Heuristic Evaluation for Gameful Design

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Abstract
Despite the emergence of many gameful design
methods in the literature, there is a lack of evaluation
methods specific to gameful design. To address this
gap, we present a new set of guidelines for heuristic
evaluation of gameful design in interactive systems.
First, we review several gameful design methods to
identify the dimensions of motivational affordances
most often employed. Then, we present a set of 28
gamification heuristics aimed at enabling experts to
rapidly evaluate a gameful system. The resulting
heuristics are a new method to evaluate user
experience in gameful interactive systems.

Author Keywords
Heuristic Evaluation; Gamification; Gameful Design.

ACM Classification Keywords
H.5.2. User Interfaces: Evaluation methodology; H.5.3.
Group Interfaces: Evaluation methodology.

Introduction
Gamification, using game design elements in non-game
contexts [9], complements user experience (UX) meth-
ods to increase user motivation and engagement in
many different fields, such as education, health, social
networks, and business [14,33,38]. Some gameful de-
sign frameworks and methods have been suggested

Heuristic Evaluation for Playability (HEP) [6]

A set of heuristics for playability comprised of four categories: gameplay, game story, game mechanics, and game usability.

Games Usability Heuristics (PLAY) [7]

A set of seven principles aimed to evaluate action-adventure, RTS, and FPS games.

Game Approachability Principles (GAP) [8]

A set of guidelines to create better tutorials or experiences for new players.

Playability heuristics for mobile games [18]

A set of heuristics for mobile games comprised of three categories: game usability, mobility, and gameplay.

Networked Game Heuristics (NGH) [32]

A set of heuristics that consider specific issues related with group play over a network.

Heuristics for social games [30]

Created from a critical review of video game evaluation heuristics

GameFlow [39,40]

A comprehensive heuristic set designed as a tool to evaluate player enjoyment.

Table 1: Existing heuristic evaluation models for game design.

[11,23] with prescriptive guidelines on augmenting an application with motivational affordances. We refer to *gamification* and *gameful design* interchangeably since both frame the same set of phenomena from different points of view [9]. Motivational affordances are properties added to an object, which allow its users to experience the satisfaction of their psychological needs [10,42]. In gameful design, motivational affordances are often used to facilitate intrinsic and extrinsic motivations as advocated by self-determination theory (SDT) [4,35–37]. Thus, motivational affordances that support the user's feelings of competence, autonomy, and relatedness are used to facilitate intrinsic motivation, whereas rewards facilitate extrinsic motivation.

Although many gameful design methods have emerged recently, designers still lack standard evaluation methods. While several studies have investigated the effectiveness of gameful applications by studying their users [14], there are no guidelines on evaluating the implementation of gameful design elements into a system. For other established areas of UX, heuristic evaluation methods are commonly used [27,28]. They are fast and inexpensive tools that can be used to identify and address design issues early in a project. They are not meant to replace user tests, but rather add to the set of evaluation tools: while heuristic evaluation can be applied early in a project, user tests are conducted later to find issues that could not be captured before.

Our work aims to contribute to the HCI community by presenting a new set of guidelines for heuristic evaluation of gameful design in interactive systems. First, we reviewed several gameful design frameworks and methods to identify which dimensions of motivational affordances were most common. Next, we created a set

of heuristics focused on each of the identified dimensions. The resulting heuristics set provides a new way of evaluating gameful user experiences. It is the first tool of its kind focused specifically on evaluating gameful design through the lens of intrinsic and extrinsic motivational affordances.

Background

In usability engineering, heuristics are general principles or broad usability guidelines that have been used to design and evaluate interactive systems [29]. Heuristic evaluation is the use of said principles as a usability inspection method by experts to identify usability problems in an existing design as part of an iterative design process [27,28].

Several heuristic evaluation models for game design exist (see Table 1). However, to the best of our knowledge, no heuristics set is available for gameful design. Some heuristics for evaluating games or playability could also be employed to gameful applications; however, they will not cover the full range of common motivational affordances. For example, *meaning* is a dimension of motivational affordances often used in gameful design which is not covered by existing heuristics. Some of the existing gameful design methods, namely Octalysis [3], HEXAD [21], and Lens of Intrinsic Skill Atoms [11], suggest procedures to evaluate an existing system. Nevertheless, these procedures are aimed at providing a starting point for the design process. They are less-suited for being used as a separate evaluation tool by an independent quality control team because they lack a concise set of design heuristics with concise descriptions, which could be quickly checked by an independent expert. Our research aims to fill this gap.

Table 2: A summary of existing gameful design frameworks and methods considered in our research.

Review of Gameful Design Methods

Several gameful design frameworks and methods exist [11,23] (see Table 2). However, only a few of them feature a classification of motivational affordances in different dimensions, which were used as a theoretical background to devise our heuristics. Therefore, we focused our analysis on those that included this feature (see Table 3). After reviewing and comparing them, we identified twelve common dimensions of motivational affordances, which were based on the theories of intrinsic and extrinsic motivation [35–37] and behavioural economics [13], as well as the authors' experience.

Gamification Heuristics

Our set of heuristics is aimed at enabling experts to identify gaps in a gameful system's design. It was constructed based on an examination of the literature cited in Table 3, by writing adequate guidelines for each of the twelve identified dimensions. Prior research on motivation [35,36] enabled categorization of the twelve dimensions into *intrinsic*, *extrinsic*, and *context dependent* motivational categories (see Table 4). Next, we built our set of gamification heuristics based on this categorization (see Tables 5–7) to highlight the different uses of intrinsic and extrinsic motivators.

Dimension	Octalysis [3]	HEXAD [21]	RECIPE [24]	KEG [17]	Super Better [22]	MDL [11]
Purpose and Meaning	Epic Meaning & Calling	Philanthropist	Information; Reflection		Epic win	
Challenge and Competence	Development & Accomplishment	Achiever	Engagement	Competence; Challenge	Challenge; Bad guys	Challenge lenses; Intrinsic rewards
Completeness and Mastery	Development & Accomplishment	Achiever		Competence; Achievements	Complete quests	Goal lenses; Action lenses; Intrinsic rewards
Autonomy and Creativity	Creativity & Feedback	Free Spirit	Play; Choice	Autonomy		Object lenses; Intrinsic rewards
Relatedness	Social Influence & Relatedness	Socialiser	Engagement	Relatedness	Recruit your allies	Intrinsic rewards
Immersion			Exposition	Perceived Fun	Secret identity	
Ownership and Rewards	Ownership & Possession	Player		Extrinsic motivation	Power-ups	Intrinsic rewards
Unpredictability	Unpredictability & Curiosity	Free Spirit	Play			Varied challenge; Varied feedback; Secrets
Scarcity	Scarcity & Impatience					
Loss avoidance	Loss & Avoidance					
Feedback	Creativity & Feedback					Feedback lenses
Change and Disruption		Disruptor				

Table 3. Common dimensions of motivational affordances from the reviewed gameful design methods.

Intrinsic Motivation Heuristics

This category includes affordances related to the three psychological needs introduced by SDT [35,36] (competence, autonomy, and relatedness), as well as purpose and meaning, which facilitate internalization as suggested by SDT [5], and immersion as suggested by Ryan and Rigby [34,37] and Malone [20].

Extrinsic Motivation Heuristics

This category includes affordances that provide an outcome or value separated from the activity itself as suggested by SDT [36] and Chou [3]: ownership and rewards, scarcity, and loss avoidance.

Context Dependent Heuristics

This category includes the feedback, unpredictability, and disruption affordances, which can afford either intrinsic or extrinsic motivation, depending on contextual factors such as the kind and the user's personal perception regarding the task at hand.

Table 4: Categories of motivational affordances in our gameful design heuristics.

Intrinsic Motivation Heuristics
Purpose and Meaning: Affordances aimed at helping users identify a meaningful goal that will be achieved through the system and can benefit the users themselves or other people.
I1. *Meaning*: The system clearly helps users identify a meaningful contribution (to themselves or to others).
I2. *Information and Reflection*: The system provides information and opportunities for reflection towards self-improvement.
Challenge and Competence: Affordances aimed at helping users satisfy their intrinsic need of competence through accomplishing difficult challenges or goals.
I3. *Increasing Challenge*: The system offers challenges that grow with the user's skill.
I4. *Onboarding*: The system offers initial challenges for newcomers that help them learn how it works.
I5. *Self-challenge*: The system helps users discover or create new challenges to test themselves.
Completeness and Mastery: Affordances aimed at helping users satisfy their intrinsic need of competence by completing series of tasks or collecting virtual achievements.
I6. *Progressive Goals*: The system always presents the next goals users can pursue that are immediately achievable.
I7. *Achievement*: The system lets users keeps track of their achievements or advancements.
Autonomy and Creativity: Affordances aimed at helping users satisfy their intrinsic need of autonomy by offering meaningful choices and opportunities for self-expression.
I8. *Choice*: The system provides users with choices on what to do or how to do something, which are interesting but also limited in scope according to each user's capacity.
I9. *Self-expression*: The system lets users express themselves or create new content.
I10. *Freedom*: The system lets users experiment with new or different paths without fear or serious consequences.
Relatedness: Affordances aimed at helping users satisfy their intrinsic need of relatedness through social interaction, usually with other users.
I11. *Social Interaction*: The system lets users connect and interact socially.
I12. *Social Cooperation*: The system offers the opportunity of users working together towards achieving common goals.
I13. *Social Competition*: The system lets users compare themselves with others or challenge other users.
I14. *Fairness*: The system offers similar opportunities of success and progression for everyone and means for newcomers to feel motivated even when comparing themselves with veterans.
Immersion: Affordances aimed at immersing users into the system to improve their aesthetic experience [15], usually by means of a theme, narrative, or story, which can be real or fictional.
I15. *Narrative*: The system offers users a meaningful narrative or story with which they can relate to.
I16. *Perceived Fun*: The system affords users the possibility of interacting with and being part of the story (easy fun; [19]).

Table 5. Intrinsic motivation heuristics.

Extrinsic Motivation Heuristics
Ownership and Rewards: Affordances aimed at motivating users through extrinsic rewards or possession of real or virtual goods. Ownership is different from competence when acquiring goods is perceived by the user as the reason for interacting with the system, instead of feeling competent.
E1. *Ownership*: The system lets users own virtual goods or build an individual profile over time, which can be developed by continued use of the system and with which users can relate to.
E2. *Rewards*: The system offers incentive rewards for interaction and continued use, which are valuable to users and proportional to the amount of effort invested.
E3. *Virtual Economy*: The system lets users exchange the result of their efforts with in-system or outside rewards.
Scarcity: Affordances aimed at motivating users through feelings of status or exclusivity by means of acquisition of difficult or rare rewards, goods, or achievements.
E4. *Scarcity*: The system offers interesting features or rewards that are rare or difficult to obtain.
Loss Avoidance: Affordances aimed at leading users to act with urgency, by creating situations in which they could loose acquired or potential rewards, goods, or achievements if they do not act immediately.
E5. *Loss Avoidance*: The system creates urgency through possible losses unless users act immediately.

Table 6. Extrinsic motivation heuristics.

Context Dependent Heuristics
Feedback: Affordances aimed at informing users of their progress and the next available actions or challenges.
C1. *Clear and Immediate Feedback*: The systems always inform users immediately of any changes or accomplishments in an easy and graspable way.
C2. *Actionable Feedback*: The system always informs users the next available actions and improvements available.
C3. *Graspable Progress*: Feedback always tells users where they stand and what is the path ahead for progression.
Unpredictability: Affordances aimed at surprising users with variable tasks, challenges, feedback, or rewards.
C4. *Varied Challenges*: The system offers unexpected variability in the challenges or tasks presented to the user.
C5. *Varied Rewards*: The system offers unexpected variability in the rewards that are offered to the user.
Change and Disruption: Affordances aimed at engaging users with disruptive tendencies [21] by allowing them to help improve the system, in a positive rather than destructive way.
C6. *Innovation*: The system lets users contribute with ideas, content, plugins, or modifications aimed at improving, enhancing, or extending the system itself.
C7. *Disruption Control*: The system is protected against cheating, hacking, or other forms of manipulation from users.

Table 7. Context dependent heuristics.

Using the Gamification Heuristics
Similar to previous heuristic UX evaluation methods, the gamification heuristics should be used by experts to identify gaps in a gameful system's design. They can be used to evaluate the implementation of new gameful design elements into a system or to compare two different gameful systems. Experts should consider each guideline to evaluate whether it is adequately implemented into the system's design. They also need to consider the balance between intrinsic and extrinsic motivational affordances. Cerasoli *et al.* [2] showed that intrinsic motivation is a stronger predictor of performance in qualitative tasks whereas extrinsic motivation is a stronger predictor in quantitative tasks. Thus, combining intrinsic and extrinsic motivations can lead to improved performance. Additionally, prior studies have shown that evaluations conducted by many evaluators are more effective in comparison to evaluations by an individual evaluator [25–27].

Conclusion
We have created a set of 28 gameful design heuristics aimed at enabling experts to evaluate a gameful system to identify design gaps. Our heuristics are based on prior motivational theories and gameful design methods. By deriving our set of heuristics from the common dimensions of motivational affordances employed by different gameful design methods, we have presented a novel and comprehensive approach that encompasses a broad range of motivational affordances. Moreover, by categorizing the heuristics according to motivational type (intrinsic, extrinsic, and context dependent motivation), our model also contributes to raising designers' awareness of the different motivation types. Furthermore, the heuristics are written in a concise form to enable expert evaluation.

Future Work
Our future work will address the use and validation of the suggested heuristics set. First, we need to assume that a gameful system may not need to include all available affordances. The complete set of heuristics represents the best scenario; however, after identifying which affordances were not included in the system, designers will need to further evaluate if these are really needed. A system might be able to accomplish its goals without implementing all the heuristics, in the same way that a game does not need to include all existing game mechanics to be enjoyable. Therefore, future research needs to establish a way to inform designers how to better use these heuristics.

Additionally, we will compare our gamification heuristics with the game design heuristics cited in Table 1. Some overlap between them is expected; however, our method should be better suited for evaluating gameful applications or systems since it excludes heuristics that are applicable to games but not to gameful applications, while at the same time adding new dimensions of motivational affordances. Finally, we will validate our heuristic evaluation method by inviting designers and experts to use it and provide us with feedback.

Our work contributes to the HCI field by presenting a novel evaluation tool that has the potential to inform future research on gamification and gameful design.

References

1. Brian Burke. 2014. *Gamify: How gamification motivates people to do extraordinary things*. Bibliomotion.

2. Christopher P. Cerasoli, Jessica M. Nicklin, and Michael T. Ford. 2014. Intrinsic Motivation and Extrinsic Incentives Jointly Predict Performance: A 40-Year Meta-Analysis. *Psychological Bulletin*: Advance online publication. http://doi.org/10.1037/a0035661

3. Yu-kai Chou. 2015. *Actionable Gamification - Beyond Points, Badges, and Leaderboards*. Octalysis Media.

4. Edward L. Deci and Richard M. Ryan. 1985. *Intrinsic Motivation and Self-Determination in Human Behavior*. Plenum, New York and London.

5. Edward L. Deci, Haleh Eghrari, Brian C. Patrick, and Dean R. Leone. 1994. Facilitating Internalization: The Self-Determination Theory Perspective. *Journal of Personality* 62, 1: 119–142. http://doi.org/10.1111/j.1467-6494.1994.tb00797.x

6. Heather Desurvire, Martin Caplan, and Jozsef A. Toth. 2004. Using heuristics to evaluate the playability of games. *CHI'04 Extended Abstracts on Human Factors in Computing Systems*, 1509–1512. http://doi.org/10.1145/985921.986102

7. Heather Desurvire and Charlotte Wiberg. 2009. Game Usability Heuristics (PLAY) for Evaluating and Designing Better Games: The Next Iteration. *Online Communities and Social Computing: Third International Conference - OCSC 2009*, Springer Berlin Heidelberg, 557–566. http://doi.org/10.1007/978-3-540-73257-0

8. Heather Desurvire and Charlotte Wiberg. 2010. User Experience Design for Inexperienced Gamers: GAP – Game Approachability Principles. In *Evaluating User Experience in Games*, Regina Bernhaupt (ed.). Springer, 131–148. http://doi.org/10.1007/978-1-84882-963-3_1

9. Sebastian Deterding, Dan Dixon, Rilla Khaled, and Lennart E. Nacke. 2011. From Game Design Elements to Gamefulness: Defining "Gamification." *Proceedings of MindTrek 2011*, ACM, 9–15. http://doi.org/10.1145/2181037.2181040

10. Sebastian Deterding. 2011. Situated motivational affordances of game elements: A conceptual model. *Gamification: Using Game Design Elements in Non-Gaming Contexts, A Workshop at CHI 2011*, ACM.

11. Sebastian Deterding. 2015. The Lens of Intrinsic Skill Atoms: A Method for Gameful Design. *Human-Computer Interaction* 30, 3-4: 294–335. http://doi.org/10.1080/07370024.2014.993471

12. Andrés Francisco-Aparicio, Francisco Luis Gutiérrez-Vela, José Luis Isla-Montes, and José Luis González Sanchez. 2013. Gamification: Analysis and Application. In *New Trends in Interaction, Virtual Reality and Modeling*, Victor Penichet, Antonio Peñalver and José Gallud (eds.). Springer London, 113–126. http://doi.org/10.1007/978-1-4471-5445-7_9

13. Juho Hamari, Kai Huotari, and Juha Tolvanen. 2015. Gamification and Economics. In *The Gameful World: Approaches, Issues, Applications*, Steffen P. Walz and Sebastian Deterding (eds.). The MIT Press, 139–161.

14. Juho Hamari, Jonna Koivisto, and Harri Sarsa. 2014. Does gamification work? - A literature review of empirical studies on gamification. *Proceedings of the Annual Hawaii International Conference on System Sciences*, 3025–3034. http://doi.org/10.1109/HICSS.2014.377

15. Robin Hunicke, Marc LeBlanc, and Robert Zubek. 2004. MDA: A Formal Approach to Game Design and Game Research. *Workshop on Challenges in Game AI*, 1–4. http://doi.org/10.1.1.79.4561

16. Sergio Jiménez. 2015. Gamification Model Canvas. Retrieved July 10, 2016 from http://www.gameonlab.com/canvas/

17. Dennis L Kappen and Lennart E Nacke. 2013. The Kaleidoscope of Effective Gamification: Deconstructing Gamification in Business Applications. *Proceedings of Gamification 2013*, ACM, 119–122. http://doi.org/10.1145/2583008.2583029

18. Hannu Korhonen and Elina M. I. Koivisto. 2007. Playability heuristics for mobile multi-player games. *Proceedings of the 2nd International Conference on Digital Interactive Media in Entertainment and Arts*, 28–35. http://doi.org/10.1145/1306813.1306828

19. Nicole Lazzaro. 2008. The four fun keys. In *Game Usability: Advancing the Player Experience*, K. Isbister and N. Schaffer (eds.). Elsevier, Burlington, 315–344.

20. Thomas W. Malone. 1981. Toward a Theory of Intrinsically Motivating Instruction. *Cognitive Science* 4: 333–369.

21. Andrzej Marczewski. 2015. *Even Ninja Monkeys Like to Play: Gamification, Game Thinking & Motivational Design*. CreateSpace Independent Publishing Platform.

22. Jane McGonigal. 2015. *SuperBetter: A Revolutionary Approach to Getting Stronger, Happier, Braver and More Resilient*. Penguin Books.

23. Alberto Mora, Daniel Riera, Carina Gonzalez, and Joan Arnedo-Moreno. 2015. A literature review of gamification design frameworks.

7th International Conference on Games and Virtual Worlds for Serious Applications (VS-Games). http://doi.org/10.1109/VS-GAMES.2015.7295760

24. Scott Nicholson. 2014. A RECIPE for Meaningful Gamification. In *Gamification in Education and Business*, Torsten Reiners and Lincoln C. Wood (eds.). Springer, 1–20. http://doi.org/10.1007/978-3-319-10208-5

25. Jakob Nielsen and Thomas K. Landauer. 1993. A mathematical model of the finding of usability problems. *Proceedings of the SIGCHI conference on Human factors in computing systems - CHI '93*, ACM, 206–213. http://doi.org/10.1145/169059.169166

26. Jakob Nielsen and Rolf Molich. 1990. Heuristic Evaluation of User Interfaces. *Proceedings of the SIGCHI Conference on Human Factors in Computer Systems - CHI '90*, 249–256. http://doi.org/10.1145/97243.97281

27. Jakob Nielsen. 1992. Finding usability problems through heuristic evaluation. *Proceedings of the SIGCHI Conference on Human Factors in Computer Systems - CHI '92*, 373–380. http://doi.org/10.1145/142750.142834

28. Jakob Nielsen. 1994. Heuristic Evaluation. In *Usability Inspection Methods*, Jakob Nielsen and R.L. Mack (eds.). John Wiley & Sons, New York, 25–62. http://doi.org/10.1089/tmj.2010.0114

29. Jakob Nielsen. 1994. Enhancing the explanatory power of usability heuristics. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems - CHI '94*, 152–158. http://doi.org/10.1145/191666.191729

30. Janne Paavilainen. 2010. Critical review on video game evaluation heuristics: Social Games Perspective. *Proceedings of the International Academic Conference on the Future of Game Design and Technology*, 56–65. http://doi.org/10.1145/1920778.1920787

31. Rajat Paharia. 2013. *Loyalty 3.0: How to revolutionize customer and employee engagement with big data and gamification*. McGraw-Hill, New York, NY.

32. David Pinelle, Nelson Wong, Tadeusz Stach, and Carl Gutwin. 2009. Usability heuristics for networked multiplayer games. *Proceedings of the ACM 2009 International Conference on Supporting Group Work*, 169–178. http://doi.org/10.1145/1531674.1531700

33. Marigo Raftopoulos, Steffen Walz, and Stefan Greuter. 2015. How enterprises play : Towards a taxonomy for enterprise gamification. *DiGRA 2015: Diversity of Play*, 1–17.

34. Scott Rigby and Richard M. Ryan. 2011. *Glued to Games: How Video Games Draw Us In and Hold Us Spellbound*. Praeger.

35. Richard M. Ryan and Edward L. Deci. 2000. Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *The American Psychologist* 55, 1: 68–78. http://doi.org/10.1037/0003-066X.55.1.68

36. Richard M. Ryan and Edward L. Deci. 2000. Intrinsic and Extrinsic Motivations: Classic Definitions and New Directions. *Contemporary Educational Psychology* 25, 1: 54–67. http://doi.org/10.1006/ceps.1999.1020

37. Richard M. Ryan, C. Scott Rigby, and Andrew Przybylski. 2006. The motivational pull of video games: A self-determination theory approach. *Motivation and Emotion* 30, 4: 347–363. http://doi.org/10.1007/s11031-006-9051-8

38. Katie Seaborn and Deborah I. Fels. 2014. Gamification in theory and action: A survey. *International Journal of Human-Computer Studies* 74: 14–31. http://doi.org/10.1016/j.ijhcs.2014.09.006

39. Penelope Sweetser, Daniel Johnson, and Peta Wyeth. 2012. Revisiting the GameFlow Model with Detailed Heuristics. *Journal of Creative Technologies* 3.

40. Penelope Sweetser and Peta Wyeth. 2005. GameFlow: A Model for Evaluating Player Enjoyment in Games. *Computers in Entertainment* 3, 3: 3. http://doi.org/10.1145/1077246.1077253

41. Kevin Werbach and Dan Hunter. 2012. *For the Win: How game thinking can revolutionize your business*. Wharton Digital Press, Philadelphia, PA.

42. Ping Zhang. 2008. Motivational Affordances: Reasons for ICT Design and Use. *Communications of the ACM* 51, 11: 145–147. http://doi.org/10.1145/1400214.1400244

43. Gabe Zichermann and Christopher Cunningham. 2011. *Gamification by Design: Implementing game mechanics in web and mobile apps*. O'Reilly.