GAMES AND GAMIFICATION

LITERATURE REVIEW

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We acknowledge and appreciate the generous gift from Joep Lange Institute that has been crucial in making this work possible.

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INTRODUCTION: SOME CONCEPTS

Interventions in health and personal finance increasingly make use of games and gamifications. By now there is a substantial literature on the impact of games and gamification. Before discussing that literature, let us take a moment to review what a game is, and what gamification is. This somewhat tedious exercise is necessary, because gamification is a buzzword used in many different ways, some of which have little to do with games.

game

/geym/

According to the Oxford Dictionary, a game in the broad sense is “an activity that one engages in for amusement or fun”. In that broad sense, “game” is synonymous with “play”. More specifically, the Oxford Dictionary defines a game as “a form of competitive activity or sport played according to rules”.

In the same spirit, the historical Oxford English Dictionary defines a game as “an activity or diversion of the nature of or having the form of a contest or competition, governed by rules of play, according to which victory or success may be achieved through skill, strength, or good luck”.

From this, we derive a three-part working definition:
A game is *(1) an activity engaged in for fun (play), (2) governed by rules, (3) in which player(s) try to win.* **Let’s discuss these three characteristics.**

- **First, the game is** *fun* **to play, and people play it because it’s fun. People desire to win the game, and the excitement caused by the uncertainty of the outcome is pleasurable. Winning is fun, and losing can be a bit frustrating, but the excitement about the possibility of losing is part of the fun.**
    - **Many games also tap into certain** *emotions* **that in real life are negative: feeling nervous, anxious, scared, dizzy, etc. In real life, we don’t like these emotions. But in games, like in movies, when we know that there is no possible harm, we can enjoy these emotions. For instance, in real life, the nervousness we feel when seeing a clock tick down towards a deadline can be extremely unpleasant. In games, it is fun.**
- **Second, there is a clear set of** *rules* **of the game, and a clear structure. There are rules about what is** *possible* **and impossible in the game. Behaviors in the game often have clear consequences - clearer than in real life.**
- **Third, there are rules about the goal of the game - players can** *win* **the game or lose it (binary) in a certain way, or at least perform better or worse (continuous) in the game. Players may win something tangible, like money or some other prize, or something intangible like a title or honor.**

OTHER TYPICAL CHARACTERISTICS OF GAMES. In addition to these three central ingredients, here are some other characteristics that are often present in games.

- Games are often a simplified *simulation* of a real event or situation. Many games have a *story* behind them, but games are normally not real themselves. Instead, they have little real-life consequences, and hence they are just *play*.
- Games usually have a specific *location* (e.g., a game board, a field, etc.), and a limited *duration* of play.
- Players may c*ompete* with other players, or just play "against the game" - on their own, or collaborating with other players.
- Many games require some *skill*, be it physical or mental, and playing the game makes you more skilled at it - sometimes causing excellent players to be in a very pleasant state of *flow*.
- Many games also have an element of *chance*, and it is uncertain who is going to win. If it is obvious too soon who will win or lose, the rest of the game is no fun.
- Many games are made for c*hildren*, but even the games made for adults often still make use of some imagery that appeals to children (like cartoon figures, fantasy, bright colors, etc.). Many games also make use of *humor* to make it more fun.

A game is an activity that has a substantial number of the above typical characteristics, although it is hard to say which characteristics really need to be present for the activity to be a game. Note that all these characteristics are possible candidates for experimentation and manipulation. We will see later that there is surprisingly little research that surgically manipulates individual characteristics in games.

gamification

/gey-m*uh*-fi-**key**-sh*uh* n/

The Oxford Dictionary defines gamification as "the application of typical elements of game playing (e.g. point scoring, competition with others, rules of play) to other areas of activity, typically as an online marketing technique to encourage engagement with a product or service".

SOFT GAMIFICATION VERSUS HARD GAMIFICATION. Note that this definition does not say that gamification is the transformation of an activity into a full-fledged game. It says gamification is the application of some game-like characteristics to an activity, like points or competition. It is making an activity a bit more like a game. And this is indeed how gamification has been most widely conceived and implemented. We will call the application of some game-like elements to an activity soft gamification. By contrast, we call the transformation of an activity into a full-fledged game hard gamification. Hard gamification is much rarer than soft gamification, but it exists. Educational games are a good example of hard gamifications of learning. And perhaps more suprisingly, sports are a great example of hard gamifications of exercise. Soccer is gamified running. Hard gamification is very difficult, because it is difficult to turn a tedious activity into something people really engage in purely because they enjoy it. When friends get together Sunday afternoon and the question is raised what game they want to play, no-one will ever suggest to collect points for a rewards programs and to try to achieve Gold status. Rewards programs are soft gamifications, and no-one ever really engages in it purely because it is fun. You couldn't sell it in a game store. But people do play soccer because it is fun—not just to exercise. And children do play Little Professor because it is fun—at least, some children do. Hard gamification is hard, but its benefits can be immense. When hard gamification works, more research should be geared towards it.

Flatla et al. (2011) provide an instructive process for how to gamify a task. The process involves first identifying the core task or tasks that participants need to accomplish, and then carefully selecting game elements that can be added.

Building on past literature, the researchers identify four basic elements of games.

1. The first is that it is challenging: games provide challenging goal elements tied to rewards, e.g., collecting items, or shooting objects.
2. Secondly, games have a theme: they include vicarious aesthetic representation and unifying aesthetic elements, e.g., cloaking the context or player representation in a fantasy or with evocative mental imagery, such as alternate worlds or player avatars.
3. Third, games provide elements of reward to serve as behavior reinforcement, e.g., simple visual representations or pleasant sounds, like in the game Candy Crush.
4. Lastly, games show us when we have made progress through specific units and markers, e.g., levels, worlds, quests, and achievement markers, such as badges and score information.

In what follows, we first discuss the gamification of learning, followed by a discussion of gamification of other activities, like exercise, saving, etc.

GAMIFICATION OF LEARNING

EDUCATIONAL GAMES

Games have been widely used to teach knowledge and/or skills that will be useful in the real world, after the game is played. Such games are commonly called educational games. We distinguish between one-time educational games (this section) and other types of gamification of continuous learning (next section).

GAMES CAN IMPROVE KNOWLEDGE AND BEHAVIORS. Educational games can have an impact on health-related behaviors. For instance, computer games can be an effective way to teach valuable safety tips to disabled children. Coles, Strickland, Padgett, and Bellmoff (2007) presented 32 children aged 4-10 who had been diagnosed with fetal alcohol syndrome (FAS) or partial FAS with a game to teach them either fire or street safety skills. The game took place in a virtual world in which an animated dog demonstrated the correct actions in the relevant settings (crossing the street, or escaping a house fire). Children then had the chance to navigate through these situations on their own, and the dog positively reinforced the children's behavior when they chose the correct action, or told them to try again if they chose incorrectly. Children were first pre-tested on their knowledge of fire and street safety and post-tested both immediately after they had achieved "mastery," (i.e., were able to navigate through the correct actions in the game without the help of the avatar) and one week later. The children were also asked to demonstrate the correct sequence of both behaviors in real life.

Research shows that educational games can increase knowledge and improve behaviors, compared to more traditional education.

Immediately after playing the street safety game, those who had played the fire safety game demonstrated significantly increased knowledge of fire safety, and those who had played the street safety game demonstrated significantly increased knowledge of street safety. Knowledge of fire safety one week later was still significantly higher compared to fire safety knowledge in the initial pretest, but knowledge of street safety was only marginally improved. This knowledge also translated into actual performance, as the vast majority of children correctly performed 3-4 out of 4 of the desired behaviors related to fire safety both immediately following game mastery (87.5%) and one week later (81.3%). Most children also correctly performed 3-4 of the desired behaviors related to street safety immediately following the game (81.3%) and one week later (75.4%). This gamified intervention thus had somewhat lasting effects.

Games have also improved language learning. Calvo-Ferrer (2017) examined the effect of using computer games as stand-alone learning tools on learning gains and found that game increased vocabulary acquisition significantly more than a stand-alone booklet containing the same information. Fifty-nine English as a Second Language students of Spanish nationality (ages 19-20) participated in the study. These students were divided into two groups - one group who played an educational game called The Conference Interpreter, and one group which received a booklet with the same information contained in the game, but without the rewards (such as digital ribbons and level-ups), score tables, and power-ups of the game. The experiment was carried out over five days. On the first day, the students were given pre-test questionnaires and assessments, as well as assigned to the different treatment groups. In the next three days, the students individually used either the computer game or booklet in 2-hour sessions. On the fifth day, the students were given post-test questionnaires and assessments.

An analysis on the assessment scores of the students post-intervention found that students who utilized the computer game scored significantly higher (M=35.56 out of 63) than those given the booklet (M=31.63 out of 63). The author concluded that The Conference Interpreter game helped students gain vocabulary more effectively than information alone, and that this type of intervention could be a powerful tool since it does not require any instructional support.

Figure 1. The Conference Interpreter

GAMES CAN REDUCE COGNITIVE BIASES. Morewedge et al. (2015) shows that it is possible to create computer games of debiasing training to reduce cognitive biases. In both experiments, participants were either assigned to watch a 30-minute instructional video, or to play a 30-minute debiasing video game. The instructional video defined heuristics, described what each bias was, and showed vignettes of actors demonstrating each bias, while the video game task was to simply find a missing neighbor. Within the video game, participants were presented with situations in which they might commit each cognitive bias. At the end of each level, the game described each bias in detail and had participants rate how biased they were during the game. Participants were immediately given feedback about their level of bias. In experiment 1, the researchers sought to decrease the effects of a) bias blind spot, b) confirmation bias, and c) fundamental attribution error. In experiment 2, the researchers were trying to decrease the effects of anchoring, projection, and representativeness heuristics.

In both experiments, the authors found reductions in cognitive biases that are critical to intelligence analysis. Both produced medium to large debiasing effects immediately (31.94% reduction in the video game condition; 18.60% reduction in the instructional game condition) that persisted even 2 months later (23.57% reduction vs. 19.20% reduction).

GAMIFICATION OF CONTINUOUS LEARNING

GAMIFICATION OF LEARNING. As with one-time educational games, the gamification of continuous learning may effectively increase learning. Nevin et al. (2014) conducted a study on gamification-based software for learning medical information on medical residents that showed high levels of acceptance, use of software, and retention of knowledge. Note that this study did not have a control with non-gamified learning, so we cannot conclude that the gamification is what worked.

Students used the software to complete questions individually, and in a group, via anonymous usernames. Three rounds of questions on a variety of topics were picked by the faculty. Round 1 was open to 128 students at the University of Alabama Birmingham only. For round 2, 24 University of Alabama Huntsville residents were also invited, and round 3 was open to all students. Round 3 consisted of 3 daily questions – 2 new ones and one repeat from round 1 or 2. Points were given for correct answers, continued daily participation and streaks of correct answers. The leaderboard was updated continuously, and participants could see the scores of other participants whose scores were just above and below their own.

Focus groups conducted after round 1 determined that the leaderboard was the most important motivator, with people or teams at the bottom of the leaderboard experiencing less motivation as the competition progressed. The number of participants decreased after each round, yet there was a statistically significant increase in use of the program after weekly competition status emails were sent. 28.8% of questions were answered on weekends between 17:00 and 08:00 (outside normal teaching hours). Players were correct 11.9% more frequently when a question was repeated.

The limitations were that internal medicine was the only speciality tested and only residents who volunteered to participate were included.

WHEN EXACTLY DOES IT WORK?

LEARNING INTRINSIC TO THE GAME. Making educational elements intrinsic to an educational game improves learning. Habgood and Ainsworth (2011) found that children improved their mathematical abilities more when given an educational game when the math education in the game was intrinsic to the game itself. The authors define intrinsically integrated games as (a) delivering learning material through the parts of the game that are most fun to play, riding on the back of the flow experience produced by the game, and not interrupting or diminishing its impact, and (b) embedding the learning material within the structure of the gaming world and the player's interactions with it, providing an external representation of the learning content that is explored through the core mechanics of the gameplay.

The authors created a video game called "Zombie Division" specifically for this study. This game involves a fantasy context where the main character battles skeletons with symbols on their torso, where the symbols indicated what kinds of attacks would be effective in slaying them. There are three versions of this game, representing the three conditions of the study. First was the intrinsic condition, where the symbols on the skeletons were numbers and the attacks to slay them had corresponding number values. A skeleton could only be slain by an attack that could divide into the number on their torso (a #9 skeleton could only be slain by a #3 attack). The skeletons in the extrinsic and control conditions had symbols on their chest corresponding to the attacks that would slay them, but the attacks were non-numeric such as a sword or shield, thereby having the same exact gameplay in all conditions but hiding the mathematical aspects in the extrinsic and control conditions. In the extrinsic condition, the mathematical content was delivered in a quiz at the end of each level of the game. In the control condition, there was no mathematical content in the game at all. All 58 of the children in the study also received a teacher-led reflection session about mathematics after the children had become familiar with the game, but had not spent a large amount of time with it. Participants completed the mathematics outcome test as a pretest 10 days before the study started, as a post-test after the children had spent 100 minutes with the game, and as a delayed test given after the children's final playing session.

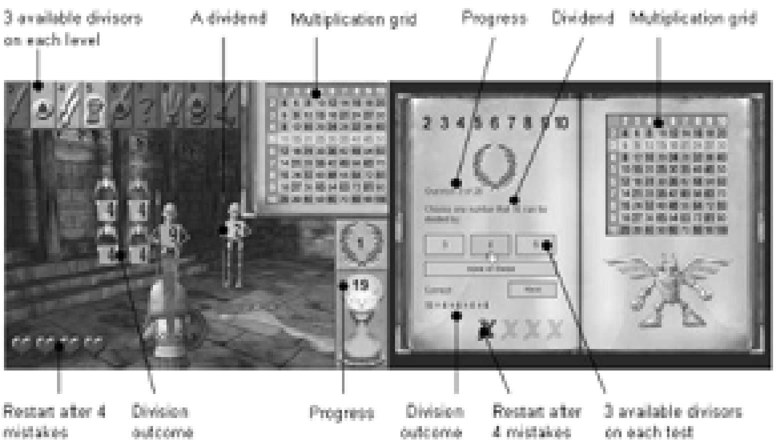

Figure 2. (from Habgood & Ainsworth, 2011): "Explanations of mathematical learning content in the intrinsic (left) and extrinsic (right) versions of Zombie Division. Comparable features are labeled"

Children who played the intrinsic version of the game not only maintained their mathematical abilities, but improved further on the following delayed test (50% to 60%). The extrinsic and control children, on the other hand, only maintained their previous levels of mathematical skill (at 39%, and 36% respectively).

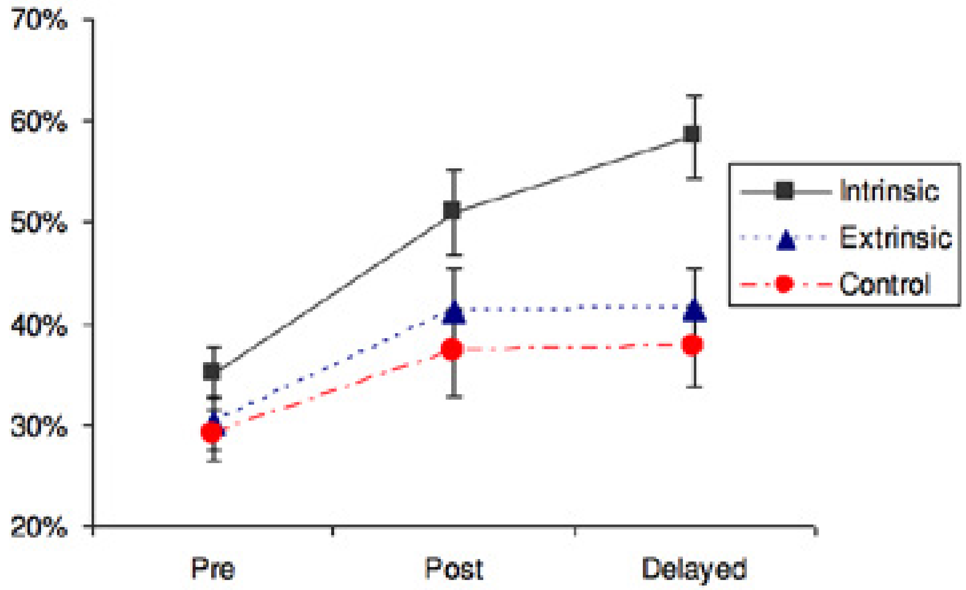

Figure 3. (from Habgood & Ainsworth, 2011): "Mean Percentage Score by Time and Game Condition"

GAMES NEED TO BE ALIGNED WITH LEARNING GOALS. de-Marcos et al. (2016) compared several game-like approaches to learning: full educational games, gamification only, social networking only, and social gamification. They found that while all approaches significantly impacted learning, social gamification was the most effective. However, depending on the type or the time of the assessment, some of the approaches performed significantly worse than the control group.

The authors recruited 379 undergraduate students attending a course on basic computer literacy (the MS Office applications Word, Excel, Powerpoint and Access), who were divided into five conditions, which were given the following treatments: a) the control condition, in which participants received standard blended learning, b) the educational game condition, in which participants played the Microsoft game Ribbonhero (this ready-made game not directly aligned with the course's learning objectives, teaches Office functions by helping an avatar to solve challenges), c) the gamification condition, in which learning objectives on the online learning platform were described as challenges, trophies were awarded, and a leaderboard kept track of people's performance, d) the social condition, in which students could communicate on a social network by posting blogs, answering Q&A's, or posting links to resources as well as liking and friending each other, or e) the gamified social condition. The gamified social condition was the same as the social condition, but with gamification rewards for social interactions, such as points for answering questions or participating in peer grading, and a leaderboard; points could also be used to buy items such as +5% on the final mark or avatar improvements.

In all conditions, including the control, participants had one lecture every two weeks and had to study independently in between. There was a pre-test before treatments began, an assignment at the end of every two-week module testing practical knowledge of the module, and one final assignment at the end of the course testing conceptual knowledge of all four modules.

In the practical assignments, all treatment conditions outperformed the control group. In the final conceptual exam, however, only the gamified social treatment group achieves results similar to the control group, with all other groups performing worse (mean grades: control 74.77, educational game 66.30, gamification 59.50, social 61.24, social gamification 72.00). The researchers hypothesize that this may be due to "shallow gamification," particularly for a learning game that is not aligned with learning objectives, and to gamification leading to an increase in the number of interactions with the learning material, but not in their quality. Unfortunately, their research design does not allow a conclusion on whether the type or the time of assessment are responsible for the worse performance of most approaches on the final exam.

For practical gamification applications, this should serve as a warning not to have the gamification elements overshadow the actual learning content—in other words, they should motivate students to engage with the learning content, rather than distract them from it.

DOES GAMIFICATION WORK BETTER FOR PRACTICAL SKILLS THAN FOR THEORETICAL KNOWLEDGE? Dominguez et al. (2013) show that students with the opportunity to complete a gamified online university course performed better on practical tasks compared to students who completed a non-gamified version, although there was no difference in final grades. The results also show that gamification has the potential to increase student motivation.

The researchers studied student motivation toward completing optional exercises using the online course "Qualification for users of ICT", which was a 15-week course in the 2011/2012 spring semester that teaches various Information and Communications Technology (ICT) tools. Students could sign up for the same course on either of two campuses. One group of 80 students was randomly assigned to complete the regular, non-gamified online course, which offers downloadable optional exercises to prepare for the final exam, whereas the other group of 131 students completed the gamified course, in which the optional exercises to prepare for the final exam were available online in a gamified version. The video-game-like exercises had three unique design features. First, students could complete two challenges per topic, and within each challenge, they could complete four tasks that were each rewarded with a trophy (copper, silver, gold and platinum). Second, by successfully completing tasks, students were awarded medals. Students knew that some medals would be awarded upon completion of a known task, whereas some medals were awarded by surprise when a special task was completed. Third, the authors included an element of competition by introducing a leaderboard that ranks players according to their number of medals earned. Students in the treatment group, however, were free to choose whether to use the gamified version, the paper version or a combined version for their optional exercises. Fifty-eight students decided to use the gamified version of the course.

Looking at the four core modules of the course, students in the treatment group performed better in practical exercises about spreadsheets (11.24 points more on a 100 point scale), software presentation (25.27 points more) and databases (29.4 points more). However, there was no difference in students' performance on word processing and in students' final grade for the course.

GAMIFICATION OF OTHER ACTIVITIES

GAMIFICATION OFTEN IMPROVES BEHAVIORS

Studies have shown that gamifying unpleasant activities, like exercising and saving, can make people participate in these activities more.

GAMIFICATION OF WALKING (STEPS GOALS). In an intervention aimed at increasing physical activity, Patel et al. (2017) found that participants in the gamified study arm achieved their step goals for a significantly greater proportion of days as compared to the non-gamified control arm. This was also true in the months after the intervention. All 200 participants had at least one family member participating with them in the study and used either a smartphone app or a wearable device (e.g., Fitbit) to track step counts. During a two-week run-up period, participants established a baseline step count and then chose a step goal increase of 33%, 40%, 50% or any goal of at least 1,000 steps greater than baseline. All participants received daily feedback via text and/or email that informed them whether they had achieved their step goal on the previous day.

Participants in the gamified study arm signed an online pledge committing to try their best to achieve their daily step goal and were also entered into a 12-week gamified intervention with their family. Each Monday, the family received 70 points (10 points for each day of the week) and each day of the week a family member was selected at random to represent the family's step count. If that member achieved his/her step goal, the family kept its 10 points. If not, the family lost 10 points for that day. All families started out at a bronze level and had the opportunity to advance up a level each week (bronze, silver, gold, and platinum). They advanced up a level if they maintained 50 points or more by the end of the week. If the family was at the gold or platinum level by the end of the intervention period, they received a coffee mug branded with the study logo. Lastly, all family members had five lifelines that they could use on days when it was not feasible to achieve their steps goal.

The mean proportion of days that participants in the gamified study arm achieved their steps goal during the 12-week intervention period was 0.53 as compared to 0.32 in the control arm. During the 12-week follow-up period where steps were counted after the end of the intervention, this trend continued. During the follow-up period, the mean proportion of days that participants in the gamified study arm achieved their steps goal was 0.44 as compared to 0.33 in the control arm. These results indicate that gamified elements have the potential to not only increase physical activity in the short-term but can also create sustainable habits of increased physical activity.

GAMIFICATION OF OTHER HEALTH BEHAVIORS. Adding a gamification element to blood glucose monitoring has also helped diabetic children keep their blood glucose levels down. Kumar, Wentzel, Mikkelsen, Pentland, and Laffel (2004) conducted a 4-week randomized clinical trial with 40 children aged 8-18 with type 1 diabetes (one participant had type 2) who were regularly treated with insulin and already regularly monitoring blood glucose levels. Each participant received a PDA, as well as diabetes software and equipment. Participants were encouraged to check their blood glucose at least 4 times a day, and to upload their blood glucose, carbohydrate intake, and insulin dose data into the PDA. This data could be sent wirelessly to the researchers. Half (19) of the children were also given a game in which they could see the first 3 blood glucose levels they recorded that day, and were instructed to guess what the 4th reading would be. They were awarded points for simply playing the game, and even more points if their blood glucose prediction was accurate. There was no element of competition, as the participants played the game against themselves.

The treatment group sent in their data significantly more often (1,662 values) compared to the control group (1,471 values, $p < .001$). During the experiment, the treatment group also experienced high blood sugar significantly less often (318 times) than the control group (377 times, $p < .001$). The children in the treatment group also exhibited greater knowledge of diabetes at the conclusion of the experiment compared to the beginning ($p < .005$). This difference was marginally significant in the control group ($p < .09$), but the researchers did not directly compare the two groups' diabetes knowledge.

GAMIFICATION OF PERSONAL FINANCE. In this paper, Liu et al. (2017) describe the design process and prototype for a savings app that involves gamification as well as other behavioral interventions. After review, an unstated claim from Liu et al. (2017) seems to be that to maximize success of the product, multiple interventions need to be leveraged. The product leveraged interventions across the target user journey of planning, saving, and keeping. Both of the gamified features in the app were found in the savings section: (a) Personal savings challenges + gamification: a feature allowing the user to set personal saving challenges against him/herself (or a computer). Based on data analytics, the app automatically suggested potential challenges and amounts to the users and sent prompts on their progress, and(b) Social Influence + gamification: a platform to compete with peers or family members on the pre-selected savings challenges (like a FitBit for savings).

The team tested the prototype through 50 behavioral interviews in the field, but the paper includes a design for a much more robust RCT to test specific aspects of the app. The paper outlines technical risks, business risks, and behavioral risks to the product, as well as a potential future business model.

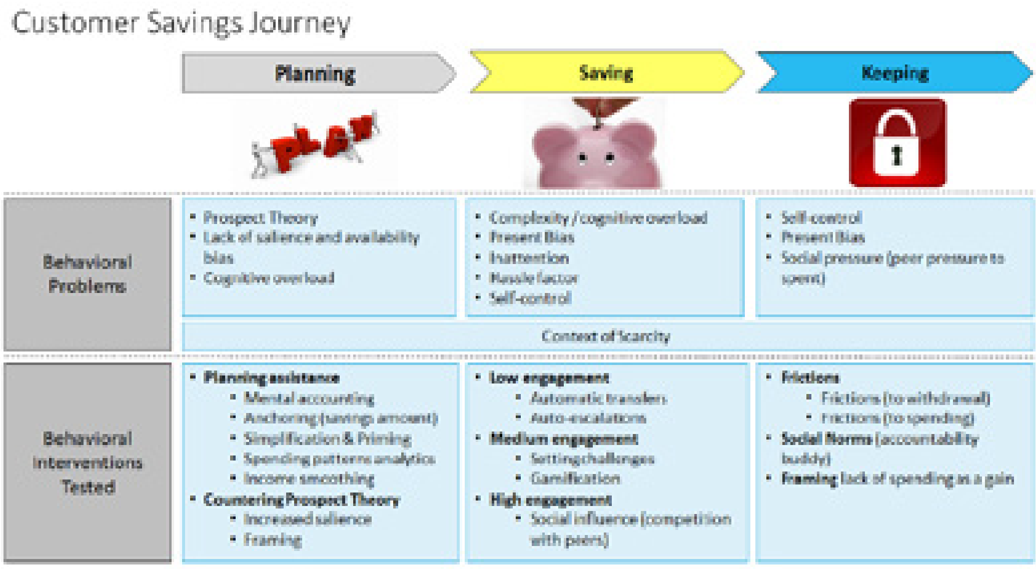

Figure 4. Personal Finance Interventions (Liu et al., 2017)

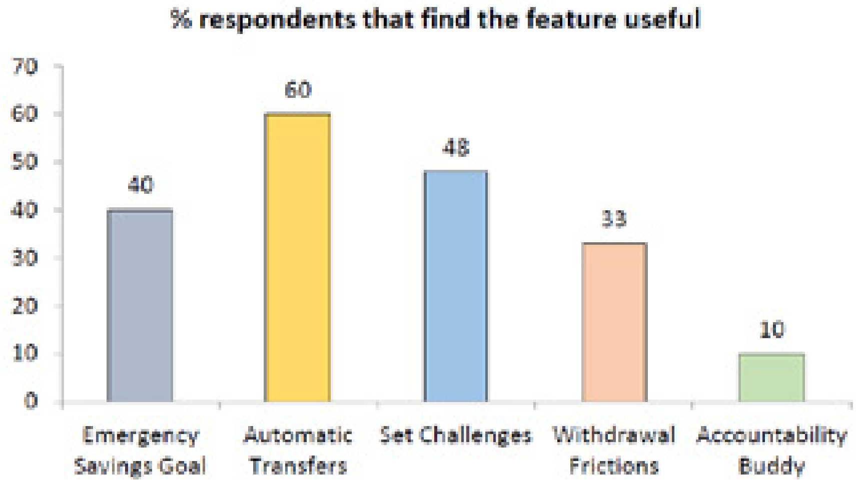

Figure 5. User Response to Product Features (Liu et al., 2011)

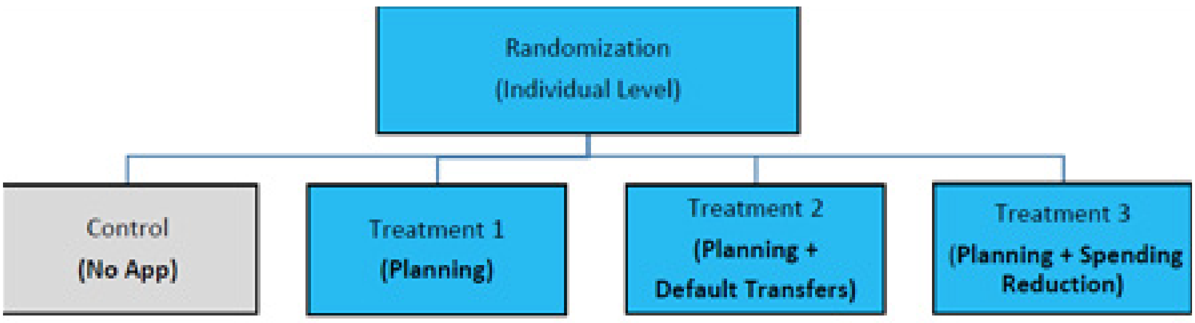

Figure 6. Liu et al.'s (2017) Intervention

Figure 7. Liu et al. (2017) gamification image 1

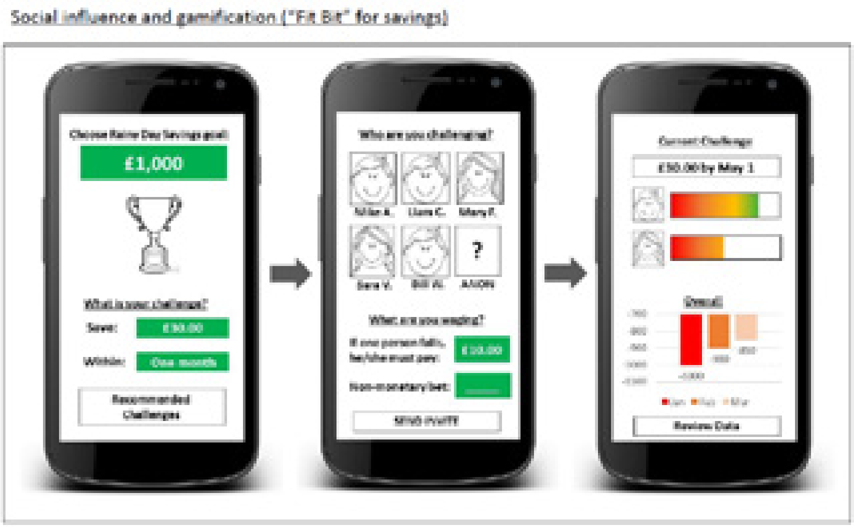

Figure 8. Liu et al. (2017) gamification image 2

GAMIFICATION OF SIMPLE REPETITIVE TASKS. Adding simple gamified elements can increase the motivation to complete even the most tedious tasks, such as calibration tasks that require hundreds of repetitive trials. Flatla et al. (2011) modified three different calibration tasks that are intended to train and inform computer-interface models of human perception. One example of these types of tasks is to provide participants many different combinations of colors and the participant determines if the two colors are different or the same (see figure 9 below). The ability to differentiate color can vary between individuals due to factors like age, fatigue, and environmental lighting. A task such as this is used to determine the best color choices for information visualization. The researchers redesigned each calibration task with several gamified elements (see figure 10).

In comparing the two versions with 36 university students (12 per task), the researchers found two main results. First, using a 5-point likert scale, participants reported that the gamified tasks were significantly more enjoyable (averaging 4.0 for the first task) and fun (averaging 4.0) than the traditional tasks (averaging 2.8 and 2.9, respectively). Second, the gamified tasks accrued significantly different calibration data than the traditional task though this does not mean that gamified data is necessarily less accurate. In fact, the researchers argue that the gamified calibration data might be relatively more accurate given that the gamified version was more enjoyable and thus participants may have been trying harder.

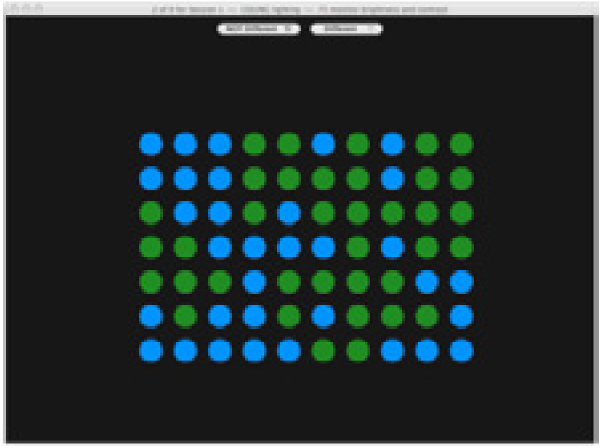

Figure 9. Color differentiation calibration task. Users respond to presentations of colored circles with 'same' or 'different' response. Approximately 1,920 presentations are used to calibrate the model.

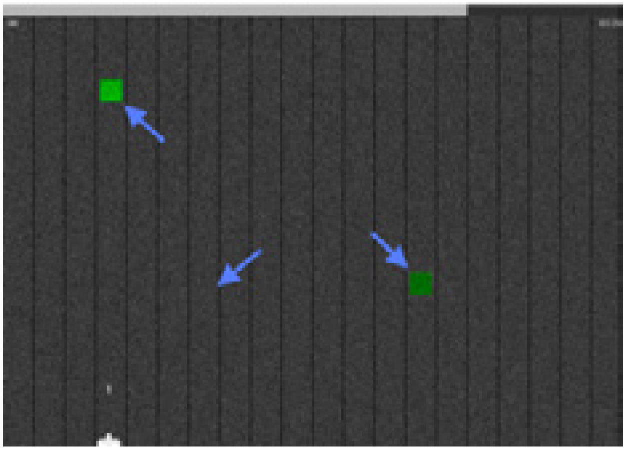

Figure 10 Gamified version of a color differentiation task.

In one gamified version of the color differentiation task, users move a spaceship horizontally across 20 fixed columns and shoot at dots when they are visible. Users try to prevent the dots from falling to the bottom. By altering the background and target colors, the "same" or "different" core task is effectively replicated, but the task becomes implicit to users (i.e. their task is to "shoot" when visible, and not report difference). The game also provides the user a progress bar, "worlds" and "levels" that represent different sets of trials, an accuracy score, a high score, and new "items," such as new missile representation and additional target explosion sound effects, for attaining high accuracy.

GAMIFICATION IN BUSINESS. Robson et al. (2015) discuss how gamification can aid customer and employee engagement, and delineate between four different types of customers and employees who act as 'players' in gamified experiences. They include four different illustrative examples of how gamification has been used successfully and unsuccessfully by different companies and conclude by presenting five lessons for managers who wish to utilize gamification. Those lessons are: a) understand your players before deciding on gamification mechanics, b) timing of rewards is key, c) add new levels, tasks, or players as needed, d) managers must act as referees, and e) use gamification mechanics to keep track of the score.

The article then concludes with some remarks on the dearth of research around gamification and areas for possible future research, such as the ethics of consent and implicit employee consent required for using gamification to engage and motivate employees.

Figure 1. Typology of players in gamified experiences

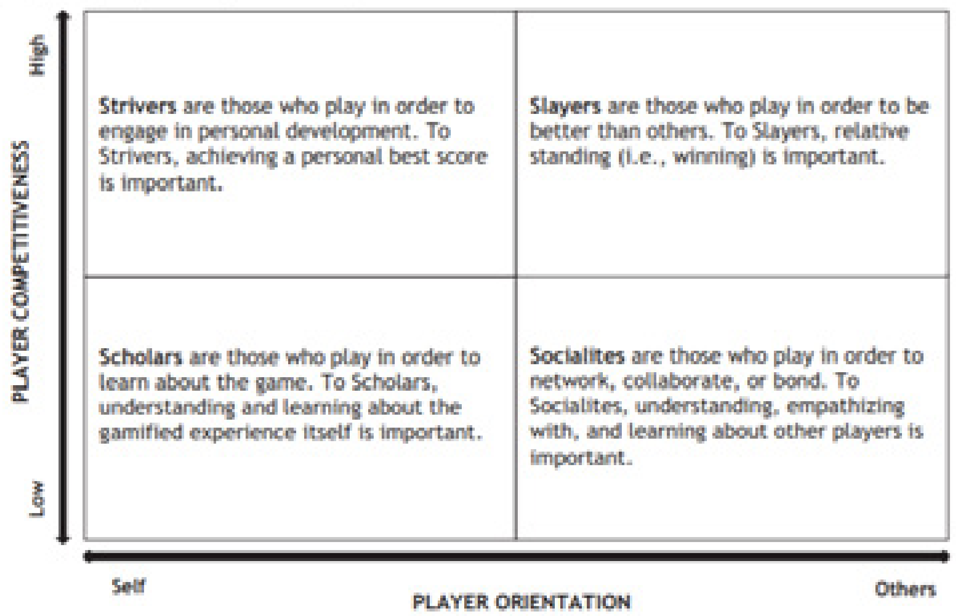

Figure 11. Robson et al. (2015) player types

Figure 2. Key gamification mechanics for player types

	Slayers	Strivers	Socialites	Scholars
Leaderboards, Badges, and Points	✔	✔		
Increasing Task Difficulty	✔	✔		
Finite End	✔	✔		
Multiplayer Orientation	✔		✔	
Infinite Play			✔	✔
New Levels		✔		✔
Team Playing	✔	✔	✔	✔
Online Playing	✔	✔	✔	✔
Real World Playing	✔	✔	✔	✔

Figure 12. Robson et al. (2015) gamification mechanics

THE EXTENT OF GAMIFICATION

MORE GAMIFICATION IS BETTER. Cechanowicz et al. (2013) showed that the effect of different gamification elements can be additive. Adding more elements can lead to significantly more participation by users, yet specific elements may also influence data quality. In their experiment, they divided roughly 600 participants of an online marketing and branding survey into three groups: a plain survey, a partially gamified condition adding interactive elements, and a fully gamified condition further adding rewards, challenges, progress elements, etc. Each of the groups received questions of the same three types: image identification, where they guessed the company behind an advertising image, slogan matching, where they connected companies to their respective slogans, and a memory quiz, in which they wrote free-form responses to questions testing their recollection of certain elements after watching a five second excerpt of an ad.

Figure 13. (from Cechanowicz et al., 2013) “Full Game (top row). Partial Game (middle), and Survey (bottom) versions of the Image Identification (left column), Slogan Matching (centre), and Five-Second Quiz (right) question types.”

Participants were free to end the survey after any question, making the number of questions answered a meaningful metric for their motivation. On average, participants in the fully-gamified condition answered about twice as many questions as those in the plain survey group (21 vs. 12, respectively), with the partially gamified condition falling somewhere in between. Notably, the researchers found no differences in the number of questions answered, nor in the impact of gamification by gender, age group, or between gamers and non-gamers.

Answer quality was similar between the conditions, but for two of the tasks, specific gamification elements affected the quality of responses: for image identification, the fully gamified condition performed better than others. This is likely because they were shown the correct answer after giving wrong answers and thus benefitted from a training effect the other conditions didn't have. For the free-form answers to the memory quiz, the researchers used answer length as a proxy for quality and found that answers in the fully gamified condition – the only one that included a timer – were slightly, but significantly shorter (by 1.8 characters) than those in the plain survey condition. As with other studies, this shows that gamification can be a useful motivator, but its potential effects on qualitative outcomes have to be taken into account in the design stage.

FRAMING AN ACTIVITY AS A GAME IS SOMETIMES ENOUGH. Although the study above found that more gamification is better in the right context, some research fails to find a difference between merely framing an activity as a game and truly gamifying that activity. Even just framing a serious activity as a game without including actual gamification mechanics increases motivation. Lieberoth (2014) found that using game-like materials was just as good for interest and enjoyment of a collegiate feedback activity as adding game mechanics. Student volunteers from third year psychology classes in college were assigned to one of three conditions. Both the framing and full game conditions involved a game board and pawns, that represented players, to move around the board. The full game condition additionally included a competitive component that was not present in the framing condition. The control participants were given sheets of paper leading them through the same core task as the framing and full game participants. Subjects were tasked with providing feedback on the psychology department. In the framing condition, each player moved one space on the game board at a time and discussed prompts related to the evaluation of the department. After this, all of the players rated the feedback of each player with a rating from 1 to 5 stars. In the full game condition, players moved their pawns based on how good of a rating they were given for their feedback, adding competition to the game. Participants in the control were given the same evaluation items to discuss, but simply went down the list of prompts on the paper. All groups received 30 minutes of required time, and 20 minutes of elective time for the task.

Participants in the framing and full game conditions did not report significantly different interest/enjoyment (averaging 3.24, and 3.36 out of 5 respectively). Participants in these game conditions reported significantly higher interest/enjoyment than the controls (averaging 2.60) on a 5 point scale. However, participants in the control condition addressed significantly more (averaging 9.80) discussion items than either of the framing or full game conditions (averaging 5.50, and 7.66 respectively). Adding a game frame to a task may have crowded out output motivation for the task.

LIMITS TO GAMIFICATION

GAMIFICATION MAY INCREASE QUANTITY BUT NOT QUALITY. Some research suggests that gamification may increase productivity only in a purely quantitative sense, but to increase quality, adding meaning works better. Both adding the gamified element of points and meaningfully framing the task increase motivation to complete the task, albeit in different ways. Mekler, Bruhlmann, Opwis, and Tuch (2013) found that people perceived a painting tagging task as more valuable when they were told that their tags would help improve computerized affective imagery categorization (i.e., helping computers label the emotional content of art), and that people gave more tags when they received arbitrary points for completing the task. The researcher had subjects provide tags (words that are perceived as related to the artwork) to 15 abstract paintings, and manipulated whether they received arbitrary points and/or whether the task was framed in a meaningful way. After completing the tag task, participants completed the Intrinsic Motivation Inventory (IMI), a measure of intrinsic motivation to complete a task.

Participants who had been told that their input would be used to improve computerized affective imagery categorization to advance science perceived the task as significantly more valuable and marginally more important, regardless of points, compared to those who were not told this. Giving points for each tag entered resulted in significantly more tags, while framing did not significantly impact the number of tags. Points did not affect the quality of tags, but meaningful framing generated significantly better tag quality. Because the task asked for tags describing the mood and emotional content of the paintings, there was a significant impact on the amount of affective tags (related to emotion) when a meaningful frame was introduced. Also, intrinsic motivation was significantly increased by all conditions against the control. It appears that giving people arbitrary points to complete a task will motivate them to complete that task, but not with the same caliber of work as when they are told that their work is meaningful. Giving people immediate feedback (in terms of points) will increase the quantity of the behavior without regard to quality.

GAMIFICATION MAY DECREASE INTRINSIC MOTIVATION. Despite the popularity of gamification, Hanus et al. (2014) argue that overly emphasizing rewards may backfire. They recruited 80 university students in two classes being taught at the same time and, in one of the classes, added badges and a leaderboard as gamification elements. Besides this addition, the course was identical for the two classes.

Figure 14. Sample badge

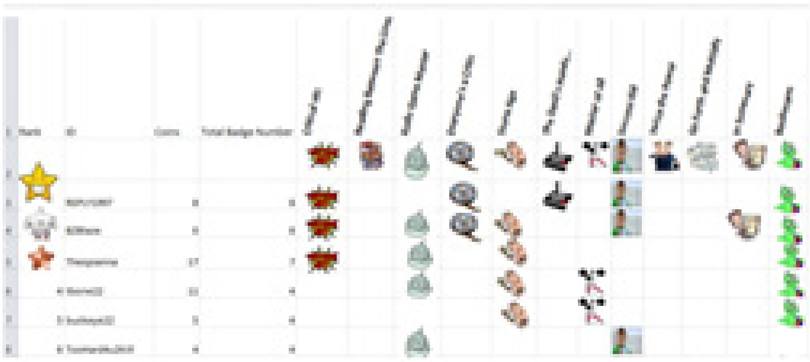

Figure 15. The leaderboard

Students' motivation (together with satisfaction, effort, feeling of empowerment and degree of social comparison) was assessed by surveys administered every four weeks for the duration of the course. In addition, learning outcomes were measured through an exam at the midpoint and at the end of the course. The researchers found that students' intrinsic motivation, having been comparable in the first assessment, was significantly lower for the gamified group during the second assessment (4.57 vs. 4.92 on a 7-point scale) and, to a lesser extent, the third assessment. This lower intrinsic motivation led to worse performance on the final exam for the gamified condition, although the researchers note that there was no direct effect of the condition on the final exam grade once they controlled for intrinsic motivation.

Besides its direct implications for the use of gamification to increase motivation, a further possible interpretation of this and related research is that gamification works well where it is the desired outcome that is gamified (e.g., filling in your LinkedIn profile), but should be used with caution in contexts in which the gamified act is only a means to achieve a desired outcome (e.g., increasing attendance to achieve better learning outcomes).

SOME RESEARCH FAILS TO FIND AN EFFECT OF GAMIFICATION. Zuckerman and Gal-Oz (2014) found that adding virtual rewards and social comparison to a mobile activity tracker resulted in no significant change in physical activity. In a first observational study, the authors found that merely introducing a mobile app that tracked walking time, enabled goal setting, and provided real-time feedback resulted in a significant increase in walking time. Thirty participants installed an accelerometer-based mobile app on their phones that tracked their activity for an initial three-day period (baselines measure) when the app was not active and a subsequent two week period when the app was active. When active, the app automatically set a goal for users that reflected a 10% increase over their baseline and gave real-time feedback on goal progression in the form of total walking time and a progress bar showing percent complete. Users also received pop-up messages congratulating them on meeting their goal if they met their daily goal. The authors compared the mean walking time achieved in the baseline measure with the mean achieved during the two weeks when the app was active and found that participants significantly increased their walking time from 20.07 minutes at baseline to 30.24 minutes during the intervention. However, since there was no control group, the authors could not be sure about the causal role of the app.

In a follow-up study, building on the same mobile application discussed above, 59 participants were randomly assigned to use one of three versions of the app for ten days. Participants either received the quantified version of the app described above or received the points version where they were awarded points for each minute walked or the leaderboard version where they could see a real-time leaderboard ranking all users based on their accumulated points. Although no differences were found with regard to the impact of the three versions on how much people walked, the authors did find that the the number of times people accessed the quantified and points version of the app had a positive impact on the amount of walking they accomplished. The authors concluded that goal-setting and real-time feedback can facilitate increased activity and that the addition of virtual rewards and social comparison might not provide any additional benefit.

Fig. 1 Main screen of the three versions of StepByStep used in Study 2. *Left* quantified version; *middle* points version; *right* leaderboard version (presented with a "mini leaderboard," pressing the + icon opens the full leaderboard)

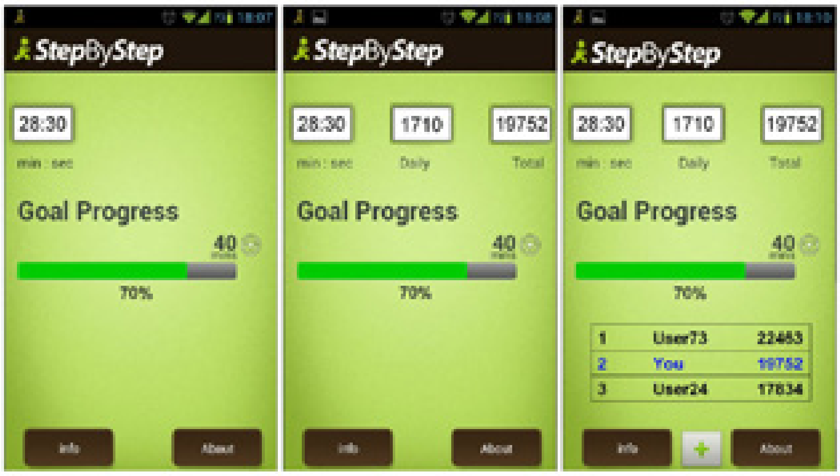

Figure 16.

Other studies also fail to find an effect of gamification. In a field experiment examining the online behavior of users of a peer-to-peer trading service (similar to Craigslist), Hamari (2013) found that gamification largely did not improve users' engagement with the online service. In three intervention groups, users were exposed to badges that they had earned, or that they could earn, as well as badges that other users had earned. In a control group, users were not exposed to any badges. The study collected the data of 3,234 users over a year and a half period. Results showed no significant differences in users' engagement with the service between the four groups. However, the researcher did find that the number of times that a user viewed her own list of earned and unearned badges (see image 2 below) had a positive correlation with her engagement with the service. The number of times that a user viewed other users' badges (see image 1 below) also was correlated with engagement with the service, but the effect size was small. In other words, the more often someone looked at their badges, the more engaged with the service they were. But, gamification by itself did not work as a motivator for more engagement.

This research suggests possible limitations to gamification. The author argues that the lack of overall effects could be explained by several factors. First, there could have been low *goal commitment*, or relatively low determination of users to reach the goal of attaining badges. Second, relatedly, the author argues that for utilitarian activities such as service trading (e.g. Craigslist), users might exercise more *cognitive involvement* than *affective involvement*, and therefore gamified (hedonic) features might be largely ignored. However, the significant effect from exposure to earned and unearned badges suggests that providing users specific and actionable steps to take is a promising way to encourage increased engagement. Of course, the challenge then becomes getting users to engage with the badges that are intended to engage them with the service.

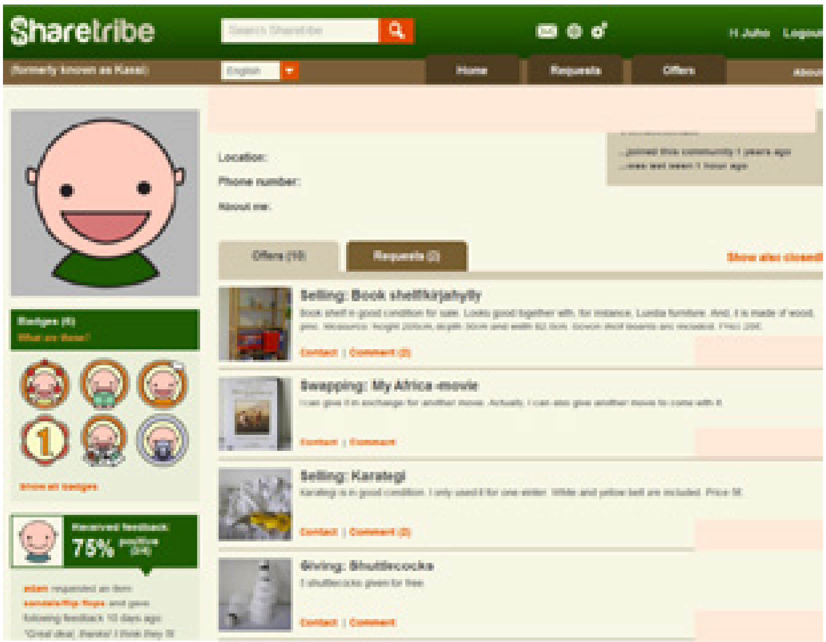

Figure 17. Sharetribe Badge Page

Figure 18. Images of intervention

INDIVIDUAL DIFFERENCES

GENDER. Koivisto and Hamari (2014) examined how the effects of gamification differ by demographic attributes and found that the perceived benefits of exercise games vary depending on the age and gender of the participant, as well as how long the participant has been engaged with the game. The authors administered online surveys to 195 users of Fitocracy, an online exercise gamification service. A link to the survey was posted in forums and in group pages within the service, so only those registered with the service were able to take part. The authors noted that these people tended to have above average technology-awareness, as well as higher overall health consciousness (which correlates often with higher-than-average education). The survey consisted of constructs for facilitating factors and social, hedonic, and utilitarian benefits. Continued exercise intentions were also measured as a behavioral outcome.

Gender differences were found for almost all measured benefits, except for the utilitarian aspect. Women seemed to have perceived the social benefits of the platform as greater than how the men perceived them, implying that women value the social aspects of gamification more than men. Finally, women were found to be more motivated to increase exercising by using the platform compared to men.

AGE. Younger people typically play more, and there is weak evidence that gamification works better on them. Webster and Martocchio (1993) show that young employees receiving microcomputer software training sessions labelled as "play" show higher motivation to learn and score higher on learning outcome measures compared to older employees. However, there is no difference in learning outcome measures between young and older employees when the software training session is labelled as "work".

Half of the 68 clerical and administrative employees of a public university that registered to participate in this software training course were randomly assigned to the training session labelled as "play", whereas the other half were assigned to the training session labelled as "work". Participants in each of the two training sessions received the same training content. The only difference between the one-hour sessions was whether the instructor labelled the session as "play" or "work" in his introduction. All participants were asked to provide demographic and background information on computer experience and training expectations, among others. After their respective training sessions, participants also completed an objective test of software knowledge as well as a questionnaire on motivation to learn.

Examining learning outcomes, Webster and Martocchio (1993) did not find any age-related difference in microcomputer software training outcomes, nor did they find differences in learning outcomes between sessions labelled as "play" or "work". The researchers did, however, find an interaction effect between training condition and age. Employees under the age of 40 who received microcomputer training labelled as "play" scored higher on learning outcome measures compared to employees above the age of 40. The researchers suspect that this result may be due to the increased work experience of older employees, which makes tasks at work less ambiguous for them. But another interpretation is possible: Maybe young people like to play more, so that it acts as an incentive for them. A limitation of this study is that it is about merely framing an activity as a game, rather than really gamifying the activity.

In Koivisto and Hamari (2014)'s survey on Fitocracy users (see earlier), age affected few of the benefits of gamification in the Fitocracy platform directly. Only ease of use decreased with age. But the authors also found an interesting interaction effect. They found that the perceived usefulness, enjoyment, and playfulness of the gamified platform decreased with time of use. This suggests that gamification may be a novelty that can help with initiation, but not as much with retention. The authors also found an interaction between age and time using the service, showing that the novelty effects are more pronounced the younger the user is. The authors state that "this finding is consistent with the general belief that younger people, while being more susceptible to playful interactions, might also get bored more quickly than more mature users." An interaction between age, length of use, and value of networking was also found. Specifically, the authors believe that the older a participant was, and the longer that the participant was on the gamified site, the more valuable they found their game social network.

In contrast with Webster and Martocchio (1993)'s finding, Cechanowicz et al. (2013) found no differences for age group. gender, age group, as well as between gamers and non-gamers.

COMPETITIVENESS. Adding competitive elements to a motivational exergame seems to have little effect on actual exercise, but may decrease self-efficacy and enjoyment in participants who do not consider themselves to be competitive. Song, Kim, Tenzek, and Lee (2010) assigned 72 undergraduate students at a university in the Midwest to one of four conditions. Participants first completed a measure of individual competitiveness (including items like "Competition is fun"), and were labeled as either low or high in the trait of competitiveness based on a median split. Next, participants were either assigned to play a the Hula Hoop Wii Fit game with or without competitive aspects in a future lab session. In the competition condition, participants were competing with three other participants (really confederates) to win a $20 gift card, while in the non-competition condition, one of the four participants would ostensibly be randomly chosen to receive the gift card. Participants were required to play the game for 10 minutes. They could also continue playing for up to 8 additional minutes after the required 10 minutes was over. This, along with a self-report measure in which participants provided seven adjectives to describe the game, was used to measure participants' intrinsic motivation. Participant mood, self-efficacy, expected competence, and heart rate were also assessed. All scales were reported from 1-10.

The authors did not find any difference between the competitive and noncompetitive games in terms of actual exercise. Nor did they find an interaction effect on exercise, between the competitiveness of the game and the competitiveness of the players. But the authors did find some other interesting results on the competitiveness of players. Participants low in competitiveness played for over a minute longer than those high in competitiveness (4.45 min vs. 3.26 min), but only when the game was non-competitive. There was no effect of the competition level on behavioral intrinsic motivation for highly competitive participants, however. Participants who were low in competitiveness experienced significantly lower positive mood following the competitive game (7.71) compared to the non-competitive game (8.5). Again, no effect was found for highly competitive participants. Participants low in competitiveness reported lower self-efficacy following the competitive game (6.13) compared to the non-competitive game (7.36). Heart rate (which the authors used as a proxy for physical exertion) increased significantly in response to the competitive game, regardless of whether participants considered themselves to be highly competitive. Highly competitive participants' heart rate was higher in the non-competitive game relative to less competitive participants.

In line with the above study, Staiano, Abraham and Calvert (2013) found that a cooperative game led adolescents to lose more weight than the control group, but they did not find this for the competitive version. More generally, Staiano, Abraham and Calvert (2013) found that exergames (video games that require motor movement), especially cooperative ones, can be an effective tool for weight loss amongst adolescents.

Fifty-four overweight and obese African-American participants aged 15-19 took part in a 20-week program. They were assigned to competitive exergame, co-operative exergame or control groups. The exergame consisted of 30-60 minutes of daily exercise using the Wii Active game. Competing adolescents were encouraged to earn the most points and expend the most calories compared to their opponent, whereas co-operative adolescents were encouraged to earn points and expend calories as a team. Data on weight, self-efficacy, self-esteem and peer support was collected at baseline, 10 weeks and 20 weeks after the intervention began.

The cooperative group lost significantly more weight (1.65 kg vs. 0 kg) and had increased self-efficacy compared to the control group. The competitive condition was not significantly different from the cooperative or control groups in terms of weight loss (.04 kg) or self-efficacy. One major limitation was small sample size, with nearly half of the participants dropping out by 20 weeks.

Smart interventions: The above research finds individual differences in the effectiveness of games and gamification. For instance, competitiveness and gender may matter. However, we did not find any literature on smart interventions that give the right games to the right people.

EXPERIMENTAL GAMES

In the studies discussed above, games and simulations are used as interventions or manipulations. Researchers in such studies are interested in the effect of (a certain version of) a game, compared to a control. Other studies make use of games and simulations not as a manipulation but as a lab environment. The real world is a messy place. In games and simulations, one can more cleanly measure aspects of behavior. Games and simulations have been widely used as lab environments, with interesting results.

The real world is a messy place. In games and simulations, one can more cleanly measure aspects of behavior.

GAMES AS LAB ENVIRONMENTS. For instance, Shah, Mullainathan and Shafir (2012) used a variety of game-style experiments to test the effects of scarcity on attentional focus on spending decisions. They found that having less makes people focus more on things directly related to scarcity but less on other things. The first experiment began with participants playing Wheel of Fortune and experimenters varying the number of guesses that each participant had in order to make "rich" and a "poor" conditions. The rich participants had 20 guesses per round while the poor participants had 6 per round. Subsequently, participants completed a Dots-Mixed task designed to measure attention and cognitive control. In all experiments, unused guesses could be saved for future rounds. Rich participants had on average 53 correct responses on the Dots-Mixed task, while poor participants had on average only 45 correct responses. The authors hypothesize that poor participants were depleted because of greater engagement in the previous game.

Another Shah et al. experiment consisted of an Angry-Birds style game where participants fired shots from a slingshot. Shah et al. made rich and poor conditions again by manipulating the number of shots. The poor earned on average 2.3 points per shot, while the rich earned on average only 1.7 points. The rich also spent less time aiming their shots. The authors also manipulated whether or not the participant could borrow more shots for the present round, with an interest rate of 100%. The interest payment was subtracted from the total number of shots for the game, so interest was effectively paid in the last round. While rich participants borrowed only 2% of their budget, poor participants borrowed 24% of their budget. Moreover, they overborrowed to such an extent that poor players who were not given the opportunity to borrow performed better.

Shah and coauthors run several other experiments in which they used games to learn about attention shifts in the poor. In a third experiment, participants played

Family Feud and the amount of time the rich and poor groups had to guess was manipulated. A control group could not borrow time from future rounds, another could borrow with no interest, and the last could borrow with 100% interest. In another iteration of this experiment, the effects of borrowing were felt before the end of the game by reducing payment in the next round by the amount borrowed divided by the number of remaining rounds. There were two borrowing conditions: one without borrowing and one with 100% interest. Lastly, another experiment made previews of the next round's topic available to some participants in order to test the amount of attention paid to the present and future between the rich and poor conditions.

SIMULATIONS AS LAB ENVIRONMENTS. Like games, simulations allow researchers to cleanly measure behavior. For instance, Webley, Levine and Lewis (1991) used a quite realistic simulation of saving and spending decisions. The authors had children participate in a "play economy". Children tried to save tokens they received to buy a very nice toy, but they were tempted to spend it immediately on sweets or entertaining activities. The experiment was staged over six days, with each session lasting about 40 minutes. The child was given 30 tokens at the start, and a 10 token allowance on each of the six days, for a total of 90 possible tokens. In order to buy the toy, the children needed to save 70 tokens. The child would spend 10 minutes in each of the four available rooms; one was the home base, containing the bank, the toy store, and a lounge area. The other three rooms provided temptation to spend. They had options for different activities that cost different amounts: each room had a 10-token option, a varying option, and a free option. The child could deposit their money into the bank at any time. The authors found that older children showed a better understanding of savings and saved more.

REFLECTION

ARE GAMIFICATIONS REALLY GAMES? In the introduction, we listed out typical characteristics of a game. Although there is not one definition of what a game is, this survey of typical characteristics of a game makes one wonder whether examples of gamification (e.g., Actify steps challenges) really make a full-fledged game out of a certain behavior. Usually there are just some game-like aspects added to the behavior. For instance, the Actify steps challenges are arguably fun to play and have clear rules, but they lack the circumscribed time and place of a typical game (e.g., 90 minutes on a soccer field), and the humor and lightheartedness of one. Of course gamifications are also different from typical games in the sense that they have real, rather than fictitious, consequences. Still, there is no reason why gamifications could not be more game-like.

SPORTS ARE GAMIFICATIONS OF EXERCISE. In that sense, sports are the ultimate gamifications of exercise. People do not typically consider sports to be gamifications, but there is no reason why they are not. Races (10K, marathon, etc.) are obviously gamified running. But soccer too is gamified running. Football is gamified bodybuilding. Etc. On the other hand, some people may feel that the circumscribed nature of time in this context is what distinguishes a game from gamification. A daily steps challenge of 10K steps is a gamification, while playing a soccer game is a game. Is there research on whether sports make people exercise more compared to non-sports exercise? For instance, could you make people run more by having them play a game of soccer compared to asking them to run?

Any thoughts or comments on this vision, feel free to drop Jan Willem a note: jwl38@duke.edu

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