



Game Transfer Phenomena and its associated factors: An exploratory empirical online survey study



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ABSTRACT

Previous qualitative and quantitative studies examining Game Transfer Phenomena (GTP) have demonstrated that GTP experiences are common. These studies have shown that many gamers report altered perceptions, involuntary thoughts and behaviors after playing video games (e.g., pseudo-hallucinatory experiences, automatic motor activations, etc.). However, the factors associated with GTP are unknown. In the present study, a total of 2362 gamers were surveyed using an online questionnaire to examine the relationship between GTP and socio-demographic factors, gaming habits, individual characteristics, and motivations for playing. Results showed that having a pre-existing medical condition, playing for 3–6 h, and playing for immersion, exploration, customization, mechanics and escape from the real world were significantly associated with having experienced GTP. Those who were 33–38 years old, playing sessions for less than one hour, being a professional player, being self-employed, and never recalling dreams, were significantly more likely to have not experienced GTP. The findings suggest that attention should be paid to young adults and the length of gaming sessions, as well as taking into consideration underlying factors such as medical conditions that may make gamers more prone to GTP.

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1. Introduction

Videogames can be pervasive in gamers' lives. This has been demonstrated from a variety of perspectives. For instance, research has reported how the perception of the real world is influenced by experiences in the game, particularly in relation to the content of the game (e.g., meta-narrative, activities in the game) (Lee, Peng, & Klein, 2010; Williams, 2006). A large variety of experimental research has demonstrated via cognitive tasks (e.g., go/no-go computer task, Stroop test, etc.) that frequent gamers and particularly those classified as problematic gamers show cognitive biases and response inhibition toward gaming-related cues (Decker & Gay, 2011; Van Holst et al., 2012). Research into Game Transfer Phenomena (GTP) has demonstrated how the game can keep on playing even after the game has been turned off. GTP are non-volitional phenomena such as altered perceptions, automatic mental processes, and involuntary behaviors (Ortiz de Gortari, 2015). The present paper takes a multimodal research approach in descriptively examining the effects of playing videogames and the underlying factors of GTP.

An analysis of more than 1600 gamers self-reports have shown that videogame playing can lead to (i) perceptual distortions of physical objects, environments, and/or sounds, (ii) misperceptions of objects and sounds that are similar to those in the videogame, (iii) interpretation of events in real life contexts that utilize the logic of the videogame, (iv) ghost perceptions and sensations of images, sounds, and tactile experiences, and (v) involuntary actions and behaviors based on experiences from the videogame (Ortiz de Gortari, 2010; Ortiz de Gortari, Aronsson, & Griffiths, 2011; Ortiz de Gortari & Griffiths, 2014a,b,c).

A recent descriptive analysis demonstrated that 96.6% of gamers had experienced GTP. The majority experienced GTP more than once (95.3%) and most of the gamers in the sample had experienced six or more different types of GTP at some point (78.9%) (Ortiz de Gortari & Griffiths, 2015). More specifically, GTP manifested as altered sensorial perceptions mostly as visualizations of videogame images or seeing videogame images with closed eyes (76.8%), hearing the music from the videogame after playing (73.9%), and experiencing bodily sensations of movement as in the videogame (50.9%). The most prominent automatic mental processes were desires to use videogame elements in real-life contexts (74.6%) and involuntary actions when gamers verbalized something related to the videogame without intention (57.9%).

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GTP appear to be short-lasting phenomena that mostly occur soon after stopping playing (Ortiz de Gortari & Griffiths, 2015). The emotional appraisal of GTP has been reported as both positive or negative, with some gamers wanting to induce GTP or wanting them to happen again (Ortiz de Gortari & Griffiths, 2014a, 2015). However, in one study, one-fifth of gamers reported distress after playing due to GTP experiences (Ortiz de Gortari & Griffiths, 2015) and experienced GTP in specific circumstances leading to risky situations (e.g., seeing images on the road while driving and trying to follow them) (Ortiz de Gortari & Griffiths, 2014a). Therefore it is important to understand what factors are associated with GTP and which individuals are susceptible to GTP so they can be assisted and reassured if needed. Based on the limited empirical literature about GTP, the factors that were considered to be important to examine in relation to GTP in the present study were: (i) socio-demographics, (ii) gaming habits, (iii) motivations for playing, (iv) underlying conditions (pre-existing medical conditions, drug use), and (v) dream recall (see literature below for the rationale).

1.1. Socio-demographic factors

Gender differences have been found in terms of playing videogames. Despite the increase of female gamers, gaming is still an activity dominated by males (52% males vs. 48%) although most females tend to play casual games (Entertainment Software Association., 2014). According to neuroimaging studies on gaming, males show greater activation in the mesocorticolimbic reward system compared to females, and this may partly explain why males are more attracted to rewarding activities such as gaming (Hoeft, Watson, Kesler, Bettinger, & Reiss, 2008). Moreover, some studies have claimed that males are more susceptible to develop gaming problems (e.g., gaming addiction) (Hsu, Wen, & Wu, 2009; Ko, Yen, Chen, Chen, & Yen, 2005). In terms of age, the average age of gamers in the USA is 31 years old (Entertainment Software Association, 2014) and in Europe, 51% of the gamers are under 35 years old (Interactive Software Federation of Europe., 2012). It has been speculated that GTP are related to failures in cognitive control (e.g., sustaining attention to the task at hand) (Ortiz de Gortari, 2015). According to some research studies, day-dreaming and mind wandering tend to decrease with age (Giambra, 1989, 1993; Zavagnin, Borella, & De Beni, 2014) so younger people may be more likely to experience GTP.

1.2. Gaming habits

Excessive gaming has been suggested as a factor relating to GTP (Ortiz de Gortari, 2010, 2015; Ortiz de Gortari & Griffiths, 2012). Moreover, research has shown that virtual immersion decreases the sense of presence in objective reality and results in gamers feeling detached from objective reality (Aardema, O'Connor, Côté, & Taillon, 2010). More specifically, longer gaming sessions may enhance the effects of neural adaptation (e.g., motion sickness, cybersickness, visual motion after-effects, etc.) (Dyson, 2010; Kennedy, Stanney, & Dunlap, 2000), where duration is proportional to exposure time (Champney et al., 2007). In addition, gaming has been correlated with sleep deprivation (Achab et al., 2011; Choi et al., 2009; Rehbein, Kleimann, & Mossle, 2010; Tazawa & Okada, 2001). Unhealthy gaming habits such as carrying on playing when feeling fatigued or being sleep deprived or skipping meals to carry on playing (Custers & Van den Bulck, 2010; Seok & DaCosta, 2012; Spekman, Konijn, Roelofsma, & Griffiths, 2013) may make gamers more prone to experience altered perceptions (Babkoff, Sing, Thorne, Genser, & Hegge, 1989; Mahowald, Woods, & Schenck, 1998; Seok & DaCosta, 2012). In a very small minority of cases, players may suffer epileptic seizures (Bigal, Lipton,

Cohen, & Silberstein, 2003). In a previous GTP study focusing on altered visual perceptions (Ortiz de Gortari & Griffiths, 2014a), some gamers reported being sleep-deprived or fatigued due to playing for prolonged periods of time when they experienced GTP. Also, experiencing cognitive failures such as the ones observed in previous GTP studies are likely as a result of being mentally fatigued (Van den Linden, Frese, & Meijman, 2003).

1.3. Motivations for playing

Motivation has an important role in initiating an activity, contributing to the maintenance of certain behaviors, and moderating the effects of pursuing an activity (Katz, 1996; King & Delfabbro, 2009). The playing of videogames offers an outlet for fulfilling basic needs (Hussain & Griffiths, 2008; Przybylski, Weinstein, Ryan, & Rigby, 2009; Ryan, Rigby, & Przybylski, 2006) and obtaining personal gratification (Sherry, Lucas, Greenberg, & Lachlan, 2006). Yee's (2006) typology of players' motivations (i.e., advancement, social, and immersion) is useful in examining which behaviors among gamers become involved in and provides an overview of cognitive mechanisms activated while playing (e.g., *explore* – paying attention to particular videogame elements, discovery, tracking, monitoring, and collecting artefacts; *customization* – paying attention to objects, shapes, contours, colors, manipulating and interchanging game elements, personalization of the game, identification). Therefore it is expected that motivations such as immersion, exploration, customization, and escape are significantly associated with GTP.

Studies suggest that hypnotic susceptibility and afterimage persistency are related to individuals' capacity for sustaining their attention to relevant cues and activities (Atkinson & Crawford, 1992), therefore GTP were not expected to be associated with activities such as finishing playing videogames as fast as possible. More specifically, wanting to finish the game as quickly as possible is the conceptual opposite to exploring and customizing that involve paying attention to elements in the videogame. It was also expected that the playing of videogames for socialization and competitive reasons would not be associated with GTP. This is because such players are less likely to get immersed in the game and interact with game elements and game atmosphere.

1.4. Medical conditions

Some of the GTP experiences appear to share similarities with a symptoms of other medical conditions (Ortiz de Gortari, 2015; Ortiz de Gortari & Griffiths, 2014a). These include photosensitive epilepsy, migraine aura (Panayiotopoulos, 1994) schizophrenia, and hallucinogen persisting perception disorder (American Psychiatric Association., 2013). Gamers have also reported seeing videogame images or hearing voices from videogames triggered by associations with external stimuli (Ortiz de Gortari & Griffiths, 2014a,b). These studies highlight the importance of investigating these variables. The comorbidity between online gaming addiction and mental disorders has been reported in several studies. More specifically, research has reported correlations between gaming addiction and symptoms of ADHD and depression (Hyun et al., 2015). Other comorbidities with gaming addiction include generalized anxiety disorders, social anxiety disorders, borderline personality, avoidant personality, eating disorders, and alcohol/substance abuse disorders (Choi et al., 2009; Gong et al., 2009; Lam, Peng, Mai, & Jing, 2009; Van Rooij et al., 2014).

1.5. Drug consumption

A previous descriptive GTP survey (Ortiz de Gortari & Griffiths, 2015) showed that the majority of the gamers were not under the

influence of psychoactive substance or medicine when GTP occurred, however, the use of psychoactive substances may make some individuals more susceptible to experiencing altered perceptions (Ohayon, 2000), and the side-effects of drugs use could be manifesting as GTP. In previous qualitative studies examining GTP (Ortiz de Gortari, 2010; Ortiz de Gortari & Griffiths, 2014a,b,c; Ortiz de Gortari et al., 2011) some gamers reported having consumed drugs or being under the influence of a psychoactive substance when they experienced GTP. Therefore it is important to examine to what extent GTP were experienced by individuals who had consumed illicit drugs.

1.6. Dream recall

Dream recall was included in the present survey as a measure of fantasy proneness, and irregular sleep patterns that are typically associated with excessive videogame playing (Achab et al., 2011; Ng & Wiemer-Hastings, 2005). According to research into dreaming, individuals prone to absorption, imagination, and fantasy tend to remember their dreams better and report vivid nocturnal experiences (Watson, 2003). Also, repetitive awakening during the night and low sleep quality have been associated with dream recall frequency (Schredl, 2009). There is also evidence of sleep disturbances among GTP experiences analyzed to date. For instance, gamers have reported abruptly waking up from dreams when sounds from the videogame were thought to have been heard. Some gamers also reported experiencing sleep paralysis or kept seeing videogame images that provoked sleep deprivation (Ortiz de Gortari & Griffiths, 2014a,b).

To date little is known about which specific factors are associated with GTP. Therefore the aim of the present study was to examine the relationship between having experienced GTP (at least once) and never having experienced GTP in terms of individual characteristics, gaming habits, and motivations for playing.

2. Method

2.1. Sample

A total of 2362 gamers completed an online survey. The majority of the participants were male (86.0%). Nearly half of the participants (46.1%) were between the ages of 18 and 22 years (with ages ranging from 18 to 54 years or older). Almost half of the participants were students (46.1%). Participants resided in 78 different countries. The vast majority of the participants who reported their residence ($n = 2077$) were from Mexico (33.8%), United States (20.0%), United Kingdom (11.4%), Sweden (5.4%) and Canada (4.7%). Numerous countries accounted for the remaining participants of the total sample (e.g., Spain, Netherlands, Venezuela, Philippines, Singapore, and Saudi Arabia).

2.2. Procedure

The participants were recruited via online gaming community forums, Facebook, and meetup.com groups over a six-month period. The recruitment of the participants was supplemented by snowball sampling via participants that were recruited with the help of leaders within videogame groups and gaming organizations. A pilot survey was carried out before the main study to examine the understanding of questions and time constraints. Informed consent was obtained from all participants before they began the survey. Ethical approval for the study was granted by the research team's University Ethics Committee. Once the participants had submitted their responses, the data were exported into SPSS 21 for analysis.

2.3. Materials

The survey comprised a total of 30 items and included questions concerning: socio-demographics, playing habits, motivations for playing, drug consumption, dream recall, and medical/health conditions. Three modalities of GTP were investigated: (i) altered perceptions (e.g., 'I have seen distorted real life environments and/or objects due to my video game playing', 'I have experienced bodily sensations of movement as if I was in a video game', 'I have heard the music from a game when I was not playing'), (ii) automatic mental processes (e.g., 'I have wanted or felt the urge to do something in real life after seeing something that reminded me of the video game', 'I have experienced still being in the mindset of a game after I have stopped playing') and (iii) behaviors and actions (e.g., 'I have sang, shouted or said something from a video game in real life without intending to do so', 'I have acted out a behavior or performed an activity influenced by a video game'). Altered perceptions were divided into further sub-modalities including visual, auditory, and body experiences (e.g., visualized or saw videogame images with closed or open eyes, perceived time and/or body differently after playing, tactile sensations, heard music, sounds or voices when not playing, etc.). All the items were scored on a Likert scale that assessed frequency (i.e., 'all the time', 'many times', 'a few times', 'once' and 'never'). Each question included one example of a GTP experience to help participants better understand the question. In addition, questions about the characteristics of GTP were included (e.g., 'On average, how long did your GTP experiences usually last?', 'What you were doing when GTP occurred?').

2.4. Statistical analysis

In the current study, chi-square tests of association were conducted to examine the differences between participants who had experienced at least one type of GTP at some point and participants that had never experienced GTP in association with a number of variables: individual characteristics (e.g., socio-demographics, medical conditions), gaming habits, and motivations for playing. Not all participants answered every single question, therefore, the total sample size was sometimes different in the analysis of different questions. A new dichotomous variable was created to measure the prevalence of GTP experiences (having experienced GTP included the responses 'all the time', 'many times', 'a few times', and 'once'). Participants who had experienced at least one GTP were classified in the group 'GTP', and participants who had never experienced GTP were classified in the group 'No-GTP'.

3. Results

Descriptive statistics and chi-square analyses are discussed together when appropriate. Only significant differences are further described. Where cell sizes fell below five participants, Fisher's Exact tests were used.

3.1. Socio-demographic variables in terms of GTP and No-GTP

3.1.1. Gender

The majority of the participants were male (86.1%) and the majority of those who had experienced GTP were male (86.0%), although when analyzing within gender almost the same percentages of males as females had experienced GTP (96.6% males vs. 97.2% females). Gender was not significantly associated with GTP.

3.1.2. Age

The majority of those in the GTP group were aged between 18 and 22 years (46.5%) compared to those in the No-GTP group

(35.8%). Age was significantly associated with having experienced GTP ($\chi^2(5) = 24.860, p < 0.01$). Participants who were 33–38 years old were significantly more likely to have not experienced GTP.

3.1.3. Occupation

Almost half of those in the GTP group were students (46.6%). Occupation was significantly associated with having experienced GTP ($\chi^2(5) = 14.186, p < 0.05$). Those who were self-employed were significantly less likely to have experienced GTP (see Table 1).

3.2. Underlying reasons explaining GTP and No-GTP

3.2.1. Medical conditions

The majority of the participants did not have any pre-existing medical condition (82.6%). Of those in the GTP group, 19.1% had a medical condition, while only 3.9% in the No-GTP group had a medical condition. This difference was significant ($\chi^2(1) = 11.528, p < 0.01$). The most predominant conditions among the small number of participants who had a medical condition and had experienced GTP were sleeping disorders (6.3%), visual disorders (4.8%), mental disorders (4.1%) and/or problematic gaming (3.5%).

Participants could also freely specify medical condition outside the pre-defined options. Conditions that were reported included: Attention deficit hyperactivity disorder (ADD/ADHD), migraines, obsessive-compulsive disorder (OCD), chronic pain, asthma/allergy, color blindness, and hypertension. Consequently, another new variable was created to identify whether the type of medical conditions that gamers' reported were either physical (e.g., epilepsy, visual disorder, hearing disorder) or psychological (sleep disorder, mental disorder, gaming addiction). Only those who had a psychological medical condition were significantly more likely to have experienced GTP ($\chi^2(1) = 7.052, p < 0.01$) (see Table 2).

3.2.2. Drug consumption and flashbacks as side-effects of drug consumption

The majority of gamers had never consumed psychoactive drugs (87.2%). Neither had they experienced flashbacks (78.3%). Findings showed that 31.0% of those in the GTP group had consumed drugs compared to 21.4% in the No-GTP group. Similarly, more gamers that had experienced GTP had experienced

Table 1
The relationship between the GTP and the No-GTP groups in terms of gender, age and occupation.

| | No-GTP % | GTP % | χ^2 | d.f | p value |
|--------------------|----------|----------|------------|-----|---------|
| Gender | n = 68 | n = 2011 | 0.279 | 1 | 0.597 |
| Male | 88.2 | 86.0 | | | |
| Female | 11.8 | 14.0 | | | |
| Age | n = 67 | n = 1934 | 24.8608*** | 5 | 0.000 |
| 18–22 years old | 35.8 | 46.5 | | | |
| 23–27 years old | 23.9 | 26.6 | | | |
| 28–32 years old | 13.4 | 15.0 | | | |
| 33–38 years old | 22.4 | 7.1 | | | |
| 39–43 years old | 4.5 | 2.3 | | | |
| 44 years or older | 0.0 | 2.5 | | | |
| Occupation | n = 70 | n = 2031 | 14.186* | 5 | 0.014 |
| Student | 32.9 | 46.6 | | | |
| Full-time employed | 31.4 | 28.4 | | | |
| Part-time employed | 8.6 | 9.1 | | | |
| Self-employed | 15.7 | 6.5 | | | |
| Not working | 11.4 | 7.4 | | | |
| Other | 0.0 | 2.0 | | | |

** p < .01.
* p < .05.
*** p < .001.

Table 2

The relationship between the GTP and the No-GTP groups in terms of medical conditions, drug use, flashbacks and dreams recall.

| | No-GTP % n = 69 | GTP % n = 1956 | χ^2 | d.f | p value |
|---------------------------------|--------------------|-------------------|----------|-----|--------------------|
| Medical condition | 4.3 | 21.2 | 11.528** | 1 | 0.001 |
| Physical medical condition | 2.9 | 7.0 | 1.757 | 1 | 0.231 ^a |
| Psychological medical condition | 1.4 | 11.8 | 7.052** | 1 | 0.008 |
| Drugs | n = 70 21.4 | n = 2040 31.0 | 2.904 | 1 | 0.088 |
| Flashbacks | n = 15 13.3 | n = 626 21.9 | 0.631 | 1 | 0.543 ^a |
| Tendency to recall dreams | n = 81 | n = 2279 | 15.158** | 1 | 0.004 |
| Always | 7.4 | 6.8 | | | |
| Very often | 25.9 | 30.3 | | | |
| Sometime | 30.9 | 39.7 | | | |
| Rarely | 27.2 | 20.8 | | | |
| Never | 8.6 | 2.4 | | | |

* p < .05. *** p < .001.
** p < .01.

^a The analysis showed that one cell had an expected count less than five, so Fisher's exact test was used.

flashbacks (21.9%) compared to those who had not experienced GTP (13.3%), but this was not significant (see Table 2).

3.2.3. Tendency to recall dreams

The majority of the gamers recalled their dreams sometimes (39.4%) or very often (30.2%). Those in the GTP group mostly recalled their dreams sometimes (39.7%) or very often (30.3%), while those in the No-GTP group recalled their dreams sometimes (30.9%) or rarely (27.2%). Dream recall was significantly associated with having experienced GTP ($\chi^2(1) = 15.158, p < 0.01$). Those who never recalled dreams were significantly less likely to have experienced GTP ($\chi^2(1) = 11.863, p < 0.01$) (see Table 2).

3.3. Gaming habits and gamers' self-concept in terms of GTP and No-GTP

3.3.1. Type of gamers

The majority of those in the GTP group described themselves as hard-core gamers (60.3%), higher than in the No-GTP group (49.4%) (see Table 3). Self-concept was significantly associated with GTP ($\chi^2(3) = 9.183, p < 0.05$). Those who were professional gamers were significantly less likely to have experienced GTP.

3.3.2. Frequency of playing and typical videogame session length

Playing 2–4 days per week was most common in both groups (35.2%, GTP vs. 35.8% No-GTP). Frequency of videogame playing was close to be significantly associated with GTP. More participants in the GTP group played 3–6 h (41.8%) than those in the No-GTP group (28.4%), while more participants in the No-GTP group (50.6%) played 1–3 h than those in the GTP group (42.9%). Videogame session length was significantly associated with having experienced GTP ($\chi^2(4) = 25.580, p < 0.01$). More gamers that played 3–6 h have significantly experienced GTP and those who played sessions of less than one hour were significantly less likely to have experienced GTP (see Table 3).

3.3.3. Motivations and in-game behaviors

In terms of motivations, there was a wide range of responses since the participants could endorse as many statements as they wanted relating to motivations to play. Those who played for immersion ($\chi^2(1) = 12.495, p < 0.01$), exploration ($\chi^2(1) = 7.223,$

Table 3
The relationship between the GTP and the No-GTP groups in terms of gamer profile.

| | No-GTP % | GTP % | χ^2 | d.f | p value |
|-----------------------|----------|----------|-----------------------|-----|---------|
| Gamer profile | n = 61 | n = 2276 | 9.183 [*] | 3 | 0.027 |
| Newbie gamer | 3.7 | 1.3 | | | |
| Casual gamer | 34.6 | 32.0 | | | |
| Hard-core gamer | 49.4 | 60.3 | | | |
| Professional gamer | 12.3 | 6.5 | | | |
| Frequency of playing | n = 81 | n = 2280 | 9.295 | 4 | 0.054 |
| Less than once a week | 2.5 | 3.3 | | | |
| Once a week | 12.3 | 4.9 | | | |
| 2–4 times a week | 35.8 | 35.2 | | | |
| 5–6 times a week | 18.5 | 22.2 | | | |
| Every day | 30.9 | 34.4 | | | |
| Session length | n = 81 | n = 2280 | 25.492 ^{***} | 3 | 0.000 |
| Less than 1 h | 13.6 | 3.6 | | | |
| 1–2 h 59 min | 50.6 | 42.9 | | | |
| 3–5 h 59 min | 28.4 | 41.8 | | | |
| 6 h or more | 11.7 | 7.4 | | | |

^{**} p < .01.

^{*} p < .05.

^{***} p < .001.

Table 4
The relationship between the GTP and the No-GTP groups in terms of motivations for playing.

| | No-GTP % n = 81 | GTP % n = 2281 | χ^2 | d.f | p value |
|--|--------------------|-------------------|-----------------------|-----|---------|
| Finish the game as fast as possible | 24.7 | 18.4 | 2.054 | 1 | 0.152 |
| Mechanics | 35.8 | 47.6 | 4.344 [*] | 1 | 0.037 |
| Improved scores and/or compete with others | 42.0 | 43.9 | 0.116 | 1 | 0.734 |
| Socialize | 28.4 | 35.5 | 1.729 | 1 | 0.189 |
| Explore | 50.6 | 65.1 | 7.223 ^{**} | 1 | 0.007 |
| Immersion | 53.1 | 71.3 | 12.495 ^{***} | 1 | 0.000 |
| Customize | 40.7 | 55.3 | 6.678 [*] | 1 | 0.010 |
| Excitement | 34.6 | 42.3 | 1.901 | 1 | 0.168 |
| Escape | 19.8 | 41.1 | 14.780 ^{***} | 1 | 0.000 |

^{*} p < .05.

^{**} p < .01.

^{***} p < .001.

p < 0.01), customization ($\chi^2(1) = 6.678$, p < 0.05), mechanics ($\chi^2(1) = 4.344$, p < 0.05) and escape from the real world ($\chi^2(1) = 14.789$, p < 0.01) were significantly more likely to have experienced GTP (see Table 4).

4. Discussion

The aim of this study was to examine which factors in terms of socio-demographics and individual characteristics, gaming habits, and motivations were significantly associated with having experienced Game Transfer Phenomena (GTP).

4.1. Socio-demographics

Most of the participants who had experienced GTP were male although when looking at gender, there were also more females who had experienced GTP than those who have not. Age was significantly associated with having experienced GTP. Those who were between 33 and 38 were significantly less likely to have experienced GTP. According to research studies, the prefrontal cortex involved in high-level reasoning and decision-making is still maturing during the adolescent years and continues to change during the early 20s (Winters & Arria, 2011). It has also been argued that task-unrelated thoughts or non-conscious information processing (i.e., daydreaming, mind wandering) decreases with age

(Giambra, 1989, 1993; Zavagnin et al., 2014). Future studies should examine and compare GTP in minors and adult gamers to obtain a clearer understanding of the effects of GTP in relation to age.

In relation to occupation, being a student was the most prevalent occupation in the GTP group. Students may engage in the game in a way that other groups of the population such as self-employed people do not, since these latter groups were significantly less likely to have experienced GTP. There may be different reasons as to why students experience more of GTP. Firstly, students recurrently attend lectures that do not necessarily require constant active participation or a high level of attention, particularly in teacher-centered lectures (Wilson & Korn, 2007). During these periods, mind wandering with videogame content may take place. Seeing or hearing something from the game and mind wandering about videogames during lectures has been reported by gamers in previous qualitative studies (Ortiz de Gortari, 2010; Ortiz de Gortari, Aronsson, & Griffiths, 2013; Ortiz de Gortari & Griffiths, 2014a,b). Secondly, students interact with friends rather than with colleagues at work. This may facilitate the imitation of videogame content and the use of videogame content for amusement (e.g., jokes, phrases) that may enhance the engagement with videogames (Poels, Ijsselstein, & de Kort, 2014).

4.2. Gamer profile and gaming habits

The majority of the participants who had experienced GTP classified themselves as hard-core gamers, while only a few gamers were newbies or professional gamers. Interestingly, professional gamers were significantly more likely to not have experienced GTP. This was unexpected if GTP is related to the amount of playing time and the salience of the gaming activity (although the significance level was marginal). This suggests that there may be differences between professional gamers and hard-core gamers. One explanation may be in terms of the variety of games the gamers are exposed to. It has been speculated that some GTP may disappear or be reduced after repeated exposure to the same game due to adaptation or habituation of videogame features (Ortiz de Gortari, 2015), similar to the side-effects of exposure to virtual simulators or 3-D games (e.g., cybersickness) (Champney et al., 2007; Frey, Hartig, Ketzler, Zinkernagel, & Moosbrugger, 2007). Professional gamers tend to play a specific type of game, while hard-core gamers may play a diverse range of games that may favor the opportunity to experience different types of GTP. Moreover, neuroimaging studies have compared brain activation of professional gamers and those with problematic gaming. Although both groups engage in intensive gaming, those with a gaming disorder demonstrate poor ability in controlling executive functions and sustaining attention (Han, Lyoo, & Renshaw, 2012). Failure of cognitive and executive control may also be implicated in many GTP experiences (Ortiz de Gortari, 2015).

According to Poels et al. (2014), associations between real life stimuli and game-biased perceptions (i.e., thoughts about the game triggered by physical objects or sound and music, daydreams, nightly dreams, unintentional use of words and expressions with videogame content) are positively related to increased playing time (e.g., the number of hours played on an average day during the last three months). In the present study, the majority of the participants who had experienced GTP were frequent players, most played two to four times per week or every day, but playing frequency was not significantly associated with GTP (i.e., had experienced at least one type of GTP at least once), while the length of the videogame sessions was significantly associated with GTP. In previous qualitative studies about GTP, several gamers reported playing for very long periods of time that went from six hours continuously to more than a day when they experienced GTP (Ortiz de Gortari & Griffiths, 2014a,c), therefore it was expected that a larger

number of gamers would report GTP when playing very extensive sessions. However, the findings in this study suggest that extremely long playing sessions are not necessarily required for experiencing GTP. More participants who had experienced GTP played 3–6 h per session whereas those who played for one hour or less were significantly less likely to have experienced GTP. In fact, previous descriptive analysis of the characteristics of GTP showed that more participants played longer sessions when GTP occurred compared to usual session length (Ortiz de Gortari & Griffiths, 2015). These results are interesting because the repeated exposure is expected to consolidate the encoding of information by the rehearsing of scripts and strengthen the effects of priming (Anderson & Bushman, 2001; Bushman & Huesmann, 2006). However, as mentioned previously, some GTP may disappear with the repetitive exposure. In previous studies, some gamers reported experiencing GTP the first time they played the game or when the game was still novel (Ortiz de Gortari & Griffiths, 2014a). In addition, while frequent playing in the majority of cases may merely indicate interest in gaming and frequent exposure, length of the gaming session may show deficient self-regulation of gaming behavior (e.g., playing longer than intended) (LaRose, Lin, & Eastin, 2003; Lee & LaRose, 2007) and is related with executive control. In this study, 3.5% of those who had experienced GTP considered they had problematic gaming or gaming addiction.

However, both longer session times and high frequency of playing have been associated with gaming disorder (Tejeiro Salguero & Morán, 2002). Different GTP may require different gaming times for manifesting. For instance, in previous qualitative studies, while some gamers reported visual experiences when playing short periods of time (e.g., one hour) (Ortiz de Gortari & Griffiths, 2014a), none of those who reported auditory experiences reported playing shorter periods of time when GTP occurred (Ortiz de Gortari & Griffiths, 2014b). To better understand the role of gaming habits, these should be investigated in relation to each GTP modality.

4.3. Motivations for playing and in-game behaviors

As expected, the motivations that were significantly associated with GTP were mostly those that implied focusing on the game world or on the elements in the game space such as immersion, exploration, customization, and mechanics (a sub-component of achievement) which denote engagement in the game by thinking about strategies to improve (Yee, 2006) rather than focusing on building interpersonal relationships by socializing while playing, competition, or playing for excitement. According to Poels et al. (2014) there is a positive but weak relationship between videogame content and physical objects, sounds and music, and dreams and involvement in the games' narrative. Also, those who played to escape were significantly more likely to have experienced GTP. In general, movies, narratives, and videogames offer ways to escape from reality (Molesworth & Denegri-Knott, 2009). Escapism can be positive as a coping mechanism (Warmelink, Hartevelde, & Mayer, 2009) but has also been found to be a predictor of problematic gaming, an even stronger predictor than time invested in playing, and contributes to the prevalence of problematic gaming (Kuss, Louws, & Wiers, 2012). A closer investigation of motivations correlated with each of the GTP modalities in future studies may clarify findings in the present study.

4.4. Underlying reasons explaining GTP

Recalling dreams was significantly associated with GTP. Those who never recalled dreams were significantly less likely to have experienced GTP. Interestingly, sleeping disorders were reported by 6.3% of the gamers. Researchers have argued that disruptions in REM sleep are related to daydreaming (Giesbrecht &

Merckelbach, 2006) and videogame playing has been associated with disrupted sleep patterns (Dworak, Schierl, Bruns, & Strüder, 2007; Higuchi, Motohashi, Liu, & Maeda, 2005; King et al., 2013). The relationship between sleep variables and GTP should also be further investigated. Poor sleep quality can affect executive control functions and may facilitate the manifestation of GTP (Ortiz de Gortari, 2015).

In terms of drug consumption, previous analysis of gamers' self-reports suggested that some gamers experienced GTP when being under the influence of psychoactive substances (Ortiz de Gortari & Griffiths, 2014a). Moreover, some experiences such as recurrently seeing images of the videogame appear to resemble symptoms that manifest after the effects of the hallucinogens have passed away, e.g., Hallucinogen Persisting Perception Disorder (HPPD) (American Psychiatric Association, 2013). The majority of the participants in the GTP group had never consumed drugs or had experienced flashbacks as a secondary effect of drug use. However, more participants among those who had experienced GTP had used drugs or had experienced flashbacks in comparison to those who had never experienced GTP, but these predictors were not significantly associated with GTP.

In terms of medical condition, the majority of the participants did not have any pre-existing medical condition, but more participants who had experienced GTP had a medical condition compared to those who had not experienced GTP. The most predominant was in those who reported having a sleep disorder, visual disorder, mental disorder and problematic gaming or addiction. Moreover, those who had a psychological mental condition were significantly more likely to have experienced GTP. Further research should examine if having a medical condition can be a predictor of GTP as well as the relationship between medical conditions within each GTP modality.

5. Limitations

The study is of course not without its limitations. The data were all self-report and are subject to many well-known biases (desirability biases, recall biases, etc.). Furthermore, the results showed associations between the variables examined rather than direction of causality. Also, the classification of groups into GTP and No-GTP was done based on a single affirmative answer to one of the 20 items for measuring GTP. This can arguably be considered as a weak measure of GTP. However, a majority of the participants experienced 6–10 different types of GTP at some point. Despite the limitations, this study provides the first insights concerning factors associated with GTP. However, the way analyses were conducted did not provide specific analysis of the factors in each GTP modality. Future analysis should use more stringent criteria to (i) classify different levels of GTP strength, (ii) examine GTP levels accordingly with associated factors, and (iii) explore associated factors in different modalities of GTP (altered sensorial perceptions, voluntary and spontaneous mental processes, and behaviors).

6. Conclusion and implications

In general, this study contributes to the understanding of GTP and its associated factors. The factors significantly associated with GTP were: (i) age (those aged 33–38 years old were less likely to be associated with GTP), (ii) occupation (students were more likely to have experienced GTP, while being a self-employed were less likely to have experienced GTP), (iii) session length (those playing less than one hour per session were less likely to be associated with GTP), (iv) self-concept (those who were professional gamers were significantly less likely to have experienced GTP), (v) having a

medical condition was significantly associated with GTP (and particularly those with a psychological condition), (vi) dream recall (those who never recalled dreams were less likely to experience GTP), (vii) motivations (those playing for immersion, exploration, mechanics, customization, and escape from the real life world were significantly more likely to have experienced GTP).

Regarding the impact of the findings, researchers should note the following. Firstly, particular attention should be paid to young adults, and students in terms of GTP. Secondly, it is important to regulate gaming habits since it is expected that gamers are more susceptible to committing cognitive failures due to mental fatigue after prolonged playing (Van den Linden et al., 2003), as well as prolonged videogame sessions that may enhance the effects of neural adaptations where duration is proportional to the exposure (Champney et al., 2007). Moreover, playing videogames before going to bed has been associated with deficits in sleep quality (Dworak et al., 2007; Higuchi et al., 2005; King et al., 2013) that in turn can compromise the gamers' cognitive control, making them more susceptible to experience GTP. Exploring the relationship between sleep habits and patterns and GTP may provide useful findings. Future studies should analyze the temporal stability of GTP in terms of gaming habits to clarify the insights in the present study. Thirdly, GTP was significantly associated with medical conditions, therefore it is important to examine more rigorously which medical conditions, particularly the psychological ones, may make gamers more susceptible to experience GTP, to discriminate between GTP and signs of underlying conditions, and being able to develop adequate preventive measures for those individuals that might be more prone to GTP and experience distress. Further research concerning GTP is needed to understand better which factors are associated and predict GTP.

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