WarCraft III	GameSpy, GameSpot, IGN, PC Gamer, UGO, The Next Level, GameRankings, Cinescape Online, Game Chronicles Magazine, GameBlitz
Age of Mythology	IGN, GameSpy, GameSpot, GamePro, Avault, PC Zone, Game Planet, Game Zone, GameBiz, Game Blitz
The Lord of the Rings: War of the Ring	Gamespy, GameSpot, IGN, GamePro, Worth Playing, Game Raiders, Game Over Online, 3D Avenue, Game Revolution, Game Zone
Lords of EverQuest	IGN, Gamespy, GameSpot, GamePro, Worth Playing, Gaming Illustrated, Game Revolution, Videogame City, PC Gameworld, Game Zone

Examining the GameFlow Elements

Our grounded theoretical analysis resulted in 165 heuristics for designing and evaluating RTS games. In this section, we report the heuristics that relate to the key issues of the GameFlow model, including heuristics for social interaction, immersion, player skills, and challenge. The full list of 165 heuristics, including those for concentration, control, clear goals, and feedback can be found in Sweetser et al. (2012).

Social Interaction

The importance of social interaction as an element of enjoyment in games was reinforced by the grounded theoretical analysis. The analysis resulted in 12 heuristics for the GameFlow element of Social Interaction, which fell into the content categories of: multiplayer, help, and editor (see Table 2).

Table 2.
Heuristics for Social Interaction

Multiplayer

- The game should provide an online service for playing multiplayer games
- The game should make it easy to connect to multiplayer games and start playing
- The online server should match opponents automatically based on skill level or game-type preference

- Teams of players should be able to play against other teams
- The online server should include features such as rank ladders, auto-handicap, ladder statistics, a chat client, and facilities for tracking friends
- The online play mode should be integrated into the game
- The online server should run smoothly and stably
- The game should include multiplayer support in-game, such as the ability to vote on the course of action if one player drops out and the ability to talk to other players
- The game should support cooperative gaming, so that players can effectively play as a team (e.g., the ability to build walled-in cities next to each other)
- Multiplayer games should require team work to achieve victory

Help

- Players should be able to record matches to replay them to recount the events of the game and learn from their previous experiences

Editor

- Players should be able to create custom maps to share online

Immersion

The analysis resulted in 17 heuristics for the GameFlow element of Immersion. These heuristics provide specific details on how to achieve the GameFlow criteria for RTS games, including how to promote immersion through narrative, graphics, sound, and gameplay (see Table 3). Moreover, these 17 heuristics form attributes of the game, rather than the player.

Table 3.
Heuristics for Immersion

Narrative

- The opening cinematic should draw the player into the game
- The campaign should include cinematics that advance the storyline, ground the player in the game world, and add depth to the game world and characters
- The campaign should tell an entertaining, involving, and memorable story and progressively add depth to the story
- The player should become attached to the game world, characters, and story
- The game should provide additional background information for the races and story through manuals or other sources

Graphics

- Detailed graphics should be used to give life and personality to the game world, structures, and characters
- The terrain, structures, and units should be used to set the atmosphere and capture the feel of the game world
- The structures, terrain, and units of different races should have a distinctive look and

feel that clearly captures the feel of the race they represent
- Different types of units should have a distinctive look and feel (not the same unit with different clothes and weapons)
- Animations and special effects should be used to give life to the game world and units
- Animations should not detract from the believability of characters and situations (e.g., repetitive nodding and awkward arm movements)
- Cinematography (e.g., camera manipulation) should be used to enhance believability in cutscenes and in-game
- The interface should be themed to the game world and race

Sound

- Voices should be used to give units distinct and vivid personalities
- Sound effects and voice responses should be varied and not repetitive
- Music should be themed for each race and help set the mood of the game

Gameplay

- The game elements should build up a rich and detailed world that is more like visiting a fully realised location than a constructed map

Group versus Individual Enjoyment

The analysis resulted in 12 heuristics for the GameFlow element of Social Interaction, 10 of which fell into the content category of multiplayer (see Table 2). These heuristics focus on supporting players in joining and interacting in multiplayer matches. Additionally, four of the heuristics in the GameFlow element of Challenge fell into the content category of multiplayer (see Table 4). These heuristics related to pacing and challenge from other players in multiplayer matches.

Table 4.
Heuristics for Challenge

Campaign

- The campaign should provide many hours of play
- The early stages of the campaign should provide a good match for the skill level of new players
- The campaign should start slow and ease the player into the game
- The player should be required to change races during the campaign, so as to challenge them to adapt and learn new strategies
- As the player progresses through the campaign and their skills improve, the missions should ramp up in difficulty to match their skills, without becoming too difficult

Missions

- The campaign should include a range of mission objectives and not just typical RTS "build up and destroy" objectives
- The missions in the campaign should vary in complexity

- The missions in the campaign should have normal and hard difficulty settings
- There should always be a way for the player to finish a mission, so that they don't experience feelings of hopelessness
- The missions in the campaign should not be easier or harder than most RTS games
- Missions should be sufficiently challenging to force the player to explore different strategies
- Finishing missions should require tactics, strategy, and skill, rather than just superior firepower

Races

- Each race should necessitate its own style of play
- Different races should be different to play, but evenly matched and balanced
- Each race should include units that are specific to that race, with functional and strategic differences
- Each race should have units that counter the units in the other races
- Different races should not include units that are functionally the same
- Hero units shouldn't become so powerful that other units become worthless
- The player should never know exactly what they will be facing, even though they know the race of their opponent
- Races should include enough strategic variation that each game is a different experience

AI

- The opponent AI should use varied strategies, not just rush tactics
- The opponent AI should maintain a balance between expanding, defending, and building an economy
- The opponent AI should be unrelenting, but not overwhelming
- The opponent AI should not attack with small, intermittent groups of units that are easy to dispatch
- The opponent AI should not be overly aggressive and crush the player
- The opponent AI should not make obvious mistakes (e.g., leaving armies idle while its base is attacked)
- The opponent AI should be robust and flexible and not rely on preset conditions and scripted sequences
- The game should have multiple difficulty settings that accommodate for all player skill levels, by adjusting the aggressiveness and efficiency of the opponent AI

Gameplay

- Units and structures should have sufficient health, so as to focus gameplay more on combat than production
- Gameplay should maintain a fast pace, by not having lengthy troughs for unit production or research
- Upgrading units should have a significant impact on unit effectiveness
- Combat should focus more on unit manipulation than on controlling large numbers of units
- The game should rely more on management than on overwhelming the opponent with large waves of units
- The pace of the game should be fast enough to be exciting and should increase as

the game progresses, ending in all-out tactical combat

- The game should provide new and unique twists on conventional RTS gameplay, to provide new challenges to experienced RTS players and to give the game appeal, depth, and lasting value
- The game should include numerous diverse maps that provide the player with varied challenges
- Small population limits should be used to force players to make hard decisions about what kinds of units to use
- Players should be discouraged from overly defensive play and forced outside of their comfort zones, by making defensive structures weaker, siege weapons more powerful, and by not starting with enough resources to win the game
- Map terrain should be varied and setup for tactical gameplay by including choke points and high ground
- As the player progresses through the game, new structures, units, and technologies should become available
- The economic aspects of the game should be compelling
- The game should use the classic RTS rock-paper-scissors format for combat between different categories of units (e.g., infantry, archers, and cavalry)
- The game should be accessible to inexperienced RTS players, who should be able to play without being overwhelmed
- The game should not have overpowered units that make all other units redundant
- The game must be sufficiently complex and challenging for experienced RTS players

Multiplayer

- Multiplayer games should be accessible to new players
- Players in multiplayer games should be allowed time to build up a base before they are rushed by other players
- Multiplayer games should not be too slow before hostilities erupt
- The game should have a skirmish mode that allows a large number of players on a single map (e.g., 12 players)

Editor

- The game should include an editor that allows players to create and share missions, which extends the replayability and life of the game

Player Skills and Challenge

The analysis resulted in 50 heuristics for the GameFlow element of Challenge and 26 heuristics for the GameFlow element of Player Skills. The Challenge heuristics, which focus on testing the player and providing a match for their skill level, fell into the content categories of: campaign, missions, races, AI, gameplay, multiplayer, and editor (see Table 4). The Player Skills heuristics, which focus on making the game accessible to new players and supporting players in developing their skills, fell into the content categories of: campaign, races, gameplay, interface and controls, and help (see Table 5).

Table 5.

Heuristics for Player Skills

Campaign

- The campaign should include an optional, introductory mission to teach new players about the controls and basics of the game (e.g., movement, combat, base building, gathering resources)
- The game should provide opportunities for the player to learn about and experiment with the game concepts contextually through the campaign, including units, structures, technologies, and races (for later use in the skirmish mode)
- The campaign should gradually introduce new units, structures, technologies, and races so the player learns a little at a time
- The campaign should consistently reward the player for their effort and achievements and motivate them to keep playing, through cinematics and story developments

Races

- Races should have some level of commonality, in terms of types of buildings, technology, and units, to allow players to easily learn how to use new races and switch between different races
- Races should vary in function (beyond the surface level), to challenge the player to develop new skills and strategies

Gameplay

- The game should conform to RTS conventions (e.g., resource gathering, base building, unit capacity, unit control, technology advances, building tree, managing defenses, forming an army, attacking the enemy) to allow the player to have an inherent understanding of the game
- The gameplay should conform to the traditional RTS model (e.g., building a base, collecting resources, producing units, upgrading and researching, amassing an army, attacking the enemy, defend own base) to meet the benchmarks of the genre
- The hierarchy of structures, units, technology, and special abilities should be kept simple
- The game should indicate which unit types are best suited to attack other unit types
- The gameplay should be easy to pickup for new players

Interface and Controls

- The game's interface should be uncomplicated and uncluttered
- The game's interface should be intuitive and easy to use
- The game's controls should be straightforward
- The game's controls should conform to RTS conventions (e.g., point and click with mouse, hotkeys, command icons, drag boxes around units to select)
- The game's interface should use RTS conventions (e.g., bottom-heavy menu)
- Detailed tool tips (i.e., descriptions of what it is, what it does, what it's good for) should appear when the player mouses over items

Help

- The player should be able to record and watch matches to learn from previous games
- The game should have a manual that covers the basics and allows novices to establish

the essentials quickly and start playing
- The game should include a technology tree to give an overview of some of the strategic avenues
- The game should have a comprehensive in-game help system that includes detailed information on technology, structures, and units
- The player should be able to click a button to view detailed information on a selected unit (e.g., combat statistics and interesting information)
- The player should be able to click on most things in the game to access well laid-out help and information screens
- The player should be able to access the technology tree in-game, with hyperlinks to detailed information on each element in the tree
- The game should have a tutorial, so that many of the more unique in-game features do not go unnoticed by the player
- The game should have a tutorial that explains the basics (e.g., building and combat)

Discussion

In Sweetser et al. (2012), we developed a concrete set of heuristics for achieving the high-level GameFlow criteria in one specific game genre, real-time strategy games. The resulting heuristics were considerably more detailed than the original criteria or Sweetser and Wyeth's (2005) analysis of how the GameFlow criteria apply to RTS games. In this paper, these detailed heuristics have enabled us to revisit and probe deeper into some of the weaknesses and uncertainties of the GameFlow model, as well as identifying some key areas for future work.

It has been suggested that social interaction doesn't belong in a model of flow (Cowley et al., 2008). In this paper, we clarified that GameFlow is a model of enjoyment, rather than flow, and that social interaction is central to player enjoyment (de Kort & Ijsselsteijn, 2008; Bond & Beale, 2009). Additionally, we found that in RTS games it is important for the game to facilitate and support players in joining, interacting, cooperating, and competing in multiplayer games, as well as creating, sharing, and recounting content and experiences.

The original GameFlow criteria for immersion are difficult to assess (Sweetser & Wyeth, 2005; Bleumers et al., 2010), as they are attributes of the player experience, rather than the game. As such, the immersion element overlaps closely with the flow experience (Ijsselsteijn et al., 2007) and can be considered at a different level to the other elements (Tijs, 2006). It has been suggested that it would be more useful to indicate what could promote or inhibit immersion, rather than describing what the player should experience (Bleumers et al., 2010). In this paper, we presented 17 heuristics that provide specific details on how to achieve the GameFlow criteria for RTS games, including how to promote immersion in RTS games through narrative, graphics, sound, and gameplay. Our ongoing work on GameFlow, player enjoyment, and immersion aims to reveal more insights and measurable results on the relationships between the various GameFlow elements and player enjoyment, as well as how these relationships vary across game genres.

It has been suggested that the Challenge criteria do not accommodate cooperative situations and that GameFlow focuses on individual, rather than group, control (Bleumers et al. 2010). The heuristics reported in the paper still focus on the individual player experience, rather than the group experience. However, some insight was provided into the multiplayer experience through heuristics for social interaction, as previously discussed, as well as heuristics for challenge in multiplayer games. Interesting future work lies in investigating the manifestation and suitability of the criteria in individual versus group experiences.

It has been suggested that the division between the Player Skills and Challenge criteria in the GameFlow model is artificial (Bleumers et al., 2010). The challenge heuristics we presented in this paper focused on testing the player and providing a match for their skill level, whereas the player skills heuristics focused on making the game accessible to new players and supporting players in developing their skills. Though we believe that this is a useful distinction in conceptualising guidelines for design and evaluation, future work in validating the model will reveal whether, and under what conditions, these elements are, in fact, separate.

Finally, we found that by analysing a set of professional game reviews, alongside the GameFlow model, we were able to develop a set of detailed heuristics for designing and evaluating RTS games. Future work will allow us to assess the usefulness, validity, and potential applications of these heuristics in designing and evaluating video games.

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List of Tables