Choosing to Learn: Achievement Goals, Immersion, and Competition in Non-Educational Gaming Contexts

Farshid Farzan, Israt Naiyer, Shaeekh Al Jahan, Brandon M Booth
University of Memphis
{ffarzan, israt.n, saljahan, bmbooth}@memphis.edu

ABSTRACT
Game-based learning environments are increasingly recognized for their potential to promote strategic thinking and adaptive problem-solving, yet little is known about learning processes and motivation within non-educational gaming contexts where meaningful learning still occurs and where goal adoption is optional. This study investigates how achievement goal orientations, immersion, competitive signaling via leaderboards, and dynamic challenges through randomized collectible placements influence player performance (i.e., learning) over time within a non-educational racing game. In this study, optimizing in-game performance represents a goal players may or may not choose to pursue, as it is not explicitly required for game completion. Participants completed multiple game play trials in varied experimental conditions, with performance tracked and analyzed using linear regression and mixed-effects modeling. Results revealed that performance-avoidance goal orientation consistently predicted lower overall performance, whereas performance-approach orientation facilitated significant performance improvements across attempts. Interestingly, higher immersion levels negatively impacted performance and this inverse relationship was amplified by the presence of leaderboards. These findings underscore the importance of accounting for motivational profiles and the effects of competitive elements and immersion in game designs aiming to foster performance-related learning behaviors in game-based environments, especially in scenarios where certain learning goals are not made explicit.

Keywords
Game-Based Learning, Achievement Goal Orientation, Immersion, Competitive Feedback Mechanisms

1. INTRODUCTION
Game-based learning environments offer interactive platforms that promote learning through active participation and adaptive problem-solving [16, 13]. Traditionally, educational research has focused on game-based learning environments explicitly designed to teach specific educational content or skills [1]. Such studies highlight the effectiveness of these games in enhancing critical thinking, cognitive development, and self-regulated learning (SRL) by simulating real-world scenarios and providing structured feedback mechanisms [19]. However, less is understood about how learning processes and motivational orientations function within non-educational gaming contexts, where explicit learning objectives and scaffolding may be absent, yet meaningful skill acquisition and cognitive adaptation still occur. Hence, this work aims to study the relationship between goal-oriented motivation and performance over time in the context of a non-educational game where performance is measured but improved performance is unnecessary for completion.

Achievement Goal Theory (AGT) has been studied in the context of game-based learning [12] and provides a lens through which to study the intrinsic motivational goals of game players. AGT categorizes learners into mastery-oriented (skill competence) and performance-oriented individuals (seeking to demonstrate superior skills compared to peers) . For performance-oriented persons, it further distinguishes approach (seeking to outperform others) verses avoidance (desire to avoid performing worse than peers) [11]. While mastery orientation typically predicts the willingness to engage in adaptive learning and effective self-regulation to enhance performance23 [23], competitive feedback, like leaderboards, can provide the feedback and recognition that drives outcome-related learning for performance-oriented individuals [15].

Our study takes place in a racing game where players complete laps without time constraints, with coins and boosts as optional targets. Performance is tested across four experimental conditions in a 2×2 design. One dimension varies coin collectible locations, creating a dynamic challenge to differentiate mastery- and performance-oriented players. The other alters leaderboard presence, providing public feedback that may differentially motivate performance-oriented individuals [15]. Additionally, we examine game immersion as a potential moderator of performance across conditions, as deep absorption in a virtual environment may further impact outcomes [25, 20]. In summary, our study explores how achievement goal orientations, dynamic challenges, competitive signaling, and immersion shape performance (i.e., game-related learning) trajectories within a non-educational gaming environment. Specifically, we seek to address the following research questions:

- **RQ-1:** How do individual differences in achievement goal orientation predict sustained improvement, stagnation, or decline in performance over repeated game trials?
- **RQ-2:** What is the relationship between post-game self-reported immersion and players' performance over time?
- **RQ-3:** How does the presence or absence of leaderboards (i.e., competitive signaling) influence players' ability to refine their performance optimization strategies?

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- **RQ-4:** How do randomized collectable locations (i.e., dynamic challenges) affect player performance and adaptation strategies over multiple gameplay attempts?

Addressing these questions will deepen understanding of motivation and learning in non-educational games and inform the design of more engaging educational interventions.

2. RELATED WORK

Achievement Goal Theory. AGT has been employed in the context of both game-based learning and non-educational games. AGT embeds two different categories of learning, mastery and performance orientation, and aims to explain how individuals' motivations drive them to achieve success [8, 10]. Elliot [9] expands AGT by introducing approach and avoidance motivations, distinguishing between mastery-approach (striving for competence), mastery-avoidance (avoiding skill decline), performance-approach (outperforming others), and performance-avoidance (avoiding failure).

AGT has been broadly applied to study relationships between outcomes and motivation [21], such as how motivation influences engagement and performance in game-based learning. For instance, Heeter [14] found that achievement and exploration motivations are not mutually exclusive during gameplay, as many players exhibit both. They found that players with strong mastery goals showed less interest in exploration, suggesting that their focus on skill development and task competence may limit their desire to explore beyond game objectives. However, players with strong performance goals did not exhibit less interest in exploration, indicating that these players may still engage in exploratory behaviors within games. However, in competitive environments where external rankings (such as leaderboards) push certain players to refine their strategies, performance-oriented players may become subsumed by avoiding failure and hence exhibit reduced interest in other activities [12]. Avoidance goals, especially performance-avoidance, are linked to anxiety, disengagement, and lower performance, while performance-approach goals can boost motivation but may hinder deep learning [8]. To our knowledge, no studies have examined how achievement goal orientations influence motivation for optional goals in non-educational games or how these motivations interact with competitive signaling and dynamic challenges.

Immersion. Immersion represents players' subjective experience of deep absorption in a virtual environment, influencing their engagement and cognitive processing [26]. While immersion can enhance engagement, it may also impose increased cognitive load, potentially hindering learning (e.g., for game-related motor tasks; [20]) and therefore diminish future potential in-game performance. We consider immersion as a moderating factor for performance improvement over time.

3. METHOD

3.1 Design

This study employed a three-phase design consisting of a pre-survey, game phase, and post-survey to examine how individual differences in achievement orientation, immersion, and the leaderboard and randomized coin conditions influence performance over time (i.e., learning) in a gaming environment. The pre-survey collected data on participants' prior gaming experience, self-reported game skill level, and goal orientation type. The game phase required participants to complete at least ten races, during which game performance was tracked. The post-survey assessed participants' in-game experience and immersion levels to evaluate their engagement and perceived absorption in the game.

3.2 Participants

Participants were recruited from Reddit and Prolific and asked to complete a pre-registration form to determine eligibility. Reddit is a popular social media platform and Prolific is an online research platform where researchers can conduct their studies. To qualify for the study, individuals had to be native English speakers, students aged 18-24, and willing to complete all three phases of the study. Only those who met these eligibility criteria were invited to participate, and invitations were given out in a rolling fashion to maximize gender and racial diversity until participants had at least begun the study by completing the pre-survey. Of these, a total of 71 participants successfully completed all three phases. We focus our analysis on these participants only in this work. Table 1 shows the gender and race characteristics of the participant sample and Table 2 presents the number of participants randomly assigned experimental conditions who completed all three phases

Table 1. Demographics distribution

		Race			Total
		Black	White	Other	
Gender	Women	17	14	4	35
	Men	14	14	5	33
	Other	0	1	2	3
	Total	31	29	11	71

Table 2. Random assignment for the game condition

		Leaderboard		Total
		Yes	No	
Random Coin	Yes	14	26	40
	No	16	15	31
Total		30	41	71

3.3 Material

Pre-survey. The pre-survey included two questionnaires. A *Self-Reported Game Skill Level* questionnaire [3] assessed perceived gaming proficiency, and the *Achievement Goal Orientation Questionnaire* [10] identified participants' degree of mastery and performance goal orientations. The Achievement Goal Type measure included 12 Likert-scale items across four goal orientations, each assessed with three items. Scores were calculated as the average of each section's three items, with higher scores indicating a stronger preference for that goal type. The Achievement Goal Orientation Questionnaire demonstrates strong internal consistency [10] and has been widely validated across academic and game-based research contexts. Similarly, the self-reported game skill measure has been used in prior gaming studies to differentiate players based on experience levels [25].

Main Game. The game phase involved a casual racing game, where participants engaged in a series of go-kart races, as shown in Figure 1. Each race used the same racetrack populated with coin collectables that increased the score and boosts that temporarily increased driving speed when driven over. The boost locations and coin collectable locations were predetermined, and the coins were placed in groups in the middle of the track by default. However, in the random coin condition, the coin groups were shifted towards a random edge of the track by a random amount, producing a dynamic challenge for players trying to optimize coin and boost collection. Throughout the game phase, the number of coins collected and the lap times were visible on screen. After each race consisting of two laps, players were presented with a race summary screen showing their race time, coins collected, and score (i.e., a measure of game performance). The game calculated the score by subtracting the number of coins collected from the race time in seconds. A leaderboard, showing the top three scores, was present on the summary screen for participants in the leaderboard condition and was absent otherwise.

Figure 1. Go-Kart race game interface

Post-survey. The post-survey included two measures, a *Game Experience Questionnaire* [24], a widely employed survey for games research that evaluated participants' engagement with game mechanics, and an *Immersive Experience Questionnaire* [18], a common measure that assessed the depth of players' involvement in the game environment [22].

3.4 Procedure

Eligible participants received access to a home page (Figure 2) along with a unique identifier. This home page listed the three phases of the study, informed participants about each phase, and guided them through it.

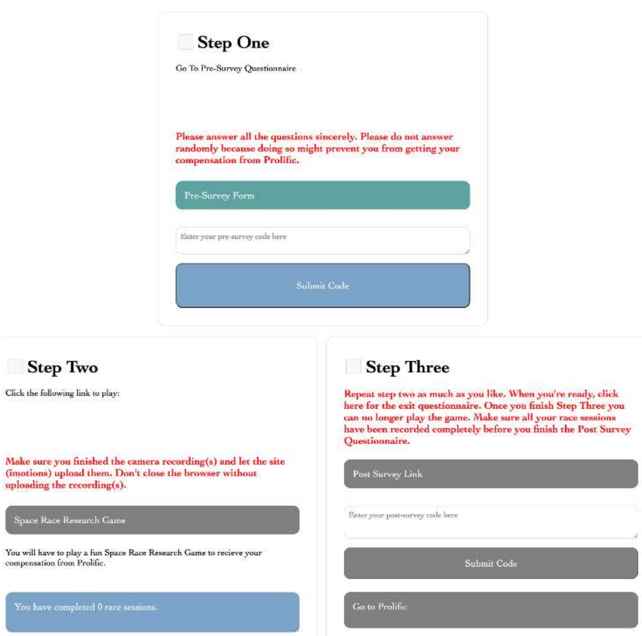

Figure 2. Participant home page

First, participants were asked to complete a pre-survey, after which they were redirected to the game home page, where the main game phase became active. The main game link directed participants to a GitHub page hosting the racing game, and participants were asked to play at least ten times. During these races, their performance and eye gaze data were tracked. All in-game events such as coins collected, boosts taken, race times, and score were logged and eye gaze was recorded using the iMotions platform [17]. In this study, we focus on game log and survey data, leaving gaze analysis for future work. After completing ten races, participants were able to continue racing as much as they liked, and they were allowed to proceed to the post-survey to complete their participation once they were ready. The entire study took approximately 90 minutes to complete, and upon successful completion of all three phases, participants were compensated $15 USD.

4. RESULT

4.1 Average Performance Models

We examine the effects of individual differences in achievement goal orientations, immersion, dynamic challenges, and competitive signaling on average performance over multiple attempts using linear regression. Since players were trying to maximize their score, we define performance as the score for each model below.

Effects of Achievement Goal Orientation on Average performance. We first model game performance as a linear function of achievement goal orientation. Results indicate a statistically significant inverse relationship between performance-avoidance goal orientation and average performance ($B = -18.3006$, $p = .0231$). We then include the weekly spent time playing games and self-reported game skill as additional predictors, which has little effect on the model ($B = -18.4366$, $p = .02315$) and neither additional factor shows significant direct moderation effects ($p > .05$). The overall explained variance for this model is relatively low ($R^2 = .08969$ with only goal orientation, $R^2 = .1099$ with additional factors).

Effects of Immersion on Performance. Next, we examine a model of game performance based on self-reported immersion. There is a significant negative effect ($B = -22.041$, $p = .0279$) and the overall variance explained remains modest ($R^2 = .0681$)

Effects of Leaderboard and Random Coin on Achievement Goals and Immersion. This model considers the experimental conditions (leaderboard vs. no leaderboard and random vs. fixed coin locations) as predictors for performance-avoidance goal orientation and immersion. Separate analyses arere conducted for participants in each condition. Results show no significant effect of the leaderboard or random coin conditions on performance-avoidance ($p > .05$). However, we observe a significant negative effect of leaderboard presence on immersion ($B = -31.15$, $p = .0223$, $R^2 = .1729$). The results for other achievement goals were not significant ($p > .05$).

4.2 Performance Trajectory Models

Our second set of analyses employs a linear mixed-effects model (LME) to examine learning trajectories by considering changes in performance over multiple attempts.

Effects of Achievement Goal Orientation on Performance Over Time. This model investigates whether achievement goal types influence performance trends. In the linear mixed-effects model, the race number (indexing races one through ten) and achievement goal types are included as fixed effects. To account for individual differences in learning trajectories, a random intercept and a random slope are specified for each participant. Results show that performance-avoidance goal orientation significantly predicts performance improvements over time (B = -22.0408, p = .00327), while performance-approach goal orientation has a positive effect (B = 18.0251, p = .01917). No significant moderation effects (p > *.05*) are present for weekly spent time or self-reported game skill.

Effects of Immersion on Performance Over Time. We repeat the previous model, instead using immersion as the independent predictor. Results indicate a significant negative effect (B = -18.500, p = .04718).

Effects of competitive signaling and dynamic challenges on performance over time. This model examines whether leaderboards and random coin assignments moderate the effects of performance-avoidance and immersion on performance trajectories. Similar to 4.2.3, no significant moderation effects (p > *.05*) are present for performance-avoidance motivation. However, leaderboards significantly amplify the negative effect of immersion on performance over time (B = -31.18, p = .0219). No significant effects (p > *.05*) are observed for random coin assignments.

5. DISCUSSION

5.1 Achievement Goal Orientation

The first research question (RQ-1) asks how individual differences influence performance improvement, stagnation, or decline over repeated attempts. Results indicate that performance-avoidance (P-Avo) goal orientation significantly predicts lower game performance (B = -18.3006, p = .0231), meaning that players with stronger performance-avoidance motivation performed worse than others. Further, P-Avo has no significant effect on the coin collection (p > .05). This result may be explained by the tendency of P-Avo individuals to become overly cautious when avoiding failure, leading to suboptimal performance rather than improved learning outcomes [8].

Furthermore, the linear mixed-effects model reveals that performance-avoidance goal orientation continues to predict lower performance over multiple attempts (B = -22.0408, p = .00327), reinforcing the idea that failure-averse players do not effectively adapt or refine their strategies over time. In contrast, performance-approach goal (P-App) orientation has a positive effect on game performance (B = 18.0251, p = .01917), suggesting that players who are motivated by outperforming others, regardless of the presence of leaderboard, are more likely to improve their performance as the game progresses. Aligned with the average performance analysis, the studies show that P-Avo and P-App have no significant effect on the coin collection (p > .05). These results indicate that P-Avo may hinder effective learning in competitive environments, regardless of the presence of leader board, while P-App motivation may foster adaptive learning behaviors over repeated attempts.

Furthermore, results show that prior gaming experience (weekly spent time and self-reported game skill) have no significant effect on game performance (p > .05). This suggests that experience alone does not drive learning adaptation, reinforcing the idea that achievement goal orientation plays a greater role. Though the casual racing game was designed to be familiar to players with prior gaming experience, the novelty of playing a new game may have reduced the advantage of participants with prior experience, requiring all players to develop new strategies.

5.2 Game Involvement

The second research question (RQ-2) asks how changes in immersion affect performance over time. Our results show that immersion significantly influences game performance, as indicated by its significant negative effect on game performance (B = -22.041, p = .0279). Since lower scores indicate worse performance, this suggests that higher immersion levels were associated with lower performance, meaning that more immersed players took longer to complete tasks (Immersion has no significant effect on coin collection, p > .05). Furthermore, the result revealed that immersion continued to predict lower performance over multiple attempts (B = -18.500, p = .04718), suggesting that immersion did not contribute to strategic improvement over time. These findings are consistent with prior observations that increased immersion may impose greater cognitive load and hinder learning of game-related motor tasks (e.g., [20]), however they also deviate from flow theory [5, 4, 7], which posits that deep engagement enhances skill acquisition and adaptive learning.

One possible explanation for these opposed perspectives may be that players who are highly immersed may be more focused on experiencing the game rather than improving their strategies, leading to longer play durations or less efficient decision-making. Another possible explanation is that immersion interacts with player skill level and game difficulty, affecting performance differently depending on the player's perceived challenge level. Players who find the game difficult may also struggle with immersion, as bored individuals have a weaker preference for moderate task demand [2]. This may suggest a nonlinear relationship between immersion, skill level, and learning outcomes, where moderate difficulty fosters engagement and performance, while extremes in challenge levels reduce both. More research is needed to understand how and why immersion affects game performance in this context.

5.3 Competitive Adaptation

The third research question (RQ-3) investigates how the presence or absence of a leaderboard influences participants' engagement in behaviors that improve performance over time (i.e., learning). Our results show that though leaderboards have no direct effect on performance over time, they significantly augment the negative effect of immersion on performance (B = -31.18, p = .0219). One possible explanation for this result is that leaderboards introduced additional cognitive load, making it more difficult for highly immersed players to focus on strategy refinement. Prior research suggests that structured competition can either enhance motivation or create excessive pressure, depending on individual differences in goal orientation [6]. In this study, leaderboards did not significantly moderate the effects of performance-avoidance motivation, indicating that competitive ranking systems alone were not enough to help failure-averse players improve performance. These findings suggest that competitive elements may not universally enhance learning and may even introduce additional barriers for players who are deeply engaged in the game but lack effective strategy refinement mechanisms.

5.4 Dynamic Challenges

The last research question (RQ-4) examines the effects of dynamic challenges, represented by random coin assignments, on player performance over time. Our results indicate that random coin assignments have no significant effect on either average performance or long-term performance trends (p > .05). This suggests that dynamic challenges, or at least the random coin implementation in this racing game, do not substantially influence problem-solving efficiency. Though the coin randomization condition changes the location of coins in every race, the average scores are similar across conditions, suggesting that players adapt their game play to this alteration successfully. One implication of this observation is that players in both the randomized and fixed coin conditions engaged with the game in-the-moment, reacting to moment-to-moment changes during the main game, rather than developing strategies between games to optimize performance. Future work is needed to test this hypothesis.

5.5 Limitations

While these findings offer initial insights into motivation and performance in non-educational games, the study's small sample size, small effect sizes, and limited sample generalizability warrant cautious interpretation. Future work should use larger, more diverse samples and focus on understanding the role and effect of immersion on performance in this context.

6. CONCLUSION

This study examined how achievement goal orientation, immersion, leaderboards, and randomized rewards influence learning in a game-based environment. Performance-avoidance goals hindered adaptation, while performance-approach goals improved performance. Immersion negatively impacted performance, likely due to highly engaged players prioritizing engagement over efficiency, an effect amplified by leaderboards. Randomized rewards had no significant impact, suggesting unpredictability alone does not enhance learning. The findings align with achievement goal theory, highlighting how performance-avoidance goals can lead to maladaptive learning behaviors. The study highlights the importance of considering motivational profiles and immersion when measuring learning related to performance outcomes in games, especially when optimal performance is not an explicit goal.

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