Proceedings Paper:
Zhou, Min, Peng, Xiaolan, Liu, Binjie et al. (6 more authors) (2025) Emotionally Challenging Games Can Satisfy Older Adults' Psychological Needs:From Empirical Study to Design Guidelines. In: CHI 2025 - Proceedings of the 2025 CHI Conference on Human Factors in Computing Systems. 2025 CHI Conference on Human Factors in Computing Systems, CHI 2025, 26 Apr - 01 May 2025 Conference on Human Factors in Computing Systems - Proceedings . Association for Computing Machinery, Inc , JPN

https://doi.org/10.1145/3706598.3713899

Emotionally Challenging Games Can Satisfy Older Adults' Psychological Needs: From Empirical Study to Design Guidelines

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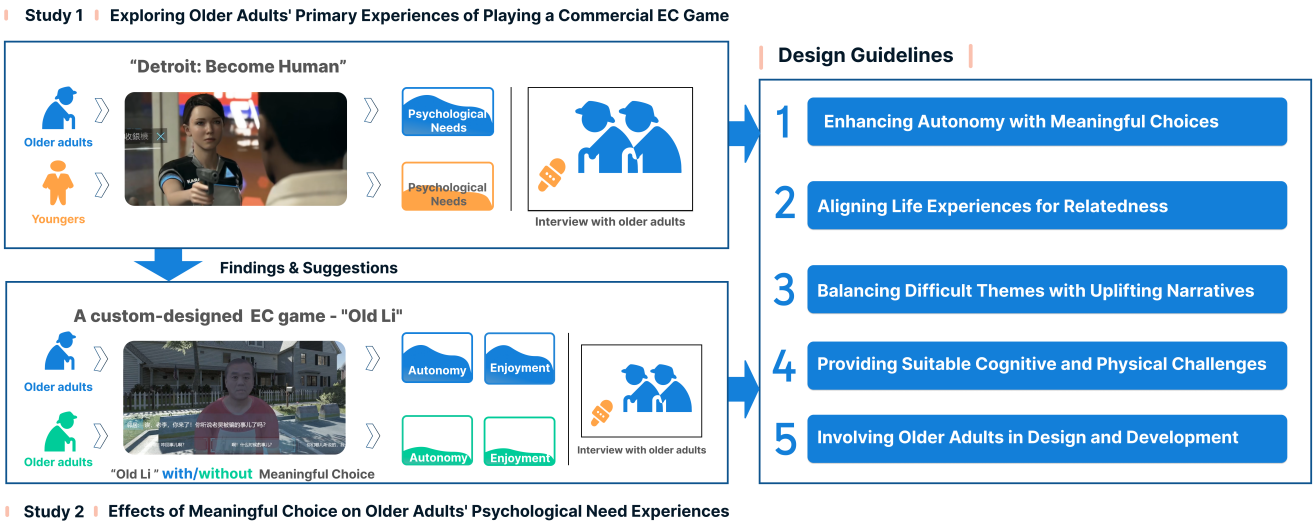

Figure 1: Exploring Older Adults' Experiences with the Psychological Needs of Playing Emotionally Challenging Games

Abstract

Older adults often struggle to meet their psychological needs due to retirement and living alone. Recent studies suggest that games featuring emotional challenge (EC) can help fulfill basic psychological needs such as autonomy, competence, and relatedness by facilitating emotional exploration. However, it remains unclear whether

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ACM ISBN 979-8-4007-1394-1/25/04
https://doi.org/10.1145/3706598.3713899

older adults can benefit from EC games, whether they find this genre enjoyable, and how these games should be designed to better meet their needs. This work explores older adults' experiences and perceptions of playing EC games through two studies. The first study involved playing *Detroit: Become Human*, revealing that older adults derived multifaceted psychological experiences from playing the game. The second study involved a custom-designed game scenario tailored to older adults, demonstrating that meaningful choices significantly influenced autonomy need satisfaction. Based on these findings, we offer five design guidelines for developing EC games that satisfy psychological needs of older adults.

CCS Concepts

• **Human-centered computing → Empirical studies in HCI**; • **Applied computing → Computer games**.

Keywords

Older Adults, Psychological Need Satisfaction, Emotional Challenge, Design Guidelines, Video Games

ACM Reference Format:

Min Zhou, Xiaolan Peng, Binjie Liu, Alena Denisova, Soumya C. Barathi, Zhuying Li, Xurong Xie, Jin Huang, and Feng Tian. 2025. Emotionally Challenging Games Can Satisfy Older Adults' Psychological Needs: From Empirical Study to Design Guidelines. In *CHI Conference on Human Factors in Computing Systems (CHI '25), April 26–May 01, 2025, Yokohama, Japan.* ACM, New York, NY, USA, 19 pages. https://doi.org/10.1145/3706598.3713899

1 Introduction

Psychological needs play an important role in supporting the overall well-being of older adults [38, 42, 72]. Due to factors such as retirement, living alone and reduced social connection, psychological needs of older adults are less likely to be met in real world daily life activities [6, 18]. Digital games grounded in the principles of Self-Determination Theory (SDT) are increasingly recognized as a valuable tool for fulfilling players' psychological needs [16, 30, 58, 83]. In this area, the concepts of competence need satisfaction and intrinsic motivation have been widely applied to analyze player experience and inform game design [75]. Despite the popularity of SDT-based game measures and papers published in human-computer interaction (HCI), most studies on psychological needs engaged with the theory on a largely surface level [74, 75].

Single-player digital games featuring emotional challenge (EC games) hold the potential to satisfy players' basic psychological needs for competence, autonomy, and relatedness by facilitating emotional exploration [16]. Emotional challenge, which has recently gained attention in games research, refers to a kind of difficulty shaped by complex, ambiguous, and often emotionally charged themes or situations in digital games [15, 22]. When players engage with EC games, they are tasked with resolving tensions within compelling narratives, identifying with virtual characters, and exploring the emotional ambiguities embedded in the gameplay. These activities lead players into a reflective state of mind, resulting in diverse, impactful, and complex player experiences [11, 15, 21, 61, 63]. Players often enjoy and appreciate playing EC games [11], as these games offer them opportunities for emotional exploration and self-reflection, which could not only satisfy their basic psychological needs like autonomy and competence, but also foster emotional connections with virtual characters in the game [16].

Research on digital games, particularly in relation to need satisfaction and emotional challenge, has mainly focused on younger players, as the industry largely caters to this demographic. As a result, older adults, who may be less familiar with new technologies, often have fewer opportunities to engage with modern gaming genres. EC games provide relatively simple mechanics for making meaningful decisions, exploring player emotions, and also allowing players to build relationships with virtual characters in the game world. These characteristics may also cater to the preferences and capabilities of old adults. Therefore, in this study, we explore whether older adults can benefit from EC games, whether they enjoy this game genre, and how these games could be better designed to address the psychological needs of this demographic.

To answer these questions, we conducted two experimental studies. In study 1, older adults were invited to play a commercial EC game and complete several self-reported player experience measures. These results were then compared with those of younger players to examine differences in their gaming experiences. Semi-structured interviews were also conducted with older participants to gather their feedback on the gameplay experience and their suggestions for future game design. Based on the findings, study 2 explored the effects of meaningful choices on older adults' need satisfaction through a custom-designed EC game tailored to this demographic. Results of this paper showed that older adults experienced a wide range of psychological responses, often with a higher intensity than the younger players. Meaningful choice was found to significantly enhance autonomy satisfaction, but showed no notable effect on competence. Drawing from the findings from both studies, five design guidelines were devised for developing EC games that promote better psychological needs satisfaction of older adults in future game design.

The contributions of this study are three-fold:

(1) We presented the first investigation into whether games featuring emotional challenge can help satisfy the psychological needs of older adults. Our findings suggest that playing EC games could offer a convenient and accessible way to provide psychological benefits for older adults, while also exploring the potential for digital games to appeal to a broader demographic.
(2) Using a custom-designed game tailored to the preferences of older adults, we investigated how meaningful choice – the aspect older individuals found most compelling and a key design component of EC games – affects older adults' experiences of need satisfaction.
(3) Building on both quantitative and qualitative findings from our experimental studies, we formulated five key design guidelines for developing EC games specifically for older adults. These guidelines address the unique needs and preferences of this demographic, serving as a practical resource for game designers, developers, and researchers.

2 Related Work

Psychological needs are central to Self-Determination Theory (SDT), which identifies autonomy, relatedness, and competence as its

core elements. Autonomy involves the sense that actions are self-endorsed and performed willingly; Competence refers to the feeling of effectiveness in one's actions; and Relatedness reflects the sense of reciprocal care, value, and belonging in social relationships [43]. SDT suggests that human well-being is closely tied to the fulfillment of autonomy, competence, and relatedness [19, 25].

Emotional well-being is intricately linked to the fulfillment of psychological needs. Positive emotions are predominantly associated with happiness, which has long been recognized as a crucial factor in sustaining mental health [41, 48]. More recently, research has shown that certain negative emotions, triggered by emotionally challenging games, can actually foster aesthetic appreciation [11], a phenomenon closely tied to psychological needs. Furthermore, studies have demonstrated that collaborative interactions within digital games can also contribute to the satisfaction of emotion-related psychological needs [71, 82].

2.1 Basic Psychological Needs Satisfaction in Digital Games

Games have the potential to offer profound experiences that fulfill players' basic psychological needs. Most research on enhancing player experiences in digital games is grounded in SDT, a leading psychological framework for understanding human motivation that has gained significant traction in HCI research on gaming [74, 75]. SDT has been used in academic research to study the motivational appeal of games [33, 43, 52, 68], inform gameful design [24, 78], analyze player experience [64, 84], and within the game industry, for evaluation and testing [7, 79].

Peng, et al. [59] explored how one's satisfaction of autonomy and competence impacts players' gaming motivation in a single-player role-playing exergame. The results indicate that players' sense of autonomy had great influence on satisfying their psychological needs. In another study with a choice-based interactive story game, *Academic*, aimed at university students, Grasse, et al. [33] observed that autonomy and competence were the most significant factors influencing players' motivation and their interactions with virtual characters. More recently, Moller, et al. [52] extended Cognitive Evaluation Theory (CET), a sub-theory of SDT, to digital games, proposing a game-specific CET model that connects competition with the satisfaction or frustration of basic psychological needs, and its impact on motivation and well-being. They also applied the Motivation, Engagement, and Thriving in User Experience (METUX) model to outline how competition in digital games influences motivation and well-being on multiple levels, offering a framework for future research and game design.

To our knowledge, there is limited research on the SDT experiences of older adults in the context of gaming. Zhao, et al. [84] explored the effects of active digital game interventions on the health and cognitive functions of the elderly, drawing on the SDT. Their findings indicate significant improvements in physical fitness and cognitive function (specifically spatial cognition) among older adults who engaged with SDT-based active digital games. However, most research in this area remains descriptive and lacks depth, as also discussed in [74]. While competence satisfaction and intrinsic motivation have been studied more widely, relatedness has received much less attention [33, 59]. Additionally, most SDT evaluation measures, like the Ubisoft Perceived Experience Questionnaire (UPEQ) [46], are designed for multiplayer games, which may explain the limited research on single-player experiences. Therefore, further research is necessary to better understand SDT in digital games, particularly in single-player settings, and its impact on player experiences. This will enhance our comprehension of how SDT could be applied in game design.

2.2 Emotional Challenge in Digital Games

Challenge is commonly at the core of the player experience [17] and is also one of the primary reasons why players enjoy playing digital games [45]. Digital games traditionally offer two types of challenges: physical challenge [17, 69] and cognitive challenge [17, 22, 69]. Unlike physical or cognitive challenge, which require skills such as speed, accuracy, reasoning and problem-solving, emotional challenge involves dealing with tension within the narrative or difficult material presented in the game and can only be overcome with cognitive and affective effort from the player [11, 15, 21, 61]. Cole, et al. [16] listed commercial games, such as *Detroit: Become Human* (see also [4, 23]), *Fallout 4* (see [61]), and *World War I in Valiant Hearts* (see [15, 53]) as having significant potential to evoke deep emotional experiences through emotional challenge.

Games featuring emotional challenge have been shown to evoke a complex and diverse range of emotional experiences among younger players [61–63], in particular, negative yet meaningful emotions such as guilt, gratitude, and regret, which can enhance their appreciation of the game [11]. Research by Bopp, et al. [11] indicates that when games tackle difficult themes, players experience emotional challenges, which also bring about a peculiar enjoyment. Additionally, the findings suggest that emotional challenges emerge when players face tough game decisions without clear positive outcomes or must deal with intense negative emotions. Emotional challenges are not limited to single-player games but also exist in multiplayer games [11]. Peng, et al. [61] explored emotional challenge in VR environments, finding that additional emotional challenge in VR elicit more complex emotional responses, including positive emotions such as hope, courage, and love, as well as negative emotions like tension, worry, and anxiety. Cole, et al. [16] propose that in hedonic environments, by overcoming emotional challenges, players can gain a deeper understanding of themselves and/or their place in the world, resulting in mixed-affect emotional experiences. The aforementioned studies have shown that EC games not only provide a sense of challenge but also offer richer and more meaningful emotional experiences.

The core of emotional challenge design lies in meaningful choices [36], which drive the game's progression through intentional decisions while evoking conflicting emotions in players. EC games provide players with opportunities to explore their own emotional experiences. In a study on why players seek mixed-affect emotional experiences, Cole, et al. [16] found that EC games fulfill players' basic psychological needs for competence, autonomy, and even relatedness with themselves. However, no experimental study has directly tested the impact of EC games on SDT-related player experiences, and existing work has not focused on how older adults

perceive such games or whether they can benefit from playing them.

2.3 Digital Games and Older Adults

Digital games are increasingly recognized as valuable tools for promoting active aging and they have been recognized as a novel approach to supporting health and well-being in older adults [31]. Early evidence has demonstrated that a custom-designed digital game can be used to assess cognitive abilities across the lifespan, evaluate underlying neural mechanisms, and serve as a powerful tool for cognitive enhancement [3]. A large number of digital games have been developed for older adults with a focus on the training of cognitive and physical abilities [26, 39, 40, 54, 80, 86]. For example, a three-months study with two long-term care facilities found that despite age-related changes and impairment affecting group engagement, older adults enjoyed playing digital games, highlighting their potential as a valuable tool for re-introducing challenge in later life [31]. For older adults, researchers have recently developed a customized VR cognitive training exercise, which has demonstrated both short-term and long-term benefits in enhancing cognitive inhibition [26]. Previous research also found that older adults who regularly or occasionally play digital games exhibit better daily functioning compared to non-players [1].

Research into the role of digital games in fulfilling the psychological needs of older adults is relatively scarce. A recent study has explored the effects of an active digital game intervention on the fitness and cognitive function of older adults in which psychological needs were mentioned at a descriptive level [84]. For older people, some studies found that exergames can also be useful to enhance psychological well-being by maintaining and fostering social interaction [47, 81, 85]. For instance, Nintendo's Wii games have been shown to enhance the physical, social, and psychological well-being of older women [73]. The Wii games not only boost older adults' confidence in using technology but also improve their social relationships with family members [73]. Considering that aging is also accompanied by a decline in emotion-related abilities, which can largely lead to increased feelings of loneliness [82], studies in digital games also try to enhance emotional experiences of older adults. For example, one study indicates that for older adults, board games can serve as an engaging emotional tool to benefit their emotional well-being and enhance their social interaction and communication skills [14]. Moreover, another study indicates that full-body motion control games can also provide positive emotional impacts while helping older adults to exercise [30]. In digital games research for older adults, there has been limited research exploring how digital games impact older adults' experiences related to psychological needs. This study aims to address this gap by focusing on the modern genre of digital games that feature emotional challenge.

3 Player Experience Measures Used in This Study

In this study, we conducted two experiments where we adopted multiple survey scales to explore player experiences. The scales include measurements of different types of perceived challenge toward playing game, the satisfaction level with basic psychological needs, players' intrinsic motivation level, and players' mixed-affect emotional experiences including emotional responses during game-playing and several important dimensions of user experiences related to interactive digital narratives.

Perceived Challenge The Challenge Originating from Recent Gameplay Interaction Scale (CORGIS) [21], a 30-item questionnaire, was used in our study to measure four types of perceived challenge: cognitive, emotional, performative, and decision making challenge. An example item to measure perceived cognitive challenge is *"I had to memorize a lot of different things when playing the game"*. Items such as *"This game is more than just a game to me"* and *"I felt a sense of responsibility for characters and events in the game"* consider perceived emotional challenge. In our study, all items were scored on a 7-point Likert scale, where 1 refers to "Strongly disagree" and 7 to "Strongly agree".

Basic Psychological Need Satisfaction and Frustration Players' satisfaction level with basic psychological needs were measured using the recent Basic Needs in Games Scale (BANGS) [9], which measures both needs satisfaction as well as frustration of autonomy, competence and relatedness using six sub-scales. Each sub-scale consists of three questions rated on a 7-point Likert scale. BANGS has been developed and validated recently by Ballou, et al. [9] based on the motivation that current measures of the psychological needs of autonomy, competence, and relatedness have significant limitations, such as failing to assess relatedness in single-player game settings, struggling to measure accurately about need frustration, and lack validity in some specific contexts.

SDT-Related Intrinsic Motivation According to the SDT, intrinsic motivation denotes activity pursued for its inherently interesting or enjoyable qualities [67]. Intrinsic Motivation Inventory (IMI) is a frequently used measurement to assess subjective experience related to intrinsic motivation and self regulation in laboratory experiments [50, 51, 68]. In our experiment, we primarily used the original version of IMI to understand players' motivations and overall experiences while playing games. The scale covers four dimensions including interest-enjoyment, perceived competence, effort-importance, and tension-pressure, encompassing a total of 18 items, each also rated from 1 (Strongly disagree) to 7 (Strongly agree).

Mixed-Affect Emotional Experiences Players' various emotional responses during the game play were measured through the 48 EARL emotions rating method in which participants rate each emotional state on a 9-point Likert scale ranging from "Did not feel even the slightest bit" (0) to "The most you have felt in your life" (8). This method is modified with Gross's rating method of each kind of emotion [34] and also combined with adoption of the Emotion Annotation and Representation Language (EARL) [70]. The 48 EARL emotions rating method has been successfully used recently in assessing the wide range of emotional responses induced by emotionally challenging games [61] and serious data stories [44].

As the game setting in our study has similar characteristics to those of interactive digital narratives (IDN), we also adopted the IDN toolbox [65] to evaluate several important dimensions of user experiences that emotionally challenging games may also evoke, such as the believability with non-player characters [10],

role-identification [55], and the eudaimonic entertainment experience of appreciation [56]. The IDN toolbox [65] was proposed in 2016 to specifically evaluate the multifaceted IDN user experiences related to interactive storytelling [66], psychology entertainment [13] and Murray's theory framework [57].

4 Study 1: Exploring Older Adults' Primary Experiences of Playing a Commercial EC Game

To explore whether older adults, a population with limited opportunities to engage with digital games, derive psychological benefits from playing games featuring emotional challenge (EC game), we invited a group of older adults to play a chapter from the commercial game *Detroit: Become Human*. Participants' self-reported player experiences – including perceived challenge, fulfillment of basic psychological needs, SDT-related intrinsic motivation and mixed-affect emotional responses – were collected and compared to a control group of 15 younger players. Additionally, we used semi-structured interviews to gather open-ended feedback from the older adults about playing the game and their suggestions for future game design.

4.1 Game Scenario of *Detroit: Become Human*

The game we chose for study 1 is *Detroit: Become Human* – a widely acclaimed third-person role-playing game; the Chinese and English versions were simultaneously published by Quantic Dream (2018). In this game, players take on the roles of three protagonists – Kara, Connor, and Markus – across different game chapters, making choices that influence the narrative and the dynamics between characters. The game has 32 chapters and requires approximately 10 hours to complete in a single play-through.

The selection of this game is motivated by three reasons. First, the game is one of the frequently mentioned games which could trigger profound experiences related to emotional challenge [16]. Second, the game incorporates relatively simple mechanics that may align with the preferences and capabilities of older individuals. Most tasks in the game can be completed with simple mouse clicks, swipes, or keyboard inputs, without requiring complex, rapid or competitive combinations of mouse and keyboard actions. For example, players can swipe the mouse upward to open a door or use the numeric keys to make in-game selections. Third, the game offers a variety of rich chapters with diverse narratives and lengths, allowing for a selection of an appropriate scenario for our study.

To choose an appropriate game chapter for older participants, the first author played though all chapters of the game and selected three as primary candidates. These chapters were then used in a pilot study with four older adults (aged 60-70, two males and two females). During the pilot, an experimenter sat beside the player to provide operational instructions and the player was encouraged to express their thoughts and feelings about the gameplay using the think-aloud protocol. Based on the participants' feedback, 'The Escape' chapter was finally selected for the experiment.

In 'The Escape', players act as Kara – an android caretaker for Todd's household. Todd has a daughter named Alice. Due to the departure of Todd's wife, Todd has become an alcoholic and frequently abuses Alice. On a stormy night, when Alice is once again subjected to Todd's violence, Kara decides to take Alice away. They board a bus and arrive in Detroit. After that, Kara must find a shelter for Alice on a cold night, which forces her to make morally questionable decisions to achieve her goal. The mission has three possible endings, each of which requires the player to face various choices such as "robbing a convenience store", "using a laundromat", or "breaking into an abandoned house". At each critical decision point, players are required to reflect on their actions to make decisions that propel the game forward.

4.2 Participants

Nineteen older adults were recruited in a local Chinese community based on criteria such as having some computer experience, the ability to express opinions on new activities, and no cognitive impairments affecting visual, hearing, or other aspects. Among them, four did not complete the experiment: one due to dizziness while playing, one due to external commitments, and two found the game operations too difficult. No participants terminated the experiment due to discomfort, fatigue and recall discrepancies. Ultimately, 15 older participants (7 males and 8 females, aged M = 63.13, SD = 5.69) completed the experiment. All of of them had little experience of playing digital games, but all have a habit of watching TV or videos. Additionally, to further understand the possible differences between experiences of older adults and young people, a group of 15 younger participants (7 males and 8 females, aged M = 21.67, SD = 3.58) who had not previously played *Detroit: Become Human* were also invited to take part in the study. Each participant, either older or young, received 30 USD for their participation.

Figure 2: An older adult playing 'The Escape' – a chapter of the game *Detroit: Become Human*

4.3 Procedure

Both older and younger participants were first given a basic introduction to the experiment, followed by obtaining a written consent form in which they were informed that they could stop at any time if they experienced any discomfort, fatigue, or other issues. Each participant then completed a tutorial segment, using a part of *Detroit: Become Human* to learn basic game operations. This took older participants around 15 minutes to complete and 5 minutes for the younger players. The main part of the study required: (1)

Reading a written introduction of 'The Escape'; (2) Playing 'The Escape' on a personal computer using a mouse and a keyboard; and (3) completing multiple questionnaires about their gaming experiences. Notably, after playing the game, each participant was asked to briefly recall the game's main content. If significant discrepancies were found in their recollection, they would not proceed to the next step. Older participants took on average about 60 minutes to complete these three stages and younger players took about 45 minutes.

Additionally, the older participants took part in semi-structured interviews to provide open-ended feedback about playing the game and their suggestions for future game design. This part took about 25 minutes. For all participants in either group, an experimenter was present to offer assistance as needed (See Figure 2). It is note that all the participants recruited are Chinese and the older participants have little knowledge on English language. Therefore, the experiment was conducted by using the Chinese-subtitled version of Detroit: Become Human. Although younger participants possess a higher level of English proficiency, the game they played was also the Chinese-subtitled version to ensure consistency across the two experimental conditions. Additionally, all the survey scales were translated into Chinese first and then administered within the experiment.

4.4 Quantitative Results: Player Experience

For all data collected using player experience questionnaires, the internal consistency reliability of each factor was assessed using McDonald's ω, which has been shown to be a sensible index of internal consistency [27]. Due to the mixed distribution of the collected data – some meeting the criteria for normal distribution and others not – Mann-Whitney U test was used to statistically assess the differences of the two participant groups using SPSS. In all figures presented in this paper, $*$ refers to $p < .05$, which indicates a significant difference between the two groups. Table 1 shows the statistical results of player experience in study 1.

4.4.1 Perceived Challenge. Older participants perceived higher levels of cognitive, emotional and physical challenge than the younger players (See Figure 3 and Table 1). There was, however, no significant difference in the decision making challenge scores between the two groups. These results suggest that, when playing 'The Escape', older participants may encounter more difficulties and put more effort into completing the game task than the younger players.

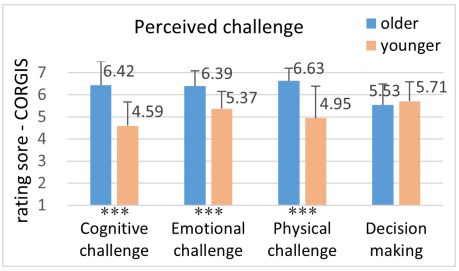

Figure 3: Participants' perceived challenge while playing 'The Escape'

4.4.2 Basic Psychological Need Satisfaction and Frustration. Older participants experienced high levels of need satisfaction with autonomy, competence, and relatedness while playing the game. Younger participants also reported satisfaction of these needs, though to a lower degree. Both older and younger participants reported relatively low levels of autonomy and competence frustration while playing the game. And older participants reported a moderate level of relatedness frustration when playing the game (See Figure 4 and Table 1), which suggests that older participants felt potential exclusion from and the lack of social connection with the characters in the virtual world of 'The Escape'.

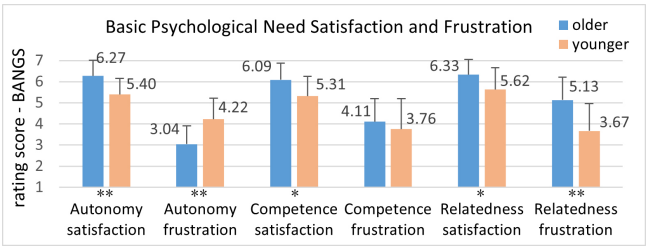

Figure 4: Participants' need satisfaction and frustration of playing 'The Escape'

4.4.3 SDT-Related Intrinsic Motivation. Except for the factor of perceived competence, older participants reported significantly higher scores than the younger group on interest-enjoyment, effort-importance and tension-pressure. Particularly regarding effort-importance, which measures the level of effort, hard work, and the desire to perform well while playing, older participants rated significantly higher than younger ones. When it comes to perceived competence, a concept similar to competence satisfaction in the BANGS scale, the results varied between the two groups (See Figure 5 and Table 1). It is important to note that in the BANGS scale, competence satisfaction pertains more to the feelings of improvement, progress, and a sense of achievement, whereas perceived competence assesses whether the player is good at playing in the game.

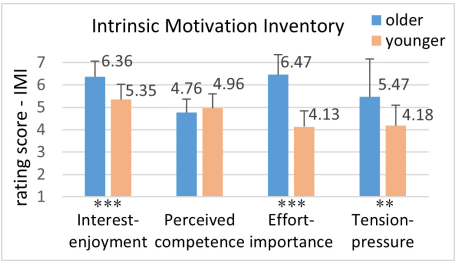

Figure 5: Participants' SDT-related intrinsic motivation of playing 'The Escape'

4.4.4 IDN-Related User Experiences. Generally, both groups had ratings of more than 4 for each dimension of the IDN-related user experiences. Notably, older participants scored significantly higher

Table 1: Quantitative results from study 1: Reliability analysis of the player experience scales (McDonald's ω), along with the Means (Standard Deviations) of each scale for the Older Adults and Younger Adults groups. Mann-Whitney U test statistics (Z), corresponding p-values and effect sizes (r) are provided to assess between-group differences. Statistical significance is denoted as: * for p < 0.001, ** for p < 0.01, and * for p < 0.05.**

Player Experience	McDonald's ω	Older group	Younger group	Z	p	r
CORGIS: Cognitive challenge	0.973	6.42 (1.09)	4.59 (1.08)	-4.12	**0.000*****	-0.752
CORGIS: Emotional challenge	0.911	6.39 (0.68)	5.37 (0.78)	-3.32	**0.001*****	-0.606
CORGIS: Physical challenge	0.985	6.63 (0.57)	4.95 (1.44)	-3.80	**0.000*****	-0.693
CORGIS: Decision making	0.693	5.53 (0.96)	5.71 (0.88)	-0.54	0.595	-0.098
BANGS: Autonomy satisfaction	0.940	6.27 (0.74)	5.40 (0.76)	-2.83	**0.004****	-0.516
BANGS: Autonomy frustration	0.712	3.04 (0.87)	4.22 (0.99)	-2.94	**0.003****	-0.536
BANGS: Competence satisfaction	0.866	6.09 (0.79)	5.31 (0.95)	-2.09	**0.041***	-0.381
BANGS: Competence frustration	0.784	4.11 (1.09)	3.76 (1.43)	-0.86	0.412	-0.157
BANGS: Relatedness satisfaction	0.961	6.33 (0.71)	5.62 (1.05)	-2.08	**0.045***	-0.379
BANGS: Relatedness frustration	0.922	5.13 (1.08)	3.67 (1.30)	-2.84	**0.004****	-0.518
IMI: Interest-enjoyment	0.786	6.36 (0.71)	5.35 (0.68)	-3.37	**0.000*****	-0.615
IMI: Perceived competence	0.581	4.76 (0.61)	4.96 (0.64)	-1.15	0.267	-0.209
IMI: Effort-importance	0.924	6.47 (0.89)	4.13 (0.70)	-4.17	**0.000*****	-0.761
IMI: Tension-pressure	0.882	5.47 (1.69)	4.18 (0.91)	-2.92	**0.003****	-0.533
IDN: Usability	0.887	4.96 (1.09)	5.42 (1.15)	-1.47	0.148	-0.268
IDN: Presence	0.918	6.16 (0.63)	4.89 (1.35)	-2.64	**0.008****	-0.481
IDN: Appreciation	0.918	6.31 (0.71)	5.33 (1.05)	-2.89	**0.003****	-0.527
IDN: Aesthetic pleasantness	0.950	6.25 (0.54)	4.75 (1.15)	-3.65	**0.000*****	-0.666
IDN: Character Believability	0.943	5.98 (0.58)	5.70 (1.11)	-0.69	0.512	-0.125
IDN: Role identification	0.910	5.62 (0.66)	5.00 (1.34)	-1.46	0.148	-0.266

in presence, appreciation and aesthetic pleasantness. With other dimensions, no significant difference were observed between the two groups (See Figure 6 and Table 1).

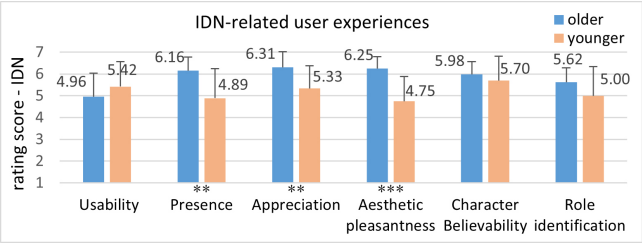

Figure 6: Participants' IDN-related user experiences of playing 'The Escape'

4.4.5 Emotional Responses. Regarding emotional responses, both groups experienced a wide range of emotions during the gameplay, many of which were mixed and complex in nature (See Figure 7). Older participants reported a higher intensity of several emotions, including courage, love, anxiety, worry, empathy, trust, sadness, and stress. In contrast, younger participants also reported a kind of hedonic experience – amusement – at a level of the score of 4.01.

4.5 Qualitative Results: Feedback and Suggestions for Future Game Design

Semi-structured interviews were conducted with all the 15 older participants in study 1. The interview covered three main aspects: their open-ended opinions of playing 'The Escape', their perceived

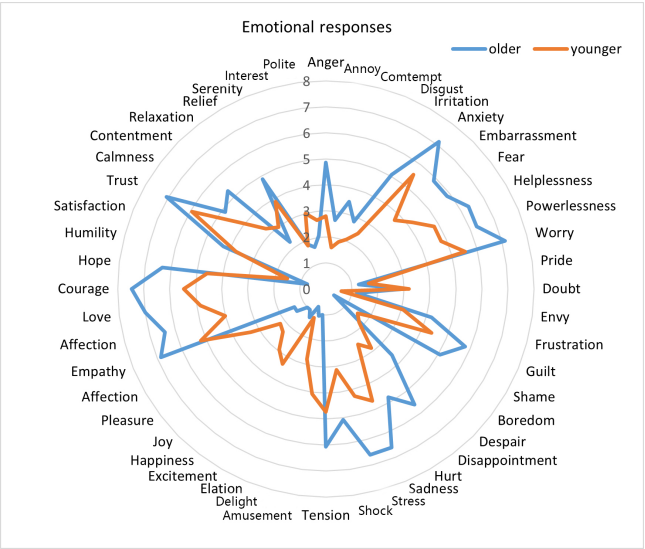

Figure 7: Participants' emotional responses while playing 'The Escape'

impact of playing EC games on their daily activity, and their suggestions for the future design of EC games. Below are indicative questions used in the interviews:

(1) Generally, how do you feel about playing the game?
(2) Which part impressed you the most and why?
(3) What are the impacts of playing this kind of game, particularly as a daily activity?

(4) What issues do you think the game has? And what aspects could be improved if designing this kind of game for older people?

Data from the interviews were collected through a combination of handwritten notes and audio recordings. It is note that all the designed questions were translated into Chinese for conducting the interview, and the responses of older participants were then translated into English presented as the quotes in the following. The audio recordings were all transformed into text first and then checked with the handwritten notes as the data for coding. Inductive thematic analysis (TA) [12, 49] was used to analyze the collected data. This method is widely used in the design evaluation and testing phases of virtual environments to better understand users' intuitive needs and suggestions, e.g. [28, 37]. The first and second authors coded the data independently. They began by breaking the raw data into smaller units and assigning keywords or phrases (codes) to capture their core meaning, along with corresponding participant information. These codes were then grouped into sub-themes based on their frequency and relevance, which were further synthesized into identified themes. Cohen's Kappa Coefficient is a statistical measure used to assess the inter-rater agreement between two raters or judges when classifying items into categorical variables. Thus, we computed the inter-rater reliability between the two raters using Cohen's Kappa, yielding a value of 0.872. Ultimately, the five most frequently mentioned themes are reported below. The quotes and references to participants from this study are denoted with P (e.g. P-01).

4.5.1 Change in Attitudes Towards Digital Games. Several participants remarked that the game play was much more enjoyable than they had anticipated. They expressed that games are solely for pure entertainment but can also provide meaningful content and provoke deep thought. This experience shifted their previous attitudes toward digital games.

> *"I've never been a fan of games and always thought they were bad, bringing a lot of negative effects. My son's gaming habits often led him to neglect my granddaughter, and now she's developed a similar addiction to competitive games. These games are not only hurting her grades but are also straining our family relationships. However, when I actually played this kind of game, I realized there are some benefits too. For example, in the game, I played as Kara, a nanny who really takes on the role of a mother and sets a great example. If my son played games like this, maybe he could learn something, especially about being a responsible father. It might even help him develop a stronger sense of accountability and ethics."* (P-08)

4.5.2 Notable Moments Involving Meaningful Choices. Almost all interviews highlighted that the most impressive parts were game moments involving meaningful choices, such as Kara takes calculated risks to guarantee Alice's safety and comfort, including intimidating a store clerk with a firearm to secure a hotel room, pilfering clothes from a laundromat and deliberating on whether to stay with the little girl forever and protect her and so on, these scenarios entail significant decisions.

> *"When I couldn't find a place for Alice to stay, I went to a convenience store to ask for help, but the clerk refused. In desperation, I pulled out a gun and threatened to get money for a hotel room. Now, if I cannot avoid being caught by the police, I will end up back on the streets with Alice on a rainy night. Thinking about this leaves me feeling really conflicted."* (P-11)

> *"When I was trying to get warm clothes for Alice, she stopped me from stealing. I was really torn between taking the clothes to keep her warm and stopping the theft and ended up going with her choice. This moment had a great impact on me and caused a lot of inner conflict. It's something that I remember vividly."* (P-07)

Some participants also mentioned that the experience of playing this type of game felt different from watching television.

> *"I don't usually play games, but I enjoy watching television and I love to discuss the things that happen to others on TV with my wife. This game was interesting. It made me make decisions on my own, like everything was happening to me, which also made me feel like I am very important. It reminded me of similar experiences I have had in my own life [...] if this kind of game could be turned into a daily activity for the elderly, it would be amazing."* (P-16)

4.5.3 Fostering Unique and Personal Emotional Connections. Playing the game helps some participants relate to their friends, the virtual characters, and their past life experiences. These result in unique and personal emotional experiences. Some participants mentioned that the game could offer warmth to those who are lonely or facing difficult circumstances, providing a sense of love and connection.

> *"Playing this game reminded me of my friend's husband, a quiet, introverted seaman who spent long months at sea. He cherished letters from my friend, which gave him a sense of love and care. After retiring, his solitary nature left him with few friends, and he became isolated, with only my friend caring for him. Sadly, he was diagnosed with Alzheimer's this year, and the doctor said his lack of social connection was a major factor. As I played, I felt the warmth of the characters and thought maybe someone like him could also find a sense of love and connection through a game like this."* (P-05)

Many older participants, especially the female ones, reported that the game evoked feelings of love and empathy towards the characters in the game.

> *"At first, I didn't want to do anything risky in the game and was okay with just finding a rundown place to stay. But when I saw Alice soaked and unhappy about staying in such a shabby spot, my heart melted. I felt a strong urge to protect her, almost like she was my own daughter. Seeing her in that pitiful state was really heartbreaking. So, in the next part of the game, I decided to risk stealing money to get her a better place, which felt like a relief. But when she stopped me from doing something bad, I started to really think about her feelings. I got why*

she was worried, but I also didn't want to let her down." (P-08)

Some participants noted that the games helped them come to terms with their past by providing an opportunity to reflect on and address lingering regrets.

> *"Playing this game made me think of my father. During the pandemic, he got sick in the nursing home, and because of strict rules, I couldn't visit him. Eventually, I found a way in and spent a precious month with him. With my busy schedule and his improving health, I decided to go back to work, even though he begged me to stay. A week later, he passed away, and I've been left with deep regret for missing his last moments. The game made me realize that every choice leads to different outcomes and that there's no perfect decision. Reflecting on this has helped me come to terms with my past, make peace with my regrets, and move on."* (P-03)

4.5.4 Acquiring New Knowledge and Improving Hand Coordination. Many participants said the game gave them the chance to engage with and learn about new technologies, which broadened their understanding and knowledge.

> *"My son is a programmer and uses a mouse for work every day. I usually handle most of the house cleaning, including wiping down his mouse and computer. I used to think these devices were too complicated to use, but when I played a game and used the mouse for the first time, it turned out to be pretty simple! This experience helped me understand how the mouse works and gave me a basic idea of how to play the game. Plus, it gave me a better grasp of my son's daily work, which made me really happy."* (P-15)

Older adults also noted that, in addition to new knowledge, the game helped improve their hands-on skills and coordination.

> *"I know very little about computer using. The game made me use both a keyboard and mouse at the same time, which was a bit tough to get used to at first. But as I kept playing, my movements became more natural, and my hands got quicker. It is fascinating."* (P-05)

4.5.5 Current Issues with the Game and Suggestions for Future Design. Overall, this game has received widespread praise from older adults. However, as it is a commercial game aimed at younger audiences, some aspects of its design and operation did not fully meet the needs of older users. To better understand the gaming preferences and needs of older adults, we have compiled and organized the recommendations from the interviews as follows:

Issue A. Unclear UI Interactions and Difficult Route Finding: Some older participants struggled with certain user interface (UI) interactions. For example, some tasks required users to hold the mouse, apply upward pressure, and then slide it in a half-circle motion to the left—a procedure they found too complex to remember. Additionally, three participants noted that some UI icons were confusing. In particular, P-15 wanted more prompts to guide them. Furthermore, some also felt disoriented while navigating the game, especially with the map. These points sometimes required assistance from the experimenter.

Issue B. Complex Operations: Some older participants found tasks that required holding down multiple buttons or frequently switching between numbers and letters also proved challenging. Since these actions were often time-sensitive, older adults' slower response times frequently led to missed tasks and frustration. Several participants noted that the game controls were too complex and stressful.

Suggestion A. Simplifying Operations and Reducing Cognitive difficulties: To ensure that older adults can independently enjoy and benefit from single-player games, simplifying game controls is advisable. The complexity of commercial digital games can be too challenging for older adults, hindering their ability to engage with and understand the games. When older adults can effectively navigate and control a game, it helps them develop operational skills and boosts their confidence [77].

Suggestion B. Crafting Daily Life Experiences into Game Content Design: Incorporating daily life experiences into game content design is advised for older adults. By integrating elements and scenarios that reflect their personal histories and values, more meaningful and engaging narratives can be created to provide more authentic and impactful experiences. This approach not only enhances immersion but also strengthens the connection older players feel with the game, leading to a richer and more fulfilling gaming experience.

4.6 Findings and Discussion

Finding 1. Games featuring emotional challenge could help fulfill older adults' psychological needs in terms of autonomy, competence, as well as relatedness.

The rating scale analysis shows that, with playing the commercial game *Detroit: Become Human* in which older participants encountered high levels of game challenge in terms of emotional, cognitive and physical, their need satisfaction of autonomy, competence, and relatedness all have been well satisfied. The SDT-related intrinsic motivation inventory shows that older participants put much effort playing the game and also obtained great interest-enjoyment. Accordingly, they achieved intense IDN-related user experiences and emotional responses such as courage, love, anxiety, worry and empathy.

Results from the semi-structured interviews may help us to learn why older participants experienced such strong experiences across different dimensions. Nearly all older participants found it deeply impressive to be able to decide the progress of the game and even the fate of the virtual characters. This is likely a primary reason why they scored highly with autonomy satisfaction and decision making. Moreover, playing this game led many older participants to care about the virtual characters and relate them to their friends and their own pasts, resulting in unique and personal emotional experiences. This might help to explain why they felt a high level of relatedness satisfaction and also reported the rich and intense emotional responses. Additionally, the commercial game has posed significant cognitive and physical challenges for the older participants, while these difficulties did not prevent them from making a great effort to play the game. In fact, they felt their skills improved when playing the game which leads to a high sense of competence satisfaction.

It is interesting that when talking about daily activity, some older participants mentioned that playing such EC game feels very different from watching TV or reading novels. This distinction becomes particularly clear because players see the game's progression as influenced by their own choices and intentions. Typically, EC games stand out by introducing engaging interactive experiences within their narratives, allowing players to actively participate and influence the story through gameplay. The decision-making process and direct engagement with in-game characters often make players feel as though they are reliving or re-imagining their own stories. This active participation can evoke more personal and vivid memories, as the gameplay aligns closely with the player's emotions, choices, and life experiences. In contrast, novels and movies are generally seen as more passive, where participants feel more like spectators engaging with a pre-designed narrative. These media may also trigger memories when the themes, characters, or events resemble their own life experiences. However, this recall is largely indirect, as the individual assumes the role of an observer rather than an active participant.

Finding 2. With respect to most of the player experiences, older adults reported a higher intensity than those of younger players.

Older participants reported significantly higher levels of physical, cognitive and emotional challenge. This may stem from age-related capability declines. The stronger emotional challenge experienced by older adults may also be due to their great effort in playing the game, which is indicated in the measure of SDT-related intrinsic motivation. Young adults also found that the game satisfied their needs for autonomy, competence, and relatedness, while these feelings were not as intense as those reported by older adults. This may be because that the older participants recruited in this study are particularly much more eager for psychological needs than the younger players, as many of the older participants were reported engaging in jobs with limited social interaction or spending long periods at home taking care of their grandchildren. In terms of mixed-affect emotional experiences, older adults reported significantly stronger experiences with most of the core emotional types than younger adults. This might be related to more complicated factors such as the greater emotional challenge older participants faced, the more effort they invested, or maybe they are more sensitive to emotional contents involved in the game.

With the need satisfaction research in digital games, competence and autonomy are relatively straightforward to understand and have garnered much attention, while relatedness is far less measured and explored. Utilizing the BANGS scale measurement [9], this study highlights that older adults can indeed experience a strong sense of relatedness in single-player games. Previous research has discussed how single-player video games can also support relatedness needs, particularly through para-social relationships [9, 32, 76]. In our study, interviews from some participants revealed that such para-social relationships had been formed with non-player characters (NPCs) in the game. For instance, during an escape sequence, older participants reported feeling a deep sense of concern for a little girl when they saw her soaking wet, which led them to immediately decide to protect her after making a promise to her.

Understanding how players generate EC game experiences and why they enjoy them is both complicated and important. Research by Julia Bopp et, al [11] has found that one major characteristic of emotional challenge is that it often evokes negative or conflicted feelings, such as regret, thereby enhancing players' appreciation of the game and eliciting a stronger gaming experience. For younger players, the appeal of emotionally challenging games can be attributed to the opportunity for emotional exploration and the fulfillment of psychological needs [16]. Their in-game decisions are often shaped by their real-life morals and values [5], offering moments of self-reflection that may foster personal growth [16]. For older adults, they approach EC games with a more reflective and serious mindset. These games frequently evoke memories from their past, fostering a deep sense of connection to their personal history and rekindling emotions tied to familiar people and meaningful life events. Furthermore, older players commonly report significant improvements in cognitive and strategic skills gained through gameplay, such as hands-on skills and coordination. The specific factors influencing these experiences in older adults remain largely unexplored. Future research is needed to examine the psychological, emotional, and neurological processes that make EC games particularly engaging and impactful for this demographic.

Despite the benefits, older adults also reported several issues with the playing of the current commercial game of *Detroit: Become Human*. For instance, the requirement to complete game tasks through coordinated two hands within a limited time frame proved very challenging for them. They also expressed a desire for certain constraints on the game's storyline, such as designing scenarios that simulate real-life situations. Moving forward, in study 2, we will conduct a controlled experiment to further investigate the specific effects of the core design element of emotionally challenging games on the psychological needs experiences of older adults.

5 Study 2: Effects of Meaningful Choice on Older Adults' Psychological Need Experiences

Meaningful choice is a core design element in emotionally challenging games. In Study 1, nearly all interviews highlighted that the most memorable aspects for older participants were the game moments involving meaningful choices. To further examine the specific impact of meaningful choices on older adults' player experiences, especially with respect to psychological needs, we developed a new game scenario, named *Old Li*, based on the principles of designing emotionally challenging games [11, 15, 16] and meaningful game choices [36]. We also incorporated older adults' suggestions from study 1. The game was designed with two versions: one featuring meaningful choices and another without. A new group of 32 older adults were invited to take part in a between-participant study, with participants divided into two groups to play one version of the game. For this study, we used the same methods as in study 1 to collect player experience data using the same questionnaires and qualitative feedback using semi-structured interviews.

5.1 Design and Development of *Old Li*

To develop a new game scenario featuring emotional challenge to cater to older adults' preferences, we began by crafting a narrative script from the viewpoint of an older adult protagonist. The game's

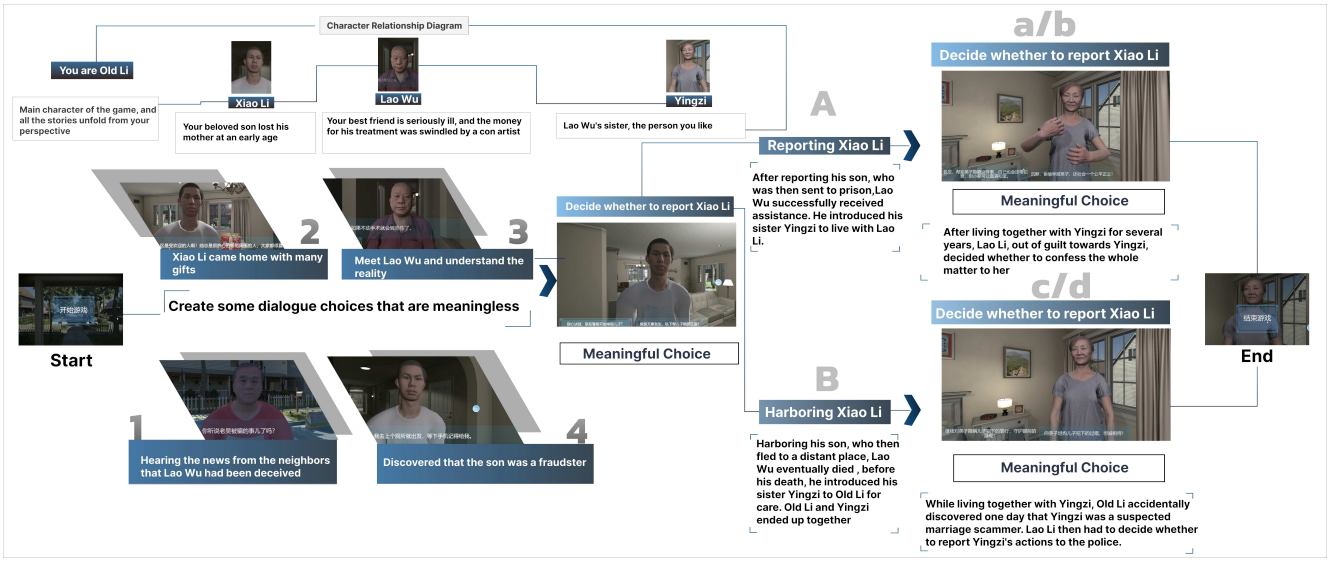

Figure 8: The custom-designed emotionally challenging game of 'Old Li'

setting encompasses his family and community, with pivotal events focused on themes like fraud and illness. With the rapid development of 3D modeling technology [8, 29, 60], researchers now have access to advanced methods and tools for customizing digital games. In this study, we adopted the models draws on the 'Virtual Reality Tool for Psychophysical Experiments' developed by Zhou, et al. [87] as 3D models to build the 3D game environment. These characters possess two interaction states: eye-gaze and head-gaze [20]. They simulate human social behavior while walking, meeting the task requirements in the game. Once all game scenes were constructed, real voice acting was applied to the virtual characters in the game. The game, including the detailed elements, was developed using Unity game engine.

To incorporate emotional challenge into the game, we drew on key design insights, such as incorporating difficult themes or decisions, creating characters with whom the player can empathize, and fostering a reflective state or a broader range of emotional experiences [11, 15, 16]. When creating meaningful choices for the narratives, we followed the highlights of moral, social, and consequential characteristics to make the game impactful for older adults [36].

To make the game cater to older adults' preferences, we also incorporated the suggestions derived from study 1: 1) Involving contents that relate to old adults' real-life experiences. 2) Involving appropriate game mechanics, such as loosing time limit to reduce cognitive efforts and operation difficulty. 3) Providing necessary hints and clear to reduce difficulty on way-finding.

Finally, a game scenario we named as *Old Li*, which takes the perspective of an older adult named Lao Li, has been developed (See Figure 8). *Old Li* allows players to actively engage with the story through both interactive inputs and decision-making choices. Players need to use keyboard and mouse inputs to control the character, Lao Li, to navigate the 3D game environment in an immersive first-person perspective. Specifically, players need to use keyboard arrow keys to move in the game environment and use the mouse to control the direction of movement. All dialogue presentations and choices should be made by players via mouse clicks. The game also incorporates a dynamic route guidance system, triggering narrative background and dialogues when players reach designated locations. Additionally, players can adjust the camera view using the mouse and activate a movement speed boost by holding the Shift key on the keyboard.

5.2 Game Scenario of *Old Li*

At the game's outset, players are introduced to the role of Lao Li, a dedicated security guard, through subtitles. They are tasked with following a designated route to reach Lao Li's front door, located near his neighbors' homes. Players must use the keyboard for movement and the mouse to adjust the camera angle as they navigate toward their destination. Upon arrival, they engage in conversations with neighbors, during which they learn that Lao Wu, Lao Li's close friend and a retired pensioner, has been scammed. This discovery prompts players to visit Lao Wu's home. Using the same controls, players navigate to Lao Wu's residence, but upon reaching the front door, a prompt informs them that Lao Wu is not at home. Players are then instructed to return home using the same navigation mechanics. As the story unfolds, key characters – including Lao Li's son Xiao Li, his close friend Lao Wu, and his prospective wife Yingzi – arrive at Lao Li's home. Through dialogue and interactions, players are required to complete various tasks using the established controls. These tasks include conversing with Xiao Li, interacting with Lao Wu, uncovering evidence of Xiao Li's involvement in a scam, deciding whether to report or protect Xiao Li, talking with Yingzi, and choosing whether to confess to her or shield her from harm.

The game intricately weaves interactions with its narrative, as players engage with NPCs and subtitles to grasp the story while

making impactful decisions that shape its progression. The narrative concludes with a resolution that reflects the consequences of the player's choices.

5.2.1 Game Scenario with Meaningful Choices. In the game scenario with meaningful choices (With MC), players could make decisions at critical junctures in the narrative. The first critical choice occurs when Lao Li discovers Xiao Li's fraudulent behavior and must decide whether to report his son to the police. This decision triggers the branching storylines of Subplot 1 and Subplot 2, each containing further critical choices: whether Lao Li confesses to Yingzi and whether Lao Li covers up Yingzi's past.

5.2.2 Game Scenario without Meaningful Choices. In the game scenario without meaningful choices (Without MC), players could not make any decisions at critical junctures in the narrative. The game's progression is randomly assigned to one of four possible outcomes: reporting the son and covering up for Yingzi, reporting the son and reporting Yingzi, covering up for the son and hiding the truth from Yingzi, and covering up for the son and confessing to Yingzi. Each of these outcomes is experienced by four participants.

5.3 Participants and Procedure

A new group of older adults were recruited using the same criteria and background as in study 1. They were then assigned to two different groups to play the two versions of *Old Li* in a between-subjects design. In total, data of 32 older participants were collected and compared: 16 participants (9 males and 7 females, aged M = 63.56, SD = 6.43) played the game scenario with MC and 16 others (8 males and 8 females, aged M = 62.88, SD = 6.06) played the scenario without MC. The quotes and references to participants from this study will be denoted with MC for the group playing the game with meaningful choices (e.g. MC-01) and nMC for the group without MC (e.g. nMC-01).

In study 2, the experimental procedure was nearly identical to that of study 1, with one key difference: the experimenter no longer sat near the player (See Figure 9). Because the operations involved in *Old Li* were specifically designed to be relatively easy, allowing older adults to play the game independently. Each participant took approximately 80 minutes to complete the whole study and received 25 USD for their participation.

Figure 9: An older adult playing *Old Li* without additional help

5.4 Quantitative Results: Player Experience

Reliability of each factor assessed in study 2 was indicated by McDonald's ω. Mann-Whitney U test was used to conduct the statistical analysis. In all the figures, $*$ of $p < .05$ indicates a significant difference between the two groups. Table 2 shows the statistical results of player experience in study 2.

5.4.1 Perceived Challenge. Unexpectedly, participants in the group with MC had significantly higher levels of perceived emotional challenge and decision making than the group without MC. Neither group experienced high level of cognitive nor physical challenge (See Table 2 and Figure 10), which indicates that when playing *Old Li*, they did not invest much cognitive effort, nor did they encounter physical difficulties that were hard to overcome.

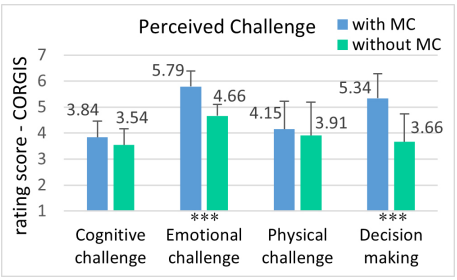

Figure 10: Participants' perceived challenge while playing *Old Li*

5.4.2 Basic Psychological Need Satisfaction and Frustration. Participants in the group with MC experienced significantly higher levels of autonomy and relatedness satisfaction compared to those in the group without MC, with the most pronounced difference observed in autonomy satisfaction. Both groups experienced similarly high levels of competence satisfaction, with no significant difference between them. With respect to need frustration, both groups rated autonomy and relatedness satisfaction as relatively low. Participants in the group without MC reported a moderate level of competence frustration (See Figure 11 and Table 2).

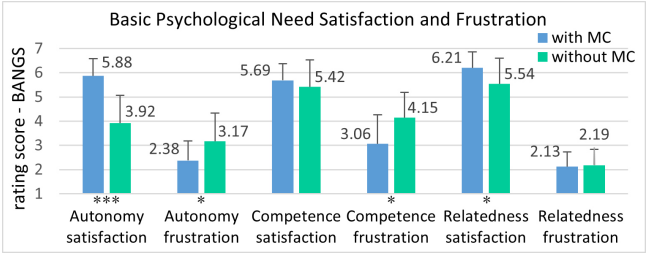

Figure 11: Participants' need satisfaction and frustration while playing *Old Li*

5.4.3 SDT-Related Intrinsic Motivation. Participants in the group with MC reported significantly higher level of interest-enjoyment compared to the group without MC. However, there were no differences between the groups in terms of perceived competence

Table 2: Quantitative results from study 2: Reliability analysis of the player experience scales (McDonald's ω), along with the Means (Standard Deviations) of each scale for the group with (With MC) or without meaningful choices (Without MC). Mann-Whitney U test statistics (Z), corresponding p-values and effect sizes (r) are provided to assess between-group differences. Statistical significance is denoted as: * for p < 0.001, ** for p < 0.01, and * for p < 0.05.**

Player Experience	McDonald's ω	With MC	Without MC	Z	p	r
CORGIS: Cognitive challenge	0.681	3.84 (0.63)	3.54 (0.62)	-1.44	0.160	-0.254
CORGIS: Emotional challenge	0.834	5.79 (0.60)	4.66 (0.45)	-4.06	**0.000*****	-0.717
CORGIS: Physical challenge	0.897	4.15 (1.07)	3.91 (1.28)	-0.70	0.491	-0.123
CORGIS: Decision making challenge	0.810	5.34 (0.94)	3.66 (1.08)	-3.61	**0.000*****	-0.638
BANGS: Autonomy satisfaction	0.885	5.88 (0.71)	3.92 (1.15)	-4.25	**0.000*****	-0.751
BANGS: Autonomy frustration	0.848	2.38 (0.82)	3.17 (1.17)	-2.04	0.047*	-0.360
BANGS: Competence satisfaction	0.905	5.69 (0.69)	5.42 (1.12)	-0.50	0.642	-0.088
BANGS: Competence frustration	0.861	3.06 (1.20)	4.15 (1.05)	-2.48	**0.012***	-0.438
BANGS: Relatedness satisfaction	0.949	6.21 (0.65)	5.54 (1.06)	-2.25	**0.032***	-0.397
BANGS: Relatedness frustration	0.817	2.13 (0.61)	2.19 (0.64)	-0.46	0.669	-0.081
IMI: Interest-enjoyment	0.913	5.81 (0.60)	4.44 (1.10)	-3.59	**0.000*****	-0.634
IMI: Perceived competence	0.723	5.23 (0.63)	5.00 (0.78)	-0.89	0.381	-0.157
IMI: Effort-importance	0.787	4.80 (1.00)	4.50 (1.04)	-1.18	0.254	-0.208
IMI: Tension-pressure	0.813	3.88 (0.98)	2.89 (0.95)	-2.34	**0.019***	-0.413
IDN: Usability	0.910	6.23 (0.94)	6.19 (0.60)	-0.64	0.539	-0.113
IDN: Presence	0.905	6.13 (0.58)	5.92 (0.93)	-0.50	0.642	-0.088
IDN: Appreciation	0.911	6.27 (0.75)	5.06 (1.10)	-3.03	**0.002****	-0.535
IDN: Aesthetic pleasantness	0.893	6.01 (0.63)	5.31 (0.84)	-2.73	**0.006****	-0.482
IDN: Character believability	0.915	6.13 (0.57)	5.81 (0.61)	-1.32	0.210	-0.233
IDN: Role identification	0.872	5.71 (0.79)	5.46 (1.11)	-0.55	0.590	-0.097

and effort-importance. Although participants in the group with MC also rated tension-pressure significantly higher than those in the group without MC, both groups maintained relatively low levels of tension-pressure overall. Notably, the perceived competence results in this study were consistent with the competence satisfaction/frustration findings from the BANGS measure in study 1 (See Figure 12 and Table 2).

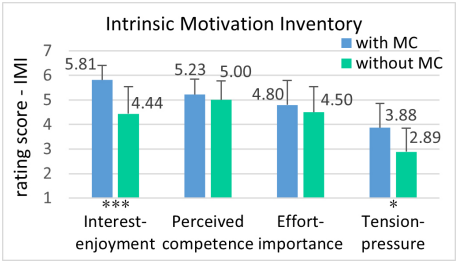

Figure 12: Participants' SDT-related intrinsic motivation while playing *Old Li*

5.4.4 IDN-Related User Experiences. Both groups had ratings of more than 5 for each of IDN-related user experiences. For appreciation and aesthetic pleasantness, participants in the group with MC rated significantly higher scores (See Figure 13 and Table 2). In this study, aesthetic pleasantness is evaluated based on items about the game's capacity to evoke reflection, relate to personal experiences, convey insights about life, inspire, and its resemblance to a work of art. The meaningful choices participants encountered also led to higher ratings on these items.

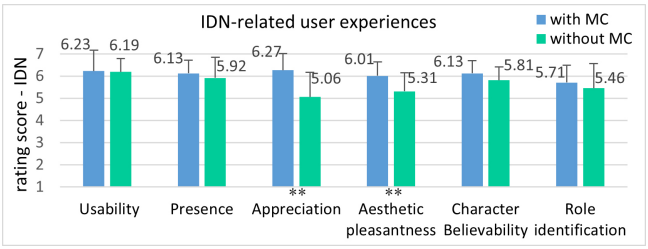

Figure 13: Participants' IDN-related user experiences while playing *Old Li*

5.4.5 Emotional Responses. Both groups experienced a wide range of emotions during the gameplay, many of which were mixed and complex in nature (See Figure 14). Participants in the group with MC reported a higher intensity of emotions including courage, satisfaction, calmness, empathy, trust, guilt, disappointment and hurt. Neither group reported any kind of hedonic experience when playing *Old Li*.

5.5 Qualitative Results: Feedback and Suggestions for Future Game Design

Most steps closely mirrored those of study 1. However, in study 2, qualitative data were collected from two distinct groups. For each group, coding was performed by the first and second author independently for each question. This approach aimed to highlight the differences in responses between the two groups to the same set of questions. The average inter-rater reliability between the two coders, calculated using Cohen's kappa, was 0.820.

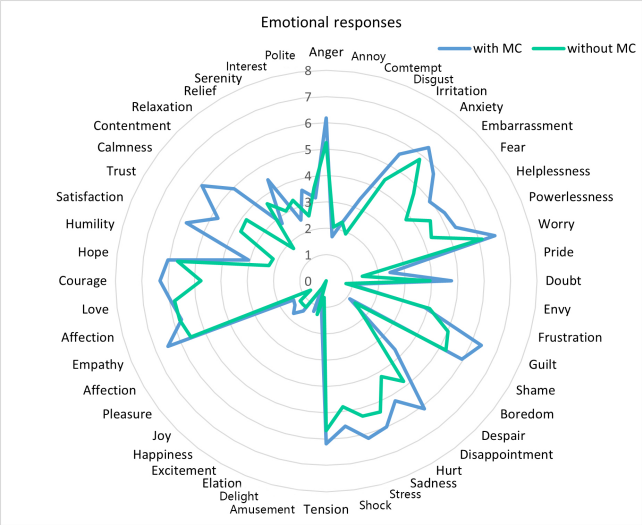

Figure 14: Participants' emotional responses during playing *Old Li*

5.5.1 *Generally, how do you feel about playing the game?*

Group with MC: Some participants described the experience as akin to directing their own story. The ability to make decisions and witness their consequences gave players a sense of control, making them feel as though they were shaping the narrative themselves.

> *"Playing this game truly makes me feel like a director. When the game develops according to my inner thoughts, I experience an unstoppable sense of joy and excitement."* (MC-14)

Group without MC: These participants likened the experience to watching a short film. They felt that these games followed predetermined storylines, limiting opportunities for exploration and reducing curiosity. The predictability of the plot and the absence of suspense made the narrative feel less engaging and less immersive compared to a more interactive experience.

> *"I was quite excited while playing, but the way the plot unfolded was disappointing. The story felt very mediocre and lacked suspense, making me lose interest in continuing to play."* (nMC-03)

5.5.2 *Which part impressed you the most and why?*

Group with MC: Most players in this group almost unanimously reported that the most agonizing and unforgettable moment in the game was deciding whether to send their son to prison. This pivotal decision left a lasting impact on them, highlighting the emotional weight of their choices.

> *"I felt as if the son was my own, completely immersing myself in the perspective of Lao Li when making the decision. They contemplated what would happen to the son in the future. Additionally, in the later linear segments, I feel the most challenging decisions were whether to confess the truth to Yingzi and whether to report Yingzi to the police."* (MC-11)

Group without MC: During the stages, where participants were not presented with meaningful choices, most reported feeling less engaged. While many found the discovery of the son's crime memorable, the absence of decision-making left them without a sense of internal conflict. The plot often seemed to pass by quickly, without leaving a strong impression. However, through our interviews, we found that when the game progressed toward a negative ending, even in the absence of choice, players were still deeply affected by the emotionally charged scenes, which left a lasting impact despite their lack of control over the outcome.

> *"When I realize Lao Wu's death was caused by Lao Li's concealment, Lao Li hiding the truth from Yingzi to maintain a happy marriage, Lao Wu being deceived, and the marriage between Yingzi and Lao Li after Lao Wu's death. I feel very angry! As if I made a mistake, I thought this was a bad story which made me feel sad."* (nMC-09)

5.5.3 *What are the impacts of playing this kind of game, particularly as a daily activity?*

Group with MC: Participants experienced emotional conflict and appreciated the psychological engagement that came with making decisions. When choices aligned with their personal inclinations, it deepened their emotional connection to the game. They felt valued and cared for through the game's storyline and characters, which fostered a sense of warmth and connection.

> *"While playing this game, I initially felt quite happy when my son brought me a gift. Later, after my son made a mistake and went to prison, the comfort from Yingzi and Lao Wu's proactive concern for me made me feel warm inside."* (MC-07)

Group without MC: Participants found the game's ending regretful, but felt it offered a valuable lesson for them.

> *"The game is very realistic, but the plot development is unsatisfying, which leads to a poor internal experience and a rather negative emotional state. The emotional depth feels lacking, which is somewhat disappointing. However, when I play the game, I will reconsider whether such situations would occur in real life and how I would respond if faced with a similar scenario."* (nMC-03)

5.5.4 *Current Issues with the Game and Suggestions for Future Design.*

A. Enrich story depth and thematic complexity.

Group with MC:. Players in this group suggested introducing additional layers to the narrative and emphasized the need for more complex social issues within the game.

> *"If possible, I hope to incorporate more social themes such as public welfare, legal knowledge, and emotional life."* (MC-04)

Group without MC: Players felt that the story was a little brief, leaving the narrative somehow underdeveloped. They desired a richer, more detailed storyline that could sustain player interest over time.

> *"I hope for further plot progression, such as transforming it into continuous chapters, to maintain curiosity about the subsequent conclusion."* (nMC-15)

B. Align story development with players' expectations and favor good endings.

Group with MC: Players suggested incorporating more narratives centered around the lives of older adults and developing the plot in alignment with the expectations of elderly characters.

> *"I hope to write the script according to my own wishes, rather than following a predetermined main storyline with limited choices. Instead, I wish to think independently about the development of the main plot."* (MC-5)

Group without MC: Participants sought uplifting outcomes and more variety in the stories. They also expressed preference for positive resolutions.

> *"I also hope for new stories to be introduced [...] if possible, I hope the story can have a happy ending."* (nMC-04)

C. Enhance character expressions, visuals, and audio realism.

Group with MC: Participants emphasized the need for more nuanced character portrayals, particularly focusing on the importance of expressive facial features to enhance realism.

> *"The music should be more upbeat and reflective of real-life experiences."* (MC-05)

Group without MC: Some players suggested that the characters lacked expressiveness. They recommended improvements in both facial animation and voice acting to make the characters more lively.

> *"The game characters should be more vivid."* (MC-04)

> *"It would be good to include more voice actors with regional accents to improve the experience and add a touch of fun."* (nMC-07)

5.6 Findings and Discussion

Finding 1. For older adults, meaningful choices of emotionally challenging games had a critical influence on need satisfaction for autonomy, a moderate influence on relatedness but no impact on competence.

With a self-designed game *Old Li* with and without meaningful choices, we found that, the game with MC presented considerably more emotional and decision-making difficulties in comparison to the game without MC. The game with MC has met the psychological needs of older adults in terms of autonomy, competence and relatedness. Particularly, meaningful choices had a critical influence on need satisfaction for autonomy. Interviews from the two groups also showed differences related to the autonomy satisfaction. Participants playing the game with MC felt the playing as if they were directing the story and were impressed by the moments involving critical choices. However, participants playing the game without MC had rather a different view, stating it as "like watching a film" and having few notable moments about the playing.

Meaningful choices also influenced the need satisfaction for relatedness but only at a moderate level. Participants playing the game without MC still gained a high level of relatedness satisfaction. Results of interviews also showed that they felt care and worry about the virtual characters even without the autonomy to make critical choices to influence the story. This may be the reason that participants in the group without MC also reported intense emotional responses such as love, affection, anxiety, worry and empathy. With respect to the need satisfaction for competence, both groups obtained high levels. In the design of *Old Li*, we also involved a number of dialogue-based unmeaningful choices in both groups. Perhaps it is due to the presence of these unmeaningful choices which also require player actions that make participants in the group without MC experience a high sense of competence, without any differences to the group with MC.

Finding 2. For older adults, meaningful choices of emotionally challenging games had a critical influence on SDT-related intrinsic motivation of interest-enjoyment.

The SDT-related intrinsic motivation inventory shows that participants in the game with MC obtained great interest-enjoyment while the other group did not. Results of interviews also showed that participants in the group without MC had relatively low interest in playing the game and may not like to play this kind of game in daily activity. In addition, both group of participants achieved intense IDN-related user experiences and emotional responses such as courage, love, anxiety, worry, anger and sadness. Meaningful choices did not influence much with these dimensions of experiences.

In Study 1, we found that the game *Detroit: Become Human* elicited strong emotional experiences among older participants. In contrast, in study 2, the 3D human models in *Old Li* were perceived as less realistic compared to those in *Detroit: Become Human*. As a result, older participants reported experiencing relatively lower emotional engagement while playing *Old Li* than in Study 1. In both experiments, we carefully monitored the emotional well-being of the older adults. Upon leaving the lab, all participants confirmed that they greatly enjoyed participating in the experiment.

6 Guidelines for Designing Emotionally Challenging Games for Older Adults

Finally, with both quantitative and qualitative findings in the two studies, this paper offers five design guidelines for developing emotional challenge games to better satisfy the psychological needs of older adults.

6.1 Designing Meaningful Choices to Enhance Sense of Autonomy and Enjoyment

When designing emotionally challenging games (EC games) to meet the psychological needs of older adults, meaningful choice is one of the most fundamental design factor, as it usually plays a crucial role in influencing players' sense of autonomy. It is found that older adults like to make decisions by themselves and enjoy the feeling of direct the game process in the game. The absence of meaningful choices significantly diminishes the autonomy experienced by them. The specific design of meaningful choices can be guided by the highlights of moral, social, and consequential characteristics [36] to make the game impactful for older adults. EC games can, of course, incorporate some less meaningful choices to enhance overall

interactivity, potentially supporting the psychological need for competence.

When designing meaningful choices for older adults, it's worth considering offering more options. In most existing EC games, meaningful choices are often limited to binary, either-or decisions, where the two options are usually in strong conflict, adding to the difficulty of the decision making. This may appeal to younger players by enhancing the sense of excitement and challenge, while older adults seem less inclined to make such extreme decisions, especially when the game content is already intense. Therefore, we may suggest that EC games could offer more than just two options to cater to a wider range of preferences among older adults.

Incorporating meaningful choices in EC games holds the potential to improve players' sense of interest-enjoyment. In traditional, players often enjoy playing hedonia-focused hardcore games primarily because these games provide a sense of fun and pleasure. EC games, on the other hand, tend to include less purely entertaining interactions and content. In this study, both of the EC games we selected and designed had very few of entertaining interactive elements, and participants rarely reported hedonic experiences during gameplay. As older adults grow older and accumulate life experiences, their focus often shifts from seeking hedonic pleasure to pursuing eudaimonic fulfillment. In this context, meaningful choices may be instrumental in fostering a eudaimonic form of enjoyment, which goes beyond mere pleasure or entertainment.

6.2 Aligning Life Experiences to Meet the Need for Relatedness

Compared to autonomy and competence, previous research has paid less attention to relatedness need satisfaction, probably because traditional games, especially single-player ones, struggle to highlight its importance with this respect. In the two experiments of our study, participants – whether older or younger, and whether in the group with or without MC – reported a high level of satisfaction in terms of relatedness. This satisfaction appeared to be largely unaffected by the presence of meaningful choices. These findings highlight the strong potential of single-player EC games in fulfilling the relatedness need of older adults.

Therefore, it is suggested to align the in-game player experiences with older adults' real-life experiences to meet their deep-seated need for relatedness. This involves creating narratives and scenarios that resonate with the life journeys, memories, and emotional landscapes of older players. By doing so, the games can foster a sense of connection and belonging, making the gaming experience not only entertaining but also profoundly meaningful.

To achieve this alignment, game developers may consider incorporating themes that reflect the common experiences of aging, such as retirement, grand-parenthood, lifelong friendships, and the pursuit of new hobbies or passions. These themes can serve as a bridge between the virtual world and the players' real lives, allowing them to see parts of themselves in the characters and stories they encounter. With advanced technologies, it is also possible in the future to create personalized game content specifically tailored to their individual preferences.

6.3 Balancing Difficult Themes with Uplifting and Empowering Narratives

It is important to recognize that EC games may include some difficult themes, such as illness, fraud, loss, or personal struggle. These themes reflect the real-life challenges that many older adults face, and addressing them in a thoughtful and respectful manner can help validate their experiences. However, to truly meet the psychological needs of older players, it is crucial that the narrative also incorporates positive objectives. This means creating storylines that encourage character development, showcase the strength and resilience of the characters, and provide resolutions that lead to a sense of hope and well-being.

Incorporating positive objectives involves more than just a happy ending; it requires a journey that allows players to see growth and transformation. For example, characters might overcome adversity through the support of friends and family, discover new passions and interests, or find ways to give back to their communities. These elements can help players feel empowered and inspired, reinforcing the idea that challenges can be met with strength and optimism.

6.4 Providing Appropriate Levels of Cognitive and Physical Challenge

When designing EC games for older adults, it is crucial to create experiences that not only engage them emotionally but also meet their psychological needs for competence. Balancing cognitive and physical challenges is essential to ensure that the game remains accessible and enjoyable. By carefully calibrating these challenges, designers can help older adults focus on the emotional depth and narrative richness of the game, fostering a stronger connection with the story and characters. This approach not only enhances immersion but also allows older players to achieve a sense of mastery and competence as they independently navigate and complete the game by themselves.

6.5 Involving Older Adults in Participatory Design and Development

Older adults possess a wealth of life experiences and a strong desire for self-expression, particularly through storytelling [2, 35]. This characteristic has been evident in our experimental interviews, highlighting their eagerness to share and create. By involving older adults in the participatory design process of EC games, they can infuse their personal preferences and unique perspectives into the game, thereby exercising their autonomy and creativity. This collaborative approach not only empowers older adults but also ensures that the resulting games are more aligned with their interests and psychological needs.

7 Limitations

One limitation of our work is that all elderly participants were from China, with the majority having only a middle school education and very few having attended college. This suggests that our findings may be influenced by both educational background and cultural context. Another limitation of this study is that all the measurement scales were first translated into Chinese by two of the authors before being administered to the older adults. This

translation process could potentially impact the generalizability of the results to some extent. A third limitation of this study is that the age range of the elderly participants was concentrated around 60 years old. As a result, the conclusions drawn from this research may not be applicable to a wider scope of older demographic. Lastly, due to the difficulty in selecting a commercial EC game suitable for older participants to conduct a controlled experiment, this study involved the efforts to design and develop a custom game. However, the quality of this custom-developed game may not match that of commercial games. This discrepancy in production quality could potentially influence the study's conclusions, introducing a bias that might affect the generalizability of the results to other games of varying quality levels.

8 Conclusion

In this research, we explored the potential of emotionally challenging video games in addressing the psychological needs of older adults, particularly in terms of competence, autonomy, and relatedness, and the overall gaming experiences of this audience with these games. Through two complementary studies – study 1 (N=30) and study 2 (N=32) – we found that older adults playing *Detroit: Become Human* experienced high levels of psychological engagement, often reporting more intense emotional responses than younger players, particularly with making choices that they considered meaningful. Study 2, which built on these findings, further demonstrated that meaningful choices were deemed essential for maintaining older adults' interest, as low engagement was observed when such choices were absent. Based on our findings, we offer five design guidelines to help develop emotionally challenging games that better satisfy the psychological needs of older adults, providing a foundation for future game design aimed at enhancing their well-being through interactive experiences.

Declaration This study was conducted in accordance with the ethical guidelines of the local ethics committee. Prior to participation, all participants provided informed consent, and their confidentiality and anonymity were strictly maintained throughout the study.

Acknowledgments

This work was supported by the National Science and Technology Major Project (2022ZD0118002), the National Natural Science Foundation of China (62332017, 62302494, 62172397) and the Project of Institute of Software Chinese Academy of Sciences (ISCAS-ZD-202401, ISCAS-JCMS-202306). Soumya C. Barathi would like to thank Cardif University's School of Computer Science and informatics for supporting her research.

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