Persuasive Elements in Videogames: Effects on Player Performance and Physiological State

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Abstract. This paper presents an exploration into the effects of specific types of persuasive technology in videogames according to a performance and a physiological perspective. Persuasive mechanisms are often employed to change the behavior of a determined person during a known time frame. In videogames, these approaches are expected to produce results in a more limited time window especially concerning the player's performance. Literature regarding how this type of persuasive mechanisms affects a user during a game is scarce. We conducted a set of experiments with different games, on distinct platforms and with thirty individuals per experimental period. Results suggest that different persuasive techniques can effectively be used to improve or decrease player performance as well as to regulate physiological state. We provide a detailed analysis of these results along with a thorough discussion regarding the design implications and opportunities of these findings and how they are related with existing literature in the area.

Keywords: Persuasive Interfaces, Deception, Videogames.

1 Introduction

Videogames are currently one of the most important segments within the entertainment industry. Annual ESA reports shows a growth tendency from 2007 to 2010, where revenues have gone up from US$9.5 billion to US$25.1 billion, respectively. As of 2011, the videogame industry was valued at US$65 billion [9]. In recent years, we witnessed a focus into using videogames as a driving force for behavior changes [2], promoting a less sedentary life [29] and improving personal well-being [17][25]. Regardless of the game's purpose and area of application (e.g. pure entertainment, rehabilitation [11], therapy or sports [15]), players typically desire to achieve the best performance possible according to their skill set. Different mechanics are often employed to motivate users into achieving better performances [1] such as providing rewards, attempting to gather the attention of the user by exploring emotionally engaging gameplay sequences, etc. While some of these provide a positive experience to users [3], others may detract them from having an enjoyable time [12], ultimately leading them to forfeit playing the game. Independently of how they are delivered to players, these mechanisms are, in their nature, persuasive technology (henceforth PT)

D. Reidsma, H. Katayose, and A. Nijholt (Eds.): ACE 2013, LNCS 8253, pp. 45–60, 2013.

[19] – they are employed to effectively motivate the player within the game, promote better performance displays and, in particular cases, attempt at changing the player's behavior or improving their well-being [2][22][27].

Persuasive technology gained momentum in recent years, particularly through the interdisciplinary commitment to create applications which are augmented with videogame-related features (via a technique called gamification [6][7][14]). The aforementioned temporary rewards, scoreboards and motivational messages are some of the approaches used to accomplish the desired results. Among these techniques emerged what some researchers address as nudge interfaces – a strategy which capitalized on subtle persuasive and motivational cues to drive end-users into improving their performance in an application / game [1][8][16] or effectively changing their behavior [18][21]. Nudge interfaces typically recur to well-known persuasive approaches (e.g. motivating through natural language or through the employment of persistent / temporary reinforcements such as achievements). Unfortunately, information concerning what kind of immediate effect these mechanisms have on end-users is virtually non-existent [4][20][28], leaving more questions unanswered. Furthermore, existing research often relies on long persuasive intervention processes [25][29], failing to address the disruptive effect of persuasive interfaces. Recent research trends in HCI also explore the possibility of capitalizing on deceptive designs to motivate and drive users to change their behavior [1]. However, empirical evidence on these effects is scarce.

We seek to research the effects of specific types of PT (which are not related with task completeness or long motivational processes) in videogames and how a player reacts from both a physiological and performance perspective. We also want to drive the existing literature about PT forward, by providing empirical evidence whether the knowledge about presence of persuasive rewards [13] is sufficient regardless of that reward being delivered or not [1]. This article presents the main results of this research, focusing on the physiological and performance shifts presented by players. Testing was carried out with a total of 60 users in two different games. Results show quite different effects and open the way to the definition of a set of PT design guidelines according to the categorization of the empirical evidence hereby presented.

2 Related Work

Our review of existing literature tackles a few themes: PT and related models, how these are applied in videogames and game studies regarding the influence of such mechanisms on player experience.

3 Persuasive Technology

PT typically relies on identifying a behavior which should be modified by presenting the target user with adequate information, steering him / her towards a desired chain of events. This approach has been conceptualized in the Persuasive System Design (PSD henceforth) model [24]. The model is composed by three primary elements – the intent, the event and the strategy. In sum, these three elements stipulate what is the expected behavioral change, the environmental context (e.g. technology involved, user characteristics) of the subject of intervention and the way the persuasive cues are delivered to the subject, respectively. This model comprises the typical approach adopted to convey a behavior changing chain of events, profiling a user and choosing an appropriate medium to deliver the persuasive content.

The number of applications which recur to PT has been increasing in recent years. This momentum might be, in part, justified due to the proliferation of low cost modern smart-phones [25][27]. Cheap downloadable applications which promote healthier lifestyles [2][22] and are able to effectively change an individual's habits [27] are part of the driving force behind this momentum. Nevertheless, PT was rooted way before the popularization of these devices. Fogg [10] provides a thorough overview of the application of such technology in everyday life situations and scenarios. Two approaches stand out from the rest in what concerns our research: influencing users through language and persuasion through praise. The first relies on presenting written content in a language understandable by the recipient. For instance, informative cues ("Are you sure you want to proceed?") and teasing messages (e.g. "You have 29 new mails. Why don't you check them?") fall into this category. More sophisticated approaches rely on practically human-like persuasive messages to convey information to a target user or even induce him / her to pursue determined goals. Commerce sites such as Amazon[1] or gaming / lottery sites such as Iwin[2] typically recur to such techniques. Persuasion through praise slightly capitalizes on psychology and seduction to motivate the target person: by emphasizing the positive aspects of a performance (e.g. messages such as "good job!", "congratulations!"), the user is able to feel more confident in him / herself. Fogg supports this approach by presenting a study in which users were confronted with this type of messages. The results show that they felt empowered, had more confidence in their capabilities and generally felt better about themselves. King [19] discusses yet another persuasive approach named "the environment of discovery", which effectively empowers users by giving them rewards [13] according to their performance, behavior or as a mere stimulant for the persuasive process. This approach is relevant to our research, since videogames are known to sport different types of rewards (persistent or temporary) to entice players to perform better or explore the game using different strategies.

3.1 Persuasion in Videogames

Persuasive technology has not been thoroughly explored and researched in commercially available videogames. The lack of a clear physical or cognitive improvement driving force behind this type of entertainment may be a decisive factor for this scarcity. Nevertheless, there are still many opportunities and challenges which may influence the design of such mechanisms for this and other areas. In fact, games have historically recurred to PT to motivate players. Scoreboards (e.g. Dead Nation[3]),

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[1] `http://www.amazon.com`

[2] `http://www.iwin.com`

[3] `http://uk.playstation.com/psn/games/detail/item228392/Dead-Nation™/`

presentation of informative messages (e.g. Guitar Hero[4]), conveyance of praise messages (e.g. Unreal Tournament[5]), use of achievement lists (e.g. World of Warcraft[6]) or the inclusion of temporary reward mechanics (e.g. Super Mario[7]) are but a few of the mechanisms used in modern videogames. If we analyze these approaches closely we can identify a parallel between these mechanics and the PT strategies proposed by both Fogg [10] and King [19]. However, what are the effects of these disruptive PT mechanisms on a player from both a physiological standpoint and a performance perspective? Is there a relation between player performance, his / her physiological state and the employed PT mechanism? Unfortunately, research regarding this issue is practically non-existent. Following these questions, Adar [1] also suggests deception may have an important role to play in application design, effectively helping users to achieve better results. This line of thought was not, unfortunately, supported by appropriate empirical evidence, leaving a research opportunity to assess whether deceptive persuasive mechanisms are able to boost a player's performance within a game.

Persuasive technology has not only been paired with commercially available videogames. Serious games – ludic applications which aim at raising awareness for particular issues, and are often related with well-being promotion, healthy habits or exercising – are a popular way to achieve this goal. These applications typically adopt the Persuasive Systems Design (PSD) model, ensuring designers are conscious about the idiosyncrasies of both target domain and target demographic. Examples such as MoviPill [25], Molarcropolis [27] and Playful Bottle [2] testify the importance of applications for improving medicice in-take compliance, oral hygiene and water saving, respectively. These examples, while successful in their own way, rely on long intervention periods, attempting to alter the target user's behavior over that time frame. This type of games rarely combines continuous and disruptive persuasion, thus covering research regarding the first type of persuasion (continuous) but leaving any existing opportunities and challenges concerning the latter open.

4 Research Questions

With this research we seek to enrich the HCI, persuasive and videogame research communities, broadening existing knowledge and empirical evidence about the effects of PT on players. Particularly we want to address if any changes are produced on the player physiological state and on the performance within the game. To drive current literature even further we question whether players are able to feel motivated through reinforcements whether the latter is effectively delivered to them or not. The following are the research questions for this work:

- **RQ1:** can different types of PT effectively regulate (e.g. increase or decrease) a player's physiological signals while playing a videogame?

[4] http://hub.guitarhero.com/
[5] http://www.unrealtournament.com/
[6] http://eu.battle.net/wow
[7] http://mario.nintendo.com/

- **RQ2:** are different types of PT able to induce a player to improve or decrease their performance within a videogame?
- **RQ3:** do players react in the same way (physiological and performance perspective) to the existence of rewards regardless of these being delivered to them or not (deceptive persuasive elements)?

5 Experimental Games

Two games were developed to support our research: a casual game capitalizing on "Whack-a-Mole" gameplay mechanics called Ctrl-Mole-Del and an arcade racing game entitled Wrong Lane Chase.

5.1 Ctrl-Mole-Del

The first game developed within the context of this work was Ctrl-Mole-Del (Fig. 1) for Windows Mobile platforms. This is a simplistic game which has Whack-a-Mole (Aaron Fechter, Creating Engineering, Inc. 1971) as its main inspiration.

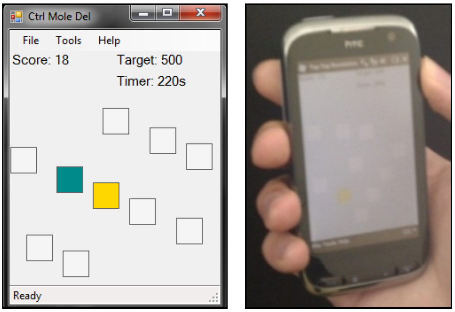

Fig. 1. Ctrl-Mole-Del's interface

The goal of the game is to interrupt an invasion of moles in an open field – the gaming area is typically populated by various holes from which the moles emerge for a brief period of time. The players need to hit them using a plastic tool (arcade version) or clicking / tapping over the mole (in recent versions).

Rules. Players are rewarded for hitting active moles and are penalized for missing to hit the moles or idling (i.e. not taking any action for several seconds). The intent of these design options is to keep the users interested in the game. Table 1 contains a summary of the scoring rules for the game. Moles appear at random intervals, with a 1.5 to 3 seconds interval between each other. Once they spawn, the player has approximately 1 second to hit them before they disappear. Each game lasts until the player earns 500 points or for a maximum of 4 minutes. To interact with the game players are able to tap the screen to hit the targets. Each time the game is executed, the locations of the targets is randomly chosen, in order to avoid training bias.

Table 1. Ctrl-Mole-Del's actions and score modifiers

Action	Score Modifier
Successfully hit a target	2 points
Failing to hit a target	-1 point
Idling	-1 point per second after 3 seconds without taking any action

Experimental Prototypes and Persuasive Mechanisms. In order to assess the different types of reinforcements we detailed in the previous sections we developed four different Ctrl-Mole-Del prototypes:

- **First prototype** – consists in the basic version of the game, stripped of any PT mechanics. Targets are highlighted using a yellow tint and the player must hit them while the target is lit.
- **Second prototype** – comprises a reinforcement mechanic which consisted in extending the time available to earn 500 points in 7 seconds. The reinforcement appears at random time intervals and is represented by a teal colored target.
- **Third prototype –** the third prototype was created with the intent of assessing the deceitful reward mechanic. We mimicked all features present in the second Ctrl-Mole-Del prototype, but we did not award any time extension to the player. In summary, players still observe the rewards, they can collect them, but they have no behaviour.
- **Fourth prototype** – stripped of any temporary rewards. Instead, we adhered to an approach based on the "influencing through language" PT paradigm and displayed the player's accuracy in the upper right corner of the screen.

5.2 Wrong Lane Chase

Wrong Lane Chase is an arcade racing game (Fig. 2) developed for Windows PC platforms. The player controls a police car in pursuit of a vehicle driven by bank robbers. The chase forces the player to drive against incoming traffic on a busy highway with 4 lanes. While doing so, the player must also retrieve gold coins being dropped by the robbers. After collecting enough coins, the player enters a final confrontation

Fig. 2. Wrong Lane Chase's interface

to stop the robbers, having to shoot their vehicle until they pull over while dodging spike strips spawned by the fugitives.

Rules. Wrong Lane Chase is a two phase game: during the first, the player needs to avoid incoming traffic and collect gold coins; during the second phase, the player is required to pull over the robbers' vehicle by shooting it, while avoiding spike strips spawned by the enemy. Table 2 presents the score policies for phase 1 and phase 2.

Table 2. Wrong Lane Chase's scoring policy

Action	Score Modifier
Collect gold coin	200 points
Hit incoming obstacle	-40 points
Avoid an incoming obstacle	2 points
Bullet hit	10 points
Avoid 40 obstacles in a row	100 points

On both phases, obstacles are generated at random positions within the highway and at random intervals. Players control their police vehicle with the keyboard's arrow keys during both phase 1 and phase 2. A new command is introduced in phase 2 – shooting a bullet – which is triggered by pressing the Z key. The full list of controls is available in Table 3.

Table 3. Wrong Lane Chase control scheme

Command	Action
Press ↑ key	Moves police car up
Press ↓ key	Moves police car down
Press ← key	Moves police car to the left
Press → key	Moves police car to the right
Press 'Z' key	Shoots a bullet (phase 2 only)

Experimental Prototypes and Persuasive Mechanisms. Four Wrong-Lane-Chase prototypes were developed to test the different types of reinforcements:

- **First prototype** – contains a basic version of the game deprived of any PT.
- **Second prototype** – encompasses a real reinforcement which temporarily decreases the speed of incoming obstacles. The reinforcement appears on the game as a green bubble containing the letter 'B'. Note that for the sake of realism, both the obstacles and the background scenery are slowed down.
- **Third prototype –** contemplates a deceitful reinforcement mechanic. Upon picking this reinforcement, only the background scenery slows down, while the obstacles maintain their normal speed. In sum, again, no reward is provided for the player in the third prototype.
- **Fourth prototype** – employs a set of feedback messages which are displayed when the player attains a certain achievement (e.g. "You avoided 40 obstacles in a row", "You earned 2000 points", etc.), reminiscent of the persuasion through praise approach.

6 Experiment

We designed two experimental periods which aimed at testing the PT features present in both games. Each experimental period encompassed 30 subjects.

6.1 Users

A total of 60 individuals (50 male, 10 female; M=27.5; SD = 8.3) participated on both experimental periods. 30 subjects were recruited for our first experimental period with Ctrl-Mole-Del, while the remaining 30 participants were recruited for Wrong Lane Chase's experiment. No significant age differences were found between the two groups. A quick profiling interview revealed that over 95% of the subjects played videogames with some regularity and all of them were proficient and daily users of computers and modern smart-phones.

6.2 Metrics

We chose the following metrics for both experimental periods:

- **Average Heartbeat Rate (HBR)** – this metric is capable of quickly reflecting changes due to stress or anxiety [23][26].
- **Score** – score policies are described in the previous section. They are relevant to include as a game performance metric in both experimental periods.
- **Average Obstacle Avoidance Streak** – an obstacle pass streak corresponds to the number of obstacles a player is able to avoid in a row without colliding with them. This metric represents the average obstacle pass streak for a given player. This only pertains to Wrong Lane Chase.

6.3 Procedure

Both experimental periods were comprised by a pre-task and a set of tasks pertaining to each one of Ctrl-Mole-Del and Wrong Lane Chase prototypes. Each task lasted for roughly 4 to 5 minutes. The following tasks are coincident for both experiments, allowing users to interact with the basic version of each game and improved versions encompassing the addition of the reinforcements described in previous sections:

- **Pre-Task** – during this period, players had a one minute trial to get acquainted with either Ctrl-Mole-Del's or Wrong Lane Chase's controls (using each game's first prototype). We also took this opportunity to obtain a quick profile about the subject's proficiency with technology and videogames.
- **Task 1** – participants interacted with the first prototype of either Ctrl-Mole-Del or Wrong Lane Chase. We used this task to establish the baseline for the users' physiological signals.
- **Task 2** – for this task, participants were confronted with the second prototype of the game they were assigned to. As a reminder, the second

prototype encompassed a time extension reinforcement mechanic for Ctrl-Mole-Del and a temporary obstacle slow-down mechanism for Wrong Lane Chase.

- **Task 3 –** here, participants had to interact with the third prototype of the game assigned to them (the deceitful version of the reward). For Ctrl-Mole-Del, players were informed about a time extension of 3 seconds if they successfully hit the bonus, while in reality no added time was given to them. In Wrong Lane Chase, the game simulated the obstacle delay by employing a visual technique which decreased the speed of the background scenery (akin to what happens in the real version of the incentive). In any variant, participants were not informed about the existence of a deceitful mechanic.
- **Task 4** – in this task participants played the fourth prototype of either Ctrl-Mole-Del or Wrong Lane Chase. This prototype presented some sort of feedback to users during gameplay period: the player's accuracy in Ctrl-Mole-Del and praise messages for certain feats in Wrong Lane Chase.
- **Post-Task** – during this debriefing period, we disclosed all of the experiment's details to the subjects, while simultaneously asking them to comment on any play-style options they assumed during each task.

Task order was randomly assigned to each subject. In our experimental design we assured there was a balanced distribution in the task order to eliminate any task order related bias. Participants were in stationary settings sitting in a chair on a well-lit room interacting with the different games (even though Ctrl-Mole-Del was played on a mobile device). Scoring policies were disclosed to players with one exception: in Wrong Lane Chase they were not informed that avoiding a certain number of obstacles in a row awarded more points. Subjects were only informed about the purpose of the experiment at the end. For Ctrl-Mole-Del's experimental period, subjects were handed a Windows Mobile phone (HTC HD2), previously loaded with the 4 prototypes for that game. For Wrong Lane Chase's experiment, participants had access to a Sony VAIO VPCS13S9E laptop model connected to a Dell 27'' 2709W monitor. In both settings, an AliveTec Heart Monitor[8] sensor, previously prepared with electro-gel for better signal acquisition was used to retrieve heartbeat rate data. Sensors were placed approximately 5cm apart over the heart's location on the subject's chest.

6.4 Results

In our result analysis we employed a set of Friedman tests (data was not normally distributed) accompanied by signed-rank Wilcoxon post-hoc tests to identify which tasks yielded statistically significant results. The presented results account for a Bonferroni correction to eliminate type-I errors.

Ctrl-Mole-Del. Table 4 and Fig. 3 present the results for Ctrl-Mole-Del's trial. We found statistically significant differences between tasks for the HBR metric ($\chi 2 = 26.46$; $p < 0.001$) and for the score metric ($\chi 2 = 52.41$; $p < 0.001$), leading us to assess which ones yielded those results.

[8] AliveTec: `http://www.alivetec.com/products.htm`

Table 4. Ctrl-Mole-Del's results

		Task 1	Task 2	Task 3	Task 4
HBR	M	99.92	85.02	86.88	93.3
	SD	20.23	15.08	14.18	20.3
Score	M	299	350.12	339.53	297.63
	SD	57.26	32.41	46.88	48.98

In what concerns the average HBR, players presented a significantly lower HBR when comparing Task 2 (Z = -4.14; p < 0.001), Task 3 (Z = -4.23; p < 0.001) and Task 4 (Z = -3.54; p < 0.001) to Task 1. No statistically significant differences were found when comparing Task 2 to Task 3 (Z = -1.73; p = 0.082).

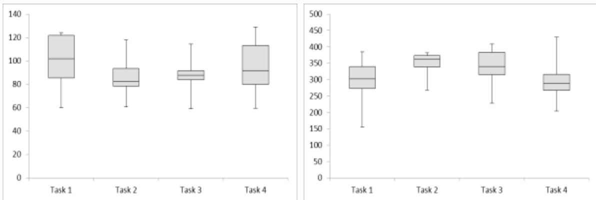

Fig. 3. Ctrl-Mole-Del's box plots for HBR (left) and score (right)

Score results show that the only statistically significant results emerged from the comparison between Task 1 and Task 2 (Z = -4.55; p < 0.001) and Task 1 and Task 3 (Z = -3.04; p = 0.002). The tasks which involved PT based on a real reward (Task 2) and on a deceitful reward (Task 3) did not present any statistically significant differences between them (Z = -1.36; p = 0.171).

Wrong Lane Chase. Table 5 and Fig. 4 present the results for the participants' average HBR, score and obstacle avoidance streak for the 4 tasks of Wrong Lane Chase, respectively. The Friedman test for the HBR metric indicated there were statistically significant differences across tasks (χ^2 = 36.92; p < 0.001). The same happened to the score metric (χ^2 = 50.04; p < 0.001) and the average number of obstacles avoided in a row (χ^2 = 42.19; p < 0.001).

Table 5. Wrong Lane Chase's results

		Task 1	Task 2	Task 3	Task 4
HBR	M	83.98	80.17	79.2	79.38
	SD	11.33	10.6	11.13	10.54
Score	M	4262.86	4628.6	4535.9	5259.33
	SD	827.21	728.6	774.48	1333.31
Obstacle Avoidance Streak	M	68.53	81.93	82.9	134.86
	SD	22.44	26.39	25.6	24.1

A deeper analysis showed that the differences between Task 1 and Task 2 (Z = -4.78; p < 0.001), Task 1 and Task 3 (Z = -4-43; p < 0.001) and Task 1 and Task 4 (Z = -3.78; p < 0.001) yielded statistically significant differences. No statistically significant differences were found between Task 2 and Task 3 (Z = -0.89; p = 0.371).

We also found statistical significance when addressing the score metric (χ^2 = 50.04; p < 0.001). Players displayed significantly better performances when confronted with a real reward when compared to Task 1 (Z = -4.20; p < 0.001); similarly, they also reacted positively in terms of performance when confronted with the deceitful reward mechanic (Z = -3.15; p = 0.002). Here we need to emphasize the lack of statistical significance when comparing Task 2 to Task 3 (Z = -0.83; p = 0.405).

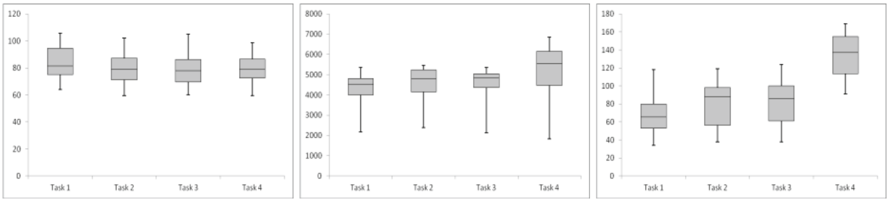

Fig. 4. Wrong Lane Chase's box plots for HBR (left), score (middle) and average obstacle avoidance streak (right)

The results for the average obstacle avoidance streak (χ^2 = 42.19; p < 0.001) again forced us to carry out a full comparative analysis between all tasks. Players presented significantly higher avoidance streaks when comparing Task 2 (Z = -1.99; p = 0.046), Task 3 (Z = -2.55; p = 0.011) or Task 4 to Task 1 (Z = -4.72; p < 0.001). Task 4 also presented significantly higher streaks than any other task.

7 Discussion

The discussion of the obtained results tackles a few fronts: how different types of PT affect players, the potential of deception as a persuasive mechanism and the challenges behind this strategy.

7.1 Persistent Persuasive Messages

In Ctrl-Mole-Del's experiment we assessed whether the display of informative data regarding the player performance (respecting Fogg's influence through language approach) was able to produce any significant changes in a player's physiological traits and / or performance. Our experiment is not entirely conclusive regarding this particular type of PT applied to videogames. While players did present significantly lower average HBR values when confronted with this PT, there were no significant differences concerning their score performance. Are we able to state that influencing through language may not be a valid PT approach? We disagree. In fact, we believe there are two justifications for our results: our feedback design approach was not the most adequate and was ignored by most users; or the game genre was too fast paced for them to momentarily peek at the feedback area. Judging by some of the user feedback we obtained from the debriefing period, we have to abide that it was a mix of the two which caused the players to completely ignore the language based PT used for Ctrl-Mole-Del: “I was so focused on hitting the targets, I completely forgot about my accuracy”; “I noticed how much time I had left in the beginning, but then I just wanted to play the game and score the highest possible”. Can we already answer any of our research questions? Not entirely, but these results partially support RQ1.

7.2 Praise the Player

Existing literature shows some evidence that praising a user can effectively persuade him / her into having a more positive posture [10]. We wanted to assess if such approach was also valid in traditional videogames – to do so we recurred to Task 4 in Wrong Lane Chase’s experimental period. The usage of praise messages which appear to inform players about reaching certain feats provided us with unexpected results. In this task, players capitalized on those persuasive cues to improve themselves and attain higher scores. Some of our subjects stated: “I enjoyed the popping motivation messages” or “This type of feats always leads me to want to improve more”.

Results for Task 4 are straightforward: not only players had a lower average heartbeat rate throughout the test, they also had a significantly higher score and, more importantly, presented longer obstacle avoidance streaks. The first remark can be linked with a tenuous relaxation due to the praise effect. Taking into account existing literature on flow in videogames and that “players should be warned about the outcome of their actions” [5][28], it is natural that showing this type of information relieves the players of some stress. The higher score, on the other hand, is a direct consequence of a behaviour shift and compliance with the PT in play. Like previously mentioned, players were not informed that avoiding a certain number of obstacles in a row awarded them with extra points. As such, they did not feel the obligation to pursue this feat in other tasks due to the lack of an obvious reward. However, we witnessed that players often preferred to skip a gold coin to avoid an incoming obstacle than collecting all coins as fast as possible. Such behavioural change resulted in them attaining multiple avoidance streaks which ultimately awarded them with even more points. In summary, displaying these praise messages was a catalyst to the creation of a sub-game or a secondary objective which, in a vast number of cases, replaced the main goal of Wrong Lane Chase. Based on these results, we argue that the display of praise sentences regarding feats is able to not only prompt users to pursue different ways of playing the same game, but also to excel and overcome their own limits as players. In light of these results and on the previous ones (regarding persistent persuasive messages) we can point that RQ1 and RQ2 have been answered positively.

7.3 Temporary Reinforcements as Motivators

Existing literature on rewards in videogames summarize the utilization of reinforcements in the following fashion: “players should be rewarded when they achieve a certain milestone" [28]. Although we agree with this sentence and it holds true for a diversity of games, there are numerous cases in which players are able to benefit from temporary reinforcement mechanics which are not related with any accomplishment at all. Developers populate games with multiple ephemeral rewards which, although not game-breaking, can alter the player's abilities in order to introduce brief changes in gameplay. Compared to the stripped versions of Ctrl-Mole-Del and Wrong Lane Chase, the addition of reinforcements produced less physiological strain on our subjects. Furthermore, their scores were higher on both games. Although this performance assessment may seem minimalistic, having into account we are merely analysing one metric, we stay true to our arguments and experimental design, which both capitalize on the usage of two different games, in distinct genres. Also, the analyzed rewards are completely different from each other, reinforcing the importance of the empirical evidence here discussed. Overall, we are able to confirm King's view on rewards as PT and conclude that their usage is capable of providing players with a sense of reinforcement, actively aiding them in performing better than with the absence of these mechanisms.

Deceitful Persuasion Technology. The most interesting contribution of this work concerns the analysis of whether reinforcement's persuasive nature was strong enough for players to perform better, despite no actual change taking place in the game. Results indicate that our subjects, indeed, had a significant higher performance in the presence of such persuasive mechanisms. Their average HBR decreased, hinting at a possible relaxation effect. To conclude, we have to emphasize the importance of not having statistically significant differences between the tasks in which real reinforcements were offered (Task 2 for both experiments) and the tasks where deceitful reinforcements were provided (Task 3) – this means that the physiological and performance effects of these incentives can be independent of whether a real reward is offered or not. We also found a negative correlation (Spearman's Rank Order ($\rho s=-0.49$; $p=0.006$) between the players' average heartbeat rate and average number of obstacles avoided in Wrong Lane Chase's Task 2 (presence of a real reward) and a positive correlation between the players' heart rate variance (the standard variation of their heartbeat rate over time) and the average number of obstacles they avoided in Task 3 ($\rho s=0.53$; $p=0.003$). These correlations support and answer RQ3 as we found two relations between physiological and performance metrics supporting both the real and deceitful rewards we addressed. Furthermore, they are in line with Adar's [1] theoretical essay on benevolent deception.

Ethics. A final question can be asked regarding deceitful PT: is it ethically acceptable? We defend that these are acceptable mechanics for games. Provided the deceitful rewards are carefully designed to avoid easily identifying them, our results show that these have a similar persuasive / motivational effect as real rewards. Of course, the identification of a deceitful persuasive element by a player might alienate him / her and provoke a feeling of distrust towards the game or the developer. However, this is a design exercise which falls outside the scope of our research and competence.

8 Conclusion and Future Work

Our main conclusions point that PT can act as a physiological regulator, allowing players to present more relaxed states depending on the type of PT employed, answering our first research question. User performance can also be significantly affected by the PT approach used in a videogame, thus providing the support to answer our second research question. In this case, praise messages and reward provision displayed different impacts on how they changed a player's performance. Nevertheless, this experiment's breakthrough was the analysis of whether the knowledge of the existence of rewards was a strong enough persuasive cue to influence players regardless of that reward actually changing anything within the game. Results showed no statistically significant differences regarding the players' physiological reactions as well as their performance shifts. This introduces a new type of PT which can be applied to videogames and this provides enough evidence to answer our final research question.

In the future we want to explore scenarios of application for deceitful persuasive mechanics. In particular, we want to address some of the questions we left unanswered in this article such as whether the deceitful persuasive element derived changes decay with experience and what is the best design strategy to seamlessly transit from a deceitful reward mechanic towards a real one.

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