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Electronic Game's Feedback Loops: Balanced Design Feedback Loops by Applications of SDT Enhance Player's Motivation

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Abstract: In the modern electronic game industry, several key design factors are commonly mentioned and used by general designers. Feedback loops are one of the most popular and necessary techniques that have been used implicitly in game designs and other fields. This research will discuss the connection between the logic behind this technique and some psychological theories, mainly the self-determine theory, which will relate to the effectiveness of generating motivation for users with this technique. With the hypothesis above being proposed, common players' reactions toward different examples related to the topic will be collected as direct data from real-life scenarios, which would prove the correctness of this research. Although players have been constantly experiencing positive and negative feedback loops while gaming, this reward system has already become a norm inside video games. The main target for this article is for readers to have a deeper understanding of this system and be able to recognize the importance of their existence in products and their connection to self-determine theory. This paper will also present a framework for creating feedback loops from psychological aspects as a useful tool for readers to utilize.

Keywords: game design, feedback loops, self-determine theory, motivation

1. Introduction

The Self-Determine Theory has been used as a framework for the study of human motivation which defines intrinsic and extrinsic sources from the outside world for creating motivation through the process of internalization. Feedback loop is a concept applied in various fields of study that is mainly about taking input from the user and returning an output based on the user's performance to modify the subject's behavior. However, there isn't an article in the field of game design that well explains the relevance between these two concepts, self-determination theory (SDT) and feedback loop, with data taken from real-life scenarios. The main targets of this research are to justify that modifying the subject's behaviors in electronic game products is a process of forming motivation. Second, to discuss the reasons behind this process by connecting it to the SDT and several other physiological theories through the feedback loops. Third, create a framework that will cover the fundamental needs to build successful feedback loops through the aspects of SDT. This paper will explore the centric concept of SDT and the feedback loop, then examine the three feedback loop examples from popular electronic

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games to discuss their correlation with SDT as a hypothesis, which will be proved later from the data collected.

2. Self-Determine Theory (SDT)

Self-Determine Theory is the macro psychological theory that suggests three fundamental psychological needs, Competence, and Relatedness for humans to have motivation towards an object. In the study by Gagné, Marylène, and Edward L. Deci, they found that people need to feel competent, autonomous, and related to the activity in order to maintain their intrinsic motivation. When there's a clear goal, people will obtain the desired consequence and avoid the undesired one, so they are energized into activity [1]. In the field of game design, Autonomy, and Competence are more obvious to be observed by the user, which should let them be able to gain mastery, a sense of being able to control their environment, achieve tangible goals, and gain rewards that are equal to their performance so that they will be satisfied with the given task and result. Even if a user has never heard of or experienced the product, presumably, the process of internalization will start if the product has the elements listed above [1]. The external expectations from the video game creates satisfaction within the user, becoming a rewarding system that encourages them to complete and follow the instruction with more effort. The internalization is completed when external expectations have become an intrinsic goal for the user as shown in figure 1.

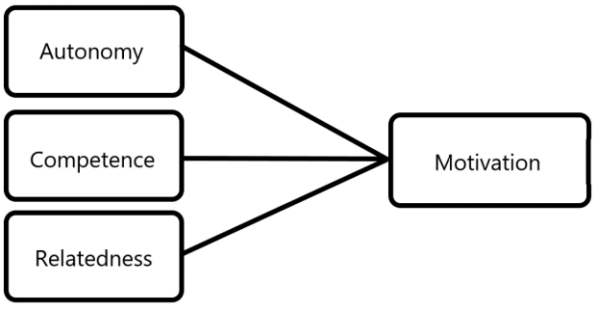

Figure 1: Model For SDT.

3. Feedback Loop

Feedback loops can be identified as positive (reinforcing) or negative (balancing) loops. The system will take the output from the subject and give feedbacks which will change based on the performance of the subject. In general, a Reinforcing Feedback Loop is recognized as the cycle that would first accept one or multiple arguments from the user, process the given data inside with an internal measurement system, and return the positive result as an argument if the user reached the expected performance. With this process being executed repeatedly, it would encourage the subject to give input that would favor them by the measurement system each run, and its final goal is to modify and reinforce the player's behavior by giving different returns, which can be understood as a reward system that's based on the manifestation of the user. On the other hand, Negative Loop is significant for balancing the system. Its existence is to challenge users who gain over the average amount of benefit from Reinforcing Loop and give more opportunity to users who gain less than average to create the fit amount of equilibrium (remember, the fit amount of equilibrium doesn't stand for the restoration of equality while the game process) between users [2]. Both loops are indispensable mechanisms in the design of Feedback Loops. To attract users to develop an interest in the product, there must be sustainable and visible goals for users to achieve, which is the Self-Determine Theory that this paper have already discussed above about how users could gain intrinsic motivation from

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feeling competent and autonomous, but have to be careful that it would be meaningless if the goal is worthless for the player to reach, which doesn't develop the player's mastery, or the opposite, which is too hard to achieve, which strikes the player's confidence, and this is when Negative Feedback Loops perform when a game becomes overly simple or hard for the user, as its purpose is to balance the inequality between the user and the product. But different from Positive Feedback Loops, it should be designed implicitly since its main target is to generate a certain number of equilibriums, which implies that one side will be intentionally put at a disadvantage by the designer, which contradicts the player's motivation and SDT for one side of the team, which is to have high rewards with high performance and to be able to control the trend of the game. However, it creates less damage to the player in advantage but gives more motivation and chances for the player in disadvantage so that the system still follows the SDT. With the explanation above, there should be a perfect balance between two loops or the user would find the process to be vapid or even irritating. The following text will introduce some classic and successful examples of Positive & Negative Feedback Loops, discuss their role in giving player motivation, and balance the system to improve the subject experience through the application of psychological theories. Remember that these loops aren't necessary to reach their perfection in all aspects, but all achieve their goal of giving motivation and creating balance for the system.

3.1. Bounty System

League of Legends is a multiplayer online battle arena video game presented by Riot Games in 2009, with over 180 million active players in 2022. As the most popular multiplayer game around the globe, it has used many references to feedback loops from products that were out earlier, for example, Defense of the Ancients, and done its original upgrade to the existing frameworks. A direct feedback loop is the Bounty System, which is designed to reward players who out-skilled their opponent and give opportunities to the side of the team that is in irreversible disadvantage by giving them more gold rewards than the other team, an amphitropic design that both reinforces player behavior and balances progress. It provides competence or challenge and allocates more resources to the side in order for them to gain more chances to keep their interest in the game process by being competent, while also allowing both sides to gain mastery and be able to visualize a tangible goal. However, this design had many negative objections towards it due to its obviousness and its excessive impact during the game process. A player would feel frustrated and unconfident if their performance or decision had become meaningless and negligible, which couldn't affect the trend of the game, and according to SDT, the decline of interest from players in the game would then be inevitable. Fortunately, after the remodification of the numerical values in the loop, the system has become relatively balanced. The pro for this specific system is that its efficiency can be directly experienced by players, and such distinct feedback would modify a player's behavior. For example, a player in Advantage's play style might change from aggressiveness into conservatism due to the punishment from the loop. But the cons are its obviousness and the stochastic outcomes. The negative loop system is revealed too explicitly, which would result in the loss of the user's autonomy, and changes in other functions in the game system would affect the balance of the loop as well. As this paper discussed the Bounty System in League of Legends (LOL), the following feedback loop would represent a successful reach to the optimal solution of balance in its game system.

3.2. Currency System

Counter-Strike Global Offense is a first-person multiplayer shooting game created by the notable Source Engine which is developed by Valve. It has a maximum of 1.3 million players around the globe and can be counted as one of the most classic electronic games in game history. In each match,

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the currency system executes as both reinforcement and balancing feedback loops; its central function is for players to gain consistent income to purchase items after each round. The currency system has a fundamental income and rewards players' superb performance by giving extra gold. The amount of extra gold would also be determined by the type of item that the player chooses, items that require more gold are usually easier to master and are more powerful, but the player's gold reward would not be as much as if they used an inferior item to kill an enemy. The purpose of the system above is to reduce the economic gain for the team in the lead since the side in advantage usually carries better items that don't require players to risk and have higher efficiency in defeating the enemy. On the other hand, the team at the disadvantage will gain more possibility towards winning by giving players more gold from kills. Another mechanism in the currency system is the additional gold reward for the team that suffers consecutive defeats, which also serves the same purpose of balancing the match. From the Curiosity-Drive Theory, the research had a specific definition for the motivation that exists within humans when meet situations with "uncertainty". It states that curiosity is a desire for humans to seek further knowledge or experience, which motivates exploratory behavior directed towards the acquisition of new information and is usually associated with receiving rewards like other natural desires in humans [3]. The currency system in this case provides "uncertainty" for both teams, which would trigger subjects to explore and advance in this match further than a match with an absolute ending. SDT also states that the experience of gaining mastery and being able to control the result directly is the key factor for maintaining motivation, which would be hard to achieve when the scales of victory are tilted too much toward one side.

3.3. World Level

This is the most classic example and known Feedback Loop in the game industry, which is level up. The general concept is the appearance of new elements, rewards, or challenges when the subject is proceeding the game in a positive direction, level up is usually positive and linear and irreversible which represents the total comprehension from the player to a certain point during the game process. Genshin Impact is a popular open-world RPG game that was out in recent years and has accumulated about 8 million players from 2020 until 2022. A major system for players to proceed with the game is the level up of the World Level. To rise to the World Level, the player is required to complete a certain number of missions and level up their character to a certain level. The rise of World Level would provide new content in the game, including new areas for exploration, extra currency that allows the player to purchase new items, and access to new features and storylines. All of the elements above can stimulate the subject's curiosity. Meanwhile, the difficulty of the game would rise as well. The success of GI is due to multiple factors, but there's no doubt that its design of Feedback Loops in the game's mechanism is fully referenced and integrated with SDT and other psychological theories which create intrinsic motivation inside players through internalization [4]. whether it's from the aspect of enhancing the player's mastery through creating new challenges, creating "uncertainty" by unlocking new items and chapters for the player to explore, or even Relatedness by creating a connection and bond between the player and the storyline through Narrative Immersion which brings the user a sense of belonging and attachment to characters [5].

4. User Experience

The examples discussed above include hypothetical assumptions of the relationships between psychological theories and Feedback Loops in electronic games, however, this research shall continue the process of justification through real-life interviews with skillful players by asking them about their general experience with the Feedback Loops that were introduced above. This process should collect players' opinions about whether the system motivates them, and the reason for how the loop

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inspires them to put more effort or not. From the information that gained above can prove if the Feedback Loops are truly motivating players and whether this motivation is coming from the application of SDT in their design concept.

4.1. General Form of the Interview

To ensure that the data collected from subjects is related and effective to this research, it is important to know whether the subject has a relatively adequate experience in the area of video gaming; otherwise, their data would become inconsequential. One of the most direct methods to check if the subject is a valid candidate for data collection is to ask about their time, effort, or participation in video games during the interview. Therefore, the first question would be, "How recently have you been playing electronic games per week?" To know the time and effort that the subject has been putting into video games to evaluate its subsequent response based on their depth of experience and understanding.

The subject would then be given a brief description of the feedback loops mentioned above and asked for their evaluation of the three systems. The question can be, "Here are some of the mechanisms that you are familiar with in LOL, CS, and GI. Do you think the following systems will motivate you and improve your game experience as a player in each of the games? Or do they not match your value and discourage you from putting in more effort?"

The subject will then be asked about their specific reasons for their preference of the systems. With these data, this research can dive deeper into the physiological logic behind their decision through their aspect as clients of the products and then be connected to the SDT and other theories that have mentioned above. The question can be formed as "Why do you hold the opinions above? Give reasons for why you think these systems work the way you think they do."

To make a well-designed interview, it is necessary to build some scenarios for the subject that they might not have thought of, for example, how would the game logic change without the functionalities mentioned above? After setting up the scenario, it would re-ask the subject to evaluate the situation and give further explanations or adjustments to their previous answers. Do you think you would still participate as much as you do now if the systems above disappeared from these games, and why do you think they are irreplaceable or replaceable? (Further investigation of user's attitudes toward the system by setting a new scenario for users to reflect on the necessity of the system with positive and negative feedback loops for generating intrinsic motivation.)

4.2. Data Collection

A total of 12 subjects (A–L) participated in the interview and gave valuable and referenceable responses for this research. The graph below shows the number of positive and negative comments from the subjects for each system.

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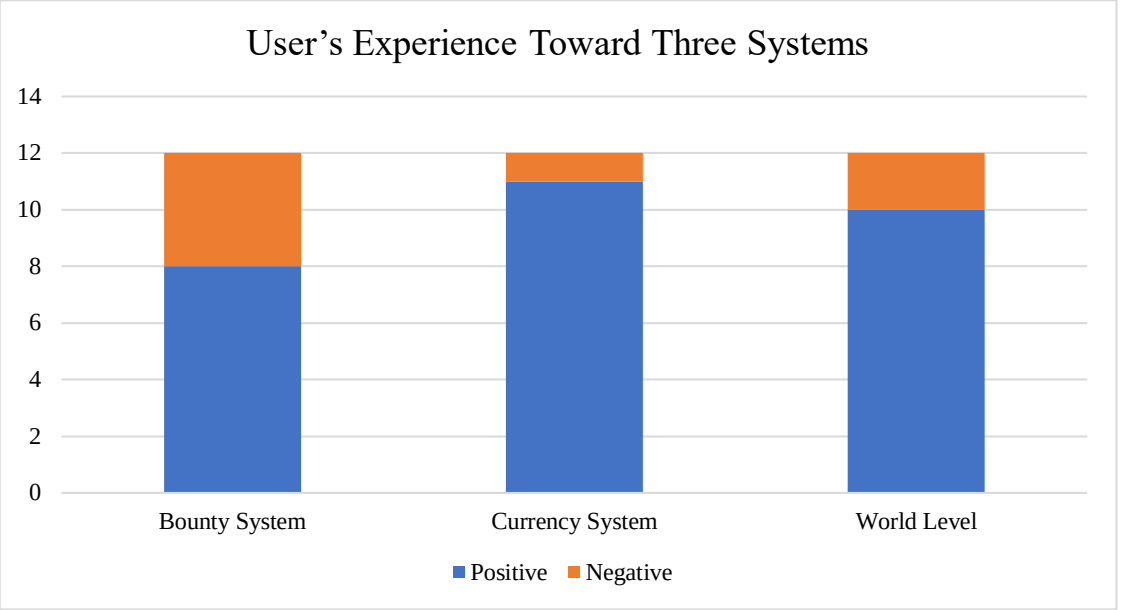

Figure 2: Results of subject's interviews.

From Figure 2, a majority of users have positive feedback towards the systems, especially in CS and GI, which have a ratio of 11:1 and 10:2, respectively. From the previous discussion, this paper have compared and contrasted each system by connecting them with the SDT, and now with the support of the subject's data, it can make a further connection between the theory and Feedback Loops.

During the interview, about 92 percent of the subjects spoke about how they were motivated by the system because of the reward that they will gain after completing a certain goal or mission, and 83 percent of the subjects think that over-rewarding and punishing are the major reasons that cause them to lose interest. In particular, subject F states that "Sometimes when what a player can do become ineffective to the tie of the match, at that moment, the person would lose their interest in this match since it's fruitless to put more effort into something that you would never gain. For example, the Bounty System is not balanced because no matter which side has a better performance early on, they can still lose their advantage and be turned into a disadvantage due to the enormous amount of extra gold from the system that goes to the enemy team." From this example, problems like intangible goals, loss of competence, excessive direct results, and idle effort, all of which contradict SDT. In contrast, 10 other subjects have the same opinion on the World Level System, and all have had the same experiences playing GI for a consecutive amount of time of about 10 hours. They state that "the reason for us to play it for a such long time in a day is that there was a new event that it could both get EXP to level up and unlock a lot of new contents, and the missions were quite interesting." From this scenario, the importance of giving tangible goals and sufficient rewards to players as an efficient strategy for building players' autonomy, also according to the effort-reward imbalance, the subjects will face adverse effects on health and well-being if they are in a mismatched system between high efforts spent and low rewards received, which will strike the subject's confidence and autonomy since the extra performance become meaningless, which also mean that only the equal risk and reward would have positive outcomes for subjects, which is what the World Level System has achieved [6]. On the other hand, most of the subjects didn't have a clear opinion toward the currency system, but 75 percent of them opposed the dispensability of the system when set up the scenario of the current game without the system for them during the interview. Subjects B and G state, "There are games that give all players a static amount of gold for each round, but if there is a gold reward for my extra performance, I would be more than glad to put more effort into the game. And also, it would be very

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helpful that I can still get extra gold in a lost strike, otherwise, there would be no point to continue the game with a settled ending." From the interview above, how SDT is affecting the subject's gaming experience again. The design of the currency system includes a dynamic balance system that was able to create a chance for the team at disadvantage to win and gain competence for the team in advantage, which all fit the base principle of SDT.

5. Framework for Building Feedback Loops

From the analysis of the data above, it has become possible to create a framework based on this research that would guide our readers during their process of understanding and creating other feedback loops by utilizing some of the physiological theories that would motivate subjects. First, the reinforcing loop should be well-platformed before the balancing loop since it's used to amend the flaws in the reinforcing loop. It would be ideal to set the goal of the system in a visible and tangible form since that's the basic element to motivate players, and it would damage players' interest if the goal was unclear or unreachable. The next part to consider is the performance evaluation system used to recognize a player's effort. The reward should be given according to the player's performance, as in the Effort-Reward Imbalance state, a player will only gain motivation when the effort and reward are balanced. With the performance evaluation system, it's now time to consider the balancing loop. In this part of the overall functionality, it shall remain the positive feedback on better performance, but avoid the situation of unfair advantage or disadvantage for one side of the match. It should create a certain amount of equilibrium between players with the purpose of giving the team at disadvantage a chance to win, which would keep their interest in putting in more effort and giving the side in tremendous advantage and more challenge for them to gain competence, which is a part of SDT. From the data collected above, it's crucial to not have exceeded reward or punishment to make the game process meaningless, so when designing this system, it is important to keep the balance between player's gaining and losing to keep their motivation from challenging their capability and seeking for an unknown game process and ending that satisfies the curiosity-drive theory.

6. Conclusion

This paper has come to several conclusions from the s above: first, a correctly balanced feedback loop will improve the subject's experience and motivate them for further actions in the product. Second, all the feedback loops are designed to satisfy the human's three basic psychological needs of autonomy, competence, and relatedness from the SDT to create motivation. Third, hypothetical work can be put into any creation or observation of the Feedback Loops System. This research has ameliorable points, for example, an increase in the number of subjects for data collection, a wider area of electronic games besides modern popular games, or a more comprehensive interview for subjects for data. In the future, this research can improve on the points above to reach a more full-scale conclusion.

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