



# First Insights into Applying the Game Transfer Phenomena Framework for Positive Means

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**Abstract.** Gamers have reported that their gaming experiences are pervasive and manifest even when they are not playing, re-experiencing sensorial perceptions (e.g., seeing images, hearing sounds, voices, tactile sensations), automatic responses toward game-related cues, urges to performed activities as in the game, etc. This paper proposes applying the Game Transfer Phenomena (GTP) framework and what has been learned on GTP for: (i) strengthening interventions using virtual technologies, (ii) developing or enhancing pedagogic tools for intrusions in mental disorders, and (iii) understanding underlying symptoms of psychiatric and neurological conditions, including gaming addiction or Internet Gaming Disorder. Can we apply the GTP mechanisms to develop virtual applications for positive means such as learning skills, modifying interpretation of stimuli, changing dysfunctional habits, etc.? This paper overviews GTP (e.g., GTP types and characteristics), introduces the GTP framework, outlines core factors relevant for GTP, GTP mechanisms, and game contents commonly transferred, and discusses potential applications of GTP.

**Keywords:** Game Transfer Phenomena · GTP · Video games effects  
Virtual reality side-effects · Virtual interventions · Mental disorders  
Involuntary phenomena · Mental health

## 1 Introduction

Playing video games is considered either an enhancer of life experiences, training for cognitive skills, and a tool for promoting positive means (e.g., rehabilitation, psychopedagogic tool), or as an entertainment activity of concern (e.g., excessive use, gaming disorder, consumption of controversial contents) [1, 2].

In research on Game Transfer Phenomena (GTP), gamers have reported that game experiences are pervasive in their life, and manifest even when they are not playing. Examples include: (i) re-experiencing sensorial perceptions (e.g., seeing images, hearing sounds, voices, tactile sensations), (ii) automatic responses toward game-related cues (e.g., objects, environments), (iii) keep replaying the game using real-life

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objects or in real-life sceneries, and (iv) change of behaviors due to video game experiences, etc.

Instead of focusing on the challenges GTP may represent to certain individuals due to the intrusive, spontaneous manner and the circumstances in which some of the GTP are experienced – usually in diurnal contexts when doing automatic activities, including driving – this paper aims to propose the GTP framework, and what has been learned on GTP for (i) strengthening interventions using virtual technologies, (ii) developing or enhancing pedagogic tools for intrusions in mental disorders, and (iii) understanding underlying symptoms of medical conditions (psychological and neurological disorders), including gaming addiction or Internet Gaming Disorder as labelled in the current edition of the DSM (DSM-5) [3].

More specifically, this paper posits the following questions: (i) Can we apply the GTP mechanisms to develop virtual applications for positive means, such as learning skills, modifying interpretation of stimuli, changing dysfunctional habits, etc.? (ii) Can we use the intrusiveness of GTP with neutral or positive content to interfere, distract and reduce unwanted and distressful intrusions such as intrusive thoughts and imagery? The paper is divided into: (i) video game mechanisms, (ii) core factors relevant for GTP, (iii) overview of GTP (e.g., types, characteristics), and (iv) mechanisms of GTP. The paper ends by discussing some of the potential applications of GTP.

## 1.1 Video Games and Game Mechanisms

Video games are designed as sequences of repetitive events; they have rules, goals, involve progression (e.g., levels), opponents (e.g., competition), and provide scheduled psychological reinforcement and punishment (e.g., rewards, prizes) when goals are accomplished or failed [4]. Moreover, video games pair in-game events with sensory cues with specific meanings of a rewarding or punishing nature which require a response that unchains events [5].

## 1.2 Core Game Characteristics and In-Game Phenomena Relevant for GTP

GTP appears to be facilitated or enhanced by the practice of repetitive in-game behaviours, prolonged exposure to sensory cues including the repetitive manipulation of game controls, as well as by realism or simulations of physical stimuli, embodiment, and trance states while playing (e.g., immersion in the game) [5–7].

Four core elements related to the video games' structural characteristics and in-game phenomena (e.g., immersion, telepresence) have been proposed as elements that facilitate GTP (see Ortiz de Gortari & Griffiths, 2017, for details on the modalities and types of GTP associated with each of the factors). These are as follows:

**Sensory perceptual stimulation** – interaction, usually for prolonged periods of time, with repetitive and sometimes stereotypical synthetic sensorial stimuli.

**High cognitive load** – interactive and demanding activity that requires processing a large variety of sensorial stimuli simultaneously and in a short period of time, involving executive functions, perceptual and motoric skills at play.

**Dissociative states** – involved in normative dissociative phenomena (i.e., a form of non-pathological dissociation that takes place in recreational activities [8]) such as losing track of time, states of flow, immersion, and sometimes sense of presence and embodiment.

**High emotional engagement** – rewarding and amusing activity which tends to lead to modification of mood states and physiological responses (e.g., arousal) directly related to in-game events and the gamer's performance in the video game.

## 2 Overview of GTP

This section includes: (i) GTP definition, types and modalities, (ii) GTP framework, and (iii) main characteristics of GTP (e.g., duration, manifestation, video games and in-game activities associated with GTP).

### 2.1 Defining GTP and the GTP Framework

GTP is defined as the transfer of experiences from the virtual to the physical world that can manifest as sensorial perceptions, sensations, automatic mental processes, behaviors and actions with video game content.

**Altered sensorial perceptions** comprise perceptions and/or sensations in all sensorial channels, cross-sensory or multisensory.

**Automatic mental processes** comprise thoughts, urges and automatic mental actions.

**Behaviors and actions** comprise a variety of trivial actions to more elaborated behaviors, making distinctions between: (i) *intentional behaviors*; these are deliberately initiated by gamers such as modelling game movements or game characters for amusement, making jokes or using slang to communicate with others, and (ii) *automatic behaviors*, which occur spontaneously and without control under episodic lapses of lack of awareness, usually triggered by game-related cues (Fig. 1).

To explain the interplay of physiological, perceptual, and cognitive mechanisms involved in GTP, a theoretically eclectic approach is used, sustained mainly on socio-cognitive and behavioral theories (e.g., pavlovian conditioning, schema theory, social cognitive theory) based on the premise that our previous experiences influence, at least temporarily and to a variety of degrees, the way we perceive, interpret and respond to the world around us [14].

The GTP framework proposed by de Gortari [14] is not limited to video game contents, game platform, online/offline, excessive playing, dysfunctional or pathological gaming. The GTP framework combines the research fields of video game effects and involuntary phenomena (i.e., sensorial, cognitive or motoric intrusions that arise without premeditation or intention, awareness and control). The GTP framework focuses on examining the relation between structural characteristics of the video games, in-game phenomena (e.g., immersion, trance state, embodiment), and the use of hardware and peripherals, which can influence gamers' sensory perceptions, cognitions and behaviors beyond the game.

In the research on GTP it is very important to make a clear distinction between inner or endogenous experiences from outer or exogenous experiences (e.g., visualizing images vs seeing images in front of the eyes, hearing sounds in the head vs hearing sounds coming from objects associated with the game), as well as to establish the difference between volitional and non-volitional phenomena (e.g., intentional use of slang from a video game vs involuntary verbal outbursts) because it is believed that the psychosocial effects of video games depend on the form and conditions of how GTP manifests [5, 9].

	Altered visual perceptions	Altered auditory perceptions	Altered body perceptions and others	Automatic mental processes	Behaviours& actions
Main Types of GTP per modality	<ul style="list-style-type: none"> <li>-Mind visualizations/ imagery</li> <li>-Seeing images (closed/open eyes)</li> <li>-Distortions of environments or objects (e.g., shape, color)</li> <li>-Visual misperceptions or confusions of objects.</li> </ul>	<ul style="list-style-type: none"> <li>-Re-plays of music, sounds or voices</li> <li>-Internal monologues</li> <li>-Thoughts voiced out loud</li> <li>-Distortions of sound (e.g., tempo, pitch)</li> <li>-Auditory misperceptions.</li> </ul>	<ul style="list-style-type: none"> <li>-Tactile sensations</li> <li>-Body sensations of self-motion</li> <li>-Involuntary movements of limbs</li> <li>-Uncoordinated movements</li> <li>-Stereotypical body movements</li> <li>-Out of body experiences</li> <li>-Chronoceptive distortions.</li> </ul>	<ul style="list-style-type: none"> <li>- Wanting to use game elements</li> <li>- Still in the mind set of the game: Evaluations based on game logic, irrational expectations, automatic replays of the game, selective attention</li> <li>-Urges to do something as in the game.</li> </ul>	<ul style="list-style-type: none"> <li>-Changes of behaviour</li> <li>-Behaviours influenced by the game</li> <li>-Slips of action/oral slips (e.g., verbal outburst)</li> <li>-Involuntary motoric activations</li> <li>-Activities inspired by the game.</li> </ul>
Most prevalent types of GTP	<ul style="list-style-type: none"> <li>Visualized/seen images w closed eyes.</li> </ul>	<ul style="list-style-type: none"> <li>Re-plays of music from a game.</li> </ul>	<ul style="list-style-type: none"> <li>- Body sensations of self-motion</li> <li>-Tactile sensations.</li> </ul>	<ul style="list-style-type: none"> <li>-Wanting to use game elements in real life</li> <li>-Urges to do something in real life triggered by a game-related cue</li> <li>-Still in the mind set of the game.</li> </ul>	<ul style="list-style-type: none"> <li>Unintentionally sang, shouted or said something with video game contents.</li> </ul>

Fig. 1. GTP modalities, types and most prevalent GTP based on three different samples [10–12]

## 2.2 Characteristics of GTP

**Time of manifestation** – GTP usually tends to occur hours after or directly after playing, but can also occur within days or later on.

**Duration** – usually lasts for short periods of time – seconds or minutes – but some gamers have reported effects that last for hours, days and even longer. Some GTP has been reported while playing, although this seems more common with location-based augmented reality games [7]. The duration mainly varies according to the type of modality of GTP. Sensorial experiences (seeing or hearing elements from the game) can last for prolonged periods of time, while thoughts and behaviours usually occur episodically or recurrently.

**Circumstances** – GTP seems more common in diurnal contexts rather than nocturnal (i.e., lying in bed or trying to sleep), when gamers are doing everyday chores or automatic activities. Thoughts and behaviours usually are triggered by game-related cues or by the resemblance between physical world stimuli and the game, while sensory experiences are less likely to be triggered by associations, but they can also arise from a trigger (e.g., seeing menus during a conversation, seeing a map while searching for an address, seeing power bars above people’s heads).

**Types of games** – GTP has been reported in a large variety of video game genres and platforms, including localisation-based augmented reality games such as *Pokémon Go* [7]. Gamers who reported severe levels of GTP (i.e., experiencing several types of GTP and very frequently) were more likely to report GTP when playing MMORPG, simulation games, adventure games, first-person shooter games, puzzle games, music and dance games and role-playing games, compared to those with moderate or mild levels of GTP.

**In-game activities** – activities that imply focusing the attention in the game world rather than those related to socialising while playing. These include: i) *exploring* which implies getting immersed in the game activity by discovering, searching, collecting items, paying attention to particular elements and engaging in repetitive activities such as smashing items, approaching corners, etc., and ii) *customising* which requires focusing on appearance, accessorising characters, vehicles and creatively personalising characters by engaging in the repetitive manipulation of game menus.

### 3 Mechanisms of GTP

Various mechanisms of GTP have been identified which can be useful to have in mind for applying GTP. The most important ones are:

**Everyday contexts** – GTP is usually experienced in everyday contexts. More common in diurnal contexts rather than nocturnal.

**Automatic transfers** – GTP is experienced automatically, spontaneously, without awareness and without control.

**Preserved contents** – the contents from the game are transferred with a high degree of similitude.

**Bizarre contents** – illogical or bizarre contents that raise awareness.

**Triggered by associations** – associations between physical stimuli that have been simulated in the game or that resemble those in the game, and video game elements; in general, affordances found in real-life contexts that facilitate associations and allow executions of video game-related activities or actions.

**Repeated and recurrent** – contents are repeated automatically, sometimes even in an intrusive manner.

**Practiced routinely** – once game content appears automatically, behaviors can be adopted and become habitual, sometimes in a playful way. Some practice them even in a compulsive manner.

**Modification of processes** – at least temporary changes in cognition (e.g., interpretations of physical stimuli associated with the virtual experience), perceptions (e.g., perceiving physical stimuli with different characteristics – color, shape, velocity) and behavior (e.g., change of behavior toward game-related cues-approach, avoid, etc.) (Fig. 2).

	Altered visual perceptions	Altered auditory perceptions	Altered body perceptions	Automatic mental processes	Behaviours & actions
Examples of game elements transferred	Feedback features/Game accessories: maps, Power bars, HUD, menus, Cross hairs Special visual effects (change in color, slow motion, etc.) Stereotypical images.	Background music Percussive, binaural sounds Sounds of lasers, bullets, explosions Beeps, rings, coins steps, vehicles Voices, screams Whispers.	Slow motion, high velocity, feeling as if flying, bouncing, etc. Embodying big/small characters Pushing buttons, haptic control.	Game strategies Game mechanisms Activities: Tracking objects, searching, exploring, climbing, jumping, running, hiding, driving, arranging, counting steps.	Mimicking body positions, walking style, using game slang Activities: picking, hiding, exploring, jumping, walking, running, hunting, flying.
GTP examples	"I get different answering options as a picture in my head from Dragon Age. My sister insulted me, and I thought "What am I going to answer?" Right back at you!" "I see it as options in my head... the game triggered it ... I feel organized" "Every time I talk to someone, the 'Mass Effect' conversation wheel comes up at the bottom of my vision"	"Every time someone welcomes me, no matter the phrase I hear 'Wind' from Castlevania: Portrait of Ruin in my head saying 'you are back'" "After years of playing Outrun whenever I drive under a sign on the road, I hear in my head 'CHECKPOINT!'"	"Our subway system often announces stops and service, and I swear it feels as if I'm Gordon Freeman going into work every morning" "feel' the constant movement of an arena fight...I had done the whole damn arena list before bed. I can liken this to feeling the waves at the beach after you get home"	"Overwhelming urge to shoot at CCTV cameras, or at least stay out of their line of sight" "Once I stayed up all night to play Lemmings. The next day, when I was trying to read, I kept trying to figure out how to get the Lemmings across the sentences"	"Need for Speed 2 helped me through a bad slide on ice. When I hit the ice, my brain went into gaming mode. It felt like I was with the controller in my hand...I ended up off the slide" "I haven't played a Zelda game for 2 years...I was looking in the drawers a game. When I found it without even realising I sang the open chest theme"

Fig. 2. Examples of video game elements transferred in each modality and GTP experiences.

#### 4 Applications and Potential Applications of GTP

GTP offers a broad **frame for assessing the effects derived from the use of virtual technologies that:** (i) takes into account the interplay between physiological, psychological and social aspects, (ii) is not limited to a video game genre, platform, online/offline or dysfunctional or pathological gaming, and (iii) considers digital contents and their structural characteristics, the interaction with hardware (e.g., keyboard) and in-game phenomena (e.g., immersion, embodiment, telepresence).

GTP can help to identify video game features that provoke discomfort after playing, beyond only looking into psychophysiological side effects (e.g., motion sickness), and potentially reduce risks associated with neural adaptations, particularly when playing using highly immersive technologies, that are believed to strengthen the effects of GTP. A valid and reliable GTP scale with (twenty items) has been developed [13] and a revision is in progress.

Moreover, informing and demystifying GTP appear to be an important contribution to gamers' health, avoiding misinterpretation of normally occurring phenomena which can lead to anxiety, stress and contribute to the development of mental illness, as well as encouraging self-control against performing automatic actions when urges to behave as a response towards game-related cues appear [14].

If the GTP framework [14] is applied with a specific purpose and rigor it may bring some of the following benefits:

#### **4.1 Enhanced Virtual Tools**

Identify virtual features (e.g., special sounds, visuals) that cause discomfort, or those that can be included, to: (i) strengthen the effectiveness of interventions using digital tools for therapeutic or pedagogic purposes (e.g., trigger associations, change interpretations of harmful stimuli, change behaviors), or (ii) enhance the engagement with the virtual application.

##### **4.1.1 Take Advantage of Naturally Occurring Phenomena**

Naturally occurring mix-ups during the manipulation of virtual technologies can be applied. For example, mobile augmented reality games require the gamer to constantly switch the view between the screen and the real world, which has been found to be associated with mix-ups between the virtual and the real world. More specifically, *Pokémon Go* players have reported looking for Pokémon outside the screen while playing [12].

#### **4.2 Understanding the Underlying Mechanisms of Problematic and Pathological Gaming**

Identify and assess factors that contribute to the maintenance and development of symptoms of gaming addiction or Internet Gaming Disorder, and understand further changes in behavior associated with dysfunctional gaming, such as: (i) *selective attention*: focus the attention on particular virtual cues has been found and induced in laboratory settings [15]. GTP also shows this, but in everyday contexts with real-life triggers, where further consequences can be identified (e.g., thought automatization, change of behavior, or even sensorial intrusions when gamers see images or hear sounds guided by top-down processing or by sensory cortex activations triggered by game-related cues [16]), (ii) *identify thought mechanisms* associated with the game (e.g., content, irrationality), (iii) *neural adaptations and over-sensitization to stimuli* that may be related with the activation of dopaminergic neurotransmissions associated with game elements and rewarding virtual experiences.

Other potential applications of assessing GTP in video games and the general use of virtual technologies include:

#### **4.3 Clinical-Related Contexts**

Various clinical applications can be exploited including mimicking symptoms of medical conditions for psychopedagogic or research purposes. This is because

phenomenological similarities (e.g., circumstances of manifestation, type of phenomena) have been observed between GTP and symptoms of mental disorders (e.g., schizophrenia, Hallucinogen Persistent Perceptual disorder, alcohol withdrawal, sleep disorders) [17].

#### 4.3.1 Psychopedagogic Tool

This can be used in diverse ways: **(i) psychopedagogic tool with patients:** it can help to explain their symptoms to patients outside the frame of pathology, learning about the commonality of intrusions in the non-clinical population; and learning about the mechanisms of involuntary phenomena and perhaps encourage strategies to confront, reduce or tolerate them, **(ii) promote empathy towards mental illness in the general population:** simulation of hallucinations via voice simulation tapes [18] or virtual reality simulation [19] have been used to reduce stigma among the non-clinical population. GTP experiences can be used for explaining that involuntary phenomena can also be experienced by common activities such as playing video games, explain the GTP mechanisms, evolution from intrusions to change on behavior, etc. To this end, a collection of over 60 cartoons based on gamers' experiences has been created to explain GTP to the general public<sup>1</sup>.

#### 4.3.2 Investigate Symptoms of Medical Conditions

Investigate individuals who are highly prone to certain GTP types for understanding symptoms and underlying mechanisms of medical conditions. Moreover, GTP can be used for investigating symptoms such as *overreaction toward stimuli* – social anxiety disorders (PTSD, phobias); *hallucinations, delusions* – schizophrenia; *perseverative mental states, sensory sensibility* – autism; *nocturnal involuntary movements, eidetic images, imagery, hypnagogic* – sleep disorders.

#### 4.3.3 A Tool for Evaluating Therapeutic Interventions Using Video Games/VR

Evaluate the effects of the intervention in the everyday life of the patient for: (i) avoiding unwanted effects (e.g., intrusive thoughts, hallucinations) derived from interventions using virtual technologies, (ii) identifying factors that reduce or interfere in the treatment or reduce its efficacy (e.g., harmful automatic associations between virtual elements and real-life elements), (iii) identifying which virtual elements are transferred and how they are transferred into real-life settings for potentially using them to enhance the treatment.

### 4.4 Enhanced Interventions

Playing video games, mainly *Tetris* (a tile puzzle game), has been used for taxing the visuospatial resources required for the formation of flashbacks in PTSD or cravings in addictions in lab environments [20] and in real-life settings [21, 22] with a degree of success. Ortiz de Gortari and Griffiths have argued that the intrusiveness of GTP (e.g.,

<sup>1</sup> <http://gametransferphenomena.com/resources/cartoons/>.



recurrent images, thoughts about the game) may play a role or can be used to strengthen interventions using video games for reducing, interfering or substituting the unwanted and distressful intrusions with neutral contents [23].

#### 4.5 Predictive Tool for Future Development of Medical Conditions

Perhaps it could be useful to identify individual characteristics associated with the proneness to develop future medical conditions or cognitive impairment, e.g., identify individuals in prodromal phases to develop psychotic illness. For instance, research has found that Parkinson patients without a history of hallucinations experienced them during a virtual intervention, and years later only this group reported development of hallucinations [24].

## 5 Conclusion

Research on GTP has from a novel perspective demonstrated how playing video games can lead to at least temporary changes in cognition, sensorial perception and behaviors in everyday contexts, especially how associations between physical stimuli (e.g., objects, environments) and video game elements and experiences are automatically established after playing games.

The author believes that if GTP mechanisms are applied with specific purposes and rigor it is possible to take advantage of GTP, e.g., modifying interpretation of real-life stimuli associated with distress, interfere or replacing distressful thoughts and unwanted sensorial material such as imagery, voices, etc. The applications of GTP remain to be tested and the GTP framework should be applied carefully, having in mind that some gamers (at least 20%) have reported distress or dysfunction at some point due to GTP [10], and also that transfer of effects requires a certain amount of time to settle down (i.e., frequent gaming and prolonged gaming sessions). More research on GTP is needed to better understand the mechanisms and characteristics of GTP that can potentially be used either to enhance the effectiveness of virtual tools/virtual experiences, or for developing interventions based on naturally and commonly occurring involuntary phenomena with digital content that have a long-term effect.

## References

1. Griffiths, M.D., Kuss, D.J., de Gortari, A.B.O.: Videogames as therapy: an updated selective review of the medical and psychological literature. *Int. J. Priv. Health Inf. Manag.* **5**, 71–96 (2017)
2. Greitemeyer, T.: Intense acts of violence during video game play make daily life aggression appear innocuous: a new mechanism why violent video games increase aggression. *J. Exp. Soc. Psychol.* **50**, 52–56 (2014)
3. APA: Diagnostic and Statistical Manual of Mental Disorders (DSM-5), Washington DC (2013)
4. Dill, K.E., Dill, J.C.: Video game violence: a review of the empirical literature. *Aggress. Violent Behav.* **3**, 407–428 (1999)

5. de Gortari, A.B.O., Griffiths, M.D.: Automatic mental processes, automatic actions and behaviours in Game Transfer Phenomena: an empirical self-report study using online forum data. *Int. J. Mental. Health Addict.* **12**, 432–452 (2014)
6. Shapiro, S., Rotter, M.: Graphic depictions: portrayals of mental illness in video games. *J. Forensic Sci.* **61**, 1592–1595 (2016)
7. de Gortari, A.B.O.: Empirical study on Game Transfer Phenomena in a location-based augmented reality game. *Telemat. Inform.* (in press)
8. Butler, L.D.: Normative dissociation. *Psychiatr. Clin. North Am.* **29**, 45–62 (2006)
9. de Gortari, A.B.O., Griffiths, M.D.: Altered visual perception in Game Transfer Phenomena: an empirical self-report study. *Int. J. Hum.-Comput. Interact.* **30**, 95–105 (2014)
10. de Gortari, A.B.O., Griffiths, M.D.: Prevalence and characteristics of Game Transfer Phenomena: a descriptive survey study. *Int. J. Hum.-Comput. Interact.* **32**, 470–480 (2016)
11. Dindar, M., de Gortari, A.B.O.: Turkish validation of the Game Transfer Phenomena Scale (GTPS): measuring altered perceptions, automatic mental processes and actions and behaviours associated with playing video games. *Telemat. Inform.* **34**, 1802–1813 (2017)
12. de Gortari, A.B.O.: Empirical study on Game Transfer Phenomena in a localization-based augmented reality game. *Telemat. Inform.* (in press). <https://doi.org/10.1016/j.tele.2017.12.015>
13. de Gortari, A.B.O., Pontes, H., Griffiths, M.D.: The Game Transfer Phenomena Scale: an instrument for investigating the non-volitional effects of video game playing. *Cyberpsychology Behav. Soc. Netw.* **18**, 588–594 (2015)
14. de Gortari, A.B.O.: The Game Transfer Phenomena framework: investigating altered perceptions, automatic mental processes and behaviors induced by virtual immersion. *Ann. Rev. Cybertherapy Telemed.* **9**, 9–15 (2016)
15. Boot, W.R., Kramer, A.F., Simons, D.J., Fabiani, M., Gratton, G.: The effects of video game playing on attention, memory, and executive control. *Acta Psychol.* **129**, 387–398 (2008)
16. de Gortari, A.B.O., Griffiths, M.D.: Beyond the boundaries of the game: the interplay between in-game phenomena, structural characteristics of video games, and game transfer phenomena A2 - Gackenbach, Jayne. In: Bown, J. (ed.) *Boundaries of Self and Reality Online*, pp. 97–121. Academic Press, San Diego (2017)
17. de Gortari, A.B.O., Larøi, F., Lerner, A.: Can game transfer phenomena contribute to the understanding of the psychophysiological mechanisms of gaming disorder? A comparison of visual intrusions induced by videogames and mental disorders. In: 4th International Conference on Behavioural Addictions, pp. 9–10 (2012). *J. Behav. Add.*
18. Ando, S., Clement, S., Barley, E.A., Thornicroft, G.: The simulation of hallucinations to reduce the stigma of schizophrenia: a systematic review. *Schizophr. Res.* **133**, 8–16 (2011)
19. Penn, D.L., Ivory, J.D., Judge, A.: The virtual doppelganger: effects of a virtual reality simulator on perceptions of schizophrenia. *J. Nerv. Mental Dis.* **198**, 437–443 (2010)
20. Holmes, E.A., James, E.L., Coode-Bate, T., Deerprouse, C.: Can playing the computer game “Tetris” reduce the build-up of flashbacks for trauma? A proposal from cognitive science. *PLoS ONE* **4**, e4153 (2009)
21. Iyadurai, L., et al.: Preventing intrusive memories after trauma via a brief intervention involving Tetris computer game play in the emergency department: a proof-of-concept randomized controlled trial. *Mol. Psychiatry* **23**, 674–682 (2018)
22. Skorka-Brown, J., Andrade, J., Whalley, B., May, J.: Playing Tetris decreases drug and other cravings in real world settings. *Addict. Behav.* **51**, 165–170 (2015)
23. de Gortari, A.B.O., Griffiths, M.D.: Commentary: Playing the computer game tetris prior to viewing traumatic film material and subsequent intrusive memories: examining proactive interference. *Front. Psychol.* **7**, 260 (2016)
24. Albani, G., Pedroli, E., Cipresso, P., et al.: Visual hallucinations as incidental negative effects of virtual reality on Parkinson’s disease patients: a link with neurodegeneration? *Parkinson’s Dis.* **2015**, 6 p. (2015). Article ID 194629. <https://doi.org/10.1155/2015/194629>