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Connecting in-game performance, need satisfaction, and psychological well-being: A comparison of older and younger players in World of Tanks

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Abstract

The need satisfaction and psychological benefits derived from gameplay are generally understudied for older video game players. This study connects the Self-Determination Theory, Motivational Theory of Life-Span Development, and Socioemotional Selectivity Theory to understand players' in-game behaviors and their corresponding need satisfaction from a developmental perspective. Survey data from 1213 randomly sampled World of Tanks players were combined with their behavioral data to investigate how players' behaviors and their corresponding need satisfaction differ or converge across age. Age and in-game behaviors were tested as moderators for the relationship between perceived need satisfaction and psychological well-being. The results showed that despite underperforming and having fewer in-game connections, older players reported no significant difference in their perceived competence and relatedness than younger players. Perceived competence and relatedness contributed to psychological well-being for both older and younger players, although it carried more weight for the younger. Theoretical and practical implications are discussed.

Keywords

Basic psychological need satisfaction, Motivational Theory of Life-Span Development, older player, Self-Determination Theory, Socioemotional Selectivity Theory, well-being

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Video game research has mostly focused on adolescents and young adults (Lee et al., 2021b; Wu and Guo, 2020). However, with the ongoing expansion of players and aging of existing cohorts, especially the cohort of Baby Boomers now entering retirement age, the percentage of older players has increased tremendously worldwide in recent years (Nelson- Kakulla, 2019). For example, drawing on data from 15 regions, a recent report from Global Web Index (2021) found that gamers between the age of 55 and 64 have grown 32% from 2018 to 2021. In the United States, video game players over the age of 50 have increased from 40.2 million in 2016 to 50.6 million in 2019 (Nelson-Kakulla, 2019). Despite a marked increase in the use of digital games among older players, the extant literature offers only limited theoretical and empirical insights into older players' in-game behaviors and their psychological need satisfaction derived from the gameplay (Brown, 2015; Lee et al., 2021a).

Age-related changes in perceptions, motor control abilities, and lifetime experiences are likely to contribute to unique play habits and experiences across age (De Schutter and Malliet, 2014; Nap et al., 2009). A handful of initial efforts in this direction found that different developmental stages have been associated with varying gaming preferences and play patterns (Birk et al., 2017; De Schutter, 2011). Although providing in-depth understanding, this line of research has relied on small samples or been conducted in a laboratory environment (e.g. Subramanian et al., 2020), limiting the generalizability of their findings. Regarding gameplay effects on older players, although some studies have touched upon the social and psychological benefits of leisurely gameplay for players across age (e.g. Greenberg et al., 2010; Zhang and Kaufman, 2015), there is comparatively little research investigating games' psychological benefits as entertainment sources that satisfy older players' basic psychological needs (Lee et al., 2021a).

Older players have also generally been overlooked by the gaming industry (Osmanovic and Pecchioni, 2016). Most digital games on the market target a younger audience, and their content resonates less with older adults (Nap et al., 2009; Paaßen et al., 2017). For example, 89% of League of Legends players are below 35 years old, with fewer than 1% of players over 40 (Statista, 2019). Quantic Foundry (2016), an independent market research company specializing in gaming motivation, surveyed 220,000 players worldwide and noted that among 21 popular video games (e.g. League of Legends, DotA), World of Tanks (*WoT*) has the broadest age appeal. Although Quantic Foundry's sampling may not be representative, their finding on *WoT*'s age distribution is indeed a reflection of the target audiences of the game (Takahashi, 2020). This unique demographic feature of *WoT* is well-suited for this study. Based on the age distribution of *WoT* players, we view older players (over 35) as relative to younger players (below 35; Petry, 2002). The separation criterion, age 35, also aligns well with the average age of all games in the United States in 2019, which was about 33 years old (Entertainment Software Association, 2020). We also echo Brown and De Schutter's (2016) call to use a life course perspective to explore gameplay experiences by replicating the analyses with age entered as a continuous variable.

This study adopts Self-Determination Theory (SDT; Ryan and Deci, 2000a) as an overarching theoretical framework and two developmental theories, the Motivational Theory of Life-Span Development (MTLSD; Heckhausen et al., 2010) and Socioemotional Selectivity Theory (SST; Carstensen et al., 1999) to make more nuanced

hypotheses on players' in-game behaviors and need satisfaction from a life-span perspective. It utilizes both unobtrusive behavioral data and survey data from *WoT*. The behavioral data represent cumulative portraits of players' in-game behaviors overtime, while survey data represent players' appraisals of their play experience at the moment. The combination of the two offers a rare opportunity to examine players' perceived need satisfaction and psychological well-being across age while investigating and controlling for their in-game actions. However, it has been commented that as a competitive first-person shooter game, the game mechanics of *WoT* make it particularly appealing to male audiences (Shen et al., 2020). Random sampling of *WoT* players in this study indeed exhibits a genre-specific, skewed gender distribution. This article proceeds by first laying out the theoretical frameworks used for this study.

SDT

SDT (Ryan and Deci, 2000a) is a theory about human motivation, development, and well-being. According to SDT, humans have three intrinsic, basic psychological needs that motivate their behaviors: (1) *competence*, (2) *relatedness*, and (3) *autonomy*. Satisfying them is essential for psychological well-being. SDT also investigates conditions that foster or undermine human motivation, optimal functioning, and well-being (Ryan and Deci, 2000a).

In game studies, SDT is one of the most widely adopted approaches to examining players' intrinsic need satisfaction derived from gameplay and their subsequent enjoyment and mood repair (e.g. Rieger et al., 2014). It also provides insight into how a game's particular affordances can fulfill or hinder players' psychological needs. For example, Przybylski et al. (2014) found that competence-impeding play led to higher aggression levels, whereas competence-supportive play prompted continued gaming motivation.

However, previous studies investigating the application of SDT have some limitations. First, despite the substantial increase in older players noted above, few have attempted to look at SDT across the lifespan (Boletsis and McCallum, 2016). Second, most studies on SDT adopt self-reported measures of need satisfaction and have been unable to account for how players' actual behaviors may operate to drive the satisfaction process. Building upon prior work on SDT, the next section discusses each of the three basic psychological needs across age groups based on two developmental theories: MTLSD and SST. Then, separate hypotheses are drawn for players' in-game behaviors and perceived need satisfaction.

A handful of recent studies have incorporated MTLSD and SST to examine SDT from a life-span perspective (e.g. Geldhof et al., 2017). MTLSD posits that as individuals' age, they shift their focus from *primary* to *secondary* control processes (Heckhausen et al., 2010). Primary control is motivated by the intrinsic need to exert control over the environment to promote goal attainment. Secondary control means changing internal interpretations to preserve or enhance perceptions of personal control. These control processes are relevant for studying the development of self-determination as they highlight the importance of agency for self-determination. SST (Carstensen et al., 1999), another development theory, argues that as individuals age, they prioritize emotion regulation goals over knowledge acquisition goals. As Geldhof et al. (2017) note, the assumptions

of SST parallel that of SDT, that is, that humans have intrinsic needs of relatedness and autonomy. Similarly, SST assumes that individuals are intrinsically motivated to build social relationships and to exert agency.

Competence

Competence is "a need for challenge" and feelings of effectiveness (Ryan et al., 2006: 349). In the gaming context, this means a need for in-game challenges and meeting them. For example, perceived competence in games might be achieved by learning new skills to conquer challenges with increased difficulty (Peng et al., 2012). However, although people across age groups need competence, their actual competence and perceived competence may differ across age for desired and undesired outcomes.

MTLSD (Heckhausen et al., 2010) is used to draw inferences about older and younger players' differences in in-game and perceived competence. MTLSD helps understand how individuals at different developmental stages have different goals that motivate their behaviors, interpretations of behaviors (e.g. winning/losing), and perceptions of need satisfaction. Human motivation and actions are the product of personal (i.e. needs, motives, goals) and situational factors (i.e. incentives and punishments; Heckhausen and Heckhausen, 2008). This basic structure of human behavior is also applicable to study players, as humans experience gaming situations with incentives within a virtual world and act based on their motivations, needs, and goals (Bostan, 2009; see also Moon et al., 2013; Sayago et al., 2019). In a game setting, primary control is related to manipulating the game characters with skill, strategy, and knowledge. Secondary control concerns persistent gaming behaviors and flexible interpretations (Moon et al., 2013).

Due to declines in various cognitive and physical functions (Gamberini et al., 2008), it is likely that older players may not play as well as their younger counterparts. As a compensatory mechanism, older players get better at accepting objective failure and loss. They are more likely to disengage from unattainable goals, but this is not a passive acceptance. Individuals actively engage in more *secondary* self-protection strategies, including focusing on successes in other domains and reinterpretations of events and failures, to minimize the potential damage that failures can have on self-perception and motivations. Although challenge is one of the most popular play motivations of older adults (De Schutter, 2011), research has shown that they have different experiences of winning and losing from younger players. Their perceptions of challenge, fun, and a drive for improvement did not vary with their performance (Gajadhar et al., 2010). Unlike younger players, older players do not necessarily play to win. Independent of their actual performance, older players may have higher perceived competence due to their feelings of effectiveness through this process of internal negotiation and reinterpretation of failure and loss (i.e. the secondary control process). Consequently, we predict the following:

H1a–H1b. Older players will show (a) lower in-game competence than younger players but (b) higher perceived competence than younger players.

Relatedness

Relatedness is experienced when connected to others, either through a direct connection or being involved in social contexts (La Guardia et al., 2000). It occurs through personal networks of ties where social capital develops (Coleman, 1988), and where stronger and weaker ties (Granovetter, 1973) tend to lead to more bonding or bridging social capital, respectively (Putnam, 2000). Relatedness is associated with a sense of attachment, security, belongingness, and intimacy with others and with one's community (Deci and Ryan, 2004). In the game context, research has shown that the satisfaction of relatedness is positively related to enjoyment and continued play (Ryan et al., 2006). Although players have a need for relatedness, their perceptions might differ. SST (Carstensen et al., 1999), a developmental theory of motivation focusing on relational and emotional aspects, provides further insights on how players might differ across age on in-game and perceived relatedness.

SST proposes that perceptions of time influence people's goals and priorities. As people age, they tend to perceive more constraints on time. Therefore, older people place more value on quality over quantity. Older adults strategically and adaptively cultivate their social networks to "maximize social and emotional gains and minimize social and emotional risks" (Lim and Yu, 2015: 2). Emotion becomes the motivating factor for forming relationships as individuals age (Carstensen et al., 1999). Although the number of connections might drop with age, it is attributed to keeping relationships with a high degree of emotional contact and expression. This tendency to value quality over quantity can also be approached from the social capital literature. Weak-tie relationships tend to yield bridging social capital, as they usually lead to a broader set of information and resources (Granovetter, 1973). Strong-tie relationships, on the contrary, tend to yield bonding social capital and provide emotional and substantive support (Williams, 2006). That is, bridging social capital is more about the quantity of relationships while bonding social capital is more about quality of relationships (Putnam, 2000). In the context of the current study, it can be interpreted that despite having fewer friendship ties in games, older players will report higher perceived relatedness because they are more likely to accrue bonding social capital derived from strong ties. Therefore, it is hypothesized that:

H2a–H2b. Older players will show (a) lower in-game relatedness and (b) higher perceived relatedness than younger players.

Autonomy

Autonomy refers to a sense of volition or control when undertaking a task (Deci and Ryan, 2000; Ryan et al., 2006). In the gaming context, perceived autonomy can vary in two dimensions. First, perceived autonomy can be high when individuals engage in activities for intrinsic reasons, such as interest and value rather than external rewards. Second, it can be increased if in-game features support a sense of volition, such as providing users with choices (Peng et al., 2012). As gameplay outside of experimental settings is almost always voluntary (Bartle, 2004), perceived autonomy derived from gameplay should always be high (Ryan et al., 2006), and measuring what variance there

is tends to be hard without adequate manipulation. Moreover, because *WoT* players can choose to play in different modes with varying degrees of sociability (e.g. play alone or together), the interplay between relatedness and their play preferences makes it messy to measure autonomy with a single game's in-game play data alone. Due to such barriers in operationalizing in-game autonomy, this study focused on two of the three basic psychological needs in SDT: competence and relatedness.

Psychological well-being

SDT posits that satisfaction of the basic psychological needs leads toward health and well-being (Ryan and Deci, 2000b). The needs, if not satisfied or are hindered, may cause negative consequences such as pathology (Uzman, 2014). Even though the meaning of specific goals varies across cultures, SDT research has supported that the relation between underlying need satisfaction and well-being is consistent across contexts, including schools, nursing homes, and workplaces (e.g. Baard, 2002; Tian et al., 2014). Extending this line of research to the game domain, the perceived fulfillment of basic psychological needs in games may in turn be associated with better psychological well-being (e.g. Reer and Krämer, 2018; Wulf et al., 2020):

H3a–H3b. Perceived (a) competence and (b) relatedness will be positively associated with psychological well-being.

Although the association between need satisfaction and psychological well-being is well supported (e.g. Johannes et al., 2021; Rieger et al., 2014), little is known about how actual, in-game behaviors affect players' psychological processes in natural environments. This is likely because it is challenging to acquire behavioral data and pair them with psychometric data. Therefore, we propose the following research question to explore the relationship between how players across age groups *see* themselves (i.e. perception), what they *do* (i.e. in-game behavior), and how these collectively relate to their psychological well-being:

RQ1. How do age and in-game behaviors moderate the relationship between perceived need satisfaction and psychological well-being?

Methods

Study context: WoT

We situate the current study in *WoT*, a large-scale vehicle-based team combat game played by millions around the world (Takahashi, 2020). It is a player-versus-player, vehicle-based shooter game. Unlike most shooter games, *WoT* has a relatively slower pace. As *The Sims*' creator Will Wright said, *WoT* is "a first-person shooter for old people" (Takahashi, 2013). It features more than 600 highly detailed tanks from the mid-20th century that the users can collect and battle with. A combination of the five types of tanks shapes a team of up to 15 players. In each battle, players navigate a bounded map with a

tank of choice to capture the enemy team's base or destroy all enemy tanks. On average, each battle takes 6–7 minutes.

Players battle in different game modes. The most common is "random battle" where the matchmaking system assigns players with no prior interactions into two teams and randomly selects a map for them. Analogous to other team combat games, players can join more permanent social structures called "clans" where they can engage in more team-oriented modes. As strategic play and cooperation are crucial to winning, players are motivated to play with familiar players. Skilled players often win more with their higher shooting accuracy and damage. However, as a team-based game, no player can carry every single battle. Therefore, players can invite up to two in-game friends to join random battles together for better coordination and more fun. Players can add their offline friends as in-game friends, or meet new friends in clans.

Participants and procedure

In April 2019, in partnership with the game operator, Wargaming, a large-scale online survey was conducted. The study was approved by our institute's ethical review board, and all respondents gave informed consent. We also received a parent permission waiver because the research was deemed to have no more than minimal risk to minors. Direct invitations were randomly sent from the company to 9729 players on the North American server who have completed at least 200 battles. This threshold was somewhat arbitrarily decided to reflect that it takes a while for *WoT* players to get connected to the gaming community and make SDT functions possible. A total of 1819 complete responses were collected with a response rate of 18.70%, and all answers were anonymized. Respondents' corresponding behavioral data were unobtrusively collected from Wargaming's data warehouse and matched with survey data using a player ID. This ID was anonymized with an encrypted hash function before reaching the research team. After tightening the age range to 13–80 and removing invalid responses, data from 1213 respondents (97.4% male, 1.3% female; age, $M = 43.21$, $SD = 16.20$) were retained for the analyses.

Measures

Survey variables. Based on a bimodal distribution of age (see Figure 1), respondents were split into younger and older players by age 35. Those under 35 (younger players; $n = 400$) were assigned a value of 0, and those equal to or over 35 (older players; $n = 813$) were assigned a value of 1. Income was included as a control variable when examining players' psychological well-being (*H3* and *RQ1*) because previous research has shown that increased wealth leads to better well-being (e.g. Fischer and Boer, 2011).

Perceived fulfillment of competence and relatedness were assessed using the Basic Psychological Need Satisfaction Scale (La Guardia et al., 2000), modified to reflect the game context. Each question started with "when I am playing *WoT*" to note that it was a *WoT*-specific question (rated on a scale from 1 to 5, with 1 = *not at all true*, 3 = *somewhat true*, 5 = *very true* and *hard to say*, which was dropped from analysis).

Respondents indicated how true each statement was for them: for perceived competence, "I feel like a competent person," "I feel very capable and effective," and "I do not

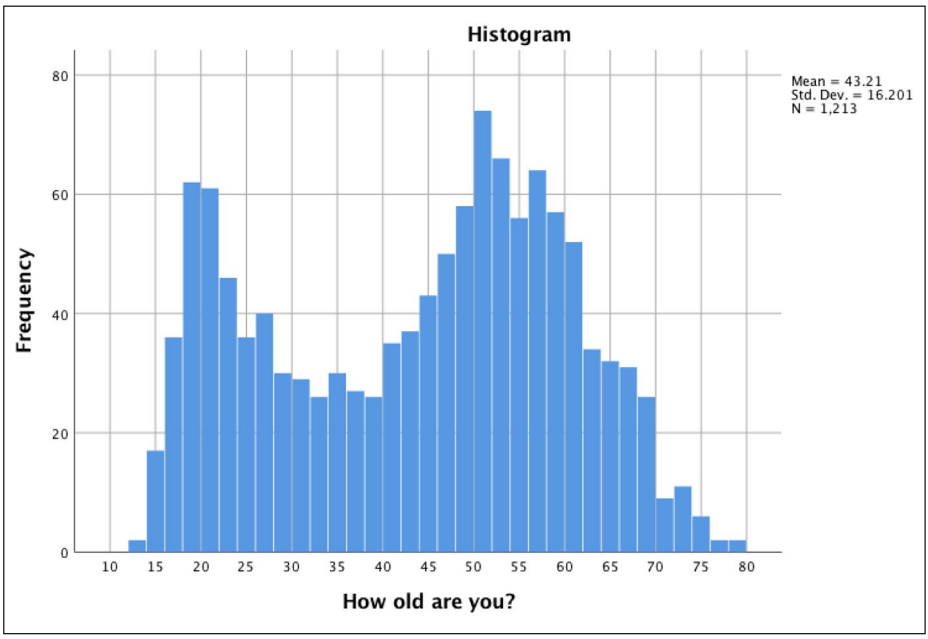

Figure 1. Histogram of a bimodal distribution of age.
After restricting the age range to 13–80 and removing invalid responses.

feel very competent" (reversed) ($\alpha = .74$, $M = 3.68$, $SD = 0.80$); for perceived relatedness, "I feel cared about in this gaming community," "I feel a lot of closeness in this gaming community," and "I feel a lot of distance in the gaming community" (reversed) ($\alpha = .74$, $M = 2.68$, $SD = 0.93$).

Psychological well-being was assessed using the Flourishing Scale (Diener et al., 2009). This scale provides a single score based on eight items covering perceived success in important areas such as relationships, self-esteem, and optimism. Respondents indicated their agreement with each statement (rated on a scale from 1 to 5, 1 = *I disagree completely*, 3 = *neither agree nor disagree*, 5 = *I agree*, and a *Hard to say*): for example, "My social relationships are supportive and rewarding," "I am optimistic about my future," and "People respect me." ($\alpha = .91$, $M = 4.15$, $SD = 0.72$).

Behavioral variables. Respondents' win-rate ($M = .49$, $SD = .03$; note that the mean is not 50% because the game allows ties) was collected as a proxy for their in-game *competence*. As *WoT* is a team-based battle game, win-rate indicates the percentage that a player's team won a match among all the matches that the player has played. Although the variance around win-rate is fairly tight, players know this and interpret it accordingly. It is an indicator of whether a player has the capacity to carry the team to a win despite a skill disparity. A high win-rate means a player can do so consistently, while a low win-rate suggests the player might be the one that forces others to carry them at times. The number of friends added ($M = 52.24$, $SD = 72.31$) was collected as a proxy

Table 1. Intercorrelations among key variables.

		1	2	3	4	5
1.	Age					
2.	In-game competence	−.08**				
3.	In-game relatedness	−.05†	.17***			
4.	Perceived competence	.01	.16***	.11***		
5.	Perceived relatedness	−.01	−.10**	.12***	.26***	
6.	Well-being	.16***	−.06*	.01	.42***	.21***

Age is a dichotomized variable.
†$p < .10$, *$p < .05$, **$p < .01$, ***$p < .001$.

for in-game *relatedness*. Adding friends in the game is a prerequisite for many relationship building and maintenance activities, such as direct messaging and co-play. It also enables players to check the online status of their friends, thus providing a sense of social presence. The number of battles ($M = 18{,}080.57$, $SD = 15{,}339.22$) was used as a control variable in all the analyses as it is an indicator of a player's in-game experience and engagement. It is tightly related to a player's capacity to practice gaming skills and make in-game friends (see Table 1 for intercorrelations among key variables).

Analytic procedures

Two sensitivity analyses followed the main analyses to address potential problems regarding the age group classification and the low proportion of non-male subjects. The main analyses were conducted using multiple regression analyses with the dichotomous age group variable. The first sensitivity analysis replicated the process with age entered as a continuous variable. The second sensitivity analysis repeated the main analyses and the first sensitivity analysis after dropping non-male samples. Results did not change when dropping non-male samples.

Results

Competence

H1a–H1b predicted that older players would have lower win-rate than younger players but higher perceived competence than younger players. Controlling for the number of battles, the regression model (see Table 2) showed that the main effect of age on players' in-game competence was significant, $\beta = -.29$, $p < .001$. The main effect of age on perceived competence was not significant, $\beta = -.03$, $p = .309$. When age was entered as a continuous variable, the main effect of age on in-game competence was still significant in the predicted direction, $\beta = -.36$, $p < .001$. However, the main effect of age on perceived competence was negative and significant, $\beta = -.07$, $p = .019$. Therefore, *H1a* was supported and *H1b* was not supported.

Table 2. Results of multiple regressions on the in-game and perceived competence.

	In-game competence			Perceived competence		
	β	*B*	*SE*	β	*B*	*SE*
Predictor						
Age	−.29***	−.02***	.00	−.03	−.05	.05
Control variable						
Battle count	.32***	.00***	.00	.12***	.00***	.00
Total R^2			.13			.01

SE: standard error.
Age is a dichotomized variable.
***$p < .001$.

Table 3. Results of multiple regressions on the in-game and perceived relatedness.

	In-game relatedness			Perceived relatedness		
	β	*B*	*SE*	β	*B*	*SE*
Predictor						
Age	−.18***	−28.30***	4.23	−.01	−.03	.06
Control variable						
Battle count	.43***	.00***	.00	.01	.00	.00
Total R^2			.17			.00

SE: standard error.
Age is a dichotomized variable.
***$p < .001$.

Relatedness

H2a–H2b predicted that older players would show lower in-game relatedness but higher perceived relatedness than younger players. Controlling for battle count, the regression model (see Table 3) showed that the main effect of age on players' in-game relatedness was significant, $\beta = -.18$, $p < .001$. The main effect of age on perceived relatedness was not significant, $\beta = -.01$, $p = .665$. When entering age as a continuous variable, the results were consistent: the main effect of age on in-game relatedness was negative and significant, $\beta = -.23$, $p < .001$. The main effect of age on perceived relatedness was not significant, $\beta = -.01$, $p = .766$. Therefore, *H2a* was supported and *H2b* was not supported.

Perceived need satisfaction and psychological well-being

H3a–H3b predicted that perceived fulfillment of competence and relatedness are positively associated with psychological well-being. Controlling for battle count and income, the results of a multivariate regression analysis (see Table 4) showed that perceived competence ($\beta = .38$, $p < .001$) and relatedness ($\beta = .12$, $p < .001$) were positively associated with psychological well-being. Therefore, *H3a–H3b* were supported.

Table 4. Results of multiple regressions on psychological well-being.

	Psychological well-being		
	β	*B*	*SE*
Predictors			
Perceived competence	.38***	.34***	.03
Perceived relatedness	.12***	.09***	.02
Control variables			
Battle count	−.04	.00	.00
Income	.24***	.10***	.01
Total R^2			.25

SE: standard error.
Age is a dichotomized variable.
***$p < .001$.

Table 5. Results of multiple regressions of need satisfaction (competence) on psychological well-being.

	Psychological well-being		
	β	*B*	*SE*
Predictors			
Age	.46***	.71***	.19
In-game competence	−.19	−4.09	2.59
Perceived competence	.47	.42	.34
Interaction terms			
Perceived competence × age	−.44***	−.17***	.05
Perceived competence × in-game competence	.09	.16	.68
Control variables			
Battle count	−.02	.00	.00
Income	.23***	.09***	.01
Total R^2			.27

SE: standard error. Age is a dichotomized variable.
***$p < .001$.

RQ1 further asked how age and in-game behaviors moderate the relationship between each perceived need satisfaction and psychological well-being. For the perceived competence, the interaction between age and perceived competence was negative and significant, $\beta = -.44$, $p < .001$ (see Table 5). For younger players, a 1-point increase in the rating of perceived competence (scale range 1–5) was related to a .47 increase in the rating of well-being. For older players, a 1-point increase in the rating of perceived competence was related to a .02 increase in the rating of well-being. The interaction between in-game competence and perceived competence did not have a significant association with psychological well-being, $\beta = .09$, $p = .817$. Results were consistent when age was entered as

Table 6. Results of multiple regressions of need satisfaction (relatedness) on psychological well-being.

	Psychological well-being		
	β	*B*	*SE*
Predictors			
Age	.38***	.58***	.13
In-game relatedness	−.05	.00	.00
Perceived relatedness	.34***	.26***	.04
Interaction terms			
Perceived relatedness × age	−.34***	−.17***	.05
Perceived relatedness × in-game relatedness	.08	.00	.00
Control variables			
Battle count	−.03	.00	.00
Income	.23***	.09***	.01
Total R^2			.13

SE: standard error. Age is a dichotomized variable.
***$p < .001$.

a continuous variable. The interaction between age and perceived competence was negative and significant, β = –.12, $p = .012$. The interaction between in-game and perceived competence did not have a significant association with psychological well-being, β = .23, $p = .574$.

For the perceived satisfaction of relatedness, the interaction between age and perceived relatedness was negative and significant, β = –.34, $p < .001$ (see Table 6). For younger players, a 1-point increase in the rating of perceived relatedness (scale range 1–5) was related to a .34 increase in the rating of well-being. For older players, a 1-point increase in the rating of perceived relatedness was related to a .09 decrease in the rating of well-being. The interaction between in-game relatedness and perceived relatedness did not have a significant association with psychological well-being, β = .08, $p = .401$. Results were consistent when age was entered as a continuous variable. The interaction between age and perceived relatedness was negative and significant, β = –.14, $p = .014$. The interaction between in-game and perceived relatedness did not have a significant association with psychological well-being, β = .09, $p = .319$.

Discussion

Given the ongoing expansion of older players and the potential therapeutic effects of entertainment games, the study aimed to broaden the scholarly discussion on how gaming contributes (or does not) to players' need satisfaction and psychological well-being from a life-span perspective. To fill the gap between gaming and developmental research and provide more nuanced explanations, SDT was bridged with MTLSD and SST to predict and explain players' gaming motivations, experiences, and psychological well-being across age. Distinctively, this study directly compared players' *actual behaviors* in

a natural setting with their *perceived need satisfaction* by combining unobtrusive in-game behavioral data with psychometric survey data. The results provided support for SDT, as individuals' perceived satisfaction of the basic psychological needs is positively associated with psychological well-being across the lifespan, regardless of their in-game performance. Further decomposition of the interaction effects between age and perceived need satisfaction showed that the tie between perceived need satisfaction and well-being bear more weight for younger than older players.

This study provided novel findings regarding players' gaming behaviors, experiences, and well-being across age. For *competence*, results indicated that although older players performed significantly worse than younger players, the perceived satisfaction of competence did not differ between the two populations. According to MTLSD, older players can feel a sense of competence even without the existence of actual success due to their self-protective cognitive reappraisal of the objective performance. Although *H1b* was not supported, taken together, the results indeed indicated a disconnection of perceived need satisfaction and actual performance for older players. The internal negotiation of the meaning of success seemed to serve as a self-protection strategy that kept older players resilient in a competitive game that requires more cognitive and sensorimotor resources from older players. This also showed that, for older players, the actual win-rate in the game is not as important as it is for younger players. Older players' sense of competence may come from game affordances that make them *feel* effective, which might be effective communication and coordination among team members, making progress at their own pace, and so on. In addition, the divergence between in-game performance and perceived need satisfaction might be because older players fulfill in-game goals with the mind-set "I did my best." That is, their bar of feeling competent is lower than that of younger players. The different ingredients of feeling competent across age might provide some useful implications for game developers in terms of matchmaking between teams and within a team, or for marketers looking to appeal to their target age group through efficacious motivations.

For *relatedness*, although older players had significantly fewer in-game friends than younger players, their perceived satisfaction of relatedness did not differ from that of younger players. The disconnection of relationship quantity and quality for older players provided support for the main thesis of SST: as individuals feel more limited in time as they age, they will have different social motivations (Carstensen, 1998, 2006). Specifically, younger adults have a larger sense of future time, leading them to prioritize future-oriented goals, and thus are more likely to compose a social network from a broad range of candidates that might be useful for information gathering and networking (Lang and Carstensen, 2002). As individuals' future time becomes limited, they tend to prioritize present-oriented goals and prioritize relationship quality over quantity (Carstensen, 2006; Carstensen et al., 1999). By intentionally limiting the number of social ties, older adults prioritize close and rewarding social ties and limit distant, peripheral ties (Fung et al., 2001; Lang and Carstensen, 2002). Our results extend the application of SST in a video game setting by suggesting that the social ties of older players may carry more weight in predicting perceived relatedness in the game than those of younger players. Steinkuehler and Williams (2006) argued that online games provide "third places" that are well-suited for informal sociability and the formation of bridging social capital. We

add more nuance to this line of research by showing that while younger players tend to form and benefit from bridging social capital in the virtual world, older players are more likely to form and benefit from bonding social capital. This also suggests that the reduction of social network size might be adaptive as individuals age. Older adults are more likely to be satisfied with their current network size and do not actively try to increase it (Bruine de Bruin et al., 2020). It is also important to note a difference between sociability (social dimensions of the play experience) and social play (play with others) in games (Stenros et al., 2009). Our results indicate that older players may need different types of social play than younger players to derive a sense of sociability. Practically, these findings suggest that game features that support in-depth communication and relationship maintenance might help retain older players, while game features that encourage relationship formation might help keep younger players.

As SDT predicts, all the paths from perceived need satisfaction to *psychological well-being* were positive and significant. If players can get what they need in the game, they are more likely to have better well-being. Interestingly, the results showed that age moderated the relationship between perceived need satisfaction and well-being. Self-reported competence and relatedness positively contribute to psychological well-being for all players, yet it weighed more heavily for younger than older players. The reason might be that older players generally have better psychological well-being than their younger counterparts (e.g. Bowling, 2011). Their well-being is already at a higher level, posing a ceiling effect that makes it harder to vary. Moreover, from the perspective of MTLSD, the internal negotiation of loss and gains of older adults makes them more resilient at dealing with adverse life events. Research has shown that older adults are better at emotion regulation when responding to challenging situations (Charles and Carstensen, 2008). While SDT has been applied in gaming contexts, this study is the first, to our knowledge, that investigated how the association between perceived need satisfaction and well-being varies across age.

This study also advanced SDT. First, although SDT has informed game motivation research, with a few notable exceptions (see Johannes et al., 2021), most studies did not utilize in-game behavioral data as a reference to players' self-reported gaming experiences. Taking advantage of both types of data, we showed that the path from perceived need satisfaction to psychological well-being was not moderated by corresponding behaviors. We also extended the existing literature by explaining the consistency or discrepancy between perceived need satisfaction and actual behaviors. This is evidenced by our results for *competence*, for instance. The results showed that older players performed worse than younger players, yet they did not perceive themselves as less competent. This age difference on actual behaviors and perceptions added more nuance to SDT by examining it from a developmental lens. The marriage between SDT and two developmental theories, MTLSD and SST, is the first empirical effort to reflect the distinct age differences between objective outcomes and subjective interpretations. Future research should consider that individuals' actual behaviors do not necessarily translate into their perceptions and vice versa. More individual characteristics, such as age and gender, should be taken into account when studying gaming motivation and outcomes.

Practically, this study demonstrated the preventive and interventive potential of video games in improving older adults' health outcomes. In addition to improving older

people's cognitive and motive abilities, which are major benefits that previous studies have focused on (e.g. Fang et al., 2020), our results suggested that video games can be utilized to achieve further mental health gains: if the basic psychological needs are fulfilled in games, these games are likely to improve users' psychological well-being.

One limitation of the study is that the participants were predominantly male, and so the results cannot generalize across genders. This is in the end a study of only one game, and one played predominantly by men, and by perhaps a larger than average number of older men. Nevertheless, it is important to note that no single game is representative of all others. Other games may have different gender- and age-related differences. We encourage other researchers to replicate our approach for broader generalizability. In addition, the operationalizations of in-game SDT measures in this study are game-specific and may not reflect all dimensions in the original SDT constructs. Although this study took advantage of the logged behavioral data as proxies for key SDT concepts, the logged data present cumulative portraits of players' behaviors across their *WoT* career whereas self-reported measures represent players' current appraisal of their play experiences. For example, we used a composite number of friends as an indicator of in-game relatedness. However, other relationship maintenance behaviors, such as co-play, may better capture the nuance of relatedness. This study also initially attempted to operationalize in-game autonomy as the number of tanks a player has collected to provide a more comprehensive picture of how all the three key SDT elements unfold in game contexts. The rationale was that each tank has a different role in the team, thus having more tanks can expand what one can do, both feature- and role-wise. However, there are larger pieces missing from the operationalization. A better one should account for players' ability to play solo or with others, when and how they want, yet this drifts far enough into relatedness. Given the characteristics of this particular game setting, it is not feasible to look at play data to measure in-game autonomy. Instead of viewing logged and self-reported measures as two sides of the same coin, future research should keep their experiential differences in mind and explore how the two types of data may complement each other in meaningful ways. In addition, future research may consider in-depth qualitative methods to further explore older adults' psychological mechanisms in interpreting in-game performance and their perceived fulfillment of needs, especially the negotiation process through which older players interpret poor performance as satisfactory.

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References

Baard PP (2002) Intrinsic need satisfaction in organizations: a motivational basis of success in for-profit and not-for-profit settings. In: Deci EL and Ryan RM (eds) *Handbook of Self-Determination Research*. Rochester, NY: University Rochester Press, pp. 255–275.

Bartle RA (2004) *Designing Virtual Worlds*. Indianapolis, IN: New Riders.

Birk MV, Friehs MA and Mandryk RL (2017, October) Age-based preferences and player experience: a crowdsourced cross-sectional study. In: *Proceedings of the Annual Symposium on Computer-Human Interaction in Play*. pp. 157–170. https://doi.org/10.1145/3116595.3116608

Boletsis C and McCallum (2016) Smartkuber: a serious game for cognitive health screening of elderly players. *Games for Health Journal* 5(4): 241–251.

Bostan B (2009) Player motivations: a psychological perspective. *Computers in Entertainment (CIE)* 7(2): 1–26.

Bowling A (2011) Do older and younger people differ in their reported well-being? A national survey of adults in Britain. *Family Practice* 28(2): 145–155.

Brown J (2015) Establishing a theory for senior digital gaming. *Gerontologist* 55: 391.

Brown JA and De Schutter B (2016) Game design for older adults: lessons from a life course perspective. *International Journal of Gaming and Computer-Mediated Simulations (IJGCMS)* 8(1): 1–12.

Bruine de Bruin W, Parker AM and Strough J (2020) Age differences in reported social networks and well-being. *Psychology and Aging* 35(2): 159–168.

Carstensen LL (1998) A life-span approach to social motivation. In: Heckhausen J and Dweck CS (eds) *Motivation and Self-regulation across the Life Span*. Cambridge: Cambridge University Press, pp. 341–364.

Carstensen LL (2006) The influence of a sense of time on human development. *Science* 312(5782): 1913–1915.

Carstensen LL, Isaacowitz DM and Charles ST (1999) Taking time seriously: a theory of socioemotional selectivity. *American Psychologist* 54(3): 165–181.

Charles ST and Carstensen LL (2008) Unpleasant situations elicit different emotional responses in younger and older adults. *Psychology and Aging* 23(3): 495–504.

Coleman JS (1988) Social capital in the creation of human capital. *American Journal of Sociology* 94: S95–S120.

De Schutter B (2011) Never too old to play: the appeal of digital games to an older audience. *Games and Culture* 6(2): 155–170.

De Schutter B and Malliet S (2014) The older player of digital games: a classification based on perceived need satisfaction. *Communications* 39(1): 67–87.

Deci EL and Ryan RM (2000) The" what" and" why" of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry* 11(4): 227–268.

Deci EL and Ryan RM (2004) *Handbook of Self-determination Research*. Rochester, NY: University Rochester Press.

Diener E, Wirtz D, Biswas-Diener R, et al. (2009) New measures of well-being. In: Diener E (ed.) *Assessing Well-Being*. Dordrecht: Springer, pp. 247–266.

Entertainment Software Association (2020) 2019 essential facts about the computer and video game industry. Available at: https://www.theesa.com/wp-content/uploads/2019/05/ESA_Essential_facts_2019_final.pdf (accessed 25 July 2019).

Fang Q, Ghanouni P, Anderson SE, et al. (2020) Effects of exergaming on balance of healthy older adults: a systematic review and meta-analysis of randomized controlled trials. *Games for Health Journal* 9(1): 11–23.

Fischer R and Boer D (2011) What is more important for national well-being: money or autonomy? A meta-analysis of well-being, burnout, and anxiety across 63 societies. *Journal of Personality and Social Psychology* 101(1): 164–184.

Fung HH, Carstensen LL and Lang FR (2001) Age-related patterns in social networks among European Americans and African Americans: implications for socioemotional selectivity across the life span. *The International Journal of Aging and Human Development* 52(3): 185–206.

Gajadhar BJ, Nap HH, De Kort YA, et al. (2010) Out of sight, out of mind: co-player effects on seniors' player experience. In: *Proceedings of the 3rd international conference on fun and games*, Leuven, 15–17 September, pp. 74–83. New York: ACM.

Gamberini L, Alcaniz M, Barresi G, et al. (2008) Playing for a real bonus: videogames to empower elderly people. *Journal of Cybertherapy & Rehabilitation* 1(1): 37–48.

Geldhof GJ, Fenn ML and Finders JK (2017) A self-determination perspective on self-regulation across the life span. In: Wehmeyer ML, Shorgen KA, Littlt TD, et al. (eds) *Development of Self-Determination through the Life-Course*. Dordrecht: Springer, pp. 221–235.

Global Web Index (2021) Digital trends report 2021. Available at: https://www.gwi.com/reports/the-gaming-playbook (accessed 28 July 2021).

Granovetter MS (1973) The strength of weak ties. *American Journal of Sociology* 78(6): 1360–1380.

Greenberg BS, Sherry J, Lachlan K, et al. (2010) Orientations to video games among gender and age groups. *Simulation & Gaming* 41(2): 238–259.

Heckhausen J and Heckhausen H (2008) *Motivation and Action* (Vol. 22). New York: Cambridge University Press.

Heckhausen J, Wrosch C and Schulz R (2010) A motivational theory of life-span development. *Psychological Review* 117(1): 32–60.

Johannes N, Vuorre M and Przybylski AK (2021) Video game play is positively correlated with well-being. *Royal Society Open Science* 8(2): 1–14.

La Guardia JG, Ryan RM, Couchman CE, et al. (2000) Basic psychological needs scales. *Journal of Personality and Social Psychology* 79: 367–384.

Lang FR and Carstensen LL (2002) Time counts: future time perspective, goals, and social relationships. *Psychology and Aging* 17(1): 125–139.

Lee S, Oh H, Shi CK, et al. (2021a) Mobile game design guide to improve gaming experience for the middle-aged and older adult population: user-centered design approach. *JMIR Serious Games* 9(2): e24449.

Lee S, Shi CK and Doh YY (2021b) The relationship between co-playing and socioemotional status among older-adult game players. *Entertainment Computing* 38: 100414.

Lim KTK and Yu R (2015) Aging and wisdom: Age-related changes in economic and social decision making. *Frontiers in Aging Neuroscience* 7: 120–131.

Moon J, Hossain MD, Sanders GL, et al. (2013) Player commitment to massively multiplayer online role-playing games (MMORPGs): an integrated model. *International Journal of Electronic Commerce* 17(4): 7–38.

Nap HH, De Kort YAW and IJsselsteijn WA (2009) Senior gamers: preferences, motivations and needs. *Gerontechnology* 8(4): 247–262.

Nelson- Kakulla B (2019) *Gaming Trends of the 50+*. Washington, DC: AARP Research.
Osmanovic S and Pecchioni L (2016) Beyond entertainment: motivations and outcomes of video game playing by older adults and their younger family members. *Games and Culture* 11(1–2): 130–149.
Paaßen B, Morgenroth T and Stratemeyer M (2017) What is a true gamer? The male gamer stereotype and the marginalization of women in video game culture. *Sex Roles* 76(7): 421–435.
Peng W, Lin JH, Pfeiffer KA, et al. (2012) Need satisfaction supportive game features as motivational determinants: an experimental study of a self-determination theory guided exergame. *Media Psychology* 15(2): 175–196.
Petry NM (2002) A comparison of young middle-aged older adult treatment-seeking pathological gamblers. *Gerontologist* 42(1): 92–99.
Przybylski AK, Deci EL, Rigby CS, et al. (2014) Competence-impeding electronic games and players' aggressive feelings, thoughts, and behaviors. *Journal of Personality and Social Psychology* 106(3): 441–457.
Putnam RD (2000) Bowling alone: America's declining social capital. In: Crothers L and Lockhart C (eds) *Culture and Politics*. New York: Palgrave Macmillan, pp. 223–234.
Quantic Foundry (2016) Revisiting the strategy genre map: age, audience homogeneity, and the Lasso effect. Available at: https://quanticfoundry.com/2016/03/23/revisiting-the-strategy-genre-map/ (accessed 25 July 2019).
Reer F and Krämer NC (2018) Psychological need satisfaction and well-being in first-person shooter clans: investigating underlying factors. *Computers in Human Behavior* 84: 383–391.
Rieger D, Wulf T, Kneer J, et al. (2014) The winner takes it all: the effect of in-game success and need satisfaction on mood repair and enjoyment. *Computers in Human Behavior* 39: 281–286.
Ryan RM and Deci EL (2000a) Intrinsic and extrinsic motivations: classic definitions and new directions. *Contemporary Educational Psychology* 25(1): 54–67.
Ryan RM and Deci EL (2000b) Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist* 55(1): 68–78.
Ryan RM, Rigby CS and Przybylski A (2006) The motivational pull of video games: a self-determination theory approach. *Motivation and Emotion* 30(4): 344–360.
Sayago S, Rosales A, Righi V, et al. (2019) Digital games and older people from a theoretical and conceptual perspective: a critical literature review. In: Neves BB and Vetere F (eds) *Ageing and Digital Technology*. Singapore: Springer, pp. 83–96.
Shen C, Sun Q, Kim T, et al. (2020) Viral vitriol: Predictors and contagion of online toxicity in World of Tanks. *Computers in Human Behavior* 108: 106343. https://doi.org/10.1016/j.chb.2020.106343
Statista (2019) Distribution of U.S. League of Legends fans 2018, by age. Available at: https://www.statista.com/statistics/1018224/league-of-legends-fans-by-age-usa/ (accessed 6 January 2021).
Steinkuehler CA and Williams D (2006) Where everybody knows your (screen) name: online games as "third places." *Journal of Computer-Mediated Communication* 11(4): 885–909.
Stenros J, Paavilainen J and Mäyrä F (2009) The many faces of sociability and social play in games. In: *Proceedings of the 13th international MindTrek conference: Everyday life in the ubiquitous era*, Tampere, 30 September–2 October, pp. 82–89. New York: ACM.
Subramanian S, Dahl Y, Skjæret Maroni N, et al. (2020) Assessing motivational differences between young and older adults when playing an exergame. *Games for Health Journal* 9(1): 24–30.
Takahashi D (2013) Sims creator Will Wright: next consoles can become "connective tissue" between games & entertainment. Available at: https://venturebeat.com/2013/05/08/sims-cre-

ator-will-wright-says-next-game-consoles-can-become-connective-tissue-between-games-and-entertainment/ (accessed 6 January 2021).
Takahashi D (2020) How Wargaming enlisted 160 million World of Tanks players over a decade. Available at: https://venturebeat.com/2020/08/15/how-wargaming-racked-up-200-million-players-over-a-decade-of-world-of-tanks/ (accessed 6 January 2021).
Tian L, Chen H and Huebner ES (2014) The longitudinal relationships between basic psychological needs satisfaction at school and school-related subjective well-being in adolescents. *Social Indicators Research* 119(1): 353–372.
Uzman E (2014) Basic psychological needs and psychological health in teacher candidates. *Procedia-Social and Behavioral Sciences* 116: 3629–3635.
Williams D (2006) On and off the net: scales for social capital in an online era. *Journal of Computer-Mediated Communication* 11(2): 593–628.
Wu H and Guo C (2020) The older gamer in games studies: marginalised or idealised? *Cultural Science Journal* 12: 23–35.
Wulf T, Bowman ND, Velez JA, et al. (2020) Once upon a game: exploring video game nostalgia and its impact on well-being. *Psychology of Popular Media* 9(1): 83–95.
Zhang F and Kaufman D (2015) The impacts of social interactions in MMORPGs on older adults' social capital. *Computers in Human Behavior* 51: 495–503.

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