MASTER THESIS

THE EFFECT OF EXTRAVERSION, EXTERNAL AROUSAL, AND GAME-EXPERIENCE ON MEMORY PERFORMANCE IN IN-GAME ADVERTISEMENTS.

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Abstract

This study investigates the interaction between the level of extraversion, the level of external arousal and game-experience and its effect on memory performance in video games for advertising purposes. One-hundred participants (i.e., 50 introverted, 50 extraverted) voluntarily participated in a between-subjects experiment executed in the video game Grand Theft Auto V under either the low-arousal or the high-arousal external condition. The performance of participants was investigated with recall and recognition (i.e., explicit memory), and word-completion (i.e., implicit memory) tests. Results show that participant's recognition performance on brand identifiers were based on an interaction between extraversion, external arousal and experience. Introverted participants performed better in the low-arousal condition while extraverted participants performed better in the high-arousal condition, only if the participants had high game-experience. Low-experienced participants did not differ significantly. Recall performance was based on an interaction between extraversion and external arousal. Introverted participants performed better in the low-arousal condition while extraverted participants performed better in the high-arousal condition. Implicit memory performance was based on experience and extraversion. Introverted participants performed better than extraverted participants in any condition due to the probable use of intentional retrieval strategies by introverts. Finally, the practical implications of this study were that investors with an introverted target group should integrate their brand identifier in low-arousal video game contexts, whereas investors with an extraverted target group should integrate their brand identifier in high-arousal video game contexts (i.e., blood, screams, fast speed, weapons, cursing, etc.).

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Introduction

Brand placement is the implementation of brand identifiers through audio and visual sources within the terms of mass-media communication in return for paid advertising or other promotional considerations (d'Astous & Chartier, 2000; Gupta & Gould, 1997; Karrh, 1998). Brand identifiers are names, terms, signs, symbols and designs used to differentiate brands from competitors (Kotler, 1991). The concept of brand placements is increasingly used as a response to developments that provide the viewer control to ignore advertisements in the television industry, such as Netflix and Youtube (Lee & Faber, 2007; Nelson, 2004).

Brand placement positively differs from traditional advertising on two central aspects: They are used to avoid interruption in consumer activities and are not necessarily perceived as marketing messages (DeLorme & Reid, 1999). Brand placement negatively differs on one central aspect from traditional advertising: Advertisements are primary focal points in traditional advertising, whereas brand placements are secondary focal points (Lee & Faber, 2007). Forcing the placements as primary focal points may be ineffective as the gamer controls the video game and therefore allocates attention and creates mental maps of the game-space (Grodal, 2000).

Current study investigated memory of brand placements in video games. This type of brand placement had not been researched thoroughly, especially in comparison with movie placements. There are five developments why this concept should be researched more thoroughly: 1) Gamers have improved performance in attentional flexibility and visual discrimination leading to increased recall and recognition (Green & Bavelier, 2003; 2007); 2) Video game characteristics allow brand placements to be interactive, more vivid and more adept to stimulating creative perceptions than movies (Steuer, 1992). Interactivity enhances memory effects and increases recall (Lombard & Ditton, 1997; Kim & Biocca, 1997); 3) Gamers have more positive attitudes (i.e., appreciation of realism) towards advertising than

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non-gamers (Nelson, 2002; Youn et al., 2003); 4) The games industry is one of the fastest growing industries with a value of approximately $66.3 billion in hardware and software sales with an expectation of $86.1 billion in 2016 (Newzoo, 2013). This growth increased diversity in age, lifestyle and gender up to a representation of nearly every person in society (Chaney et al., 2004; Van Opstal, 2011); and 5) Organizations increasingly invest in in-game advertising: approximately $77 million in 2006 and an expectation of approximately $7.2 billion in 2016 (Gaudiosi, 2008; Takahashi, 2011). It is important to study how to optimize these investments.

Current study focused on understanding why and under which circumstances these brand placements in video games are effective or ineffective, while focusing on the level of extraversion. Extraversion is associated with in-game behavior and gaming motives (Yee, Ducheneaut, Nelson & Likarish, 2011). Graham and Gosling (2013) argue that individuals express personality in video games (i.e., MMORPGs) in the same way they express personality in other virtual environments (e.g., Facebook or other websites). Knowledge of this plausible effect of personality on in-game memory is important in in-game advertising. Personality is likely to have an impact on the individual effectiveness of in-game advertisements. Extraversion is closest related to attention and memory (Graham & Gosling, 2013; Mahyari, Drennan & Luck, 2009). Therefore, it is plausible that extraversion affects recognition and recall in video games along with other personal attributes, such as visualization, imagination, innovativeness, and curiosity. Furthermore, Howarth and Eysenck (1968) found that extraverts recalled twice as many associations than introverts in a time-pressured assignment, demonstrating that memory performance and extraversion are related. Another study found that high-arousal contexts resulted in optimal performance for extraverts and low-arousal contexts resulted in optimal performance for introverts (Eysenck, 1967).

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Therefore, current study focused on how extraversion affects in-game advertising memory performance in high-arousal and low-arousal context.

Current study investigated how extraversion affects implicit and explicit memory performance on brand placements in high-arousal and low-arousal video games. Brand placement, implicit and explicit memory, extraversion and high-arousal were defined in order to study the role of extraversion in in-game advertising. The video game Grand Theft Auto V was used during current study. This video game allowed the researcher to control arousal in a virtual environment that offers a great amount of advertisements.

Literature Review

Brand Placement

Since the 1940s brands have been used as background filling, character development and stimulation for realism in movies. Nowadays, brands pay movie-developers and game-developers $25,000-$700,000 to use the product within the movie or video game based on interactivity and visibility (Chunovic, 2002).

An important advantage of brand placements is the *possible* unobtrusiveness (i.e., they are generally secondary aspects, do not interrupt the viewer and they often add realism to the context) and are therefore less likely to result in persuasion knowledge (Edwards, Li & Lee, 2002; Friestad & Wright, 1994). Persuasion knowledge means that consumers recognize persuasion attempts. If consumers recognize persuasion attempts, this may lead to negative coping strategies such as message rejection and counter-argumentation (Petty & Cacioppo, 1986).

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In-game Advertising

In-game advertising is the paid implementation of brand identifiers through audio and visual sources within video game programming in order to increase brand awareness (D'Astous & Chartier, 2000; Karrh, 1998). Nelson (2002) was one of the first to study the effects of in-game advertising by measuring recall and recognition effects after short gaming sessions, where participants played a racing game, Gran Turismo 2, and were exposed to multiple billboards in the game. She found that 30% of the advertisements were recalled after the session and 10% after five months. Many researchers followed upon her suggestion to study the effects more specifically, but failed to find grounded evidence that could be generalized over the population, genres and the type of brand placement. Nearly all studies that followed focused on the sport or racing genres, because these genres are in real life also associated with many advertisements (Chaney et al., 2004; Grigorovici & Constantin, 2004; Nelson, 2002; Nelson, 2004; Schneider & Cornwell, 2005). Nelson (2002) even found that the absence of expected brands affected perceived realism negatively.

Implicit and Explicit Memory

Memory is the acquisition, storage and retrieval of information (Solomon, Bamossy, Askegaard & Hogg, 2010). Current study differentiated between two types of memory: explicit and implicit. Explicit memory is the intentional and conscious retrieval of events and is based on cognitive processing (Lee, 2002). Implicit memory, also known as procedural memory, consists of memory effects that occur without intentional and conscious retrieval (Law & Braun-LaTour, 2004).

Explicit and implicit memories are dissociated in terms of brain activation. Explicit memory occurs through the frontal lobes of the brain in an effortful process, whereas implicit memory occurs through the subcortical areas in a fight-flight response (Law & Braun-LaTour,

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2004). This means that in order to measure effectiveness of advertising, it is necessary to study both implicit and explicit memory.

In order to notice and process stimuli from events into the memory, the stimuli need to become part of the attention span of a certain user. Primary objects that demand attention in video games are playing and experiencing the game (Grigorovici & Constantin, 2004). Secondary objects that demand attention are optional focal points (e.g., advertisements). The limited capacity model assumes that cognitive capacity is limited and will be allocated to primary and secondary objects or tasks. If certain cognitive capacity has been allocated to a primary object, there is no possibility of allocating the same capacity to a secondary object (Nelson et al., 2006). Game-experience has been demonstrated to be closely related to capacity-allocation. Experienced players need less cognitive capacity to play a video game, leaving to use the remaining capacity for secondary aspects, whereas inexperienced players use more cognitive capacity to control the in-game character (Lee & Faber, 2007; Schneider & Cornwell, 2005). Furthermore, experienced players outperformed inexperienced players in change-detection leading to better memory creation (Boot, Kramer, Simons, Fabiani & Gratton, 2008).

Explicit memory is easy to measure and therefore it has been used in many in-game advertising studies. However, implicit memory is equally as important and may influence the interpretation of choice behavior and remains longer available in memory (Law & Braun-LaTour, 2000). Furthermore, implicit recognition is important to measure, because people tend to be unaware of what they actually experienced while playing the game.

Explicit memory stores the information of the objects allocated with cognitive capacity, while implicit memory may store the information of the objects that were not consciously allocated with cognitive capacity.

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The Effect of Extraversion on Implicit and Explicit Memory

Extraversion is the sensitivity to positive cues based on the level of warmth, gregariousness, assertiveness, activity, excitement seeking and positive emotions (Costa & McRae, 1995). Individuals that are low in extraversion (i.e., introverts) are individuals with an exaggerated thought process in relation to observable behavior. Individuals high in extraversion (i.e., extraverts) are individuals with a reduction of thought processes in relation to observable behavior (Freyd, 1924).

Many studies claim that differences in dopamine levels result in a certain level of extraversion. Based on the type of brainstem, the reticular formation (e.g., for filtering incoming stimuli) regulates the release of dopamine (see Figure 1). The prefrontal cortex is responsible for working memory, the basal ganglia is responsible for procedural memory formation (Saint-Cyr & Taylor, 1992) and both are for normal functioning dependent on the amount of dopamine (Cohen & Servan-Schreiber, 1992).
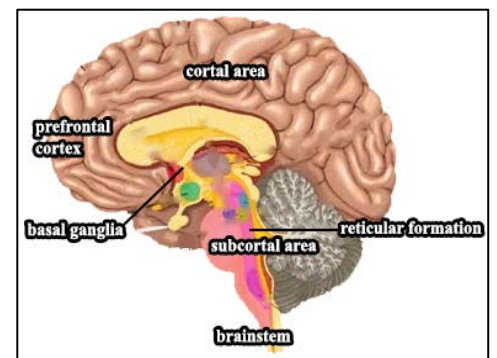
Figure 1: Simple representation of the relevant brain areas.

Dopamine is a neurotransmitter for the evaluation of pleasure, alertness, energy and happiness and is responsible for the normal functioning of working memory and procedural memory (Cohen & Servan-Schreiber, 1992). High extraversion is the result of a low level of internal arousal and creates more dopamine than internally high-aroused introversion. This increase of dopamine leads to higher performance in working memory and procedural memory, which are needed in order to recall and recognize brands. However, external arousal is equally as important, because low-arousal external context results in optimal performance for introverts and high-arousal external context results in optimal performance for extraverts (Eysenck, 1967). High-arousal external context can be created by stimulating virtual blood

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and screams of pain in video games (Jeong, Biocca, Bohil, 2009; Jeong, Bohil & Biocca, 2011).

Howarth and Eysenck (1968) demonstrated that optimal performance differs between the levels of extraversion by asking participants to remember seven pairs of associative words in a laboratory setting with retention intervals of 0 minutes to 1 day. The more immediate the recall, the bigger difference was found between introverts and extraverts. Extraverts recalled twice as many associations as introverts did.

Few studies investigated the effect of extraversion on implicit memory (i.e., procedural learning) (Corr, 2003). This is due to the possible contamination of implicit measurements: 1) A participant adopting an intentional retrieval strategy; and 2) The awareness of being tested (Schacter et al., 1989). An intentional retrieval strategy occurs when the participant consciously retrieves information from the experiment in order to give the correct answers (e.g., completion of the word fragment). Findings from one of the few studies on personality and implicit memory are that extraversion correlates with better task performances within procedural learning. In their study a drug called haloperidol (i.e., in order to decrease arousal activity) was used to artificially control the level of extraversion. Introverts performed more optimal after taking the drug, assuming that lower internal arousal increases procedural learning under time-pressure (i.e., high-arousal) external context (Corr & Kumari, 1997).

This literature review demonstrated that next to the current known aspects that affect the effectiveness of in-game advertising (e.g., prominence, frequency, visibility, age, context, game experience) (Van Opstal, 2011) studying extraversion adds an important aspect to this list, because of three reasons:

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I. Eysenck (1967) argues that extraversion is one of the most important role players in learning and memory. Extraverted participants even outperform introverts participants on time-pressured memory performance. Therefore, we hypothesize:

1A	Extraverts perform better in recall tasks in the high-arousal context than introverts.
1B	Extraverts perform better in recognition tasks in the high-arousal context than introverts.
1C	Introverts perform better in recall in the low-arousal context than extraverts.
1D	Introverts perform better in recognition in the low-arousal context than extraverts.

II. Corr and Kumari (1997) demonstrate that lower internal arousal (i.e., extraversion) increases procedural learning (i.e., implicit memory). Therefore, we hypothesize:

2A	Extraverts perform better in implicit memory tasks in the high-arousal context than introverts.
2B	Introverts perform better in implicit memory tasks in the low-arousal context than extraverts.

III. Boot et al. (2008) and Schneider and Cornwell (2005) demonstrate that inexperienced players use most of their cognitive capacity on controlling the character and that experienced players outperform inexperienced players in accuracy of change-detection. This leads to smaller differences between the players, because it is only a side-assignment for the inexperienced participants. Therefore, we hypothesize:

3A	High experience is needed to demonstrate the interaction between arousal and extraversion for recall tests.
3B	High experience is needed to demonstrate the interaction between arousal and extraversion for recognition tests.
3C	High experience is needed to demonstrate the interaction between arousal and extraversion for implicit memory tests.

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Method

The design of current between-subjects experimental study was based on the model in

Figure 2, which is created from the literature review on extraversion, arousal and memory.
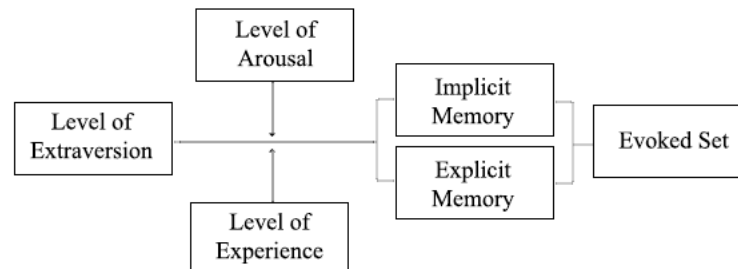

Figure 2: Extraversion Effect on Brand Placement Memory Performance Moderated by Level of Arousal and Level of Experience.

Current study used a 2 (low extraversion, high extraversion) x 2 (low in-game arousal,

high in-game arousal) x 2 (low experience, high experience) between-subjects

experimental design.

Participants

One-hundred participants from gaming forums (e.g., http://xgn.nl and http://gtagames.nl) and

the environment of the researcher (80 men and 20 women; 68 highly educated and 32 poorly

educated) average aged 26.3 years (SD = 13.4) voluntarily participated in this experiment.

There were 50 introverts and 50 extraverts randomly assigned to each of the two arousal

conditions. Fifty-seven participants were experienced in GTA V and 43 participants were

inexperienced in GTA V.

Procedure

Participants were told that the study investigated the relationship between personality and

memory performance. They completed a personality test (see Appendix 1) and listened to

instructions about the experiment. They drove through the virtual world (see Appendix 6),

followed the instructions of the researcher (see Appendix 5) and performed tasks for fifteen to

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twenty minutes. After the play session, the participants were given a recall test, a recognition test, and a word-completion test, each with its own instructions (see Appendices 2, 3 and 4).

Pre-test

In order to demonstrate the difference in arousal between the low-arousal context and the high-arousal context, a pre-test was executed with sixteen participants wearing a Polar RCX5 Heartbeat Control. From these statistics heartbeat measurements were used at zero minutes (null-measurement), three minutes, six minutes and twelve minutes in both the low-arousal and high-arousal condition. This was done in order to confirm the research design and demonstrate that the factor of stress or arousal was significantly higher in the high-arousal condition than in the low-arousal condition.

An ANCOVA [between-subjects factor: arousal (low, high); covariate: null-measurement heart beat] revealed that the heartbeat (in beats per minute) was significantly higher in the high-arousal condition than in the low-arousal condition at three minutes, six minutes and twelve minutes. At nine minutes, the heartbeat was non-significantly higher in the high-arousal condition than in the low-arousal condition (see Table 1 and Figure 3).

Measure	Low-arousal		High-arousal		F (1, 13)	p
	M	SD	M	SD		
At three minutes	71.41	2.58	82.47	2.58	7.54	0.02
At six minutes	70.16	2.07	81.46	2.07	12.26	<0.01
At nine minutes	71.41	3.21	81.59	3.20	4.14	0.06
At twelve minutes	71.54	2.22	79.96	2.22	5.91	0.03

Table 1: Means and standard deviations of pretest.

Figure 3: Example of low-arousal versus high-arousal (heartbeat per minute), illustrating the typical differences between the two conditions.

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Stimulus materials

The Dutch-revised Eysenck Personality Questionnaire was utilized in this study (see

Appendix 1). It is a questionnaire containing nineteen yes- or no-questions dealing with

personality. In the past Cronbach's Alphas of 0.72-0.85 were reported in seven studies

(Sanderman et al., 2012). Cronbach's Alpha in current study was 0.834 based on the nineteen

items (n=100).

The video game Grand Theft Auto V was used for controlling arousal and used as

input for memory performance tests (see Figures 4, 5, 6 and 7 for examples). It is a free-

roaming video game released in 2013 where the player decides whether to play violent or

non-violent, containing thousands of non-existent brand identifiers. These non-existent brand

identifiers increase the possibility to test in isolation (Nelson et al., 2006). The gaming

consoles Sony PlayStation 3 (with a DualShock 3 Controller) and Microsoft Xbox 360 (with

an Xbox 360 Wireless Controller) were used to play the video game.

Figures 4 & 5: Participants bought candy and took a holiday self-portrait in front of 'Vinewood' in the low-arousal condition.
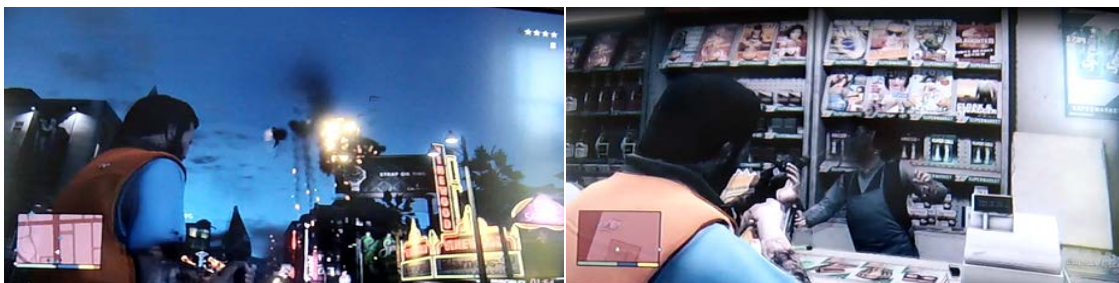
Figures 6 & 7: Participants destroyed police helicopters and robbed the supermarket in the high-arousal condition.

The environment of the experiment was either in a living room or bed room offline.

Skype (http://skype.com) and an iPad Mini with webcam and microphone were used to

execute the experiment online. The logo sheet was sent in a Microsoft Word file.

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A custom-made memory test was utilized in this study (see Appendices 2, 3 and 4): A memory test containing three sections of recall (nine categories), recognition (63 brand logos) and fourteen word-completion tasks.

Measures

Current study used independent variables extraversion, experience and arousal. The dependent variables were recall, recognition and word completion performance.

Extraversion. Sanderman et al. (2012) revised the Eysenck Personality Questionnaire in The Netherlands for the evaluation of extraversion based on nineteen items (see Appendix 1). The level of extraversion increased with yes-answers on questions 1-5, 7, 9, 10 and 12-19, and with no-answers on questions 6, 8 and 11. For the purpose of the study design, two groups were formed: introverts (score 0-9) and extraverts (score 10-19).

Experience. This variable was measured with a 1-item scale. Participants had to indicate their level of experience with the video game GTA V on a scale from one (i.e., no experience) to five (i.e., ten hours or more experience). Participants with over 6 hours experience in-game were assumed to be experienced and those with less experience were assumed to be inexperienced.

Recall. This variable was measured by the number of correct recalls. Participants were asked to name all the brand names they could remember from the play session and were assisted with nine categories, in which the brand names could fit (websites, car brands, radio channels, daily life products, shops, restaurants, beer, television programs and the category 'other'). Recall is a suitable measure for memory performance, because the data are easy to compare due to the pragmatic nature of surveys (Law & Braun-LaTour, 2004). Considering that awareness is the goal of brand placement, the fitting of these tests is high. Recall test questions are "Which car brands did you notice while playing the game?"

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Recognition. This variable was measured in the number of correct answers of logo recognition corrected with the incorrect answers. The maximum number of correct logos was 46 and the maximum number of incorrect logos was 17. The final score was calculated with the d-prime analysis in order to filter sensitivity and bias. d' is the standardized difference between the means of the Signal Present (hit and miss) and Signal Absent (false alarm and correct rejection) distributions. This d' score was calculated using the formula $d' = z(H) - z(F)$. $z(H)$ is the z-score of the hit rate and $z(F)$ is the z-score of the false alarm rate. The d-prime analysis calculates the sensitivity bias in order to correct mistakes made by participants that were biased to claim that they had seen a lot of logos of which a certain number was a false alarm (Keating, 2005). As an illustration, a low score of -0.03 consisted of thirteen correct recognitions (hits) and five incorrect recognitions (false alarm). A high score of 2.68 consisted of 26 correct recognitions and zero incorrect recognition.

Word-completion. This variable was measured in the number of correct completions of word-fragments (see Appendix 4). The highest possible score was 14. Implicit recognition is more difficult to measure, using performance tests such as the word-completion test (McDowell, Lustig & Parkin, 1995; Tulving, Schacter & Stark, 1982) to find changes in performance (Yang, Roskos-Ewoldsen, Dinu & Arpan, 2006). In this test a word fragment (e.g., Total B) needs to be transferred into meaningful combinations by filling in the missing word (e.g., Total Bankers).

Results

This section analyses the effect of extraversion on the memory performance scores of participants in the video game Grand Theft Auto V played in both conditions.

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A total of 100 participants filled in the memory tests. In Figure 8, aided recall and word completion represent the number of correct recalls or correct completions of brand names in the test. Recognition is the d' score (see section Recognition for calculation).

Measure	N	Min	Max	M	SD
Aided Recall	100	0	18	7.12	4.14
Word Completion	100	0	9	2.61	1.61
Recognition	100	-0.33	2.68	1.02	0.70

Figure 8: Descriptive statistics of the memory performance tests.

Recall

A 2x2x2 ANOVA was conducted to investigate the effects of arousal (low, high), extraversion (low, high) and experience (low, high) on recall. Shapiro-Wilk and Levene's tests were used to evaluate the assumptions of normality and homogeneity of variance. Neither was violated.

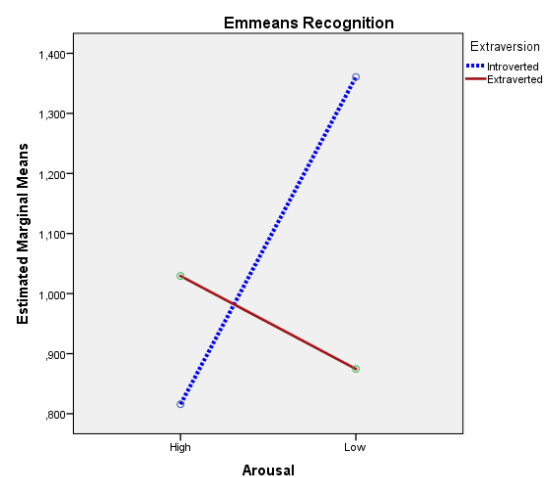The ANOVA revealed a main effect of experience, $F(1, 92) = 61.13$, $p < 0.01$. High experience levels ($M = 9.26$, $SD = 3.57$) had significantly higher recall than low experience levels ($M = 4.28$, $SD = 2.30$).There was no significant main effect for arousal, $F(1, 92) = 1.41$, $p = 0.24$, or extraversion, $F(1, 92) = 0.03$, $p = 0.87$.

A significant interaction between arousal and extraversion was found, $F(1, 92) = 13.026$, $p < 0.01$. In the high-arousal condition extraverts had significantly higher recall than introverts and in the low-arousal condition extraverts had lower recall than introverts (see Figures 9 and 10). Therefore, hypotheses 1A (extraverts perform better in recall tasks in the high-arousal context than introverts) and 1C (introverts perform better in recall in the low-arousal context than extraverts) are accepted. See Figure 9 for means and standard deviations of the four conditions.

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Condition	Introversion		Extraversion	
	M	SD	M	SD
High-Arousal	5.40	3.11	7.84	3.85
Low-Arousal	8.88	5.06	6.36	3.34

Figure 9: Means and standard deviations of recall in the four conditions.

The predicted interaction among arousal, extraversion and experience was not significant, F (1, 92) = 0.90, p = 0.35. Therefore, hypothesis 3A is rejected: High experience is needed to demonstrate the interaction between arousal and extraversion for recall tests.
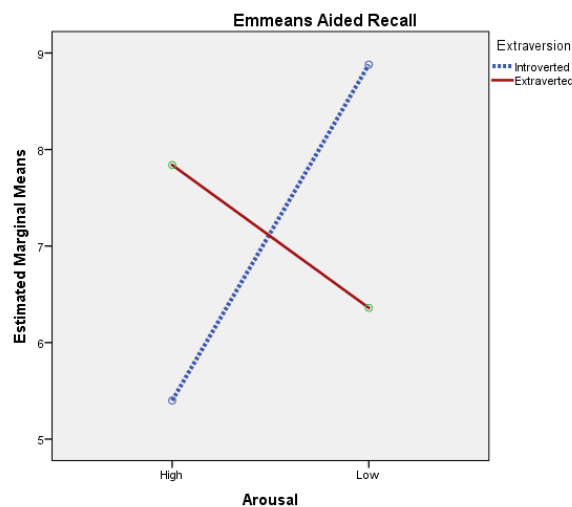
Figure 10: Estimated Marginal Means of Recall demonstrate the interaction between arousal and extraversion.

4.2.1. Recognition

A 2x2x2 ANOVA was conducted to investigate the effects of arousal (low, high), extraversion (low, high) and experience (low, high) on recognition. Shapiro-Wilk and Levene's tests were used to evaluate the assumptions of normality and homogeneity of variance. Neither was violated.

Figure 11: Estimated Marginal Means of Recognition demonstrate the interaction between arousal and extraversion.

The ANOVA revealed a main effect of experience, F (1, 92) = 20.84, p < 0.01. High experience levels (M = 1.26, SD = 0.67) had

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higher recognition than low experience levels (M = 0.70, SD = 0.59). There was no significant main effect for arousal, $F(1, 92) = 2.45$, $p = 0.12$, or extraversion, $F(1, 92) = 1.08$, $p = 0.30$.

A significant interaction was found for arousal and extraversion, $F(1, 92) = 6.02$, $p = 0.02$, as can be seen in Figure 11. In the high-arousal condition extraverts had significantly higher recognition than introverts and in the low-arousal condition extraverts had significantly lower recognition than introverts (see Figures 12, 14 and 15). Therefore, hypotheses 1B (extraverts perform better in recognition tasks in the high-arousal context than introverts) and 1D (introverts perform better in recognition in the low-arousal context than extraverts) are accepted.

Condition	Introversion		Extraversion	
	M	SD	M	SD
High-Arousal	0.82	0.64	1.02	0.74
Low-Arousal	1.36	0.69	0.87	0.59

Figure 12: Means and standard deviations of recognition in the four conditions.

Also a three-way interaction between arousal, extraversion and experience was revealed, $F(1, 92) = 7.75$, $p < 0.01$. High experienced extraverted participants had higher recognition in the high-arousal condition than high experienced introverts and high experienced introverted participants had higher recognition in the low-arousal condition than high experienced extraverts (see Figures 13-15). The interaction between arousal and extraversion was non-significant for low experienced participants (see Figure 14). Therefore, hypothesis 3B was accepted: High experience is needed to demonstrate the interaction between arousal and extraversion for recognition tests.

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| | Low Experience | | | | High Experience | | | |
| | Introversion | | Extraversion | | Introversion | | Extraversion | |
Condition	M	SD	M	SD	M	SD	M	SD
High-Arousal	0.68	0.60	0.48	0.41	0.92	0.67	1.46	0.66
Low-Arousal	0.89	0.66	0.78	0.66	1.67	0.51	0.95	0.53

Figure 13: Means and standard deviations of recognition in the four conditions split by experience.
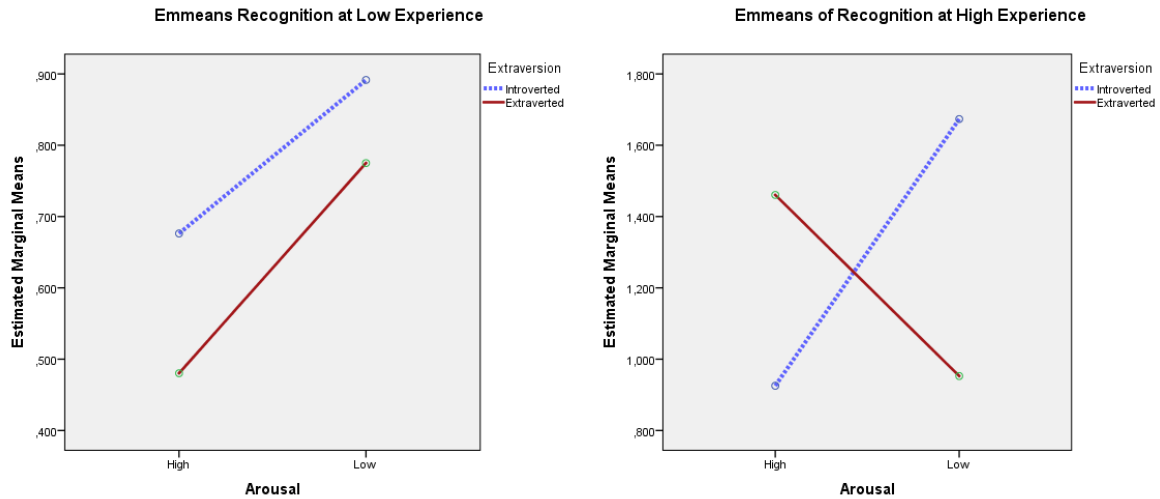
Figures 14 & 15: Estimated Marginal Means of Recognition demonstrate no interaction between arousal and extraversion in low experience and an interaction at high experience.

4.2.2. Word completion

A 2x2x2 ANOVA was conducted to investigate the effects of arousal (low, high), extraversion (low, high) and experience (low, high) on word completion. Shapiro-Wilk and Levene's tests were used to evaluate the assumptions of normality and homogeneity of variance respectively. Homogeneity was not violated, but one group (introversion in low-arousal) violated the Shapiro-Wilk assumption.

The ANOVA revealed a main effect of extraversion, $F(1, 92) = 4.40$, $p = 0.04$. Introverts ($M = 2.94$, $SD = 1.63$) had significantly higher completion performance than extraverts ($M = 2.28$, $SD = 1.54$). Also a main effect was revealed for experience, $F(1, 92) = 15.12$, $p < 0.01$. High experience levels ($M = 3.12$, $SD = 1.74$) had significantly higher

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completion performance than low experience levels (M = 1.93, SD = 1.12). There was no significant main effect for arousal, $F(1, 92) = 1.49$, $p = 0.23$.

These main effects were not qualified by interactions between arousal and extraversion, $F(1, 92) = 2.32$, $p = 0.13$, or arousal, extraversion and experience, $F(1, 92) = 0.15$, $p = 0.70$ (see Figure 16). Therefore, hypotheses 2A (extraverts perform better in implicit memory tasks in the high-arousal context than introverts) and 3C (high experience is needed to demonstrate the interaction between arousal and extraversion for implicit memory tests) are rejected. Hypothesis 2B, introverts perform better in implicit memory tasks in the low-arousal context than extraverts, is accepted.
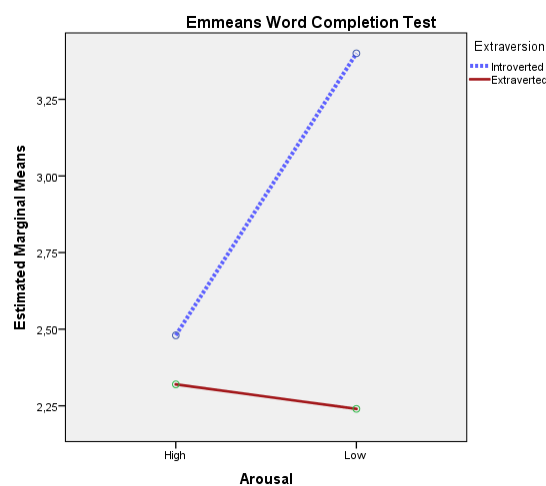
Figure 16: Estimated Marginal Means of Word-Completion demonstrate no interaction between arousal and extraversion.

Conclusion

This study found evidence for an interaction between arousal and the level of extraversion that affects memory performance on in-game advertised brands. It turned out that experience was another important factor in determining performance and even interacted with both extraversion and arousal when it concerned recognition. In the results section the acceptance or rejection already had been demonstrated for the first time.

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For recall, the level of extraversion interacted with the arousal condition. Extraverts performed better in the high-arousal condition than introverts, while introverts performed better in the low-arousal condition. Furthermore, game-experience was demonstrated to be a main effect in the performance on recall for all conditions.

For recognition, the level of extraversion interacted with the arousal condition and with the level of experience. Extraverts performed better in the high-arousal condition than introverts, while introverts performed better in the low-arousal condition, only if the participants were high-experienced. In a low-experienced context, extraversion did not play a significant role. No interaction was found between arousal and extraversion for low-experienced participants. Also for recognition, experience demonstrated to be a main effect in the performance for all conditions.

For word-completion, the level of extraversion did not interact with the arousal condition. Extraverts did not perform better in the high-arousal condition than introverts. However, the level of extraversion demonstrated to be a main effect on the word-completion performance. Introverts performed better in total than extraverts and thus in the low-arousal condition.

In Figure 17 this study's hypotheses are summarized as accepted (V) or rejected (X).

H#	Hypothesis	
1A	Extraverts perform better in recall in the high-arousal context than introverts.	V
1B	Extraverts perform better in recognition in the high-arousal context than introverts.	V
1C	Introverts perform better in recall in the low-arousal context than extraverts.	V
1D	Introverts perform better in recognition in the low-arousal context than extraverts.	V
2A	Extraverts perform better in word-completion in the high-arousal context than introverts.	X
2B	Introverts perform better in word-completion in the low-arousal context than extraverts.	V
3A	Experience demonstrates the arousal-extraversion interaction for recall.	X
3B	Experience demonstrates the arousal-extraversion interaction for recognition.	V
3C	Experience demonstrates the arousal-extraversion interaction for word-completion.	X

Figure 17: Summary of acceptance (V) or rejection (X) of this study's hypotheses.

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Discussion

The results of this study are an important addition to the current knowledge on in-game advertising and extraversion. The findings of this study are the first to demonstrate the effect of extraversion on memory performance in in-game advertising. Specifically for practical purposes on how to reach target groups based on personality in video games, this study formulates a clear vision of how to reach introverted and how to reach extraverted targets.

Consistent with existing literature. In current study, the findings that extraverts perform better than introverts in high-arousal contexts and introverts perform better than extraverts in low-arousal contexts is in line with many studies into extraversion and explicit memory performance (Eysenck, 1967). This is because extraverts have a lower level of internal arousal, resulting in more dopamine creation, which is responsible for the functioning of working memory and procedural memory (Cohen & Servan-Schreiber, 1992). Extraverts have low internal arousal and can therefore progress more external arousal. Introverts reach the maximum of their internal arousal faster, resulting in lower performance when external arousal is high (Eysenck, 1967; Howarth & Eysenck, 1968). Also in line with existing research is the reason why the high-arousal context was considered to be more arousal-creating. This is because of the high amount of violence, blood, screams and speed in the high-arousal compared to no blood, no violence, no screams and slower speed in the low-arousal condition (Jeong, Biocca & Bohil, 2009). The findings of this study demonstrated that experience, especially for recognition, had an important interaction with arousal and extraversion, which is in line with studies by Boot et al. (2008). This lack of significant recognition effect for low-experienced participants can be explained with studies by Lee & Faber (2007), Grigorovici and Constantin (2004), and Schneider and Cornwell (2005). Advertising is one of the secondary aspects in video games, playing the video game is the primary aspect. In case of inexperienced players, a high amount of cognitive capacity is

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allocated to the primary aspect. Therefore, there is a limited amount left for the secondary aspects. Playing Grand Theft Auto V turned out to be quite difficult for non-experienced players.

Inconsistent with existing literature. The findings of the study are not in line with implicit memory performance studies by Corr and Kumari (e.g., 1997). Introverts performed better in word-completion, no matter the condition. As described in the literature review, introverts are characterized by exaggerated thought processes in relation to observable behavior (Freyd, 1924). This means that introverts were more likely to use intentional retrieval strategies as described by Schacter et al. (1989). Because of the intentional retrieval strategy (i.e., in contrast to the necessary unintentional retrieval strategy), introverts could more easily think about the correct word-completion. Therefore, introverts could get higher performance on this specific test. However, in the high-arousal condition, introverts still had a low performance due to the fact that these participants did not process the brand identifiers during the stressful play session. Extraverts, on the other hand, performed poor on both conditions because of the fact that these participants were less likely to use their thought processes and were therefore less likely to use intentional retrieval strategies (Freyd, 1924; Schacter et al., 1989). This caused random and even non-existent completions of the word-fragments by extraverts, resulting in poor performance scores. Finally, unfamiliarity kept the performance scores relatively low, causing a smaller potential of differences in the conditions due to higher cognitive elaboration (Nelson, 2002; Russell, 2002). For example, many inexperienced participants mentioned brands such as Sprite, Coca-Cola, Audi, Mercedes-Benz, because they had seen the parody brand Sprunk, eCola, Obey or Benefactor.

Future research. For future research, it would be interesting to apply this study design on other media. Television programs, movies, internet websites, and applications all could show similar effects, which are important to know if an organization is willing to target

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on extraversion or personality in general. Until this date, there are a few or no studies that connect extraversion with memory performance of brand placements. Finally, the number of participants in current study was quite low due to time-constraints. More participants of each cell can therefore increase the significance and generalization of current study. Other personality characteristics (e.g., neuroticism) may as well be researched within this study design as an extra variable.

Practical implication. The practical implication of the results of current experiment is that those who were investing time and money in in-game advertising without the acknowledgement of the effect extraversion has on memory performance in video games (i.e., advertisement effectiveness) should re-consider their view on in-game advertising targeting. The current study supports the idea that the level of extraversion has an effect on memory performance based on low-arousal or high-arousal conditions. Investors with an introverted target group should integrate their brand identifier in low-arousal video game contexts, whereas investors with an extraverted target group should integrate their brand identifier in high-arousal video game contexts (i.e., blood, screams, fast speed, weapons, cursing, etc.).

General conclusion. Current study demonstrated that extraversion has a significant effect on memory performance based on the external arousal created by the environment. Furthermore, it was demonstrated that game-experience is an important central aspect that affects both the absolute performance (i.e., high-experience results in higher performance) and the relative performance (i.e., high-experience results in more significant differences between the levels of extraversion) in in-game advertising.

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Appendix 1: Eysenck Personality Questionnaire (Dutch)

Would you kindly answer each question with yes or no? There are no correct or incorrect answers possible. It is not needed to think about the answer long.

ja nee

1 Heeft u veel verschillende hobby's? ☐☐

2 Bent u een spraakzaam persoon? ☐☐

3 Bent u een levendig persoon? ☐☐

4 Kunt u zich meestal op een levendig feest uitleven en er geheel van genieten? ☐☐

5 Vindt u het prettig om nieuwe mensen te ontmoeten? ☐☐

6 Bent u iemand die geneigd is zich op de achtergrond te houden tijdens

sociale evenementen (bijv. op feestjes)? ☐☐

7 Houdt u veel van uitgaan? ☐☐

8 Vindt u lezen fijner dan mensen ontmoeten? ☐☐

9 Heeft u veel vrienden? ☐☐

10 Bent u degene die meestal het initiatief neemt bij het maken van nieuwe vrienden? ☐☐

11 Bent u meestal stil als u in een gezelschap bent? ☐☐

12 Kunt u gemakkelijk wat leven in een nogal saai feestje brengen? ☐☐

13 Vindt u het leuk moppen en grappige voorvallen te vertellen aan uw vrienden? ☐☐

14 Vindt u het prettig om in contact met mensen te komen? ☐☐

15 Heeft u altijd een "antwoord klaar" als mensen tegen u praten? ☐☐

16 Vindt u het leuk dingen te doen waarbij u snel moet handelen? ☐☐

17 Kunt u een feest op gang brengen? ☐☐

18 Vindt u het prettig om veel drukte en opwinding om u heen te hebben? ☐☐

19 Vinden anderen u een levendig persoon? ☐☐

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Appendix 2: Aided Recall Test

Would you kindly take a look at the following categories and recall each brand you can remember from this play session?

Websites	Radio channels
Television programs	Restaurants and cafes
Car brands	Beer brands
Stores	Daily products
Other	

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Appendix 3: Image Recognition Test

Would you kindly take a look at all the logos and determine whether or not you have seen it during the play session? You can tick the boxes behind the logos, which are in the correct order represented. There are correct and incorrect answers possible.

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Appendix 4: Word Completion Test

Would you kindly complete each word fragment by filling in the first word that comes up your mind? There is a possibility of correct and incorrect answers.

Total B

White W

Digital D

Full Moon F

Subu

Dungeon C

Hippy F

Smell Like a B

Hardcore C Store

Von C Hotel

Tsu

Dop

Egoc   P's &

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Appendix 5: Task lists

	Low-arousal	High-arousal
	First instructions: **do not drive faster than other cars, do no drive through red traffic lights, do not hit other cars or people.**	First instructions: **drive fast, road-kill pedestrians, ram other cars, etc. Use the cheat code of invincibility: →, X, →, ←, →, R1, →, ←, X, Triangle.**
1	Leave Michael's (main character) house. Open your mobile phone. Go to the internet browser. Search for the term 'life' and open the first website. Scan this website.	Leave Michael's (main character) house. Open your mobile phone. Go to the internet browser. Search for the term 'life' and open the first website. Scan this website.
2	Enter Michael's car, select radio channel **Non-Stop Pop FM** and drive to leave the garden. Go to the right and again to the right, Mind the traffic lights.	Enter Michael's car, select radio channel **Channel X** and drive to leave the garden. Go to the right and again to the right, Mind the traffic lights.
3	Follow the road until I say so → go outside of your car and **take a holiday picture of the street view**. Be aware that you include everything you think is important in this view. **Get into the car, follow the road** and scan the long street for the word 'Doppler'. If you have found the word, you may tell me the color of its letters.	Follow the road until I say so. **Kill some pedestrians with your car.** Go outside of your car and take a picture of the street view and the **victims**. Be aware that you include everything you think is important in this view. **Choose your gun, shoot everyone you see and kill the police. Run through the street** and scan the long street for the word 'Doppler'. If you have found the word, you may tell me the color of its letters.
4	After you found Doppler, you can go to the next intersection, **park your car safely** and get out of the car. In the middle of the intersection, you may take a selfie (self-portrait) with the white letters in the back on the mountain. Drive towards those white letters and go left on the next intersection. In this street you can find a supermarket on your right. If you have seen it, you can enter the supermarket. In the supermarket you have to look for donuts and choose a color, also look for beer and choose the brand you would like to purchase. Go to the shop-owner, find out if you have the correct payment methods and **buy some candy and soda**. Leave the shop.	After you found Doppler, you can go to the next intersection, **park your car on the middle of the intersection to cause traffic chaos** and get out of the car. In the middle of the intersection, you may take a selfie (self-portrait) with the white letters in the back on the mountain. Drive towards those white letters and go left on the next intersection. In this street you can find a supermarket on your right. If you have seen it, you can enter the supermarket. In the supermarket you have to look for donuts and choose a color, also look for beer and choose the brand you would like to purchase. Go to the shop-owner, find out if you have the correct payment methods, **rob him and kill him. Shoot the soda bottles and get away from the police.**
5	Go back to the intersection where you took a selfie and go straight to the next intersection. Go to the right, enter the parking and look around you. **Drive to the clothing store on your map, go inside and purchase a shirt.**	Go back to the intersection where you took a selfie and go straight to the next intersection. Go to the right, enter the parking and look around you, **buy a weapon. Drive full-speed with your car against the door of the clothing store and kill the people in front of it.**

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Appendix 6: Controlled Route

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