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Application of Psychological Questionnaires in Games Design to Create Customized Experiences

Hongqian Huang

College of Arts Media and Design, Northeastern University, Boston, MA, United States

huang.hongq@northeastern.edu

Abstract:

The contemporary gaming industry serves a diverse array of players from various backgrounds and caters to the needs of distinct audience segments. There is a growing demand for personalized gaming experiences. This paper explores the feasibility and methodology of employing psychological questionnaires to uncover players' intrinsic needs in order to craft tailored experiences. Initially, the paper reviews prior research and relevant endeavors within the gaming industry. Subsequently, it proposes three distinct approaches to customizing gaming experiences based on psychological theories and scales: approaches grounded in personality traits, emotional states, and risk preferences. Each approach is analyzed for its strengths and weaknesses, as well as its applicability to game development. This interdisciplinary approach holds the potential to enhance player experience; however, further investigation is required into the accuracy of data collection, the interpretation of player behaviors, and the corresponding game design methodologies. This study offers novel insights for game experience design and is anticipated to foster innovation in the realm of gaming experiences.

Keywords: Game design; psychology; interaction design; adaptive gameplay

1. Introduction

In recent years, with the rapid development of digitalization, the gaming industry has become an important cultural, economic and entertainment component of the world. According to statistics, the global game time scale has exceeded 183 billion US dollars in 2023 , and it is still growing steadily [1]. As the market expands, different groups of people are beginning to enter the gaming market, and players' personalized needs for the gaming experience and the social responsibility of games are growing. As a medium with great potential, games have the special feature of interactivity, which allows players to experience their own stories in the game, interact with the game world in the way they want within the framework of

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the game rules, and profoundly change the game world as the game progresses. Although today's technology can already create very complex games, most games still use relatively simple systems for long-term feedback on player behavior, such as favorability systems, branching selection systems, and option scoring systems. Although these systems are simple and easy to understand, and have a low learning cost for players, how to effectively translate the individual differences and emotional needs of players into a customized gaming experience is still an urgent problem that needs to be solved. When the characters in the game can bring a more human and anthropomorphic experience to the player, it may increase the player's sense of immersion and also make the player invest more emotion in the game. Although the application of psychology in game design has a long history, it is mostly limited to macro-level user experience design and lacks a refined consideration of the psychological characteristics of individual players. Psychological questionnaires, as a mature psychological measurement tool, have proven their effectiveness in personalized services in other fields. Introducing psychological questionnaires into the customization of game narratives can not only improve players' game experience and satisfaction, but also open up new avenues for the application of games in education, mental health and other fields. From an academic perspective, although there have been studies on the personalization of game narratives, there is still a lack of research on the systematic application of psychological questionnaires to game plot customization. This research not only fills an academic gap, but also provides a new methodology for game design, with the potential to promote interdisciplinary innovation in game design, psychology, and computer science.

Therefore, research on the application of psychological questionnaires in games to create customized plot experiences has important theoretical and practical value. It not only helps to improve the user experience and market competitiveness of games, but also may provide new ideas and tools for the application of games in education, mental health, and other fields, thereby having a positive impact on society.

This paper aims to review and explore the feasibility and methodology of applying psychological questionnaires in games, and to discuss their application in analyzing and classifying players, as well as in designing storylines and character responses. Section 1 of this paper introduces the application of psychological questionnaires in games and early research, as well as some mainstream designs of multiple story branches. Section 2 of this paper explores the player needs approach based on psychological questionnaires. Section 3 of this paper explores the ways to integrate it into games and the key technologies it may require, as well as the key indicators for system design. Section 4 of this paper discusses the possible applications of this design in various game products. Section 5 of this paper discusses the challenges and future research directions.

2. Background and Early Research

2.1 Early Research on the Application of Psychological Questionnaires in Games

In the design of games, both academic and industrial applications play a very important role. When a game is a commodity, market feedback becomes the standard for judging the quality of a design. Research on player types can be traced back to Bartle's 1996 theory of player types, which divides multi-user dungeon (MUD) players into four types: Achievers, Explorers, Socializers and Killers (Fig.1).

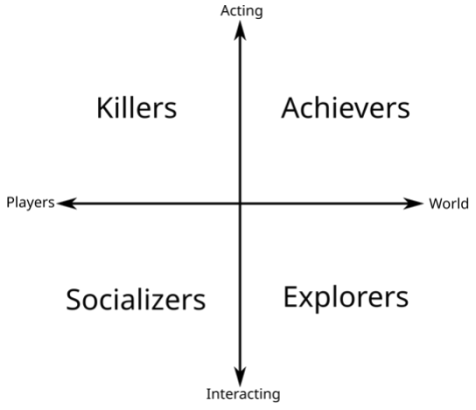

Fig. 1 Four types of player [2]

This classification is based on two dimensions: acting VS interacting, and player-oriented vs world-oriented. For example, achievers, located in the acting and world quadrants, are players who enjoy completing things in the game. They are immersed in the game world and gain a sense of accomplishment [2]. Bartle's theory provides a simple and effective classification method for understanding player behavior, but its limitation is that it assumes that players cannot be driven by multiple goals at the same time, and that different types of players are mutually exclusive. Subsequent research and practice have challenged this theory. The following research reflects a shift from categorical thinking to a multidimensional and dynamic perspective. Factors such as a player's personal experience, emotions, feelings, and values all influence a player's decisions, causing players not to always be in the same category. This is reflected in later research. When studying massively multiplayer online role-playing game (MMORPG) players, Yee used factor analysis to

categorize player motivations into three broad categories: Achievement, Social, and Immersion, and then subdivided them into ten subcategories. Among them, the Achievement motivation includes progress, mechanism and competition, the Social motivation includes socialization, relationships and teamwork, and Immersion includes discovery, role-playing and customization. At the same time, this study also shows that the different motivations of players are not mutually exclusive, and players may have multiple motivations at the same time, which also lays the foundation for more complex player model research in the future [3,4,5]. With the development of technology, Sharma et al. proposed a case-based drama manager (C-DraGer) in 2010, hoping to analyze the behavior of players in the game and customize dynamically adjusted personalized interactions based on this. The C-DraGer system includes three main modules: the game engine, the player modeling module, and the drama management module. The game engine is responsible for the game state, executing the game content, and processing player input. The player modeling module utilizes case-based reasoning (CBR) techniques to construct a player interest model based on the player's game trajectory, which is used to guide the drama manager's responses. Based on the results of the player modeling module, the drama module uses the Expectimax algorithm to plan the best plot intervention strategy, combining the player model and the author-defined story guidelines.

2.2 Early Attempts to Customize the Game Plot Experience

In the gaming industry, there are many attempts to personalize the experience, many of these games have achieved commercial success with relative simple or different method than the academia. A variety of narrative methods are used in different types of games. In CD Projekt Red's The Witcher 3: Wild Hunt designers use a similar branching plot tree system, but compared to making it easier for players to obtain information, they obviously focus more on immersion and plot experience. The player's choices can affect the direction of the plot, and the player's character abilities and skill point allocation also affect the options available to the player in the branching plot. At the same time, these choices are not only found in plot options, but also in the player's behavior. For example, in some missions, the player does not necessarily have to kill the current enemy, but can let them live to open a new plot. Sometimes there is no explicit text prompt for such behavior, but only hints such as the game character begging for mercy. At the same time, the design team often puts players in moral dilemmas, and many dialogues and tasks do not have a correct option. Players need to make judgments and choices based on their own understanding, and the choice may not really reveal its results until after dozens of hours of gameplay [6]. This kind of design makes the plot more realistic and immersive. In visual novels and romance simulation games (GalGames), the favorability system is a common way to personalize the narrative. The focus of these games is usually on the plot, which is often determined by complex branching dialogues and a favorability system. The player's interaction with different characters affects the corresponding favorability, and when a specific threshold is reached, special events will be triggered or specific endings will be unlocked. Although this system is relatively simple, it can effectively customize the game experience according to the player's preferences and choices. Players often collect different plot lines and endings by timely saving and reading [7,8].

In addition to actively allowing the game plot to branch off in different directions based on the player's choices, there is another type of game that achieves a similar effect through other means, such as The Legend of Zelda: Breath of the Wild and the Dark Souls series. The Legend of Zelda: Breath of the Wild does not have a traditional linear main storyline. The game allows players to naturally form their own gaming experience through free exploration by designing different environments and interaction systems, as well as open area exploration and challenge sequences. In the broad sense, the game only tells the player an ultimate goal, and how to achieve this goal, and in what order, all depends on the player's own choice. The game world is scattered with a large number of environmental narrative elements, and the player can freely decide the order and depth of exploration. This design allows each player's game experience to become a unique story, and the different exploration orders and methods naturally bring the player's own preferences, which form a story in each player's mind that is the same at the beginning and end, but completely different in the process. The Dark Souls series uses a fragmented narrative approach. The game tells the story by encouraging players to explore and observe, using scattered information such as items, environments (including but not limited to the destruction of religious statues, murals, battlefields, etc.), NPCs, enemy arrangements, and Boss interactions and images. Players need to piece together and interpret this information themselves [9, 10]. This has also led to the emergence of many videos on the Dark Souls worldview and story interpretation online, keeping the game a hot topic for a long time. Although there are fewer personalized choices, it allows players to fill in the information gaps based on their own imagination and reason, thereby constructing a game ex-

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perience with a complete historical background and a plot that is highly personalized through personal understanding.

As these examples showed, both the gaming industry and academia have their own achievements in terms of customized storylines, however the implementation differs. The game industry favors a more controlled, simple to understand and produce, easy to play approach, with a more limited degree of personalization in commercial games. Academic research is less often applied to the design of commercial games, and has not been validated in the marketplace.

3. Game Experience Customization Methods via Psychological Questionnaires

3.1 Methods Based on Personality Traits

Gaming is a prolonged process during which players perform numerous actions, providing opportunities to explore their more stable personality traits. The Five-Factor Model (FFM) is one of the most recognized and widely applied personality theories in contemporary psychology. Given that the gaming industry must cater to diverse consumer groups and cultural backgrounds, the FFM, supported by extensive experimental research, demonstrates its effectiveness and cross-cultural applicability. Incorporating FFM questionnaires into the statistical and narrative designs of games allows for the collection of analyzable data. Since this data is derived from the players' in-game behavior and remains unknown to them, it can be considered more credible. In the FFM, individuals are categorized into five primary personality dimensions [11]:

l Openness to Experience: reflects an individual's receptiveness to new experiences, including imagination, aesthetics, emotional richness, curiosity, and creativity.

l Conscientiousness: reflects an individual's self-discipline, responsibility, and achievement orientation.

l Extraversion: reflects the individual's level of activity and enthusiasm in social interactions.

l Agreeableness: reflects the individual's friendliness and level of cooperation when getting along with others.

l Neuroticism: reflects the individual's emotional stability and sensitivity to stress.

To understand the personality traits of players and categorize them, the game system first needs to classify the players. Considering its ease of application in game design, this paper exemplifies the use of the Likert Scale. The Likert Scale is a widely used psychometric scale named after its inventor, Rensis Likert. Typically, it employs a 5-point scale, ranging from 1 (strongly disagree) to 5 (strongly agree). If the design necessitates player choices, the neutral option (3) might be omitted [12]. Question design is typically based on the dimensions being tested and includes both positively and negatively worded questions. Scores for negatively phrased questions are reversed to counteract social desirability bias and ensure more accurate responses. It is crucial to avoid questions that detract from player immersion. Where necessary, five questions can be reduced to binary yes/no questions, with varying weights assigned to questions of different importance. Scoring primarily involves calculating the total and average scores for each dimension, and can be standardized using Z-scores. The formula is:

$$Z = \frac{(X - \mu)}{\sigma} \tag{1}$$

where X is the raw score, μ is the mean, and σ is the standard deviation.

Z-score processing standardizes scores across different dimensions, facilitating the elimination of scale differences and enabling comparative analysis. Z-scores also help in identifying outliers and mitigating the impact of scale length variations (i.e., time spent on different game contents). In game design, this scale can be integrated into various aspects. For instance, to measure Neuroticism, different difficulty levels could be designed in level creation, with high difficulty leading to greater stress, fewer resources, and higher rewards, whereas low difficulty would offer more rest areas and lower stress but also lower rewards. Based on these results and theoretical knowledge, individuals with high Neuroticism scores tend to exhibit high emotional volatility, stress sensitivity, impulsiveness, and a tendency to worry, making them more prone to frustration [11]. To address this, the game could adjust the auto-save interval, slightly optimize the critical hit rate, provide more psychological rewards, or create a more engaging flow experience through numerical adjustments. Asynchronous social features could also be introduced to reduce players' psychological stress via platforms like player message boards and user-generated content (UGC), such as motivational messages, to alleviate feelings of isolation.

The FFM theory, based on well-established psychological principles, is highly scientific and reliable. Its classification method can be applied to various game genres. Based on the findings, the game system can be adjusted to accommodate players' different preferences. This approach is suitable for games with long play cycles and multiple choices (not just narrative choices, but also route, strategy, and in-game decision-making). However, there are also drawbacks to using this theory in game design. Firstly,

it introduces complexity in system design and narrative development. Secondly, personality trait assessments are relatively stable and may not capture short-term changes in players' moods and preferences, potentially leading to more stereotypical gameplay experiences.

3.2 Methods Based on Emotional States

Emotions, as a more rapidly changing aspect than personality, are an important part of the gaming experience, but also a more difficult part to measure. The original intention of incorporating psychological questionnaires into game design was to create a better game system to better help players immerse themselves, and to allow the game to be changed to a certain extent according to the player's preferences. However, due to the short duration of emotions, they may be masked by new emotions. To capture such emotional changes, it is sometimes necessary to rely on means that affect the player, such as the player's dialogue options, the player's self-insight and feedback, or the acquisition of the player's physiological data by sensors. This can interrupt the player's sense of immersion, negatively affect the gaming experience, or raise privacy concerns. With this in mind, the following discusses a possible example of a delayed game system design.

This evaluation system design is based on the Positive and Negative Affect Schedule (PANAS) scale. The PANAS is a self-report scale used to measure an individual's positive and negative feelings. It includes 20 terms, 10 for positive feelings and 10 for negative feelings. For example, strong, proud, depressed, etc. Compared to the previous FFM, PANAS is shorter and more suitable for completing during breaks in the game. The calculation is divided into Positive Affect (PA) and Negative Affect (NA) sections, and the score of the section is summed to get the total score of the section [13]. A high PA score indicates a high level of energy, full concentration, and enjoyable participation in the game, while a low score indicates that the player is sad and listless. A high NA score indicates that the player is in a state of pain and unhappiness, while a low score indicates that they are now calm. The design is an interface similar to a diary or a space for imagination. It requires the player to recall what happened in the previous paragraph (e.g., today in the game) in a safe space in the game (such as a safe house, the player's home in the game, etc.), and then use the form of self-inquiry by the game character to make the player place the desired words on the left and right sides of the interface. One side represents agreement, and the other side represents disagreement. Due to the length of the game, the number of words and the density of the information, using PANAS or PANAS-SF, which are 20-word and 10-word versions of the scale, may have better results. At the same time, the 20 words in the optional word library that are not related to the experience in the previous paragraph can be eliminated to avoid wasting display space and player energy. This stage can be skipped, and if completed, some achievements or rewards that do not affect the balance of the game should be given. The game system calculates the player's current interest state based on the ratio of PA and NA scores. For example, if NA increases due to excessive difficulty, the difficulty can be reduced by changing the value. At the same time, it can be observed whether the player has adjusted the level of some negative emotions to a high level. If so, the program will make certain changes to the game without greatly affecting the experience design to help the player pass the difficult level. In addition, the player can also be cared for in the dialogue of the NPC. For example, when the player sets the level of frustration to a high level, the NPC in the player's team can take the initiative to care for the player the next day and empathize with the player.

This system design is evaluated through safe spaces in the game, attempting to minimize disruptions to the gaming experience and incorporate it into the narrative to reduce its sense of presence. However, as mentioned earlier, the use of this method has limitations and is time-lagging, and the evaluation of fast-paced games in particular may not be accurate. At the same time, because it is evaluating emotions, the score is difficult to avoid distractions outside the game and may pose challenges for value and task design.

3.3 Methods Based on Player Risk Preferences

Risk appetite determines a player's attitude when faced with choices and reflects their decision-making style. Each player has a unique risk appetite, and forcing a player with a low risk appetite into high-risk activities can lead to discomfort. By understanding a player's risk appetite and allowing them to play according to their preferences, it is possible to enhance their sense of immersion in the game. Taking the Barratt Impulsiveness Scale (BIS-11) as an example, this is a widely used psychological assessment tool that can be employed to measure various aspects of a player's impulsiveness and to dynamically adjust level layouts, monster spawns, item drops, and game values [14]. The BIS scale primarily evaluates three dimensions: Attentional Impulsiveness, Motor Impulsiveness, and Non-Planning Impulsiveness [14, 15].

Based on the test results of players' activities within the game world, this paper attempts to provide an analysis and design example. Using the Motor Impulsiveness section as an illustration, players with high scores tend to act immediately. For example, when encountering an en-

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emy, they will initiate combat without prior observation. These players prefer a fast-paced gaming experience over lengthy tactical planning. They favor a high-risk, high-reward style. Players with lower scores are more risk-averse and find fast-paced games uncomfortable. They will consider the consequences more carefully before acting and meticulously plan their strategies. If they face a group of enemies, they may opt to sneak and observe carefully, deciding whether to sneak up based on enemy characteristics, whether to take out ranged enemies first, or whether to attack directly, etc. During combat, for more impulsive players, assistance can be provided at critical moments (such as near-death scenarios), or the enemy AI can be adjusted to behave more recklessly, making them easier to defeat. For more cautious players, designers can adjust the AI's patrol patterns, the density of dropped or spawned items in camps, etc., to assist them in defeating enemies one by one, reducing their sense of frustration, and slowing down the pace of the game.

By understanding a player's risk appetite, the game system can selectively enhance positive feedback to the player, making guidance measures more appropriate and creating a better flow experience. However, this method also has its drawbacks. First, it is relatively complex, and balancing values, especially in online games, can be challenging. Second, for some players who prefer to follow strategies, this design makes achieving their desired outcomes more difficult. Therefore, an indicator that can be turned off and is off by default can be added to indicate the player's current preferences. The applicability of BIS-11 may vary in different cultural contexts and should be designed in conjunction with the actual circumstances of the game.

4. Applications, Challenges and Future Research Directions

In the realm of game design, the application of psychological principles is crucial for balancing the psychological impact of games on players. The design of challenges and tasks lies at the heart of gamification strategies, as they can stimulate players' intrinsic motivation and foster active participation. Challenges should be well-matched with players' skill levels, neither so simple that they induce boredom nor so difficult that they lead to frustration. For instance, Fortnite has successfully enhanced players' immersive experience by dynamically adjusting the game's difficulty to match player skills.

Challenges faced include ensuring a balance between the game's challenge and the player's capabilities, as well as effectively collecting psychological data from players without disrupting the immersion. The collection of such data may be influenced by various factors, including the player's state and the gaming environment, necessitating further research to enhance the accuracy of analysis. Future research directions could focus on how to reduce the disruption to players' immersive experience through implicit assessments and how to obtain player information at appropriate times effectively. For example, understanding players' inner thoughts through implicit psychological questionnaires can serve as a means to enhance immersion and gameplay experience.

The application of interdisciplinary integration methods, such as combining knowledge from cognitive psychology, human-computer interaction, and game design, can assist developers in creating game experiences that are more aligned with expectations and logically sound. For instance, the Game Psychology course offered by the Communication University of China covers the application of psychology in game design, which is an essential component of interdisciplinary integration methods. By applying these interdisciplinary methods, game developers can create games that not only provide entertainment experiences but also promote players' mental health. This approach requires close collaboration between developers, psychologists, cognitive scientists, and human-computer interaction experts to ensure that game design meets players' needs while promoting their mental health and well-being. Future research can further explore how to integrate knowledge from these fields more effectively into game design and how to assess the impact of these interdisciplinary methods on players' mental health.

5. Summary

This paper has delved into the intricate interplay between psychological principles and game design, offering a synthesis of prior research and a framework for tailoring narrative elements within the gaming sphere. It explores the integration of psychological questionnaires into game design, aiming to enhance personalized gaming experiences. The paper introduces three customized methodologies for game plot development, drawing from psychological scales and theories. These include approaches grounded in personality traits, emotional states, and players' risk preferences.

Each method has been scrutinized for its strengths and limitations, with a focus on their practical application within game design. The integration of psychological insights allows for a nuanced understanding of player psychology and behavior, potentially elevating player satisfaction and the overall gaming experience. By enabling game mechanics to dynamically adapt to individual

players, these methods can align with the diverse playing habits and preferences of the gaming community, thereby enhancing the player's interactive journey.

The proposed methods in this paper represent a significant step towards a more personalized and psychologically attuned gaming environment. They advocate for a collaborative effort between game developers, psychologists, and users to create games that are immersive, responsive, and mindful of the players' emotional landscapes. As the field progresses, it is crucial to evaluate the impact of these methods on player psychology and to iterate on the design principles to better serve the evolving needs of the gaming community.

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