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What is Game Balancing? An Examination of Concepts

Alexander Becker [1,✉] and Daniel Görlich [2]

[1] *Wolfsgrubenweg 25, 67069 Ludwigshafen am Rhein, Germany,*
alex@aowbecker.de
[2] *SRH University Heidelberg, Ludwig-Guttmann-Str. 6, 69123 Heidelberg, Germany,*
Daniel.Goerlich@SRH.de

Abstract

Balancing is commonly considered critical to any game's success. However, there is no consensus on what "game balancing" actually means. This paper examines fourteen publications by experienced game designers and other renowned authors. The results of a formal semantic analysis of the respective authors' reflections prove that no two authors share identical understandings of "game balancing." Their differing concepts of the term are analyzed and discussed in order to identify key aspects, similarities, and differences. Contrary to what one might expect, concepts such as fairness, flow, or user satisfaction are identified to be important, but no central or fundamental concepts for the definition of game balancing.

Keywords: Game Balancing · Video Games · Semantics · Concepts

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1 Introduction

Good game balancing is considered critical to creating successful games [1]. Surprisingly though, there is no consensus on what "game balancing" actually means. In a highly abstract way one can interpret "game balancing" as the activity of tuning a game's rules, levels, difficulty, numbers, algorithms etc. to achieve desired goals (see, for example, [2]) such as keeping a game winnable, making it fair for all players, keeping it challenging, making it replayable, etc.

Much has been published about "game balancing", though rarely from a scientific point of view. Considerations on the term and the process of balancing a game most often stem from practitioners. We therefore reviewed fourteen publications by renowned authors and performed a formal concept analysis, comparing these authors' concepts of "game balancing." The results prove the authors' definitions to be diverse, focusing on their respective goals and key aspects of game design. Although the authors' concepts often overlap, especially with respect to central aspects of game balancing, every author has an at least slightly differing view, a different concept, and therefore a unique understanding of game balancing. There are no two authors or teams of authors who agree on completely identical concepts of "game balancing."

2 Methodology

To the best of our knowledge, no extensive semantic or ontological analysis of the term "game balancing" has been published by other authors so far. Also, no publications seem to exist addressing game balancing for serious games and other types of games focusing on other goals than fun. Few scientific publications such as [1], [3], [4], and [2] focus on game balancing and especially automated or even dynamic game balancing, instead relying on definitions from practitioners or adopting simplified reinterpretations of the term relating to their respective goals (e.g., [2]). In section 3, we therefore present the practitioners' definitions first before continuing with the state of the art in scientific publications.

In order to obtain the fullest possible understanding of the term "game balancing", we have reviewed the one most important publication of each practitioner or team of practitioners that can be regarded as renowned due to his/her/their influence on the games industry and/or game development education. Many of them are experienced game designers and authors of acclaimed standard texts or books, and some of them even teach game design. Others are traditional journalists or YouTubers focusing on game design, game development or game education. Each practitioner or team is briefly introduced in section 3 to prove his/her/their reputation.

In section 4 we present and in section 5 we discuss the results of the semantic analysis based on a slightly modified formal concept analysis [5] as described in [6], with additional intermediate steps: While the authors are simply treated as formal objects, their work is condensed into concise formal properties. All properties are connected to their authors and identical properties thus connect to multiple authors. The resulting table can be used to generate lattice diagrams that visualize all connections, and therefore are quantifying consensus and dissensus to a certain degree. An excerpt from this table is provided in Table 1.

Based on these authors' descriptions, opinions and reflections, more than 500 resulting properties of "game balancing" were grouped into 48 concepts; those 22 concepts that were described by more than one author, were used as the basis for a formal concept analysis. The results were consolidated and visualized using the Online Lattice Editor by [7], employing its "Build Concept Lattice (AddIntent)" and "Min intersection layout (using Cenexp algorithm)" settings. The resulting structure was beautified, but otherwise not changed for depiction in Fig. 1. A table of the objects, concepts and properties identified in a first formal concept analysis, at that time based on 11 instead of 14 publications, can be found in [8]; an exemplary excerpt from the up-to-date table is printed in Table 1.

3 State of the Art

While Ernest Adams has worked as a game designer since 1989, he is also a game design consultant and has written several books about the same field. He also is founder of the International Game Developers' Association (IGDA). For several years, as in publications [9] and in [10] together with Andrew Rollings, author of "Game Architecture and Design", Adams has elaborated on the player's skill, especially in decision-making. Balancing should have the goal of keeping skill the determining factor for a game's outcome despite some chance still being a desirable quality in most games. Fairness in player vs. player (PvP) games, having equal chances of winning at the beginning of a match no matter what available options are chosen, and difficulty in player vs. environment (PvE) games are substantially connected to this. Those PvE games should provide constant challenges without ever frustrating the player.

Keith Burgun is an independent game designer, author, composer, visual artist, and author of two books on game design. In [11], he sees the prime objective of game balancing in keeping game elements relevant. This is mainly done to prevent a ruination of the game by dominant strategies and to keep a player's decision impactful. Game elements must be weighed against others within all contexts they compete in.

David Sirlin, president of Sirlin Games, is a game and graphics designer working mostly on competitive multiplayer games. In [12], he centres his concept of game balancing around providing viable options and fairness in the aforementioned sense to the player. Viable options refer to meaningful decisions between promising alternatives.

James Portnow is a game designer and game design consultant, known for his theories on socially positive game design and as co-founder of the YouTube Channel "Extra Credits." His channel's episodes present, among others, the concept of perfect imbalance [13]: While a balanced game can easily lead to a stagnation of strategy discovery, since it only becomes a question of executing proven ones, slight differences in power between game elements encourage players to constantly search for new solutions against currently popular strategies.

Dan Felder worked for Blizzard Entertainment as a game designer on "Hearthstone" and later as senior game designer at Electronic Arts. In [14], he sets the premise that balancing should help games to create a positive experience. This cannot be fulfilled when any game contains broken gameplay, which consists of strategies or even singular actions rendering a lot of decisions meaningless. However, perfect equality would also do that since there would be no reason left to choose any action over another. Implementing small power gaps is considered a critical part of game balancing.

Jeannie Novak is lead author and series editor of the "Game Development Essentials" series. Similar to Rollings & Adams in [10], she introduces the reader of [15] to the distinction between static and dynamic game balancing. While all authors emphasize the impact the player's skill should have on the outcome of a game, those two types of balancing focus on complementary parts of a game: Static game balancing is concerned with rules, mechanics, values and their relations to each other, while dynamic game balancing influences how the players' actions change the course of a running game, and therefore could be considered a form of real-time balancing.

Richard Rouse III has worked as design and narrative lead for Ubisoft and Microsoft Studios. He establishes in [16] games being a collection of interacting subsystems. Changes within one subsystem almost certainly affect other parts of the game as well, so their dependencies must be strongly considered when balancing a game.

Jesse Schell is professor for game design at Carnegie Mellon University and former IGDA chairman. In his award-winning book "The Art of Game Design: A Book of Lenses" [17] he describes multiple contrasting concepts that typically appear in video games, e.g. challenge vs. success, or skill vs. luck. To identify the right middle ground, one has to take the audience into account. To achieve it, one can manipulate not only game mechanics but their combinations and relations as well.

Ian Schreiber began programming and designing games in 2000, has written two books on games, is co-founder of the Global Game Jam and assistant professor for interactive games and media at Rochester Institute of Technology. In [18], Schreiber uses a primarily mathematical approach towards game balancing. He calls everything within a game quantifiable to some degree. However, numbers only have a meaning within their given context(s) and have no meaning if not related to anything. Game balancing is not only concerned with this, however, but also with the players themselves: Games offer different levels of information access, players have differences regarding their ability to process information and expectations. Even factors beyond the actual game can influence their behavior.

Tynan Sylvester, founder of Ludeon Studios, has been designing games since 2000 and has written an instructional game design book [19]. To achieve the prime goal of creating and keeping multiple viable strategies, he states that one must work on the relative differences in power game that elements have. Strategies are considered viable if all of them have similar chances of leading to a victory.

Marc Brown is a game journalist and creator of the "Game Maker's Toolkit" Youtube channel and series. In [20], he focuses on fairness in multiplayer games and how those must not only provide a balance of game elements, but of all options a game offers, including singular actions and strategies. Additionally, the players' perception of balance is just as important as the actual balance. Balancing does not stop there though; one also must measure and interpret the state of balance correctly and should communicate changes accordingly to players to prevent misconceptions.

Rym DeCoster and Scott Rubin host the "GeekNights" talk radio show. On the PAX South 2018 [21], they presented an approach for balancing multiplayer games around the player instead of mainly mechanics and numbers. Among other things, this includes how to match players accordingly.

Adam Millard runs a Youtube channel named "The Architect of Games", which started in 2011. In [22], he does not exactly try to find a new definition of game balancing, but instead shifts the focus from providing a perfectly balanced game to preserving an equilibrium of power within a game. According to him, a developer's obligation is to keep exactly that equilibrium intact and not to achieve numerical perfection.

There are only a few scientific publications on game balancing. They use or extend the term, often adopting definitions from practitioners: Andrade et al. [1], for example, references Raph Koster's "A Theory of Fun for Game Design" [23], concluding that "game balancing aims at providing a good level of challenge for the user" and keeping the player interested in playing the game. They evaluate dynamic game balancing approaches, stating that those must satisfy at least three basic requirements: adapting to the player's initial level, tracking the evolution and regressions of the player's performance, and keeping the game "believable." Their evaluation indicates that adaptive approaches may be more effective, resulting in better user satisfaction than traditional, non-adaptive, pre-defined game balancing using static difficulty levels.

Similar to Andrade [1], Tijs et al. [3] state that dynamic game balancing requires adjusting a game's parameters such as the difficulty level to a player's skill level while playing: To be enjoyable, these parameters should be changed over time to avoid undesired player emotions, such as boredom and frustration. They argue that the player's emotional or affective state must be considered by dynamic game balancing, so that the game can become emotionally adaptive.

Lankveld et al. [4] also define game balancing as the adaptation of the game difficulty to a player's skill or, more precisely, the relationship between a game's complexity and a player's abilities: The player should be challenged, but not frustrated by the complexity of the game. They suggest a different approach: They apply the incongruity theory, trying to avoid letting the difference between the complexity of a game and the complexity assumed by the player's internal human model becoming too large.

In order to demonstrate the feasibility of automating the game balancing process, Volz et al. [2] treat game balancing as a multi-objective optimization problem, assuming that *"game balancing is an important part of the (computer)game design process, in which designers adapt a game prototype so that the resulting gameplay is as entertaining as possible."* Similar to Schreiber [18], they define game balancing *"as the modification of parameters of the constitutive and operational rules of a game (...) in order to achieve optimal configurations in terms of a set of goals, i.e. a parameter tuning problem."*

4 Semantic Analysis for Conceptual Structuring

Although the previously introduced authors may not seem to be far apart, their ideas of game balancing differ in many details. Most obvious are their different perspectives and scopes: Some focus on game design, others already consider more technical perspectives or even reduce game balancing to adjusting or optimizing numbers. Many authors use terms such as "fairness" or "difficulty" that may also be difficult to grasp.

While all authors emphasize different aspects of game balancing, they rarely contradict each other. There are some concepts they commonly agree on, despite sometimes using divergent names or descriptions. Examples are dominant vs. degenerative strategies and (meaningful) decisions vs. (viable) options. To analyze and compare the presented concepts of game balancing, we therefore need to understand the authors' basic ideas, concepts and assumptions that some of them take for granted, but others try to define or describe explicitly in their respective publications.

Adams [9, p. 403] links balance to the player's skill: *"In the most general sense, a balanced game is fair to the player (or players), is neither too easy nor too hard, and makes the skill of the player the most important*

factor in determining her success." Adams adopts fairness, an inherently subjective concept, as a general goal, and links fairness to the player's "skill"—another term that requires more consideration. To Adams, it is generally important that chance must not be powerful enough to make skill irrelevant. To achieve that, game design should allow the player to make meaningful decisions, so that the outcome of the game primarily depends on the player's choices [9, p. 404]. Game design must therefore avoid dominant strategies, i.e. strategies that do not need to be infallible but are so strong that they leave players no reason to use any other strategy. Even singular decisions or the mere avoidance of losing the game can be considered dominant strategies [9, p. 405], as well as so-called "exploits" which trivialize parts of a game [9, p. 410f]. Dominant strategies make alternatives worthless and render the player's decisions meaningless [9, p. 405f]. Sylvester calls dominant strategies "degenerative strategies" [19, p. 160] and warns that adding new game elements does not always create more meaningful decisions; indeed, it might do just the opposite [19, p. 159].

Depending on the (in-)transitivity of involved game elements, Adams sees numerous ways to avoid dominant strategies. "Transitivity" applied to relations between game elements means there is a transitive order in power or usefulness: If game element A outclasses B and B outclasses C, A also outclasses C. In the opposite case of intransitivity, every game element can be beaten by some other, which supports the avoidance of dominant strategies. To avoid dominant strategies within a transitive relation, one can change costs or use positive feedback. Costs might be outright stated prices, but also "shadow costs", such as hidden detrimental properties [9, pp. 406–407]. Positive feedback describes giving the player rewards to accelerate future progress [9, p. 408] without creating a sure-fire course [9, pp. 429–430].

Furthermore, Adams [9] recommends assessing intransitivity in the elements' properties, instead of defining superiority, as is the case in Rock-Paper-Scissors. This can be achieved by giving elements unique traits that cannot be solely compared by their values. Adams calls this "orthogonal unit difference" [9, pp. 408–410]. Besides general criteria, Adams distinguishes between priorities for PvP and PvE games: Those are fairness and remaining able to win throughout the match for PvP [9, p. 404] vs. difficulty for PvE games [9, p. 405]. While playing a match in a PvP game, any player should have opportunities for a comeback, if he or she falls behind early on. Stalemates, the inability to win or finish the game properly, should be avoided [9, p. 404].

To Adams, fairness is of paramount importance to PvP titles. He interprets fairness as all players having a roughly equal chance of winning at the start of every game. Fairness should always be granted [9, p. 404], e.g., by accordingly balancing starting options, by protecting newer players, or by providing game updates [9, pp. 414–416]. In symmetrical games that provide identical starting conditions to all players, fairness is already given. Most games, however, come with different options at the start of a game and are called asymmetrical, which makes them more prone to developing dominant strategies [9, p. 413]. Sirlin also adds a scale to the concept of (a)symmetrical games: While symmetry is a fixed condition, a game can be more or less asymmetrical. The more asymmetrical a game is, the more important maintaining fairness becomes [12, p. 1].

Difficulty in PvE games is strongly connected to the players' expectations and requires consistency [9, p. 405]: Sudden jumps should be avoided as well as stalemates and losses the player could never have prevented. Also, important decisions should be marked as such and all necessary information to finish the game should be accessible [9, pp. 416–417]. All this serves the purpose of bringing the player into a state of flow. However, expectations of and requirements for this can vary immensely between audiences [9, pp. 418–419]. Adams subclassifies "difficulty" into:

1. Absolute difficulty. The combination of required skill and time restrictions. It highly correlates with the game's numbers, such as enemies' strengths and maximum health points [9, p. 420].
2. Relative difficulty. What is left when the player's power is subtracted from the absolute difficulty [9, pp. 420–421].
3. Perceived difficulty. What the player experiences. Also takes his or her expertise into account [9, p. 422].

Ideally, the perceived difficulty stagnates or increases throughout the game according to the target group's preference. The relative difficulty must grow faster, since the player's experience also increases. The absolute difficulty must rise even faster, if the player gains more power [9, p. 423-24]. Also, if the player can adjust the difficulty somehow, the game covers a wider audience [9, pp. 425–426].

While Burgun [11, p. 2] primarily addresses multiplayer games, he includes single player games in most of his statements, especially if they are supposed to have replay value. Generally, a well-balanced game stays interesting for longer. His definition focuses on choices [11, p. 1]: *"Gameplay is all about making choices and in a poorly-balanced game, many of the choices available to the player are essentially rendered useless."* He argues, as does Adams, that dominant strategies can render other strategies useless and game elements irrelevant. Whether a strategy is dominant or not, however, can depend on the player's skill, especially in more complex asymmetrical games. Therefore, the target group should be considered when setting a balancing goal. While tailoring to all audiences would be ideal, this is too intricate. The effort rather should focus on one group, e.g., either competitive or casual players [11, p. 2].

Furthermore, game elements must be balanced within all contexts they operate in. This includes, for example, costs compared to other elements in the same production line, their usefulness when competing with opposing elements, but also their power in relation to others that prohibit or limit each other's use [11, p. 1]. This contest on multiple layers takes place even in symmetrical games, although they typically include fewer contexts, since all players use the same selection of elements [11, p. 2].

James Portnow of Extra Credits summarizes his concept of perfect imbalance as follows [13, 0m34s]: *"Fundamentally, it is the idea in game design that you don't always want things to be perfectly balanced. In fact, in most games you actually wanna make sure that there are some imbalances in your systems.* (…) *many games are actually made far more engaging by just a little bit of imbalance, multiplayer games especially."* Portnow highlights that those imbalances refer to subtle differences, not huge gaps in power [13, 0m30s–1m00s]. The distinction between "out of balance" and "broken" is crucial: No strategy or game element should be much stronger than the rest, but only slightly. These subtle variations in power can be measured and adjusted with the help of a "power curve", a relation from cost to power for game elements [13, 3m35s–4m20s]. In the metagame, which is basically the situation or context in which the game is played, such an imbalance allows for discussions, discovery and therefore fun, while players try to find slightly advantageous strategies. They can even discover new solutions for problems without having to know all established strategies. The resulting metagame allows players to grow into the game and prevents any playstyle from becoming the best [13, 2m45s–3m35s].

In contrast to a perfect imbalance, in (almost) perfectly balanced games like chess, the best strategies are discovered sooner or later. At that point, most players are left with nothing but executing those instead of creating their own strategies. Only the best players could still find new strategies that are not already established. This removes part of the fun for a huge portion of the audience [13, 1m00s–2m45s].

Felder [14] bases his view of balancing on the avoidance of imbalance: *"I've found that the most useful definitions of balance are based on what we're trying to avoid: Broken Gameplay.* (…) *When you're designing a game you naturally want to create a positive experience for your players. When your gameplay isn't providing that experience, your game is broken. It's that simple."* An example for something broken would be a strategy that makes all others obsolete, and therefore a lot of decisions, if not all of them, as well. However, the exact opposite would also render decisions useless: If every option was equally good, there would be no reason to prefer one. Instead, subtle differences in power allow for strategic decision making.

Novak [15, p. 202] relates balancing to the player's skill: *"The ease of winning the game also increases as the players' skills increase. Random events* (…) *can still occur in the game that might decrease a skilled player's chance of winning. However, a better player should be more successful in general at the game than a less-skilled-player, unless the game is based purely on luck instead of skill."* Considering the desired results

of balancing, Novak concludes: *"A game is balanced if players perceive that it is consistent, fair, and fun,"* implying that the perceived quality of game balance may be subjective.

Without using potentially subjective terms, Rollings and Adams [10, p. 240] similarly state that *"A balanced game is one where the main determining factor for the success of the player is the skill level of that player. That does not mean that random events cannot occur, but a better player should ordinarily be more successful than a poor one unless he has an unusually long run of bad luck."* While not identical, Novak [15] and and Rollings and Adams [10] have a similar focus. They name criteria found in well-balanced games:

- The game becomes consistently more challenging [15, p. 202ff] until the climax [10, p. 272].
- The player perceives fairness by always being able to win, even after early mistakes [15, p. 202ff]. This perception extends to offering the player information, control, training and beginner protection. Unnecessary repetition of tasks should be avoided [10, pp. 272–276].
- No trivial decisions. These are decisions that have no impact, or one alternative is clearly the best [15, p. 202ff]. Additionally, micromanagement – the act of administering a high number of small elements – should never be mandatory, only optional [10, p. 276f].
- No trivial decisions. These are decisions that have no impact, or one alternative is clearly the best [15, p. 202ff]. Additionally, micromanagement–the act of administering a high number of small elements–should never be mandatory, only optional [10, pp. 277–279].
- Adjustable difficulty [15, p. 202ff] [10, pp. 279–281].

Beyond general criteria, they continue their investigations of static and dynamic balancing. Static balancing is concerned with the game's rules and how they interact. Its main goals are to avoid dominant strategies [10, p. 243] and provide fairness [10, p. 267]. Rollings and Adams [10] contribute two new aspects to dominant strategies: A strongly dominant strategy always wins the game, while a weakly dominant strategy prevents a loss. Other than the former, the latter can be beneficial to the game. Furthermore, an "almost dominant strategy" does not always win the game but is still the best option available under any circumstances [10, p. 244ff]. Novak [15] describes another strategy-related concept a game should include, so-called "obvious strategies". These are strategies that are generally the best, but explicitly not under any circumstances [15, p. 203]. Game elements with transitive relationships to each other are useful as rewards for progress [15, p. 204] [10, p. 252ff], while those with intransitive relationships profit from having orthogonal unit differences [10, pp. 228–261].

Dynamic balance covers how the game changes over time and with player interaction [15, p. 207]. It can be done passively or actively to prevent unfair advantages [10, p. 267]. Players interact with the dynamic balance in three ways [15, p. 207]:

1. Restore balance. The player restores a disturbed balance. De-balancing forces are weaker than the player or can be removed [10, p. 269].
2. Preserve balance. The player repels de-balancing forces. Those are at least equally as strong as the player. There is no win condition, and the player loses when doing nothing [10, p. 269ff].
3. Destroy balance. The player alternates the state of balance or creates chaos [10, p. 270ff].

Rollings and Adams continue with "emergence", the creation of complex results using simple rules. A world can be simulated via a reduction to basic properties and still deliver the targeted experience. This reduces complexity and preserves control for the player but might favor the formation of dominant strategies [10, pp. 262–265]. There is also a reverse version of positive feedback called negative feedback, which limits progress or leadership, e.g. by adding further costs [15, p. 206] [10, pp. 265–267].

Rouse [16, p. 493] describes games as systems composed of subsystems where *"all of these* [*sub-*]*systems must be in place, since changing one system impacts how the other systems must be setup in order to achieve the overall balance you are seeking."* He distinguishes between provisional balancing creating a balanced foundation, and true balancing using this basis mainly to adjust numbers to deliver a quality game. Play tester feedback is crucial for this iterative approach [16, pp. 493–494]. It is also necessary to understand the relations and influences within and between one's own systems to avoid unintended consequences, while being able to quickly iterate values within the game [16, p. 495].

Schell [17, p. 202] states that *"Balancing a game (...) is all about understanding subtle nuances in the relationships between the elements of your game and knowing which ones to alter, how much to alter them, and which ones to leave alone."* He continues with various patterns that frequently appear and are partially opposed to each other. Some of them are:

- Challenge vs. success. A game should neither be too easy nor too difficult. The goal is to keep the player in a state of continuous flow. However, learning rules and controls are already challenges in themselves [17, pp. 207–209].
- Meaningful decisions are an integral part of a gaming experience. However, any decision becomes meaningless if one of its options is clearly the best or the decision has no impact at all [17, pp. 210–214].
- Skill vs. chance. It is commonly good to have both in a game to a certain degree, dependent upon the audience [17, p. 214f].
- Strategy vs. dexterity. The best ratio depends on the audience [17, p. 215ff].
- Competition vs. cooperation. Although many games contain just one, they can appear combined [17, pp. 216–218].
- Short vs. long. Via changing win conditions, players should have enough time to strategize, but never get bored [17, p. 219].
- Rewards vs. punishment. Rewards are a human desire. The rewards must increase over the course of a game to keep the player interested [17, pp. 219–222]. Although rewards should generally be preferred, punishment can also enhance the experience, e.g. by increasing the challenge [17, pp. 222–225].
- Simple vs. complex. It is generally better to create complex results using simple rules, but small case-specific additions might still be beneficial. The former makes a game "elegant" and can be referred to as "natural balancing", while the latter is called "artificial balancing". Games should neither be unnecessarily complex nor simple to the point of being trivial [17, pp. 226–230].

Despite all details being important, Schell emphasizes the big picture: The game should feel right. If it does not, one should ask and search for the causes [17, p. 237].

Schreiber follows a mathematical approach: *"While perhaps an oversimplification, we can say that game balance is mostly figuring out what numbers to use in a game"* [18, p. 1]. It is important to understand that every game contains numbers, even if these are not stated outright [18, p. 1], and that numbers only have a meaning within a context [18, p. 2]. These numbers are connected within greater systems that are divided into subsystems, like combat or economy [18, p. 2].

He differentiates between "deterministic" and "non-deterministic" games. The former always produce the same outcome dependent on the action in a certain state; the latter do not, due to chance or other players' actions. "Solvability", which means that in every situation, there is a recognizable best action, would generally be an undesirable to have in a game, since it renders decision-making obsolete, at least when a player is capable of doing so in real-time. There are different levels of solvability, starting with trivial, which can be solved in real time. Others are theoretically solvable but require

too much calculation to be solved within an acceptable time frame. However, even non-deterministic games are solvable, because even random events have defined outcomes and an expected value. While every game that provides perfect information about its state is theoretically solvable, one can, for example, limit the players' access to information. This might be affected by the metagame [18, p. 1].

Another dimension to balancing is costs. Costs are everything that limits access to advantages or interferes with them. Advantage is essentially everything that benefits the player. We can view costs as negative advantages and vice versa. They can be calculated as such to create a cost curve [18, p. 3]. Schreiber adds that shadow costs can be divided into two concepts: Sunken costs and opportunity costs. The former describes prerequisite costs that are indirectly related to the stated costs, while the latter limits the player's future possibilities once s/he has spent the stated costs [18, p. 6].

Schreiber also adds to the concept of rewards. Regularly giving out smaller rewards should be preferred to fewer larger ones. Players prefer randomization, as long as it still feels like the result of their actions. Rewards and progress should support each other, and popular rewards should not be held back [18, p. 7].

Sirlin [12, p. 1] focuses on balancing multiplayer games: *"A multiplayer game is balanced if a reasonably large number of options available to the player are viable—especially, but not limited to, during high-level play by expert players."* In addition to fairness, "viable options" must be provided. This refers to meaningful decisions between promising options and excludes the existence of dominant strategies. Meaningless decisions unnecessarily increase complexity; only meaningful ones benefit a game [12, p. 1]. However, despite the need for fair starting conditions, a game does not have to be completely balanced within every state of the game. On the contrary, imbalanced states can be situationally desired, e.g. by giving rewards for playing well. He continues that "checkmate situations", in which one player is clearly going to lose but the game technically does not end, should generally not arise. Although manifold games are generally desired and provide many benefits such as counter elements and actions, no game element should be worthless. Worthless elements never contribute to making decisions meaningful [12, p. 2].

Sirlin also discusses the concept of fairness: Comeback mechanics are helpful to prevent unforeseen balancing issues. Also, new game elements should be introduced after a balanced basis is created, and banning certain elements or combinations subsequently, e.g. for tournaments, is highly undesirable. When a power curve is used, it should be noted that the exact ratios between power values are not necessarily provided. Also, decisions, that are made at the beginning of a match or game should not determine the outcome right away [12, p. 3].

Sylvester [19, p. 155] extends the importance of power from game elements to strategies: Balancing *"means adjusting game mechanics to change the relative power of different tools, units, strategies, teams, or characters."* In addition to being fair, games need to be deep which refers to meaningful play even at higher skill levels: Even experts must be uncertain as to the best option in any given situation. To achieve this, strategies should be balanced. A strategy is a specific combination of actions a player can choose from to achieve a certain goal [19, pp. 157–158]. Multiple viable strategies must be offered; even two can be enough though, since adding more decisions, even meaningful ones, can increase complexity without making the game deeper [19, pp. 161–162]. A difficulty in balancing strategies comes from having to change game elements which are typically part of multiple strategies, in order to affect a strategy [19, p. 166].

Marc Brown [20, 0m15s–0m28s] focuses on fairness in multiplayer games: *"Balance is the art of making sure that all options in a multiplayer game are fair. So, none are underpowered and thus pointless to use. And none are overpowered, and thus dominate everything else."* This mostly concerns actions, strategies and elements within asymmetrical games that feature a wide variety of different options that must be viable among players of roughly the same skill level [20, 0m20s–1m3s]. However, the players' perceptions of balance are at least as important as the numbers themselves [20, 1m18s–1m27s]; since any changes affect all players, they should be communicated to them to prevent misconceptions [20, 12m25s–12m52s].

To achieve the desired balance, developers can use a variety of means. Brown starts with what

he calls trade-offs, which basically describe the idea that everything advantageous must also come with equally large drawbacks to fit the same power budget [20, 1m46s–2m24s]. While mathematical balance is important, variety is as well, although it makes game generally harder to balance [20, 3m6s–3m36s]. Another way to balance games are counters to everything, ranging from actions over game elements to strategies. Those create counter-play by creating a cyclical structure similar to Rock-Paper-Scissors. This helps prevent all elements, actions and strategies from becoming overpowered or useless and encourages players to use different actions, elements and strategies, even if a few of them are somewhat unbalanced [20, 3m37s–7m13s]. To balance a game even further, different means such as matchmaking (pairing similarly skilled players), negative feedback loops, catchup mechanics, de- or increasing the influence of luck, and alternated playstyles may cautiously be introduced [20, 12m57s–14m18s].

Another issue Brown [20] adds is the verification that a game is actually balanced. This might require feedback and statistics. However, a global win rate alone is not an indicator since that can be influenced by various factors like usage, skill levels, reliability and some game elements or strategies simply being more or less fun [20, 7m23s–9m44s]. Developers might also look into the player-created meta, which essentially is what players consider to be effective at any given time due to sharing information outside of the actual game or its rules. The meta can also help in balancing a game since it encourages players to find counters against popular things [20, 9m45s–10m47s], not unlike the cyclical imbalance described by Portnow [13]. But even with a meta a game requires balancing from the developers. Although it can be easy to find out when something is dominating or useless by looking at numbers, it generally is more difficult to discover why that is. But as soon as the source is found the developers might "nerf" or "buff" something: A nerf can be achieved by reducing the power of something or increasing the power of its counters, and buffing can be done by increasing something's power or reducing the power of its counters. Buffs should generally be preferred though [20, 10m48s–12m1s].

Rym DeCoster and Scott Rubin [21, 42m44s–44m40s] propose rating players instead of or in addition to balancing the game: *"A balanced game is one in which all players are rated and ratings between two players predict the outcome."* They make clear early on that fun, which is important for players and spectators alike, typically is the opposite of balance and fairness [21, 3m41s–5m31s]. The authors state that asymmetric and somewhat imbalanced games would actually be more exciting for most people [21, 11m41s–12m49s]. Also, inherently imbalanced games can be balanced by changing the player order, win conditions or tournament rules, and not only in the level of mechanics and numbers or using power measurements, although all options in a game still should be viable in some way [21, 12m50s–22m14s]. The power of any game element must also take the difficulty of using or playing them into account, e.g. something easy to play should not be stronger than something that is difficult to play. While power and difficulty of using that game element can be correlated, a game cannot be well-balanced and still contain a huge margin of difficulty regarding the use of game elements or strategies [21, 26m12s–30m50s].

However, the focus of balancing should not lie on quantifiable perfection but rather on balancing the players, so the better player always wins, at least when there are no means in place to align players. Some form of matching players according to their skills is crucial so that all players consistently win around fifty percent of their games [21, 31m38s–39m4s]. This also has the problem of players almost not noticing that they are getting better since the challenge increases accordingly [21, 39m5s–42m44s]. Alongside matchmaking, this can also be achieved by using handicaps (preferably positive ones) to create a somewhat competitive experience between players of different levels of skill, despite that being more suitable for casual games [21, 44m41s–48m09s]. In any case, this balancing of players also has to take factors that lie more or less outside of the game into account, like the players' access to money input, gaming machines, geographical location, etc., so players do not get totally separated from each other [21, 48m11s–56m28s]. Also, developers, especially of competitive games, should be open about balancing discussions to their players so they can expect solutions to existing problems [21, 58m17s–59m45s].

While Adam Millard [22, 11m19s–11m32s] does not exactly provide a definition of game balancing, he relocates its focus: *"Why is balancing games so difficult? (…) because game balance works in equilibrium, it's impossible to change just one thing. Instead, any balance adjustment creates a ripple effect that changes the whole game."* Although he does not state something that was not already conceptualized by one of the previous authors, he, while also partially referring to Sirlin, emphasizes the equilibrium of counters of each other that exists within every game, similar to Portnow and Brown in many regards. It is not the obligation of the developers to create a perfectly balanced game, but only to make sure everything within the game can be countered by at least something. To keep the equilibrium intact, changes must be carefully implemented.

5 Discussion

Having analyzed the semantics behind the above mentioned authors' concepts of "game balancing", we will now look for key aspects, similarities and differences in their concepts and will then move on to discuss them. A first version of this formal concept analysis of, at that time, eleven publications, including all tables of concepts, properties, and formal objects, is available in [8, pp. 163–202]. The up-to-date version comprises a table with around 600 entries. Table 1 is just a short, but exemplary excerpt.

Table 1: Exemplary excerpt from the around 600 entry-long table of formal properties

Author's Concepts	**Formal Properties**	**Formal Objects: Game Balancing according to**												
		Ad	**No**	**Ra**	**Ro**	**Sll**	**Sy**	**Bu**	**Po**	**Fe**	**Sr**	**Si**	**B**	**DR** **M**
Balancing	Repeatedly iterating and adjusting is the best method.			Ra	Ro									
	During balancing, numbers of the game are adjusted.						Sy				Sr			
	Issues should be approached where they arise.										Sr	Si		
Characteristics of a well-balanced game	Early mistakes do not result in a loss later and do not prevent victory in later stages.		No	Ra										
	Chance is not powerful enough to render skill irrelevant.	Ad	No	Ra										
	Multiple strategies are viable even if they have smaller differences in power.									Fe				
Difficulty	The player should be able to adjust difficulty in some way.	Ad	No	Ra							Sr			
	Goal of difficulty. Achieving and maintaining a constant flow state.					Sll					Sr			

	The optimal difficulty depends on the audience.				Sll				Sr			
Symmetry	Symmetric games offer players equal starting conditions.	Ad	No	Ra	Sll	Sy	Bu		Sr	Si	B	DR
	Symmetric games are automatically fair.	Ad			Sll	Sy			Sr			DR
	In symmetry, only player skill matters.			Ra								
	Game elements still must be balanced.						Bu		Sr			

The results are further visualized in Figure 1 and described in Table 2. Figure 1 shows which author covers which concepts, and which concept is covered by which author. Also, coupled occurrences can be identified. The higher up a node appears in the diagram, the more authors and fewer concepts it contains, and vice versa. Only the green nodes are labeled, since they mark the fundamental level on which an author or concept occurs. Whatever term is in bold in Table 2 marks the first appearance of that concept or author. For an author this means that this node contains all concepts covered by this author and every directly or indirectly connected node above contains that author as

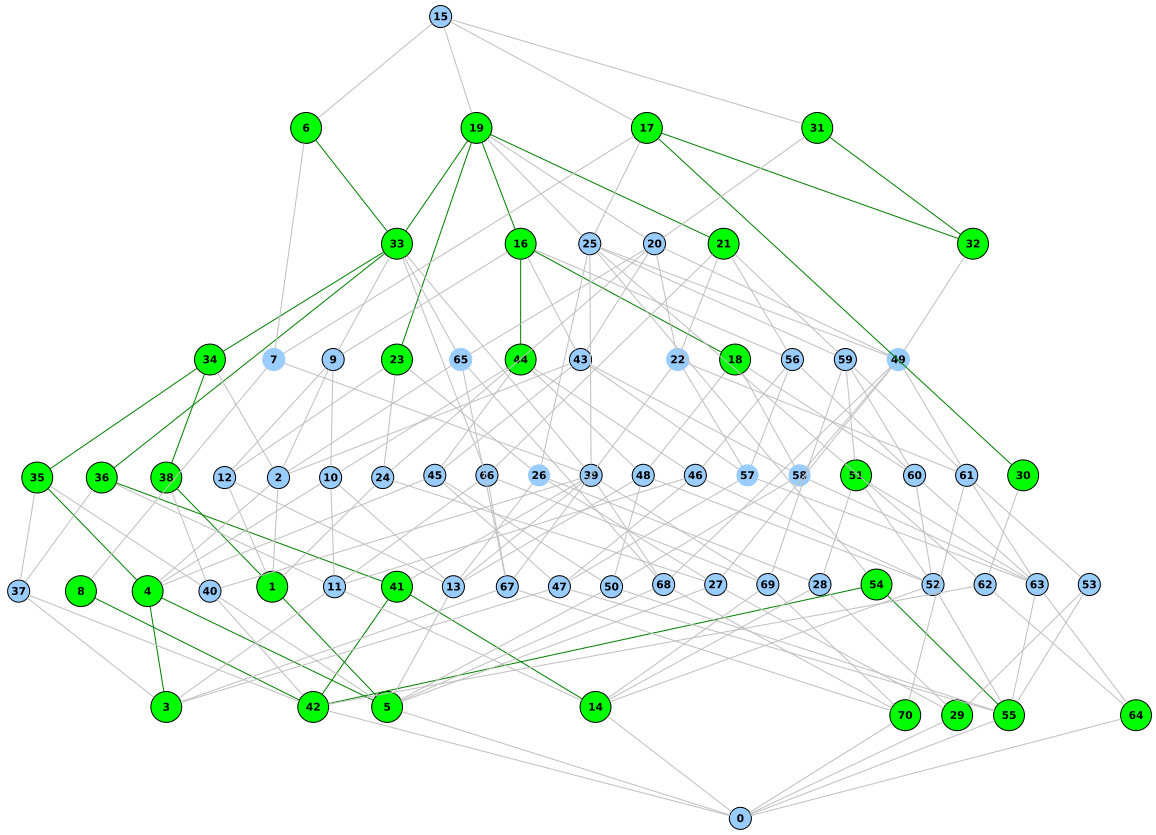

Figure 1: Conceptualization of “game balancing” as a lattice form diagram

well. For a concept this node shows all authors who cover it. Additionally, all nodes connected to this one from a lower level contain that concept as well. Smaller nodes indicate a combined appearance and can be used to follow connecting lines.

Table 2: Descriptions for Fig. 1.
Nodes are sorted by the level they appear on, from top to bottom

Level	Nodes	Author's	Concept(s)
1	6	Adams, DeCoster & Rubin, Novak, Rollings & Adams, Rouse, Schell, Schreiber	**Difficulty**
	17	Brown, Burgun, DeCoster & Rubin, Felder, Millard, Portnow, Rollings & Adams, Rouse, Schell, Schreiber, Sirlin, Sylvester	**Balancing**
	19	Adams, DeCoster & Rubin, Brown, Burgun, Novak, Rollings & Adams, Schell, Schreiber, Sirlin, Sylvester	**Symmetry**
	31	Adams, Brown, Burgun, DeCoster & Rubin, Felder, Millard, Novak, Rollings & Adams, Sirlin	**Characteristics of well-balanced games**
2	16	Adams, Brown, Novak, Rollings & Adams, Schell, Sirlin, Sylvester	**Fairness**, symmetry
	21	Brown, Burgun, DeCoster & Rubin, Novak, Schell, Sirlin	**Difficulty**
	32	Brown, Burgun, DeCoster & Rubin, **Felder**, **Millard**, Rollings & Adams, Sirlin	Balancing, characteristics of well-balanced games
	33	Adams, DeCoster & Rubin, Novak, Rollings & Adams, Schell, Schreiber	**Chance**, difficulty, symmetry
3	18	Brown, Rollings & Adams, Schell, Sirlin, **Sylvester**	Balancing, fairness, symmetry
	23	Adams, Burgun, Rollings & Adams, Schell	**Dominant strategies**, symmetry
	34	Adams, Novak, Rollings & Adams, Schreiber	Chance, difficulty, **intransitivity**, **positive feedback**, symmetry, **transitivity**
	44	Novak, Rollings & Adams, Schell, Sirlin	Fairness, symmetry, **trivial / meaningless decisions**
4	30	Brown, **Portnow**, Schreiber	Balancing **metagame**
	35	Novak, Rollings & Adams, Schreiber	Chance, difficulty, intransitivity, **negative feedback**, positive feedback, symmetry, transitivity
	36	Novak, Schell, Schreiber	Chance, difficulty, **economies**, symmetry

	38	Adams, Rollings & Adams, Schreiber	Chance, **costs**, difficulty, intransitivity, positive feedback, symmetry, transitivity
	51	Burgun, Schell, Sirlin	Asymmetry, balancing, **meaningful decisions**, symmetry
5	1	**Adams**, Rollings & Adams	Chance, characteristics of well-balanced games, costs, difficulty, dominant strategies, fairness, intransitivity, positive feedback, symmetry, transitivity
	4	Novak, Rollings & Adams	Chance, characteristics of well-balanced games, difficulty, dominant strategies, **dynamic balance**, fairness, intransitivity, negative feedback, positive feedback, **static balance**, symmetry, transitivity, trivial / meaningless decisions
	8	**Rouse**, Schreiber	Balancing, difficulty, **games as systems**
	41	Schell, Schreiber	Balancing, chance, difficulty, economies, **rewards**, symmetry
	54	Schreiber, Sirlin	Balancing, **solvability**, symmetry
6	3	**Novak**	Asymmetry, chance, characteristics of well-balanced games, difficulty, dynamic balance, economies, fairness, intransitivity, negative feedback, positive feedback, static balance, symmetry, transitivity, trivial / meaningless decisions
	5	**Rollings & Adams**	Balancing, chance, characteristics of well-balanced games, costs, difficulty, dominant strategies, dynamic balance, fairness, intransitivity, negative feedback, positive feedback, static balance, symmetry, transitivity, trivial / meaningless decisions
	14	**Schell**	Asymmetry, balancing, chance, difficulty, dominant strategies, economies, fairness, meaningful decisions, rewards, symmetry, trivial / meaningless decisions
	29	**Burgun**	Asymmetry, balancing, characteristics of well-balanced games, dominant strategies, meaningful decisions, symmetry
	42	**Schreiber**	Balancing, chance, costs, difficulty, economies, games as systems, intransitivity, metagame, negative feedback, positive feedback, rewards, solvability, symmetry, transitivity

55	**Sirlin**	Asymmetry, balancing, characteristics of well-balanced games, fairness, meaningful decisions, solvability, symmetry, trivial / meaningless decisions
64	**Brown**	Asymmetry, balancing, characteristics of well-balanced games, fairness, metagame, symmetry
70	**DeCoster & Rubin**	Asymmetry, balancing, chance, characteristics of well-balanced games, difficulty, symmetry

There are a few important points to note when using the diagram, the table and data contained therein to draw conclusions: While it can be used to draw positive conclusions about connections and semantics, the reverse cannot be accomplished: Just because an author is not connected to a concept does not mean that the author never mentions this topic or never uses the according term. It only shows that if they make mention of it, this happens within the context of another concept. It is usually only touched briefly explained there.

The diagram reveals countless implications, among them: No concept is covered by every author, which means that there is not even a consensus about one concept being the singular essential core of the term "game balancing." No author covers all concepts; instead, Schreiber, Novak, Schell, Rollings and Adams, Sirlin, DeCoster and Rubin, Brown and Burgun each introduce combinations of concepts no other author covers. These implications corroborate our original impression that there is no comprehensive definition of the term "game balancing." There is not even a common foundation or central core concept for the term, although often several authors employ the same or similar concepts.

Surprisingly, concepts such as fairness, flow, or user satisfaction appeared to be important, but there were no central or fundamental concepts for the definition of game balancing. However, there is a basis of only four concepts that are not exclusively covered together with specific other concepts, but which are shared by many authors and connected with many other concepts: Difficulty, balancing (as a purposive act or process), symmetry, and characteristics of well-balanced games. Therefore, we will now continue discussing these qualitatively while also referring to semantically related or stated concepts.

Characteristics of well-balanced games: While various characteristics meet some explicit approval, such as avoiding stagnation (3/9), allowing the user to make meaningful decisions (3/9) and chance not being powerful enough to render skill useless (3/9), other aspects are still vague. One such aspect is when exactly something becomes "stagnant": Even though the player should not have to unnecessarily repeat tasks, no boundaries are given as to when repetition becomes a problem; after all, games do feature tasks that can or must be repeated in order to progress or improve something. While examples are given such as having to repeat easy parts, there is no rule or definition that applies generally. Additionally, there is no comprehensive definition of the commonly used term "skill": Though there is an implicit distinction between skill as "decision-making" and skill as "dexterity" in executing actions, skill is rather the presumed entirety of influence a player has on the course of a game rather than a well-defined term, although it is also noted that the player should have the experience or feeling of being responsible for the outcome of his or her actions. This leads to further problems within the concept of "difficulty." Besides that some authors (3/9) question how developers should measure and interpret the current state of balance: While it is partially agreed that every player of a multiplayer game having a win ratio of around fifty percent is a good sign, this alone cannot measure whether the game is actually balanced. Most authors name different additional criteria that should be fulfilled, such as the ones already mentioned, but also the importance of counter options, of a functioning matchmaking system or of providing viable options. Beyond that the authors more or less implicitly or indirectly agree that huge imbalances are undesirable, but which level of imbalance is acceptable or

even beneficial seems to be a controversy. Examples for this include which decisions and how many of them should be meaningful and whether providing counter options to actions, game elements or strategies can be enough to compensate at least some balancing issues.

Concerning meaningful decisions, all authors (3/3) underline their importance and describe meaningless decision-making as useless or even harmful to a game. However, there is no exhaustive definition of what a "meaningful" decision exactly is; instead, it is circularly defined as not being meaningless. The type of meaningless decisions that only provide weak options plus one option that is clearly the best, can also lead to dominant strategies. If these are obviously dominant, Sylvester [19] even calls them "degenerative strategies." Those authors who talk about any sorts of strategies agree that dominant strategies should usually be avoided (7/7), with only few exceptions.

Difficulty: Which difficulty level may be right is assumed to depend on the players' perception, the players' skills and how quickly their skills improve (5/6). Although skill and the individual perception of skill are somewhat subjective quantities, they must be mapped onto in-game numbers that can be calculated and manipulated. Several authors (2/6) explicitly name the goal of keeping the player in a state of flow. In order to achieve this, the perceived difficulty must be right, by staying the same or steadily growing. This therefore is somewhat dependent on the audience and even extends to aspects that are not usually considered part of balancing, like learning controls, accessibility and presentation. Additionally, DeCoster and Rubin [21] are the only ones to emphasize a form of difficulty important for multiplayer games, while all other authors focus on difficulty in single player games: Power can be connected to or correlated with the difficulty of executing it. An extremely easy-to-use game element or strategy should not be powerful as well. This also would lead to any multiplayer game not being able to be balanced and also contain a huge variance of difficulty.

Symmetry: Many authors (6/10) explicitly state that symmetrical games are automatically fair. Many modern games, however, are typically asymmetrical, which leads to a higher balancing effort. Sirlin [12] appears to be the only author to explicitly state that a game can be more or less asymmetrical. Fairness is an important concept, most authors agree. However, Adams [9] and Sirlin especially emphasize the importance of fairness for multiplayer games, and also state that fairness alone does not provide a well-balanced game. Additionally, symmetrical games are considered to becoming boring quicker than asymmetrical ones and while they are easier to balance, their game elements still must be balanced.

Balancing: The high number of methods and means for balancing games may be an indicator for the lack of agreement on the actual goal of balancing, i.e. the pursued state of game balance: While no author denies that huge imbalances are bad, smaller ones can be accepted. Not only that: Portnow [13], DeCoster and Rubin [21], Millard [22] and Felder [14] even state that a slight imbalance might be more beneficial than perfect balance. They primarily base their view on a perfectly balanced game offering little to no reason to try something other than proven strategies, or all options being equally good; therefore, the decision between those options does not matter anymore. However, it is unclear if this is the only solution, or if players can have other reasons to use or try different strategies. This might be connected back to the concept of meaningful decisions not being fully grasped yet. Decoster and Rubin [21] take this even further and state that people, players and spectators alike, would actually like imbalance and that games should generally be designed around fun, not balance. While there still can be balancing issues, those can mostly be offset by proper player matching, which should therefore be the focus. Different authors also name various tools and methods to balance a game. Those do not obviously exclude each other and contain, for example, user statistics, spread sheets, iterating, user feedback, power curves, tier lists and game theory, although the latter is more concerned with players than game design.

6 Conclusion & Outlook

Our analysis of fourteen renowned authors' concepts of game balancing revealed that their concepts are clearly different. Although the authors usually agree on certain aspects, for example that games should provide meaningful decision options to the players, there is no central aspect, no central goal of balancing that all fourteen authors focused on in their respective books, texts, or videos. Often, the authors are not far apart, though: For example, while Novak, assuming the players' perspective, concludes that a *"game is balanced if players perceive that it is consistent, fair, and fun"*, Schell advises keeping the player in a state of continuous flow, and Koster concludes that *"game balancing aims at providing a good level of challenge for the user."*

Going into detail, it becomes obvious that some authors focus on certain types of games (e.g. Sirlin and Burgun on multiplayer games), while others try to address games in general (Adams, Schell, etc.). All of them, however, talk about games made for fun and entertainment, but not about games made for other purposes: serious games, health games, exergames and others that might need to be balanced towards achieving goals other than fun. Still, the authors' different perspectives already lead them to differing concepts about game balancing.

Our analysis, however, also revealed that never all, but at least most authors focus on four aspects of their respective game balancing concepts: the characteristics of well-balanced games, difficulty, symmetry, and the balancing process itself. Combining these authors' opinions on the characteristics of well-balanced games, meaningful decision options, player skill, and the prevention of dominant strategies seem to be pivotal. Further combing their opinions on difficulty and symmetry, most authors seem to agree that finding the right level of difficulty is essential; that the difficulty should stay the same or grow steadily according to the player's increasing skill; that fairness is inherent to symmetrical games but must be ensured in asymmetrical games alike; and that fairness alone does not make a game well-balanced.

However, concerning the balancing process and the available means to balance games, the authors' opinions and concepts differ. While many authors seem to strive to balance a game as well as possible, others argue for intentional imbalances and dynamic balancing, or even rating the players rather than balancing the game. Though it is obvious that the balancing process is of utmost interest to renowned game designers wanting to share their knowledge and experience, their concepts about the balancing process itself are diffuse: They present many aspects and ideas, ranging from feedback loops and the transitivity of game elements to chance and metagame—but no author presented a practical, clear, and concise abstraction of an actual game balancing process.

We therefore conclude that further research is required before a commonly agreeable definition of "game balancing" and a suitable abstraction of a practical game balancing process can be derived. It seems coherent that game balancing supports the design goal "fun", especially by avoiding certain occurrences that ruin its fulfillment. However, we still lack a conclusive and positive definition of game balancing that is generally applicable, as well as the uttermost basic level of understanding of what all the rules and suggestions of implementation are supposed to achieve. Not all games are necessarily designed primarily for fun and knowing what to avoid or how to tweak numbers is not sufficient to derive a full plan on how to design a game, for example. It may not be necessary to research game balancing that deeply, but we do not even know that for sure. An empirical study on how a good or bad game balance affects a game's reception and success economically or in sports could show the importance and also help to find proven properties, but this might already require a deeper or more elaborated understanding than we currently have.

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Authors' Information

– **Alexander Becker** studied philosophy with psychology at Ruprecht-Karls University Heidelberg and virtual realities at SRH University Heidelberg. Since then he has been researching game balancing and its underlying concepts.

– **Daniel Görlich** studied informatics at Humbolt University of Berlin and holds a Ph.D in Human-Machine interaction from the University of Kaiserslautern. Currently, he is professor for virtual reality and game development at SRH University Heidelberg. His research focuses on modern and novel ways to design and develop virtual worlds.

Authors' Contributions

– **Alexander Becker** prepared and conducted the semantic analysis of practitioners' publications on game balancing, focused on the semantic analysis as well as on conceptual structuring, and wrote parts of the sections 2, 3, 4, 5, and 6 of the manuscript.

– **Daniel Görlich** prepared and conducted the review of scientific approaches to game balancing, focused on discussion and interpretation of the results as well as on conceptual structuring, and wrote parts of the sections 1, 2, 3, 5, and 6 of the manuscript.

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