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A Motivational Perspective on the Personalization of Gamification

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A Motivational Perspective on the Personalization of Gamification

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ABSTRACT

The gamification of information systems has seen success in a variety of contexts. However, research has shown that the degree to which gamification is successful varies between individuals. The current paper evaluates the effectiveness of personalized gamification in a warehouse management context. Additionally, this paper explores why personalized gamification can be more successful than non-personalized gamification. Twenty-six subjects participated in a within-subject laboratory experiment in which goal setting and feedback game elements were integrated into a wearable management information system to examine their effect on user performance in a warehouse picking task. The effectiveness of personalized gamification was evaluated by categorizing participants into user types using the HEXAD model and examining performance across conditions and user types. Results show that user type significantly affects the relationship between game elements and user performance. This paper takes a step forward in exploring the motivational mechanisms that explain the efficacy of personalized gamification.

Keywords

Gamification, Personalization, Motivation, Self-determination Theory

INTRODUCTION

In the last two decades, gamification has been shown to engage and absorb users in many domains. Gamification, defined as the employment of game elements in a non-gaming context, tries to capture the naturally motivating effect of video games to transfer it to other domains, such as the workplace. In gamification, the goal is often to motivate users to complete a certain task. Therefore, theories of

motivation have often been used to gain insight into user behaviour, perception, and cognition. Self-determination theory (SDT), the most widely used motivation theory in gamification literature, posits that three psychological needs are necessary for intrinsic motivation, which leads to positive gamification outcomes such as meaningful engagement with a system and long-term performance. Within this theory, motivation is categorized as intrinsic (coming from oneself) or extrinsic (coming from an external source). In psychological literature, it is clear that the degree to which motivators are internalized varies significantly between individuals. In a gamification context, this implies that individuals will be differentially intrinsically motivated when faced with a game element. Particular gamification elements will lead to more intrinsic/autonomous motivation for individuals with certain personality characteristics. For example, an individual with socialiser characteristics will be more autonomously/intrinsically motivated by gamification components that allow for interpersonal interaction. Personalized gamified systems thus have the potential to achieve better results than non-personalized gamification. However, research related to personalized gamification systems is only in its infancy (Tondello, 2019). Additional research in a variety of contexts should be done evaluate the efficacy of personalized gamification.

RELATED WORK AND HYPOTHESIS DEVELOPMENT

Gamification has generally been successful when it comes to engagement, performance, and enjoyment (Koivisto & Hamari, 2017; Warmelink, Koivisto, Mayer, Vesa, & Hamari, 2018). The most frequently employed game elements in past research are points, goals, leaderboards, stories, and feedback. Gamification and many of its elements are oriented towards goal-setting and goal attainment. (Deterding, Dixon, Khaled, & Nacke, 2011; Tondello, Premeaux, & Nacke, 2018). However, seminal motivation theories of motivation that explicate individuals' motives to

attain goals are rarely used in a meaningful way (Tondello et al., 2018; Tyack & Mekler, 2020).

Self-determination Theory

Self-determination theory is a theory of motivation which has been applied to a multitude of domains. SDT posits that three psychological needs are necessary for intrinsic motivation, characterized by accomplishing an action for the sake of doing it, without any external reward (Ryan & Deci, 2000). Competence (1) relates to a feeling of being able to overcome a challenge; autonomy (2) is characterized by a sense of freedom when completing a task; relatedness (3) relates to a sense of connection to others (Ryan & Deci, 2000). Motivation varies on a continuum: amotivation, extrinsic motivation, and intrinsic motivation. Motivation types along this continuum range from controlled to autonomous. In short, motivation is externally regulated (controlled) on one end and is intrinsically regulated (autonomous or self-determined) on the other end. Amotivation refers to no motivation at all. Externally regulated motivation refers to extrinsic motivation. To summarize, the continuum represents varying levels of internalization of the motives to complete an action or display a behaviour. Motives for goal pursuit are also differentially internalized, which leads to a motivation type on the self-determination continuum. As is shown in research, the more a goal's pursuit is internalized, the more that goal has a chance to be successful (Koestner & Hope, 2014). Specifically, when the motivation for goal attainment comes from within, rather than an external source, more effort is directed towards that goal, making it more likely to be reached. This means that SDT's three psychological needs are important when it comes to goals and goal pursuit.

Personalization

Goal pursuit internalization has great interpersonal variability. In a gamification context, this implies that there is no universal group of gamification elements that will lead all individuals or types of users to be intrinsically motivated. The majority of user classification models were designed for video games (Bartle, 1996; Bateman & Boon, 2005; Nacke, Bateman, & Mandryk, 2014; Xu et al., 2012). Research has shown that these models do not apply to gamification (Tondello, 2019). Thus, the HEXAD model was created, based on SDT, to account for the lack of user typology for gamified systems (Marczewski, 2015; Tondello et al., 2016). Each of the six user types are motivated to varying degrees by game elements. More specifically, each type of individual internalizes various game elements in different ways.

The relevant five HEXAD user types will be presented in this paragraph (Tondello et al., 2016). Achievers (1) are intrinsically motivated by gamification elements associated with the psychological need for competence. They have a propensity to perform as best as they could. Therefore, levels, challenges/goals, and leaderboards may lead to autonomous motivation for achievers. Free spirits (2) are

intrinsically motivated by gamification that is supportive of the psychological need for autonomy. This user type does not like to be contained or restrained by external factors. They like to explore and do not like to be controlled by external forces. Game elements that may autonomously motivate free-spirits are self-set goals and exploration tasks. Socialisers (3) are intrinsically motivated by a sense of connection to others (relatedness). Game elements such as in-game chatting and team challenges will lead socialiser to be autonomously motivated. Philanthropists (4) are also intrinsically motivated by a sense of connection to others (relatedness). They are different from socialisers in the sense that they like altruism and purpose. Philanthropists will be more autonomously motivated by gamification elements such as knowledge transfer and gifting. Players (5) are intrinsically motivated by reward from an external source. Players will be more autonomously motivated by gamification elements such as points and achievements. Based on the reviewed literature, we hypothesize that HEXAD user type will influence the goal-performance relationship.

METHODOLOGY

Experimental Design and Sample

The current experiment used a within-subject design where two experimental factors were manipulated (goals and feedback). This led to three conditions: no gamification, self-set goals & feedback, and assigned goals & feedback. Twenty-six subjects participated. Their mean age was 24.4 (SD=2.1), their median age was 24, while the range was from 19 to 26. Our institutional review board approved this study. Subjects received 40\$ at the end of the study as compensation for their participation.

Experimental Task, Setup, and Stimuli

In the current experiment, participants completed one order picking task in each of the three conditions, using a wearable MIS (management information system). In each of the three picking tasks, participants had to pick varying amounts of 12 specific items from a particular location, and then place the picked items into a bin on a trolley. For example, one of the 12 picks per task could be to pick eight erasers from location C03005. Some picks were more complex (e.g. picking 12 blue pins from a box of 100 pins of various colours). Participants received instructions from the wearable MIS. Each pick had a unique location, to avoid learning effects related to the familiarity of an item's location. A simulated warehouse was created in our research laboratory (3.4 x 5.2 meters). In this warehouse, five large metal bookshelves containing 20 labelled boxes were placed. Each labelled box served as a location. All Participants started and ended at the same location in the warehouse. Their path through the warehouse was also identical.

Procedure

Participants were first instructed that they were testing a new warehouse management device. They were told that they would be picking various quantities of specific items from different locations on the bookshelves, and then put those items into a bin on the trolley they brought throughout the simulated warehouse. Participants then completed a demographics questionnaire and the HEXAD. The wearable MIS was then installed on them. This was followed with specific instructions about the picking tasks and a six-pick non-gamified training task. Special care was taken to make sure that participants fully understood the picking task procedure. This training task was put into place to limit the learning effect. After this, condition 1 was started.

Condition 1 (No Gamification – NG) contained no gamification elements, just an upwards counting timer in the corner of the screen. See Figure 2 for the picking screen. Figure 2 shows that the participant is completing pick four out of 12. This pick consists of taking 6 studio-brand pencils from location B01001. Once the items are placed into the bin, the participant must click on “item number”, at which point the item number (PRD34201) is automatically entered. The participant then manually enters the quantity (6), then clicks “Continue”. At the end of this condition, participants then complete either Condition 2 or 3, followed by the remaining condition.

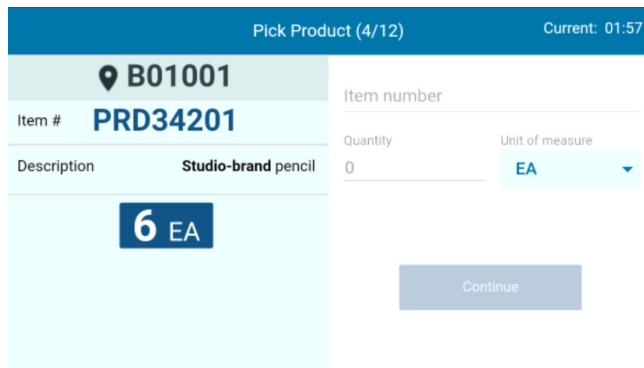


Figure 2: Condition 1 (NG) Picking Screen

In **Condition 2 (Self-Set Goals – SSG)**, participants had to select one of three time goals before starting the task. The middle choice (6:38) consisted of the average time it took participants to complete this task in a nine-participant pilot study with different participants. The top choice (5:38) was considered the difficult goal, whereas the bottom choice (7:38) was considered the easy goal. In this condition, the chosen goal was added on-screen, right under the upwards-counting time. At the end of the 12 picks, participants were told on screen whether or not they had reached their chosen goal. In **Condition 3 (Assigned Goals – AG)**, participants were assigned a goal, which was the middle goal (average time) in Condition 2 (6:38). The picking screen was the same as in Condition 2. Just like in Condition 2, participants were

told on screen whether or not they had reached the goal at the end of the condition.

Operationalization of Research Variables

Performance

Performance was operationalized using two of the main warehouse key performance indicators: (1) time taken to complete the task and (2) number of errors (Bartholdi & Hackman, 2019).

HEXAD

The HEXAD scale was used to determine participant user type. The scale contains 24 items, each scored using a 7-point Likert scale. Please see Tondello et al. (2016) for more information on the HEXAD.

RESULTS

To analyze all of our data, Wilcoxon rank-sum tests were employed. HEXAD user types were distributed in the following way: 0 disrupters, 5 achievers, 6 free-spirits, 4 philanthropists, 5 socialisers, and 5 players. In our analyses, socialisers and philanthropists were grouped because no significant differences were found between them.

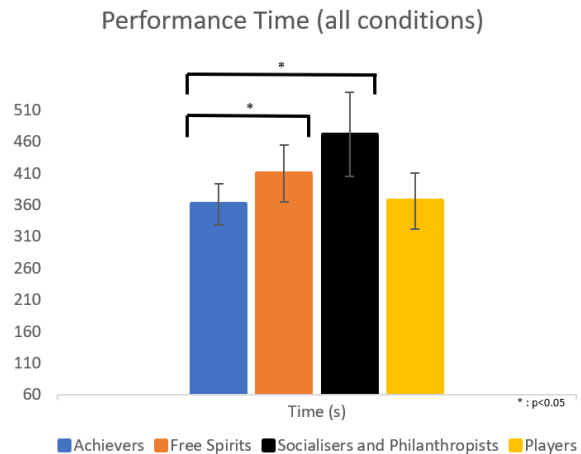


Figure 6: Performance time across user types

Performance Time and Performance Errors

Achievers

Achievers had a better performance time in all conditions than free spirits ($d=-1.21, p<0.05$), and philanthropists and socialisers ($d=-1.04, p<0.05$). When comparing players to achievers, no difference was observed ($p=0.29$). See Figure 6 for a breakdown of performance (time) by type of user.

Achievers had less performance errors in all conditions, when compared to free spirits ($d=-0.79, p<0.05$), and philanthropists and socialisers ($d=-1.06, p<0.05$). When comparing players to achievers, no difference was observed ($p=0.26$).

Additionally, achievers selected more difficult goals in the SSG condition (Condition 2), when compared to philanthropists and socialisers ($d=1.19$, $p<0.05$), free spirits ($d=0.99$, $p<0.05$), and players ($d=1.30$, $p<0.05$).

Free Spirits

Free spirits had a better performance time in the SSG condition (Condition 2) than in the NG condition (Condition 1) ($d=-0.64$, $p<0.05$) or the AG condition (Condition 3) ($d=-0.63$, $p<0.05$).

In addition, free spirits had less performance errors in Condition 2 compared to Condition 1 ($d=0.88$, $p<0.05$). No significant difference was found when Condition 2 was compared to Condition 3 ($p=0.13$).

Players

Players had better performance time in the AG condition (Condition 3) than in the NG condition (Condition 1) ($d=-0.57$, $p<0.05$) or the SSG condition (Condition 2) ($d=-0.57$, $p<0.05$).

In addition, players had less performance errors in Condition 3 compared to Condition 1 ($d=0.75$, $p<0.05$). No significant difference was found when Condition 3 was compared to Condition 2 ($p=0.19$).

DISCUSSION

Our results demonstrate that personalized gamification seems to be more effective than non-personalized gamification. User types seem to respond more favourably to specific game elements. A misalignment between user type and game element led to worse performance than when user type and element were aligned (e.g. players and assigned goals). The subsequent paragraphs will discuss the results for the relevant user types.

Achievers

Achievers had a better performance than other user types, except players. This is as expected because they have a propensity to perform as best as they could. Pursuing and reaching goals fills their need for competence, leading to internalization of goal attainment, as well as autonomous motivation. Results also demonstrated that they chose harder goals than the other types. This finding further illustrates that their need for competence is central to their autonomous motivation.

Free spirits

Free spirits had a better performance in the condition where they were able to choose their own goal. When goals were self-set, individuals feel a sense of freedom (autonomy). Free

spirits are particularly reactive to the fulfilment of the need for autonomy, in the sense it facilitates their goal pursuit internalization, leading to autonomous motivation and stronger performance. In the condition in which goals were assigned (Condition 3), the need for autonomy was not supported, which is what may have led to worse performance by free spirits, when compared to Condition 2.

Players

Players are the only type that is autonomously motivated by extrinsic reward, such as in-game currency, money, or points. In other words, they are better able to internalize external rewards. Results showed that when players were assigned a goal (Condition 3), they had a better performance. The assigned goal (an extrinsic motivator) was internalized, which led to autonomous motivation and better performance.

CONCLUSION

In conclusion, personalized gamification seems to produce better results than non-personalized gamification, in terms of performance time and errors. When considering the implementation of gamification, practitioners and researchers should therefore assess user typology to select the proper gamification elements. To be clear, gamified systems should be adapted to each individual's user type. This kind of personalized gamification fosters autonomous/intrinsic motivation, which can be especially beneficial in the workplace. In addition to being more performant, intrinsically motivated workers exhibit better well-being, compared to unmotivated or extrinsically motivated workers (Deci, 2017).

Two limitations must be mentioned. The first being that only short-term performance was measured. This means that we cannot confirm whether the effects of personalized gamification will last over time. The second limitation is that the concepts of internalization, motivation, and need satisfaction were not directly measured. We therefore cannot quantify their effect on the goal-performance relationship.

The next step would be to integrate additional gamification elements to examine how the different HEXAD user types react. Additionally, feelings of autonomy, competence, and relatedness, as well as internalization and motivation should be directly measured to examine their effect on the goal-performance interaction.

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REFERENCES

1. Bartholdi, J. J., & Hackman, S. T. (2019). *Warehouse & Distribution Science: Release 0.98.1*. Atlanta, GA, USA: The Supply Chain and Logistics Institute.
2. Bartle, R. (1996). Hearts, clubs, diamonds, spades: Players who suit MUDs. *Journal of MUD research*, 1(1), 19.
3. Bateman, C., & Boon, R. (2005). *21st Century Game Design (Game Development Series)*: Charles River Media, Inc.
4. Deci, E. L. (2017). Self-Determination Theory in Work Organizations: The State of a Science. doi:10.1146/annurev-orgpsych-032516-113108
5. Deterding, S., Dixon, D., Khaled, R., & Nacke, L. (2011). *From game design elements to gamefulness*. Paper presented at the Proceedings of the 15th International Academic MindTrek Conference on Envisioning Future Media Environments - MindTrek '11.
6. Koestner, R., & Hope, N. (2014). A Self-Determination theory approach to goals. *The Oxford handbook of work engagement, motivation, and self-determination theory*, 400-413.
7. Koivisto, J., & Hamari, J. (2017). The Rise of Motivational Information Systems: A Review of Gamification Research. *SSRN Electronic Journal*. doi:10.2139/ssrn.3226221
8. Marczewski, A. (2015). Dark Personalities and the User Type Hexad. *Gamified UK*. URL <http://www.gamified.uk/2015/10/26/dark-personalities-and-the-usertype-hexad/> (accessed 2020/01/23).
9. Nacke, L. E., Bateman, C., & Mandryk, R. L. (2014). BrainHex: A neurobiological gamer typology survey. *Entertainment computing*, 5(1), 55-62.
10. Ryan, R. M., & Deci, E. L. (2000). Intrinsic and Extrinsic Motivations: Classic Definitions and New Directions. *Contemporary educational psychology*, 25(1), 54-67. doi:10.1006/ceps.1999.1020
11. Tondello, G. (2019). Dynamic Personalization of Gameful Interactive Systems.
12. Tondello, G., Premasukh, H., & Nacke, L. (2018). *A Theory of Gamification Principles Through Goal-Setting Theory*. Paper presented at the Proceedings of the 51st Hawaii International Conference on System Sciences.
13. Tondello, G., Wehbe, R. R., Diamond, L., Busch, M., Marczewski, A., & Nacke, L. E. (2016). *The Gamification User Types Hexad Scale*. Paper presented at the Proceedings of the 2016 Annual Symposium on Computer-Human Interaction in Play - CHI PLAY '16.
14. Tyack, A., & Mekler, E. (2020). Self-Determination Theory in HCI Games Research: Current Uses and Open Questions. *CHI 2020 - Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems ACM*.
15. Warmelink, H., Koivisto, J., Mayer, I., Vesa, M., & Hamari, J. (2018). Gamification of the work floor: A literature review of gamifying production and logistics operations.
16. Xu, Y., Poole, E. S., Miller, A. D., Eiriksdottir, E., Kestranek, D., Catrambone, R., & Mynatt, E. D. (2012). *This is not a one-horse race: understanding player types in multiplayer pervasive health games for youth*. Paper presented at the Proceedings of the ACM 2012 conference on computer supported cooperative work.