The Potential and Mechanism of Artificial Intelligence Driven Non-Player Characters in Video Games for Anxiety Management

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Abstract. Anxiety management is crucial for mental health, which helps individuals navigate through stress and prevents it from escalating into debilitating disorders. Identifying symptoms early can lead to more effective management strategies and reduce the risk of complications, such as depression. Early intervention also promotes a better understanding of the condition, leading to improved self-care and support from others. By addressing anxiety, people can improve their focus, decision-making, and overall quality of life. This study investigated the existing methods of anxiety management and discussed the potential and mechanisms of Artificial Intelligence (AI) non-player characters (NPC) in anxiety in video games. Typical language models are listed and introduced. Also, effective therapeutic means of managing anxiety were introduced. Furthermore, through a series of discussions concerning the integration of video games, psychotherapy, and AI-based language model, this study proposes possible directions for development by incorporating AI-based NPC into video games in order to provide psychological help to players against anxiety. Theoretical and practical implications were discussed.

Keywords: Non-player Characters, Anxiety Management, Artificial Intelligence.

1 Introduction

In the post-Covid-19 era, anxiety has become one of biggest challenges worldwide. While traditional treatments like Cognitive Behavioral Therapy (CBT) and pharmacotherapy have proven effective in managing anxiety disorder, the face-to-face therapy has ~~the~~ drawbacks including expert subjectivity and patient non-cooperation

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in treatment [1]. Using Large Language Models (LLMs) and video games as the alternative methods, have shown promise [1,2].

Non-player characters (NPCs), as the integral part of video games, play a significant role in improving game immersion [3]. Recent studies on integrating artificial intelligence (AI) technology i.e. LLMs into in-game NPCs have further enhanced the positive effect of video games on anxiety management, making it increasingly feasible for managing anxiety disorders [4].

Before the integration of AI-driven NPCs into video games, video games have already been utilized as the effective tools for anxiety management [2]. It provides Human-Computer Interaction (HCI) primarily through gameplay and simulates anxiety treatments such as Cognitive CBT during HCI experience [4, 5]. However, an obvious drawback is the inflexible nature of the video game content and the lack of personalized support for individual requirements. The application of AI-driven NPCs can effectively mitigate those shortcomings. According to the description of LLMs, AI-driven NPCs can simulate emotional expression, understand player emotions, provide personalized support and improve the HCI, thereby enhancing the therapeutic potential of video games in managing anxiety.

Although LLMs themselves can support the anxiety management, configuring LLMs on game NPCs amplifies such an effectiveness. Video games with AI-driven NPCs offer a dynamic and immersive therapy environment, distinguishing them from standalone LLMs used in therapy. AI-NPCs engage with players during the gameplay, fostering a sense of connection [3]. Compared with LLMs, which operate in isolation, AI-NPCs can not only provide emotional conversation with users as LLMs do but also can provide an immersive game environment for users to communicate with LLMs while playing the game [3,4]. The combination of LLMs and in-game NPCs enhances the anxiety management experience of using LLMs directly or video game without AI-NPCs. What is more, such an immersive approach also promotes engagement and motivation of players as well as facilitates better therapeutic outcome.

Compared with using video games without AI-driven NPCs and LLMs as the alternative way to managing anxiety, a video game with AI-driven NPCs can provide stronger HCI experience and more immersive environment for users to communicate with LLMs. Those advantages enhance the anxiety management. This work is going to provide insightful discussion through following chapters: 2. Working principal. 3. Representative works. 4. Discussion and expectation. 5. Conclusion.

2 Working principle

2.1 Large Language Models (LLMs)

The working principle of AI-driven NPCs is centered on the use of LLMs to simulate human dialogues. LLMs are critical in creating realistic and emotionally intelligent dialogues that can aid in anxiety management. LLMs such as Generative Pre-trained Transformer (GPT), Bidirectional Encoder Representations from Transformers (BERT), and Transformer-XL are at the core of AI-driven NPCs. These models are

trained on vast amounts of data to understand and generate human-like text, enabling NPCs to process and comprehend the natural language input from players, recognize context and emotional cues, produce coherent and emotionally appropriate responses, and adapt to specific game environments based on player behavior and feedback [1,3].

To fully leverage the capabilities of LLMs, it is essential to understand the key components of LLMs: Natural Language Processing (NLP), which encompasses Natural Language Understanding (NLU) and Natural Language Generation (NLG) technologies.

NLP. NLP serves as the overarching field that encompasses both NLU and NLG, allowing NPCs to analyze and understand the nuances of human language. Using models like the Natural Language Toolkit (NLTK), NLP helps the NPCs break down the sentence structure and understand the meaning of each word. This preprocessing step is crucial for preparing language data for further understanding and generation tasks.

NLU. NLU, a subfield of NLP, focuses on the comprehension and interpretation of human language. It enables NPCs to recognize the context and intent behind player inputs, provide more accurate and meaningful responses, and identify emotional cues within the language [3]. Using models like BERT as the NLU, the NPCs can do the following: (1) Contextual Understanding: Recognizing the context and intent behind player inputs, allowing NPCs to provide more accurate and meaningful responses. (2) Emotion Recognition: Identifying emotional key words within the language to adjust responses that can help manage the player's anxiety. (3) Semantic Analysis: Understanding the meanings and relationships between words and phrases in player inputs.

NLG. NLG is another subfield of NLP. The response of NLG is to generate human-like text based on the information and context understood by the NPC. This allows AI-driven NPCs to produce natural, contextually appropriate, and emotionally resonant responses [3]. Using models such as GPT-3 or GPT-4, NLG also adapts the tone and style of responses to match the player's emotional state and context, enhancing the anxiety management. Additionally, utilizing models like Dialo GPT or Meena, NLG enables NPCs to craft coherent and engaging conversations that maintain the player’s interest and provide therapeutic support.

2.2 Advanced Human-computer interaction (HCI)

The application of AI-driven NPCs in video games has also improved the HCI experience. Such improvement in HCI has augmented the therapeutic effect on anxiety of the video game itself. Machine learning algorithms such as reinforcement

learning can enhance the responsiveness of NPCS, making their performance more realistic to boost the immersion of the game experience.

Reinforcement learning (RL) is a kind of machine learning algorithm, optimizing the decision-making process through trial and error. In the context of AI-driven NPCs, reinforcement learning can apply to adjusting the behaviors of NPCs, making them act more realistic in the game scenes. Such an adaptive learning approach provides NPCs with a more personalized and dynamic interactive experience that can help manage player anxiety more effectively.

2.3 Integration

Integrating AI-driven NPCs into a game involves incorporating LLMs and RL techniques through scripts. Here are steps: (1) Select and train LLMs: Choose an appropriate LLMs, such as GPT-4 or BERT, and train it with relevant datasets that include anxiety treatment communication records and game-related dialogues [2,6]. (2) Reinforcement Learning Integration: Implement reinforcement learning algorithms to enable NPCs to adapt their behavior based on player interactions and game scenarios [4]. (3) Scripting the Integration: LLMs Integration: Use scripting to incorporate LLMs into the game engine. This includes writing scripts which carry the pre-trained models to analyze sentences (NLU) and handle NPC dialogue generation (NLG) as NLP, ensuring that the responses are contextually appropriate and emotionally resonant. This step comprises: Step 1. NLU integration: Script the natural language understanding processes to interpret player inputs, recognizing context, intent and emotional cues [3]. Step 2. NLG integration: Script the natural language generation processes to produce coherent and emotionally appropriate responses based on the interpreted inputs [3]. (4) Reinforcement Learning Integration: Script the Reinforcement Learning algorithms to manage NPC behavior adaptation. This step includes defining reward structures and learning algorithms which can help NPCs to improve their capability of interaction over time based on player input and outcomes [5]. (5) Feedback Loop: Incorporate a feedback loop in the scripts to continuously collect player interaction data. This data is used to further train and adapt the LLMs and reinforcement learning algorithm, ensuring that NPCs evolve and improve over time [7].

By the above steps and utilizing scripting to integrate LLMs and reinforcement learning, AI-driven NPCs can be effectively incorporated into games. This creates immersive and emotionally dynamic interactions that enhance the player experience and support anxiety management.

3 Representative Works

This section reviews existing studies and works related to traditional therapies, standalone video games without AI-driven NPCs, standalone LLMs, and video games with AI-driven NPCs for anxiety management. It explores the advantages and

disadvantages of each approach and highlights how AI-driven NPCs overcome the limitations of the other methods.

3.1 Traditional Therapies for Anxiety Management

CBT is recognized as the one of the most effective methods in anxiety management. Providing face-to-face CBT has been shown to be highly effective in reducing anxiety symptoms through changing maladaptive thinking patterns, a meta-analysis reported that about 50% of anxious patients achieved remission of anxiety symptoms after completing CBT treatment [7]. Because CBT is a long-term therapy, which means that it requires the Therapist's patience and patients' cooperation. Pharmacotherapy provides rapid symptom relief, which can be crucial for patients in acute distress [8]. Both treatments have demonstrated substantial evidence to support their efficacy.

Although both of traditional therapies show their feasibility in anxiety management, they have several drawbacks. Accessing well-trained therapists for the CBT (face-to-face CBT) is always limited. Additionally, the long-term nature of CBT can result in patient compliance issues and the possible social stigma for the patients participating in psychotherapy [9]. Moreover, while pharmacotherapy is effectiveness, it may cause the side effects and medical dependency [8].

3.2 Video Games for Anxiety Management

To address the shortcomings of traditional therapies, using video games as the alternative methods to manage anxiety situation become popular in recent years. As a kind of digital intervention, video games can provide an easy-access, less-cost, more immersive and private environment for the patients to manage the anxiety, particularly for the younger population [2]. Games designed for therapeutic purposes i.e. "Serious Game", can offer the structured scenes that help the users participate in CBT, exposure treatment and other possible treatments. Compared with these face-to-face therapies, patients are more likely to receive the treatment remotely through the video games [9]. In addition, although "Serious Game" has been proved to be effective in anxiety management, general video games i.e. Commercial Games, also have the capability of helping people manage the anxiety disorders. A study of popular commercial video game Hades [10] indicated that the contents of Hades mapped to the CBT, exposure treatment and behavioral activation (BA). Hades, as a Rogue-like dungeon crawler game, integrated CBT by encouraging players to repeatedly attempt to escape the underworld, promoting cognitive restructuring. The incorporation of exposure therapy was through challenging encounters, which required players to face difficult enemies repeatedly. BA mapped in the game's achievement system, helping improve players' mood.

However, one significant drawback of most video games is the lack of HCI. These games are often inflexible, with prescribed scenarios and cannot accommodate diverse players' HCI experiences, which cannot adapt to individual players' needs and provide the personalized therapeutic experiences [2]. Such nature makes it

difficult for anxious patients to receive tailored mental support, which is the crucial part of anxiety management.

As the alternative way to traditional therapies, video game intervention addresses the drawbacks of traditional therapy to some extent but also reveals the shortcomings of not providing personalized treatment. Hence enhanced HCI experiences in video games promises to be more effective for tailored therapy.

3.3 LLMs for Anxiety Management

In recent years, the development of LLMs, becomes a possible alternative method for anxiety treatment. LLMs provides tailored interaction with users, becoming an attractive option for the anxiety management. LLMs like ChatGPT have been proved as the useful tools for addressing anxious disorders through conversational support, simulating therapist techniques and offering immediate responses to the users [1]. A study from *Dovepress* has tested the effectiveness of ChatGPT in anxiety management, and over 80 percent volunteers find the responses helpful in alleviating the anxiety [11].

Compared with the traditional therapies, using LLMs has a host of advantages. Like the video games, LLMs also provide a less-cost and easy access environment for the users to manage their anxious emotions. In addition, LLMs can mimic the therapist, giving responses to any questions, providing HCI experience, supporting the people who suffer the anxiety through pacifying their emotions and giving medical suggestions. Furthermore, LLMs can deliver its support anytime and anywhere, making them highly convenient for users [12].

As an emerging technology, LLMs are not that perfect. Although they offer advanced HCI experiences, using them standalone has several drawbacks in managing anxiety. One significant issue is the lack of regulatory oversight, leading to concerns about the accuracy and reliability of the information provided. Privacy is another major concern, as the sensitive data shared by users may not be adequately protected. Lastly, because LLMs mainly focus on the communicational function, which cannot provide an immersive experience as video game does. All above drawbacks can limit LLMs' effectiveness in anxiety management [13].

3.4 Video Games with AI-Driven NPCs for Anxiety Management

The integration of AI-driven NPCs embedded by LLMs and video games provides a new way of treating anxiety disorders. With immersive environments provided by video games and the advanced HCI experiences brought by the LLMs, this combination enables effective anxiety management more than either LLMs or video games alone. In-game NPCs use LLMs and Behavioral Modeling to create emotionally responsive interactions, enhancing both immersive experience of LLMs and HCI experience of video games [3,4], fostering engagement of users, which is crucial for anxiety management.

Taking the game "Justice Mobile" by NetEase as an example, the integration of AI-driven NPCs has been successful. The in-game NPCs use LLMs to generate

responses to any questions players may ask, and enable unique NPC reactions through the Behavioral Modeling. Such a dynamic interaction tailors the experience for individual players, providing personalized support and improving engagement as well [14]. The interaction in game between players and AI-driven NPCs helps create a more immersive and supportive environment for anxiety management.

The introduction of AI-driven NPCs in video games also fills the following gaps in these alternative anxiety management methods: (1) AI-driven NPCs make video games more dynamic, providing more personalized therapeutic experiences for individual players. It ensures that each player can receive tailored support, and improve the effectiveness of video games as a therapeutic tool [4]. (2) AI-driven NPCs enhance the HCI experience by allowing players to engage in emotional conversations with NPCs. This increased engagement helps maintain player interest and motivation, which is beneficial for the anxiety management [3]. (3) Embedding LLMs within video games enhances the immersive quality of these models. While LLMs alone might lack sufficient immersion, their integration into the interactive environments of video games amplifies their therapeutic potential [4]. (4) The integration of LLMs into video games ensures better privacy and security due to the oversight from game developers. This regulatory environment helps protect user data and enhances the safety of using LLMs for anxiety management.

4 Discussion and Expectation

The AI-driven NPCs in video games represents a significant advancement in the field of anxiety management. This section is going to discuss the potential benefits, challenges, as well as the expectations for this innovation approach.

4.1 Advantages of AI-driven NPCs in Video Games for Anxiety Management

Compared with standalone LLMs and video games, the integration of AI-driven NPCs into video games offers enhanced immersion and engagement of anxiety management. AI-driven NPCs brings a more immersive and engaging gaming experience by responding dynamically to the players, which improve the HCI experience. Such a level of engagement can increase the therapeutic benefits of video games by keeping players more involved and motivated to continue with the digital treatment [3,4].

AI-driven NPCs can provide personalized support, which traditional video games lack. Unlike video games with prescribed contents, AI-driven NPCs can provide personalized interactions through LLMs based on the player's emotional state and context. This customization allows for more effective anxiety management, as the NPCs can adapt their responses to meet the individual needs of each player [1,3].

Using AI-driven NPCs in video games to manage anxiety also helps reduce medical stigma and improve accessibility. By providing video game as a private and engaging platform for anxiety management, AI-driven NPCs can help reduce the stigma associated with seeking mental health treatment in the real world.

Additionally, video games are also more accessible to a broader audience, including those who are hard to seek traditional therapy [2,13].

4.2 Challenges and Limitations

Despite the benefits, there are considerations and challenges to address. Data privacy and security are primary concerns with using AI-driven NPCs to manage anxiety. Although the engagement of game company helps protect user privacy when using LLMs technology, data privacy and security remain primary concerns. It is crucial to implement robust data protection measures and ensures the game company can perform the safeguard users' information [13]. What is more, ethical and regulatory issues also need to be considered. Establishing guidelines for the use of AI-driven NPCs is essential to ensure they can provide safe and accurate responses to the users [12].

Due to the technical limitations, AI-driven NPCs have not been widely used in the video game. The technologies, such as the quality of output voice, real-time processing and the capability of handling complex conversations, must be addressed to improve the third dimension of AI-driven NPCs [3,6]. Technological improvement will help users to trust and accept the innovative anxiety management treatment, which requires the NPCs to be reliable, empathetic, and capable of providing meaningful support with reliable data security [11].

4.3 Expectations

There are several expectations for the further development. Firstly, enhanced emotion recognition of AI-driven NPCs can be a focus of future developments, with more accurate emotion recognition to further improve the therapeutic potential [3]. Secondly, video games and–AI-driven NPCs can be integrated into clinical trials to evaluate the effectiveness and safety of it, which will provide valuable insight and help technologies update [7]. Thirdly, using advanced gaming equipment to embed the video games with AI-driven NPCs, such as Visual reality (VR), could provide more immersive and comprehensive anxiety management. Finally, besides anxiety management and game improvement, the application of AI-driven NPCs can extend to other areas such as education and custom service. For example, the similar technology "Visual Human" is being used in providing customer service and sales interactions [15].

5 Conclusion

This article describes the potential and mechanisms of NPCs in video games to relieve anxiety and compares them to traditional therapeutic approaches. In summary, technically, there are many LLMs that have been successfully developed. It is not uncommon to build LLMs into game NPCs. Many game manufacturers are consciously doing this. The cost of using LLMs for emotional dialogue with NPCs

has become more acceptable to developers. Integrating AI-driven NPCs into video games provides a new approach to anxiety management, which allows people with anxiety to get a tailored, personalized treatment experience that traditional therapies cannot do. By combining the advantages of LLM and video games in anxiety management and the participation of reinforcement learning, AI-driven NPCs can provide personalized, engaging, and effective support to individuals dealing with anxiety, ultimately enhancing their mental health. When more interactive designs and multimodal emotion recognition are introduced, players' emotions can be understood. For example, the player's heartbeat, pulse, and the player's joy, anger, sorrow, and happiness. If the player's real-time emotions are combined into treatment methods, this will help players better alleviate anxiety problems

Authors Contribution

All the authors contributed equally and their names were listed in alphabetical order.

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