Supplementary Information 1: Gaming Glossary

Note: many modern video games combine multiple genres. For example, Fortnite is a third-person shooter, a strategy game and a battle royale. These definitions were not intended to be part of the research rather to assist the reader who may not be familiar with gaming genres.

Genre	Description	Examples
Fighting	Players fight against one another or a computer character using hand-to-hand techniques such as boxing or mixed martial arts.	Tekken, Street Fighter, Super Smash Bros
First-Person	Players take an avatar's perspective and can use a variety of handheld items including weapons, paint guns, etc. to achieve goals.	Overwatch, Splatoons, Call of Duty
Hidden Object Game	A form of Point and Click game where players locate items in a busy environment, similar to 'Where's Wally?' books.	Mystery Case Files
MMORPG	Massively multiplayer online role-playing game (MMORPG) is a subgenre of role-playing video games in which a large number of players interact within a virtual game world.	World of Warcraft
MOBA	Multiplayer online battle arena. MOBAs are a fusion of action games, role-playing games and real-time strategy games. Players control a single character in a team who compete versus another team of players, usually to destroy the opponent's base.	League of Legends
Mobile / Casual	Games played on a mobile device such as an iPhone. Can be played for short periods of time.	Angry Birds, Plants vs Zombies, Candy Crush
Music Game	The player uses either a traditional controller or a controller designed like a guitar, drumkit, or microphone to match the rhythm or melody of songs.	Rock Band, Guitar Hero
Point and Click	The player uses a cursor to interact with a flat environment, usually to solve puzzles and experience a story.	Monkey Island
Puzzle - Action	A game where the player uses a first-person or third-person avatar within a virtual world to solve puzzles.	Portal
Puzzle - Other	A puzzle game where the player does not use an avatar.	Tetris
Role-Playing Game	Players assume the roles of characters in a fictional setting. They interact with characters, complete quests and experience a rich narrative.	Final Fantasy, Mass Effect
Simulation - CMS	Construction and management simulation (CMS) is a type of simulation game in which players build, expand or manage fictional communities or projects with limited resources.	Theme Park, Theme Hospital
Strategy - 4X	4X (abbreviation of explore, expand, exploit, and exterminate) is a genre of strategy-based video and board games in which players control an empire . Similar to the board game, 'Risk'.	Civilization

Survival Horror	Survival horror is a subgenre of video games inspired by horror fiction that focuses on survival of the character as the game tries to frighten players with either horror graphics or scary ambience. There may or may not be combat.	Resident Evil
Text Adventure	All instructions are written and the game is interacted with through text prompts.	Zork
Third-Person	Players take the perspective from behind the character as though looking through a camera. There may or may not be combat.	Gears of War, Uncharted, Fortnite
Vehicle Sim	A game which simulates driving a vehicle.	Train Simulator

Supplementary information 2: Different psychological mechanisms by genre

1. RPGs (e.g. Final Fantasy)

An RPG involves the player immersing themselves in a rich narrative world. They control one or more avatars on a quest throughout a variety of environments, interacting with scripted non-playable characters and completing activities to progress through the story. RPGs are often long and densely written experiences, a typical example taking 20–50 hours to complete and involving complex themes such as morality, existentialism, romance, vulnerability, family, mortality, and many more.

The gameplay itself usually involves a combination of world exploration and combat, which may be turn-based (thus requiring strategic planning), or real-time combat where the player must master dexterity and hone physical skills to succeed. Throughout the game, the player learns an enormous amount about the people and the world they live in – *Mass Effect 2*, for example, contains 450,000 words, which is roughly the same amount as the entire Lord of the Rings trilogy. As a result, these games are emotionally evocative and psychologically engaging as well as immersive and physically challenging.

RPGs were the most played genre across all demographics in this study, and also the genre most respondents identified as being psychologically beneficial. Controlling for all other variables, respondents who played RPGs scored significantly higher in autonomy and relatedness questions. Respondents who believed that RPGs were psychologically beneficial scored higher in their emotional wellbeing, psychological wellbeing, flow state, autonomy and relatedness than those who did not. This implies that there may an inherent benefit to playing RPGs, but also an additional benefit if you are playing with the belief that the RPG is helping you. Female respondents were most

likely to believe that RPGs have a benefit, and therefore may be the demographic that derives most impact from this genre.

Autonomy

RPGs are often not very linear and allow a player to explore the world at their own pace, interact with whomever they wish, and, in some games, even make decisions that affect the plot. As a result, there is a high degree of freedom granted, and the player is rewarded for pursuing their own interests in the form of side quests.

Relatedness

Interestingly, RPGs were correlated with higher relatedness but not social wellbeing. An explanation for this is in the depth of the characters development and narrative design. The social wellbeing questions all revolved around family, friends and community; whilst relatedness gave more breadth to explore feeling connected to in game characters, "belonging", and feeling connected to the gaming community. Whilst the RPGs specified in this section are single player experiences, the characters in game are usually incredibly well developed, interesting and relatable. The player may feel connected to the characters, similar to the reader of a book feeling connected to its protagonist; or they may use the realism of the characters to explore their own relationships with others - a testing ground for reality. RPGs in their breadth of narrative can be likened to a novel, and indeed literature focusing on traditional fiction have several explanations for this benefit. Readers of fiction have higher empathy and better theory of mind and exposure to fiction is correlated with social support[1].

Emotional and psychological wellbeing

The emotional wellbeing variable included questions about player happiness, optimism, contentedness, relaxation and stress reduction. The psychological wellbeing variable instead focussed on creativity, self-confidence, self-acceptance, and vitality. There may be a few potential mechanisms within the act of playing an RPG that achieve these benefits. For example, focussing on the analogy of traditional fiction, it has been shown that underdog narratives can improve hope and motivation for the reader[2]. In RPGs, work has been done to explore the outcomes of increased character attachment – that is, the merging of the player and character's minds and the internalisation of the character within the player. Character attachment has been shown to have a relationship with player self-esteem and enjoyment[3]. In contrast to a novel, where the reader is a passive observer, the act of physically controlling the character avatar helps the player to identify with that persona, and indeed to project onto them. This may be desirable parts of the self, or those impulses and urges which are unacceptable, or a combination of both[4]. Both processes can be inherently rewarding and motivating, allowing the player to explore their identity and moral compass in a safe space and alleviate cognitive dissonance, whilst providing opportunity to achieve self-actualisation through the character's journey[4].

2. Survival horror (e.g. Resident Evil)

A survival horror game combines elements from other traditional game genres, including action and puzzle games, whilst evoking the suspense and dread inspired by psychological horror in other mediums, such as film. This sense of tension can be provoked using environmental storytelling such as manipulating the lighting and sound design, use of macabre scenery and enemies, and limiting in-game resources and therefore the sense of stability and control that the player is used to experiencing(5). Our results displayed that Survival Horror game players had higher scores for their emotional wellbeing, competence and relatedness. Male and non-binary respondents were most likely to both play survival horror games, and to perceive benefit in them.

Competence

A sense of competence is achieved when the challenge is significant but achievable, and the reward proportional to the difficulty of the challenge. Horror games often impose challenges that are higher than the player's competence at that stage in the game to increase fear and anxiety(5). The nature of the environment also forces the player to regulate strong emotional responses and remain measured in order to progress, utilising both emotion-focused and problem-focused coping strategies(6). It is possible that the combination of requiring intense emotional regulation as well as overcoming a significant physical challenge ultimately leads to a higher feeling of competence, greater reward, and higher affective benefit.

Emotional wellbeing

Data has shown that horror movie attendance increases during times of social anxiety, such as the Depression(7). The working theory behind this is that people use the intense fear incited by a horror film as a way of channelling and coping with their own anxiety(7). It stands to reason, given the immersion of a video game that this process would be transferable on an individual level – that players may be using scary games to cope with stress and anxiety in their everyday life. But how might this process occur?

The benefits of survival horror may begin with the mere act of fearful play. Play involving a predator-prey relationship, chase or otherwise being stalked or hunted is thought to be inherently rewarding to us from an evolutionary point of view. The more this is practised in a safe and risk-free environment, the greater the chances of survival when facing a genuine threat(8).

Going deeper, we can consider models of affective response in the player. Zillman proposed that suspenseful drama arouses empathic distress in the viewer - and the strength of this emotional response is carried over to the final resolution, providing a more intense ultimate experience (excitation-transfer theory(9)). Survival horror game designers will often add in specific mechanics which increase suspense, such as early warning signals to the player(5). This suspense causes intense

emotional arousal, which is then followed by a challenge to overcome in the form of an enemy fight or puzzle. Zillman's excitation transfer-theory would then suggest that the reward from completing this challenge is proportional to the suspense prior to it – and therefore a more powerful experience than games which do not have the suspenseful environment(5).

3. Music games (e.g. Beat Saber)

Music games involve coordinated responses to a beat or musical prompt. Commonly this is to "play along" with a song using a peripheral device such as a controller shaped like a guitar or other instrument. The player must combine executive function, reflexes and coordination, intense concentration, and muscle memory. These games can also be quite theatrical and may cross the line into exergames. Music games have been able to decrease depression, stress anxiety and anger in substance use rehabilitation(10), as well as enhancing social cohesion, group identity and positive self-concept in the elderly(11) and improving self-esteem and social relationship skills(12).

In this study, respondents who play music games were more likely to rate higher in emotional, psychological and social wellbeing, and flow than those who did not play music games. These effect sizes are smaller than others discussed thus far. There was no gender difference observed.

What is interesting is that music games were associated with higher levels of wellbeing across all of its component domains. Social wellbeing could be explained by music games regularly being a cooperative activity undertaken with friends. As for psychological and emotional wellbeing, it may be that the unique combination of sensory modalities – requiring the player to listen to and appreciate the music – enhances the joy of the experience as well as directly impacting sense of creativity. Another hypothesis is that the short level duration (2.5 minute average), immediacy of feedback and relatively low penalty for fault lends to greater relaxation and stress relief. This would be an interesting area for further study.

4. MOBA (e.g. League of Legends)

Interestingly, respondents who believed that MOBAs had a psychological benefit scored significantly lower on their emotional wellbeing and psychological wellbeing domains. Men were both the most likely to play the MOBA genre, and along with non-binary respondents, most likely to perceive a benefit from the genre.

In MOBA games the player must manage resources and infrastructure within a game world in real time. Generally, this process is quite intense, complex and requires high-paced thinking skills and flexibility. The nature of the genre is that lots of players work together and against each other in teams, simultaneously contributing.

However, MOBA games are renowned for their toxic player interactions such that studies have developed a "toxicity index" to quantify this(13), with it being estimated that toxic behaviour appears in 60% of all game matches(14). There are even types of toxic behaviour that have their own

terms, such as "griefing", the act of deliberately hassling another player with no in-game benefit to either party(15). When targeting one individual, toxicity and griefing can be seen as a form of cyber-bullying. Being affected by this sort of behaviour is one explanatory model for the reduction of wellbeing scores observed.

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