The Motivational Push of Games: The Interplay of Intrinsic Motivation and External Rewards in Games for Training

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ABSTRACT
Games for training aim to keep interest in training activities high by making them more enjoyable, yet interest and motivation often wane over time. Games frequently employ rewards to halt waning motivation; however, research suggests that although this approach may work for less motivated players, it may backfire for players who are already enjoying a game. To explore changing motivation patterns over time, we conducted an 11-day study of a game for training executive functioning with players who were split into two groups that reflected their intrinsic motivation induced through a manipulation of identification with an in-game avatar. Although motivation waned over time, both effort and enjoyment waned more rapidly for players who identified less. After one week, when we delivered a reward (payment), the less-identified group respond positively – increasing their effort and improving performance; however, the more identified group responded negatively – decreasing their effort and declining in task performance.

Author Keywords
Motivation; training game; gamification; self-determination

ACM Classification Keywords
K.8.0 [Personal Computing]: General - Games.

INTRODUCTION
There are many domains in which people need to invest time and effort in a training activity to see future benefit. For example, consider a person who wants to learn a second language – if she puts in the work of memorizing vocabulary, over time she will be able to communicate in another language. Or consider a person who wishes to lose weight – if he makes good eating choices every day, over time he will lose excess weight. Motivation to engage in these types of training activities often starts off quite high, with the person looking forward to the future payoff that will eventually result from their invested efforts. However, over time, motivation often wanes, resulting in people investing less effort in training, or quitting before reaching their goal.

This lost interest in training is partly because the beneficial outcome of training behaviours (e.g., being bilingual, reaching a healthy weight) takes time to achieve and is distinct from the behaviours themselves (e.g., practicing a second language, making healthy eating choices). This form of motivation – engaging in an activity because it leads to a desirable but separable outcome [48] – is called extrinsic motivation. Although extrinsic motivation can encourage participation in a training activity (e.g., [43,41,15]), it often wanes when the realization of the outcome is delayed – it takes time to become proficient at another language or lose weight. A remedy for waning extrinsic motivation over time is to make the training activity engaging enough so that people participate because they enjoy the training activity itself, and not just for the beneficial outcome that will result from sustained training. This form of motivation – engaging in an activity because it is inherently interesting – is referred to as intrinsic motivation [48]. However, the question is how to make repetitive training activities – such as verb conjugation practice – inherently enjoyable.

It has been proposed that digital games are intrinsically motivating to play [47] because they are inherently enjoyable. As such, the use of game design elements in non-game contexts – called gamification [14] – has been proposed to increase the intrinsic motivation of engaging in a training activity and avoid the waning motivation that plagues extrinsically-motivated training. However, even in games that are played solely for entertainment and are inherently enjoyable, player motivation can wane over time for a variety of reasons (e.g., loss of novelty or changes in a network of friends who play), resulting in declining participation. To retain players, many games inject rewards, tokens, or valuable in-game content. These incentives sometimes aim to increase intrinsic motivation (e.g., new game missions that are inherently enjoyable); however, a more common approach is to target extrinsic motivation (e.g., by providing a free power-up or in-game currency). Although designers intend that these doses of extrinsic rewards act as motivators to encourage players, it is unclear if they are effective at halting waning player motivation and if this approach will work in the context of gamified training activities.

Research in the psychology of motivation suggests that the effectiveness of introducing external rewards into a training

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activity could depend on the pre-existing motivation of the participants [55] – those motivated by a separable outcome (extrinsic) should respond well, whereas those motivated by the inherent enjoyment of the activity itself (intrinsic) may respond poorly [12]. This loss of motivation that occurs when external incentives are provided to intrinsically-motivated people has been demonstrated in other domains [11,23,1]; however, it is unclear whether the use of external rewards will improve motivation, halt waning motivation, or undermine the pre-existing intrinsic motivation of players of a training game. Loss of motivation in training games has major implications as they are used in many serious domains, such as for health [43] and safety training [49].

As such, we conducted an 11-day study to understand the effects of time and incentives on motivation and behaviour in a game-based training activity with 200 participants. We asked all participants to engage daily in a game-based version of an established task that has been used in various digital interventions [15,54] – a go/no-go task to train executive function [38]. Although we promised payment, we withheld it for the first week – replicating the context in which the beneficial outcome for an activity is separable from task engagement and is delayed. After seven days, we paid participants, delivering their expected reward. In addition, we facilitated intrinsic motivation in half of our participants using an existing induction approach of avatar identification [4] to create two groups who differed in their level of intrinsic motivation. Each day, we measured subjective motivation, affective state, and task behaviour – both before and after delivering the extrinsic motivator of payment.

The results of our study make three important contributions to understanding motivation and behaviour on repeated days of participation in a game-based training. First, we demonstrated that we can use a digital induction method (avatar identification) to foster intrinsic motivation, which lasted over repeated days of participation in the training activity. Second, we showed that motivation waned over time; however, both effort and enjoyment waned more rapidly for players who identified less with their in-game avatar. Third, when we delivered a reward (payment) after one week, the less-motivated group responded positively, increasing their effort and showing improvements in task performance. However, the more motivated group responded negatively to the reward – they showed a decrease in their invested effort and declines in performance on the training task. Explained by theories of human motivation, our findings have implications for games for training, games user researcher, and games for entertainment.

RELATED WORK

We first describe human motivation, followed by motivation in games for training and gamification.

Motivation

Human motivation describes a person's inspiration to act – as Ryan and Deci [48] note: "to be motivated means *to be moved* to do something". Nearly everyone who interacts with the world around them experiences motivation, thus it is a topic of interest in a diverse range of fields.

Spectrum of Motivation

Motivation varies by level, i.e., how much motivation is experienced, but also by orientation, i.e. what form of motivation is experienced [48]. The spectrum of different orientations of motivation is defined by how controlling or volitional an activity is (the regulatory style). Self-Determination Theory (SDT) suggests three regulatory styles of motivation: *internal motivation, external motivation, and amotivation* [48].

Amotivation suggests the complete lack of an intention to act [48], and results from not seeing an activity as valuable [19], feeling inept to do it [13], or not feeling that it will result in a desired outcome [51].

On the other end of the spectrum, *intrinsic motivation* is defined as engaging in a task for its inherent satisfaction [48] - an activity that is its own means to an end, e.g., playing endless hours of Tetris, not to beat the high score, but because implementing a clever strategy to clear the falling rows is enjoyable in and of itself.

Extrinsic motivation is defined by an activity in which behaviour and outcome are separable, e.g., studying (behaviour) to pass an exam (outcome) [48]. Extrinsic motivation varies depending on the congruency of an activity with our goals; the separable outcome may be desired because it leads to a reward (*external regulation*), leads to approval from the self or others (*introjection*), is something that is consciously valued by the individual (*identification*), or is congruent with an individual's self-view (*integration*) [48].

It is important not to confuse extrinsic motivation with external rewards. External rewards, e.g., points, or in-game currency, are representative of external regulation. Rewards are a fundamental concept in games and when combined with appropriate reward schedules, can enforce long-term retention [14]. However, once the reward or the expectation to be rewarded is removed, players would likely lose interest and retention would drop [17].

Undermining Intrinsic Motivation

There is literature from the psychology of motivation that suggests existing intrinsic motivation can be undermined by the application of an extrinsic reward [48]. As such, the efficacy of applying rewards in a training activity could depend on the existing motivation of the participants. Specifically, individuals who are extrinsically motivated to do the task should respond well to a reward, whereas intrinsically-motivated people may respond poorly.

This negative effect of an extrinsic reward on existing intrinsic motivation has been shown in multiple domains (e.g., education [11], philanthropic activities [23], workplaces [1], games [22], health [52]), and with a variety of demographics (e.g., kids [30], college students [32]). However, there has been controversy surrounding the existence of this so-called "overjustification effect". In a meta-

analysis of 128 studies, including four meta-analytical studies, Deci et al. [12] confirmed that extrinsic rewards – independent of whether they are received or expected – undermine intrinsic motivation. The results showed that receiving expected tangible rewards (e.g., money or marshmallows) consistently undermined intrinsic motivation, as measured by a free choice paradigm (i.e., measuring how long participants spend on a task without any expected reward). Self-reported measures parallel results from the free-choice tasks (with weaker effect sizes), except when the rewards were based on performance (e.g., receiving a reward when a threshold score is reached).

Motivating Training Activities using Games

Motivation is a central concept in the discussion of games for both entertaining and serious purposes. With the exception of professional gamers who get financial rewards (external regulation) for playing, games are generally a leisure activity that is engaged in by choice under a player's own volition [50]. Thus players need to be motivated to participate. That motivation may be intrinsic – that is, they participate because they truly enjoy the game play – or extrinsic; they play because they get social value from gaming (introjection), value from gaming as an activity (identification), or self-identify as a gamer (integration) [48].

It is important to distinguish the motivation that people have to play games from the motivational elements that designers employ within games to encourage certain in-game behaviours. Although based in the same theories of what motivates people, design decisions grounded in motivation within games (e.g., rewarding players for in-game purchases) are conceptually distinct from design decisions used to motivate participation with the game itself (e.g., giving an in-game reward every day that the player logs in). In this paper, we focus on the latter – using game elements to motivate participation in the game in general.

Motivation in Games for Training

Motivation to participate in games for training is similar to the motivation to participate in games for leisure; however, the training game can be viewed as a means to an end. Consider the example of a person who wishes to learn German and plays a game to help her learn the genders of nouns. She may actually enjoy playing the game (intrinsic motivation), may do so because her company is paying her to learn German (external regulation), because her friends all speak German and she doesn't want to be excluded (introjection), because she sees value in speaking another language (identification), or because bilingualism is congruent with her self view (integration). Although a training activity can be inherently interesting (especially at first), they generally have instrumental value in terms of leading to a separable outcome, as opposed to intrinsic value. The application of games as training activities tries to address this intrinsic value by making them more enjoyable (e.g., [43,27]). When playing games for training, players might be motivated for multiple reasons – the motivation to play might be in service of a separable outcome, e.g., learning a language as the main purpose of engaging in the game, or because the game is inherently enjoyable, e.g., because the premise is interesting or the mechanics are enjoyable [11]. In our example, playing a learning game will likely be a more enjoyable means to learning the genders of German nouns than rehearsing them without the incorporation of game elements. As such, games for training tend not just to affect the spectrum of extrinsic motivation for learning, but address the underlying enjoyment of the activity itself.

The Motivational Pull of Games

Games are fun, because they allow us to actively participate in a compelling narrative, provide us with challenging encounters, and give us the opportunity to choose our fate [45]. A variety of models [47, 57] have tried to capture the essence of player motivation. Self-determination theory [10] is a well-grounded theoretical framework that allows us to explain how satisfying basic psychological needs leads to enjoyment in games. The traditional model proposes [10] three factors. *Competence* is the need to experience mastery and control over the outcome of a challenge, e.g., mastering the skills of a champion in *League of Legends* (2009, Riot Games), or facing the increasing challenge of *Tetris* (Pajitnov, 1984). *Autonomy* is the need to engage in a challenge under one's own volition, e.g., the diamond shaped pathways in *The Legend of Zelda* (1986, Nintendo), or through race, class, and faction choices in MMORPGs, such as *World of Warcraft* (2004, Blizzard). *Relatedness* is the universal need to feel connected to others, e.g., by playing team-matches in *Counter Strike* (2000, Valve), or by feeling connected to in-game objects or characters, e.g., bonding with the companion cube in *Portal* (2007, Valve). SDT has also been extended to capture the unique characteristics of digital games with Presence/Immersion, the experience of being transported into a virtual environment; and Intuitive Control, which describes the naturalness of the game input. Satisfying these needs has been shown to increase enjoyment [45] and play-time [4] in games.

Gamification

Because of this motivational pull of games, the use of game design elements in non-game contexts – called gamification [14] – has been proposed as a method to increase the intrinsic motivation of serious games. For example, games have been used to encourage serious behaviours, such as healthy eating [2], smoking cessation [27], lowered energy consumption [27], and understanding the challenges faced by people with disabilities [16]. In terms of promoting training activities, gamification is used to motivate people in the short term in domains from human resources system training [44] to surgical skills training [32]. In addition, serious games have also been proposed for use over the long term to motivate sustained and repeated participation, increase the effort invested by the participants, and improve the retention of participants over time, with the goal of ultimately leading to more effectives training [28].

There is some controversy surrounding the use of gamification in serious contexts and even on the use of the term

gamification itself. Intentionally called *pointsification* [5] or *exploitationware* [6], thought leaders suggest that gamification is often a superficial application of trivial game elements – such as points, achievements, badges, and levels [40] – rather than the principled application of the mechanics, dynamics, or aesthetics [24] that create meaningful, emotional, and engaging play. As Bogost notes, "points and levels and the like are mere gestures that provide structure and measure progress within" the game system [5, 6]. For the purposes of this paper, we leverage the term gamification (and *gamify*) when we talk about the application of game-based elements in non-game contexts [14]. However, we clarify that our goal of including game elements is to increase motivation (either intrinsic or extrinsic) to engage in sustained and repeated training activities over time.

Waning Motivation in Games for Training

In games designed for long-term training, combating waning motivation is of particular importance. One way that researchers have attempted to maintain motivation in longer-term deployments is to keep enjoyment (intrinsic motivation) high because it is a good predictor for staying engaged in a task over time [17]. One approach is to inject novelty in the game over time. Hernandez et al. [20] deployed a 10-week trial of a networked multiplayer exergame for children with Cerebral Palsy to exercise and socialize together. To keep the novelty of the game high over the 10-week trial, they included six mini-games, which they introduced progressively every two weeks to maintain interest in the training activity. Logs of game choice and time played suggest that the strategy was effective [21]. Similarly, Mandryk et al. [35] deployed a 12-week trial of a neurofeedback training system for children with fetal alcohol spectrum disorder to learn to self-regulate. Rather than creating a neurofeedback game, their system turned any off-the-shelf game into a biofeedback game – this decision was largely motivated by the idea that allowing participants to select a commercial game of their choice to use for training would increase the enjoyment, i.e., intrinsic motivation, of training. In addition, the authors note that they originally deployed five game choices, but participants complained that they were bored of the games and thus two new games were added half-way through to keep interest high.

Gamification of training activities has been proposed as a means of keeping motivation high, and these few studies show how researchers attempt to employ novelty to sustain motivation over the long term. However, to our knowledge, there has been no systematic study of how motivation in game-based training wanes over time, and how methods of fostering intrinsic or extrinsic motivation within the context of gamified training activities affect waning motivation.

EXPERIMENT DESIGN

We conducted an online study to understand the effects of time and incentives on motivation and behaviour in a game-based training activity. We withheld payment for the first seven days, but paid participants each day thereafter. In addition, we facilitated intrinsic motivation in half of our participants using an existing induction approach of avatar identification [4]. Each day, we measured subjective motivation, affective state, and task behaviour.

Manipulating Identification: The Avatar Creator

To manipulate avatar identification, we used a character creator that has been shown to facilitate intrinsic motivation [4]. Participants were asked to create an avatar and adjust its appearance, personality, and attributes (characteristics). A minimum of four minutes in the character creator were required, but participants could take longer if they wished. After customizing their avatar, participants were shown a summary of their character and asked to enter a nickname.

Options for the appearance, personality and attributes are described in [4]. We additionally added customization of the size of nose, eyes, and ears (small, medium, big), the distance of the eyes (narrow, medium, far), and the shape of the head (oval, round, heart, strong jaw) to better facilitate similarity identification [4]. At the end of the creation process, the avatar was visually presented along with a summary of its personality and attributes, to give the player the sense that their avatar had a profile.

We manipulated identification by presenting half of our participants with the avatar creator. The other half were randomly assigned an avatar of the same sex, from a set of four. Following the approach used in [4], participants in the randomly-assigned avatar group watched a 4-minute video of the creation and customization of their avatar. We created four videos for each sex with four different personality and attribute configurations, similar to [4], with the additional face options set at the medium level. Participants who watched the video were not allowed to name their avatar; instead the avatar was represented as "Player 1".

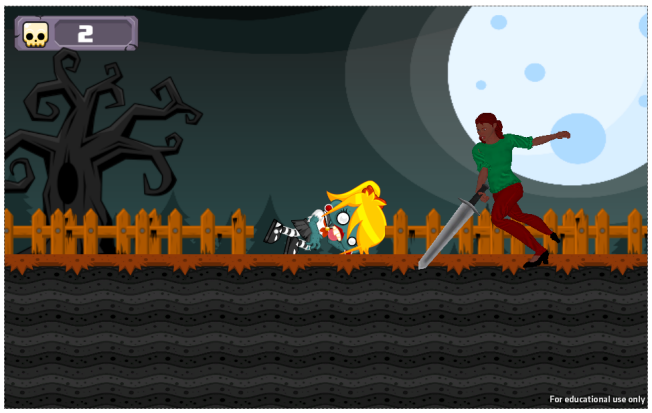

Figure 1. Go/no-go task Zombie Apocalypse showing a player hiting a Zombie.

Go/No-Go Task: Zombie Apocalypse

Zombie Apocalypse is a zombie themed go/no-go task in which participants stab Zombies with a sword, and avoid stabbing moles. The game was implemented in C# using Unity 4.6 (Unity Technologies, 2014).

We chose the go/no-go task for a variety of reasons. It is used to train cognitive functions [15], so it is a representa-

tive task for a training activity that must be repeated over multiple days. It is simple to explain and does not require a steep learning curve, making it appropriate for an experiment. Go/no-go is also a common game-mechanic (e.g., whack-a-mole), making it familiar to participants in the context of a game, and also straightforward for us to gamify by adding premise, graphical assets, and a score.

Task: The participants' created or assigned avatar stood in a fixed position holding a sword (see Figure 1). Players were instructed to respond to appearing zombies (*targets*), but not to moles (*lures*). Targets and lures were intentionally visually similar to increase task difficulty. A target or a lure appeared every second (popping up from under the ground), giving participants a 500ms window to respond by pressing the spacebar. Correct or false responses to targets or lures results in four response types with different scoring: 1) correctly responding to a target: *hit*, 2) not responding to a target: *miss*, 3) responding to a lure: *false alarm*, 4) not responding to a lure: *correct rejection*. *Hits* increased the participant's score by 1; *misses* and *false alarms* decreased score to a minimum of zero points; *correct rejections* left the score unchanged. Stabbed zombies (hit) exhibited a death animation, whereas missed zombies (miss) walked away. Stabbed moles (false alarm) turned red before disappearing to give the participant feedback, whereas missed moles (correct rejection) popped back underground safely. Each participant was presented with 80 targets, and 20 lures, presented in a pseudorandom order. Score was displayed and incremented after each target or lure. To ensure that participants understood the task and controls, we presented a training condition with 10 stimuli total (8 targets, 2 lures) before beginning the task each day.

Applications: The go/no-go task requires participants to decide between a target and lure and initiate a response in a very short amount of time, which requires focus and quick decision-making. As a result of the 4:1 relation between targets and lures, participants get accustomed to responding to targets and are thus required to inhibit the most common response, press the spacebar, to correctly reject a lure. Assessment and training of executive functioning is used in both clinical [9] and non-clinical [15] contexts.

Measures

We collected both subjective and behavioural measures.

Identification was measured using the avatar-related subscales of similarity identification, embodied identification, and wishful identification from the Player Identification Scale (PIS, [56]). Participants rated their agreement to identification-related statements measuring similarity – "My character is like me in many ways" – on a 7-pt Likert scale.

Motivation was measured using the Intrinsic Motivation Inventory (IMI, [37]). The IMI measures the constructs *interest-enjoyment* - "I enjoyed this game very much."*, effort-importance* - "I put a lot of effort into this game."*, perceived competence* – "I think I am pretty good at this game.", and *tension-pressure* - "I felt tense while playing the game.". Each construct was measured with multiple items using agreement with a 7-pt Likert-scale. The results were then aggregated into the four constructs of the IMI.

Task Performance

Performance in a go/no-go task is defined by *hits* and *correct rejections*. Negative performance is described as the number of *misses* and *false alarms*. Following [25, 53], *hits* and *false alarms* are used to compute *sensitivity* (d_L) and *bias* (C_L). d_L separates targets and lures and represents an index of difficulty for discriminating the two types of stimuli – a higher d_L indicates that targets and lures are more discriminable. Negative C_L scores indicate a liberal bias to respond to target or lure, while positive scores indicate a conservative bias to respond.

Participants and Deployment Platform

We conducted our experiment online. 200 participants (43.9% female) with an average age of 31.68 (SD=8.94) were recruited through Amazon's Mechanical Turk (MTurk), which connects workers willing to do Human Intelligence Tasks (HITs) with requesters of the work, and has been shown to be a valid environment for conducting user studies [26]. Participants were re-invited daily to participate in our series of HITs for 11 consecutive days. Participants received $4 for the first day (40 min), and $1 for each consecutive day (10 min). Ethical approval was obtained, and participants provided informed consent. The HIT was only made available to workers in the USA older than 18 with an approval rate above 90%.

Participants were excluded from further analysis if: they showed zero variability in more than 2 questionnaires, suggesting that they indicated the same response on all items independent of scale or reversed items; the number of *hits* in the go/no-go task exceeded 80, indicating that they reloaded the task; or they did not participate on day 4, 5, or 6, which were the days on which we measured identification (30 participants excluded).

Procedure

We recruited the initial pool of participants on the first day. Daily HITs were independent, so that people who skipped a daily HIT were not excluded from further participation.

Day 1

Participants were first informed about the amount of compensation they would receive ($4 for approximately 40 minutes); additionally, we informed them that the first payment would be delayed for 7 days, and that they were expected to answer attentively and quickly. It is important to note that by promising a reward at day 7, we introduce an anticipated extrinsic reward from day one. Therefore, participants might experience two different sources of motivation, i.e., the financial reward as an extrinsic source, and identification as a source of intrinsic motivation.

After being informed of the reward, participants were randomly assigned to either the customized or random avatar group. After creating an avatar (or watching an avatar being created), participants performed the go/no-go task, and then

completed the IMI. Finally, participants provided basic demographic information, e.g., frequency of play, age, and stated the purpose of the study in their own words.

Day 2 – 11

Each day, participants were informed about the compensation they would later receive ($1 for about 10 minutes), and were asked to provide informed consent. Participants entered their MTurk identification code to load their saved avatar, and then performed the go/no-go-task, before completing the IMI. On day 4, 5, and 6, we additionally asked them to complete the avatar identification scale.

Delivery of Extrinsic Motivator

On Day 8, we paid participants for their initial HIT and continued to pay them each day thereafter. This represents us delivering on a promised (but delayed) outcome (i.e., an expected tangible reward) that is separable from the training activity. Paying a delayed reward at day 8 fulfils three purposes: 1) the separable outcome becomes salient; 2) experienced extrinsic motivation is temporarily increased; 3) paying participants reinforces trust that their efforts would be compensated. We were not interested in the specific reward, but in a proxy for receiving an expected, but delayed beneficial outcome separated from the training task.

Data Analyses

All data were logged to a database on a server at the University of Saskatchewan and were analyzed using SPSS 23. IMI data were computed after each completion of the go/no-go task. Identification was computed as average identification of Day 4 to Day 6. To create two groups that varied in their initial intrinsic motivation based on our avatar customization manipulation, we performed a median split on the average similarity identification.

To analyze changes in motivation and performance over time, we performed Hierarchical Linear Models (HLM) with *day* on level-1, and the dependent measures on level-2; *identification* was entered as the covariate. Estimates were computed using Restricted Maximum Likelihood with a maximum of 100 iterations, and a maximum step size of 10. To avoid biasing the analysis, covariance was kept unstructured for random intercepts. The α-niveau was set to .05.

To compare improvement or change over time (days) for the two identification groups separately, we computed the slopes for the daily averages within an identification group. Because we used a between-participants design, the absolute performance differences on the go/no-go task between the more- and less-identified groups is not meaningful (due to the individual differences in executive function between players in these two groups). As such, our analyses of the task performance measures calculate the difference between the day of interest and performance on Day 1. Comparisons are made using this difference, which reflects absolute improvement from Day 1 values.

RESULTS

We first present the general participation rates, followed by the results on the initial phase, and then following the reward. In general, participation dropped over time (Figure 2). Day1 was a Tuesday (following a holiday Monday). The average drop-out was 30.6%. Chi-squared tests for each day showed no significant differences in participation between the two identification groups (all p>.05).

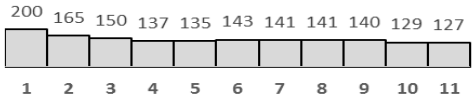

Figure 2. Participation by Day (1-11).

Initial Phase of Waning Motivation

Does motivation wane over time?

The HLM (described in the data analyses section) showed a main effect of day on invested effort ($F_{6,820.32}=6.96$, $p<.001$). Figure 4 shows that effort decreases in general over days. There was no main effect of day on enjoyment (p=.31). A general waning of effort confirms our assumptions, reflects prior research [30], and is a prerequisite for investigating the effect of a delivered reward on motivation.

Does training improve task performance?

All performance data were corrected for baseline (Day1) performance. HLMs showed that hits ($F_{6,831.33}=5.50$, $p<.001$) increase over time, whereas false alarms decrease ($F_{6,823.14}=4.11$, $p<.001$), indicating that players improved over time (Figure 5). Participants also showed an increase in d_L over time ($F_{6,828.76}=11.86$, $p<.001$), suggesting that discriminating targets and lures becomes easier over time. In addition, participants were aware of their improving performance. Perceived competence increases over time ($F_{6,825.35}=4.84$, $p<.001$). There was no difference in bias ($F_{6,829.50}=1.33$, $p=.243$), indicating that tendency to respond to target or lures didn't change over time.

Can intrinsic motivation be fostered in a gamified training task using avatar identification?

Identification can be facilitated through a variety of methods; we chose to use customization to create variability in similarity identification. While the group differences between conditions were significant ($t_{167}=4.534$, $p<.001$, $d=.70$), Figure 3 shows how the differences are derived from overlapping distributions of identification. We used a median split of identification in the remaining research questions to capture more-identified and less-identified participants regardless of their group assignment.

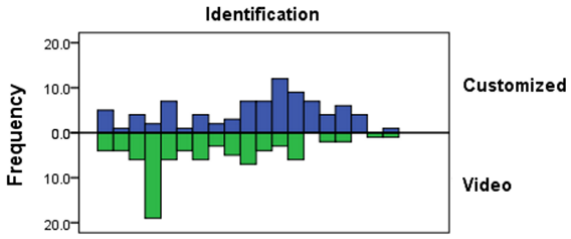

Figure 3. Split-Histogram of Identification by Condition

The HLM showed that identification is linked to motivation: players with high identification experienced more enjoyment ($F_{1,169.15}=23.19$, $p<.001$) and invested more effort

($F_{1,168.65}=10.96$, $p<.01$) compared to those who experienced low identification (Figure 4). The results confirmed that intrinsic motivation can be fostered through identification.

Is waning motivation affected by identification?

To determine whether motivation waned at different rates for the two identification groups, we regressed a line on the daily mean of participant data from Day 1 to Day 7, separately for each group. Comparison of the slopes (explained in the data analyses section) showed significant differences for experienced enjoyment ($\beta=.074$, $p<.016$) and marginally different slopes for effort ($\beta=.058$, $p=.065$). The slope values (Figure 4) show a decline of effort and enjoyment for participants who experienced lower identification, whereas motivation was more stable for participants with higher identification. See Figure 4.

Do group differences in effort translate into performance?

We applied slope-analysis [7] to investigate differences in the improvement over days for the two identification groups. Although identified participants reported higher effort, they did not improve at a faster rate than less-identified participants (Figure 4). As Figure 5 shows, performance was initially very high on all measures, showing that there was not a lot of gains to be made from practice alone. Differences in performance would be due to training executive function. We address this further in the discussion of the results.

Response to the Delivery of an Anticipated Reward

The previous results were focused on Day 1 to Day 7 of our study to establish a differential pattern of waning motivation and determine its effects on performance. In this section, we focus on Day 7 to 11, to show the differential response of participants to receiving the external reward.

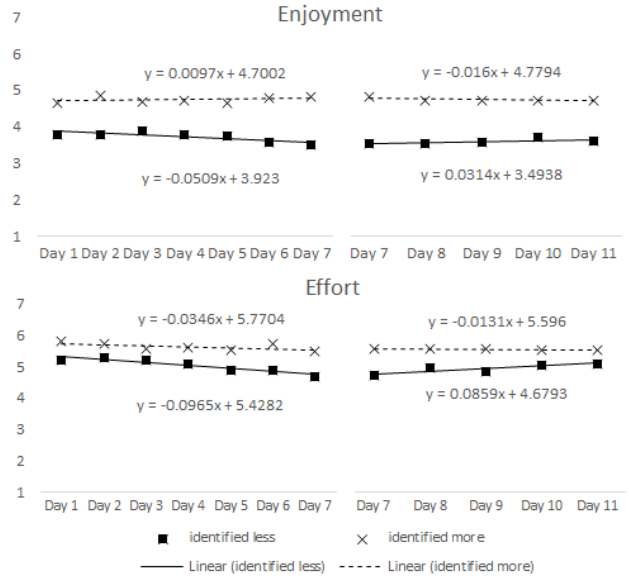

Figure 4. Means (marks), Regressions (lines), and Equations for Enjoyment and Effort from Day 1 to Day 7 (left) and Day 7 to Day 11 (right) for less and more identified participants.

How does the delivery of an anticipated reward affect motivation for differentially motivated participants?

To investigate the impact of a reward on motivation, we compared the slopes of effort and enjoyment data on days 7-11. Figure 4 shows that the lower-identified participants report an increase in their invested effort, whereas effort reported by higher-identified participants was more stable

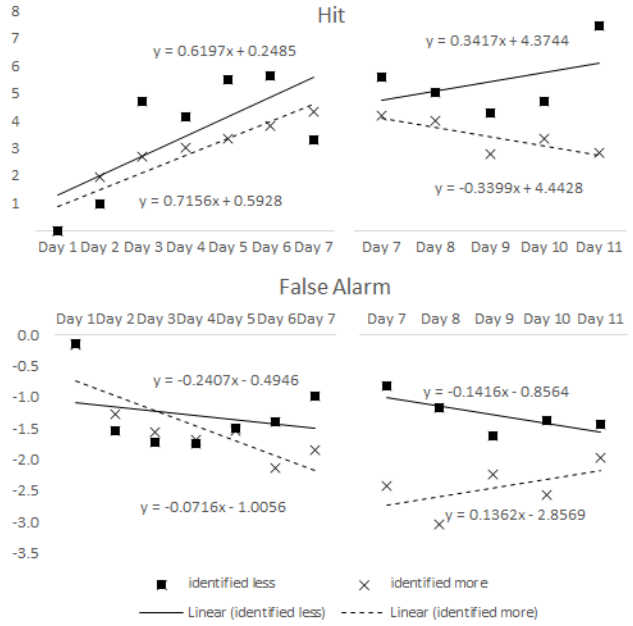

Figure 5. Means (marks), Regressions (lines), and Equations for baseline corrected Hits and False Alarms from Day 1 to Day 7 (left) and Day 7 to Day 11 (right) for less and more identified participants.

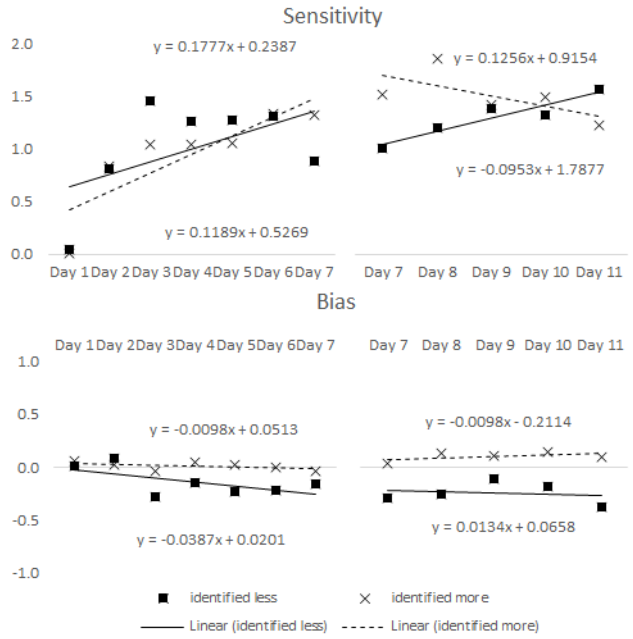

Figure 6. Means (marks), Regressions (lines), and Equations for baseline corrected Sensitivity and Bias and False Alarms from Day 1 to Day 7 (left) and Day 7 to Day 11 (right) for less and more identified participants.

(β=-.086, p=.028). There was no significant difference in the slopes for enjoyment (p=.75).

Do group differences in invested effort following the delivery of an anticipated reward translate into task performance?
We compared the slopes of task performance following the reward for the two groups. As Figure 5 shows, less-identified participants (who reported increased effort after the payment), showed improvements in performance, reflected in an increasing number of hits. However, more-identified participants showed a reversal in the improvements seen over days 1 to 7: there was a decrease in the number of hits. This difference in slopes was significant (β=-1.227, p=.012). There was a marginally-significant difference in the slopes for sensitivity (β=-.240, p=.052), showing the same trend. There was no difference in the slopes of false alarms (p=.270) or bias (p=.247).

Together, these results show that although motivation wanes for each group, identified (i.e., more motivated) participants show less of a decline in the initial 7 days in motivation and greater improvement in some measures of task performance. Following the delivery of the extrinsic motivator, the less-identified group saw improvements in motivation and performance, whereas the more-identified group actually showed declines in motivation and performance, potentially exhibiting the "overjustification effect".

DISCUSSION

We first summarize our results, and then give design recommendations for approaches to foster intrinsic and extrinsic motivation in games for training. Our discussion focuses on the application of our findings to games for training, games user research, and games for entertainment.

Summary of Results

Prior to the delivery of the external reward (i.e., on days 1-7), we found the following results.

- We first establish that motivation to invest in our game-based-training activity does wane over time. Although enjoyment of the task does not change with repeated exposure, effort – the primary measure of subjective willingness to invest in the training – decreases over time.
- Second, we show that there is improvement in the training task over time on three of the four baseline-corrected measures of behaviour (i.e., increases in hit, decreases in false alarms, increases in sensitivity). Additionally, participants were aware of their improved performance – their experienced competence also increased over time.
- Third, we demonstrate that we can foster intrinsic motivation in a gamified training task using a manipulation of avatar identification. Although prior work demonstrated this manipulation in the context of a casual game for entertainment [22], we show that the results extend to games for training. Specifically, we show benefits of identification on experienced invested effort and task enjoyment.
- Fourth, we show that the benefits of avatar identification on subjective motivation remain over repeated exposure. Although we expected differences in motivation and effort on Day 1 based on [48], we show in this study that the motivational benefits of this type of manipulation persist over time. In particular, participants with lower avatar identification experienced declining task enjoyment and invested effort over time, whereas participants with higher avatar identification show stability in both enjoyment and effort over the initial week of training.
- Fifth, we show that the group differences in invested effort do not translate into task behaviour – although the measures trend in this direction, the identified group did not improve their performance on the training task at a significantly greater rate than the non-identified group.

Following the delivery of the extrinsic reward – the delayed payment – we find the following additional results:

- Sixth, the delivery of the extrinsic reward resulted in an increase in invested effort for the non-identified participants, but not for the identified participants (i.e., those who were more intrinsically motivated).
- Seventh, the training data show that this increased effort reported by non-identified participants translated into task performance in terms of improvements in the number of target hits and marginally in greater sensitivity (i.e., a greater ability to discriminate between targets and lures).
- Finally, in a behavioural exhibition of the effect of an extrinsic reward on intrinsically-motivated people, we found that the participants who identified with their avatar showed a decrease in performance after we delivered the extrinsic reward, as reflected in a decrease in the number of target hits and marginally decreasing sensitivity.

Halting Loss of Interest through Motivational Strategies

We motivated our work with the notion that people are initially relatively enthused to begin training programs in various domains, such as to learn a new language or begin an exercise program. However, the initial enthusiasm often begins to wane after the novelty wears off, skill improvement slows down, or the person gets tired of waiting for the beneficial outcome of their efforts. Our work demonstrates that people with differing motivational engagement in a training task will respond in contrasting ways to an intervention intended to halt waning interest. Players who are less intrinsically motivated should respond well to an extrinsic reward, whereas more intrinsically-motivated players likely will not. A good strategy of piquing the interest of less-motivated players is to provide them with a reward, whereas players who are still demonstrating interest in the task might respond better to keeping their interest high. In this section, we present different in-game strategies that could be used to engender interest in a training game.

Extrinsic Motivators

Designers wishing to use extrinsic motivators to engage players in a task can reward them explicitly, but can also choose from other approaches. Here, we provide guidance based on the spectrum of extrinsic motivation [48].

External Regulation: Rewards are the classic form of external regulation as they are disconnected from the player's

goal but are salient to their interests. In-game examples of external regulation are currencies, tokens, or power-ups.

Introjection: Designing for introjection means focusing on the player receiving approval from themselves or others. Providing a player with a status item (e.g., pets in World of Warcraft), a rank that has social value (e.g., Platinum status in League of Legends), or an unlocked achievement that has personal value (e.g., Win 5000 rounds in Counter Strike:GO) target introjection.

Identification: Providing motivation for players who consciously value the activity they are undertaking should reinforce their self-endorsement of their goals. Asking a player to invest effort in service of a greater goal (e.g., grinding for a quest in World of Warcraft), or learning low-level details to achieve a desirable advantage (e.g., Champion statistics in League of Legends) are examples of identification with the personal importance of a behavior and the acceptance of the regulatory aspect.

Integration: Targeting the congruence that integrated players experience should emphasize the synthesis of the player's goals with the self-view. Challenging oneself because of internal beliefs (e.g., No-Kill run in Fall-Out 3), by accepting the demanding role to lead a team (e.g., Raid leader in World of Warcraft), or by training hard to compete in tournaments (e.g., the League of Legends World Championship) are examples of integrated motivation in games.

Intrinsic Motivation

Design choices that target intrinsic motivation should be about maintaining the interest of the players.

Enjoyment: To maintain increase of enjoyment, designers should consider adding novelty to the game [29]. This could be achieved through new game levels to play, characters to inhabit, places to explore, weapons to use, or missions to complete. Although novelty is a central concept in maintaining the interest of players, there are other ways to engender enjoyment. Self-determination theory suggests that motivation is formed through the satisfaction of the psychological needs of competence, autonomy, and relatedness. We address design options for each of these in turn.

Competence: Players should feel that they are satisfying their need for competence –that they experience mastery over challenges. Game systems use feedback in the form of scores, stars, or achievements to reinforce the experience of competence. However, a game for training (and skill acquisition in general) suffers from a fundamental problem in that improvements in skill follow a power law – that is, we see smaller improvements with more practice [39]. If we consider learning any new skill (e.g., instrument, language, game), the massive improvements seen for each unit of effort invested at the beginning begin to level off. Players often quit when the satisfaction of competence wanes (i.e., when it takes a lot of effort to see minor gains in improvement). Designers should consider how to introduce new skills or accelerate skill acquisition to avoid the leveling off of competence satisfaction that occurs over time.

Autonomy: Players should feel like they are making choices in the game and that they are acting under their own volition to feel that their experience of autonomy is being satisfied. We manipulated feelings of autonomy using avatar customization, which previous work has shown to translate into increased effort and motivated behaviour [4]. Other examples of autonomy manipulations are the branching narratives seen in The Legend of Zelda, the character behaviour choices seen in Mass Effect 3 (Bioware, 2012), and the intensive customization of Avatars seen in Second Life (Linden Labs, 2003). Focused mainly on the choice aspect of autonomy, designers could also highlight the feeling that players are acting under their own volition in choosing to play – a potentially difficult task in a training game.

Relatedness: The feeling of making and maintaining social connections is key to the satisfaction of relatedness. Multiplayer games already have several ways in which the experience of relatedness is satisfied within gameplay. Support for clan play (e.g., League of Legends), games based on a player's social network (e.g., Farmville, PotFarm, or Clash of Clans), and matchmaking algorithms that balance the skills of players in forming a team (e.g, League of Legends, Dota 2, Fifa) all enhance the experience of relatedness in multiplayer games. In addition, relatedness can be fostered in single-player games [47] by helping the player to feel close to the characters within the game (e.g., the companion cube in Portal, or Ellie in the Last of Us).

We have presented several ways in which both extrinsic and intrinsic motivation can be fostered within games. In the next section, we discuss how to apply these motivational designs in several design contexts.

Implications for Design

Our results have several implications for the design of game-based training systems, for games user research, and for games for entertainment and leisure.

Personalizing Training

Our results demonstrate how motivational patterns change over time and how responses to a reward differ for players who are more or less motivated to begin with. Characterizing the *motivational level* of players can inform design decisions on when interactive training systems should intervene to halt waning motivation. However, our work also suggests that characterizing the *motivational orientation* of users of these training systems is just as important to inform the appropriateness and timing of interventions. Understanding that people engage in training games for differing reasons, with differing expectations, and with differing levels of interest is essential.

Previous work has suggested that the efficacy of persuasive games can be improved if they are personalized to the individual player type, because different types of players are motivated by different persuasive strategies [42]. Our work

extends on this idea of tailoring games for training by suggesting that knowing the motivational level and orientation of players at any given time can – and furthermore should – inform the choice of the motivational strategy employed, for example by introducing novel content [20,35] or by providing game-based rewards [36]. As opposed to (or perhaps in addition to) the trait-based tailoring proposed in [42], our work suggests a state-based personalization that takes into account player patterns in motivation over time.

Application to Games User Research

Our findings have implications beyond games for training, including in games user research, (GUR), which is interested in understanding player experience and applying this knowledge to improve design. The methods deployed have many parallels to our context of games for training. It is common in GUR to pay people to participate in studies – sometimes over multiple days. Similar to players of games for training, gameplay testers may both enjoy the experience and be externally regulated through the payment. As such, a reward is likely to affect players' invested effort, enjoyment, and performance, depending on their level of intrinsic motivation. As such, games user researchers should be careful about how and when rewards are given to participants. In addition, researchers have to be cautious about the conclusions they draw from their tests – actual players of their games are likely to be higher in intrinsic motivation than their testers and thus will likely respond differently to the application of extrinsic in-game rewards.

Applications to Games for Entertainment

Although our research was designed to inform the area of games for training, our findings have implications in games that are designed solely for entertainment. Although the intentions of players choosing to play for leisure may differ from those engaged in games for training, there are parallels. In both cases, the goal is to retain players – the purpose in retaining players in games for training is so that they achieve a separate beneficial outcome; in games for entertainment, the purpose of retaining players is driven by the financial outcomes for the company. Next to units sold, the average revenue per paying user (ARPU) is a key metric of success for commercial games and is directly related to the number of daily active users [8]. Acquiring new players is also vital for success. A common approach to acquire new players is to leverage the existing user base through recruitment reward programs in which players receive premium currency, or vanity items (such as mounts or skins) as rewards in exchange for successfully recruiting players from their social network. Our findings suggest that the intertwined reward structure of social outreach has complex implications: the reward might be desirable for a player, but also may be perceived as externally-controlled and may negatively affect their underlying motivation and play experience if they were already enjoying the game.

Limitations and Future Work

Although our results provide several important implications for waning motivation in games for training, there are limitations in our study that can be addressed in future work. First, the results that we present are not causal: we facilitate intrinsic motivation using an established induction paradigm [4]. The paradigm creates variability in avatar identification, which in turn fosters differing motivation in players; however, we cannot interpret our results as causal. Future work can address this limitation by working with existing players who are differentially motivated to participate in a game for training a specific activity; however, randomly assigning intrinsic motivation to a subset of participants in an experiment is not possible by definition. Second, our experience with the avatar identification manipulation raised ideas on how to improve the facilitation of motivation through identification. Third, while MTurk has advantages for research in general, and longitudinal research in particular, the platform is also limited in terms of conducting research on motivation. Workers have the explicit goal to work in exchange for a financial reward. When researching motivation, it would be ideal to have full control over what drives participants to engage in a task. We plan to investigate the differences in reward types such as token rewards (e.g., money), access (e.g., premium features), or social rewards (e.g., attention from others), to create a taxonomy of rewards and their effects on players. Finally, the go/no-go task has the advantage of being simple, well described, and constrained, while also training executive functioning. Most gamified training tasks are more complex and involve layers of gamification, e.g., points, leaderboards, or social reinforcement. Therefore, our results need to be shown in the context of a more complex task, ideally "in the wild'.

CONCLUSION

There are many domains in which people need to invest effort in a training activity over time to see benefit at some future point. Motivation to engage in these types of training activities often starts off quite high, but there is a loss of interest over time, and people often quit before reaching their goal. Games for training use enjoyment to keep interest in the training activity high, even when motivation to achieve the outcome starts to wane. To explore changing motivation patterns over time and to determine how rewards affect players with differing interest levels, we conducted an 11-day study of a game for training executive functioning with players who were split into two groups that reflected their intrinsic motivation induced through a manipulation of identification with an in-game avatar. We show that motivation wanes over time; however, both effort and enjoyment wane more for players who identify less. After one week, when we delivered a reward (payment), the less-motivated group respond positively – increasing their effort and showing improvements in task performance; however, the more motivated group responded negatively in terms of their invested effort and declines in performance on the training task. Explained by theories of human motivation, our findings have implications for games for training, games user researcher, and games for entertainment.

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