The effect of computer game-induced arousal level on short-term memory

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ABSTRACT

All companies wish their brand name is remembered by consumers. Commercials on television and the Internet are still developing, making use of scientific findings, since the topic of advertisement has widely been studied. A relatively new medium in the marketing field is the videogame medium. Emotion, with arousal as a key component, is a very important aspect in remembering and forgetting. This study shows that arousal effects, found in other studies and applied to TV-commercials, might be applicable to games as well.

INTRODUCTION

The last decennia were the era in which the digital world grew tremendously. Instead of reading, people turned to watching television and instead of playing outside, children became enthusiastic computer gamers. The development of these media brought entertainment for consumers and also new possibilities for marketers. Commercial breaks are interwoven with television programs. Companies pay high rates to get their advertisements on the tube, especially when a program, show or sport match is expected to get very high viewing figures.

Besides commercials on television, advertisements have found their way to the PC as well. On the Internet, sometimes one has to watch a short commercial before the desired videoclip appears on the screen. Large scale implications of advertising in video games ('in-game advertisement') do not yet exist (Nelson, 2002, 2004 and 2006), but are bound to follow according to various videogame websites (e.g., In-game-advertising.nl, Insidegamer.nl and IGN.com).

A commercial break, as the word implies, always interrupts something. People tune in to watch a TV-program, not to watch commercials. Focusing on the commercials makes the TV-programs the context, which takes considerably more time than the commercial itself. Given this fact, it is worthwhile to examine what the influence is of the context on the memory of the commercial that should be remembered. After all, the purpose of a commercial often is the remembrance of a specific brand (Jobber & Fahy, 2009).

The perception of context can be measured by emotion. As Russell (1980) states, emotion consists of two major components: valence and arousal. Valence describes the direction of the emotion, such as: happy, sad, or angry. Arousal is the level of intensity of the emotion, for instance: very happy versus a little happy. Arousal has to do with excitement and alertness. The current study ignores the valence of emotion in favor of a focus on arousal. The main reason not to take valence into account is the requirement of a pretest to tell which games cause a particular emotion, while the level of arousal caused by a game could partly be speculated. In addition, to take both valence and arousal into account demands a higher number of participants than expected in order to find statistical significant results.

A distinction can be made between two situations where arousal can have an effect. In the first situation someone watches a TV-program, browses the Internet or plays a videogame and in doing so, an emotion is elicited. The second situation contains a commercial break. Zillmann (1971) demonstrates that the first situation acts like a stimulus which can affect the second situation. The arousal awakened by for example e.g. watching television or playing a videogame, stays active in the moments after situation one ended. This phenomenon is called excitation transfer. Newell et al. (2001) explicates in the intensity theory the influence of the excitation transfer. When arousal is high, remembrance is worse compared to remembrance in a low arousal condition.

Since such effects have been found for radio commercials (Shapiro, MacInnis & Park, 2002), magazine advertisements (Norris & Colman, 1992), and television commercials (Broach, Page & Wilson, 1995; Coulter, 1998; Furnham, Gunter & Walsh, 1998; Gorn, Pham & Sin, 2001), the next step

is to examine if the same results can be found for videogames. This leads to the research question of the current study:

What is the effect of computer game-induced arousal level on short-term memory?

It is likely that the more distraction comes up, the harder it will be to keep remembering something (e.g., Waugh & Norman, 1965; Wickens, 1972; Altmann & Gray, 2002). Memory becomes faint due to time (decay) or interference. Looking back on earlier research on this topic shows that the influence of interference is stronger in high-arousal conditions. This statements are supported by the intensity theory (Newell et al., 2001) and analysis of music-induced arousal (Ruitenberg, 2009) and program arousal effects (Bolhuis, Heuvelman & Verleur, 2006). The difficulty to keep a memory of a stimulus alive because of a high arousing state is called the post-arousal impairment (Mundorf et al., 1991). Together with the assumption that music-induced arousal and TV-induced arousal do not differ from game-induced arousal, these studies and theories leads to the hypothesis:

Participants who play a game in a low-arousal level do recall more products and brands than participants who play the game in a high-arousal level.

Two treatment conditions were framed, with level of arousal functioning as the independent variable. In condition one, subjects played the computer game in a way that the gameplay should create none or only little arousal; condition two contained a gameplay assumed to be high-arousing.

METHOD

Subjects

Participants of this study were 62 university students, of whom 18 were male and 44 were female and varying in age between 18 and 25 years old (mean age = 21.0 years; SD = 1.5). These subjects were randomly assigned to one of two conditions. A few people participated without expecting a reward, but most of the students received course credits after attendance.

Design

The design used for the study is uni-factorial (level of game-arousal: high versus low) and the acquisition is between-subjects, with memory for game details and memory for products as the dependent variables. The memory test for game details was measured with cued recall, whereas the producttest was measured purely through free recall.

Apparatus

Arousal. The level of arousal was measured using a sheet with a printed version of the Self Assessment Manikin (SAM) scale, a visual scale which represents the user's emotional response to a stimulus, with respect to the dimensions arousal, valence, and dominance (Lang, 1985). In this study, only the SAM for arousal was used. Participants are asked to indicate how they feel at the moment and select the image that corresponds most. The scale, consisting of five images standing next to each other, runs from 1 (an image showing no arousal at all) up to 9 (high aroused). Not every single number is coupled to an image, which leaves the option open to score between two manikins. In this study, two SAM-scores were obtained: the first score at the beginning of the experiment (SAM 1) and the second score directly after playing the game (SAM 2).

Stimulus. To differ in arousal, it is important to find a game in which the settings can be changed in a way that it fits for condition one and condition two. Subjects should also be restricted in the freedom of the gameplay to prevent that undesirable side-effects occur (e.g. high varieties in duration). Considering this, the race game 'Mario Kart Wii' (Nintendo, 2008) was chosen as stimulus in this experiment, because of many options to vary in gameplay. Race games give the opportunity not only to change the difficulty setting (hard for high-arousal, easy for low-arousal) but also to choose to race against opponents and use power-ups (high-arousal), or to disable those two settings. A racing game has the advantage above some other types of videogames that there is only one way to play the game, only one direction (in comparison with a first-person-shooter, where the gamer has a 'sandbox-experience': you can walk wherever you want). Another advantage is the ease to play the game: all you need is knowing how to accelerate, brake and steer. Furthermore, the game meets the three key components mentioned by Choi (2004): the *goal* of Mario Kart is to drive as fast as possible to win the race; to obtain this goal players possess a kart (the *operator*) to drive and in the high-arousal condition, players are able to use power-ups to drive faster or shoot at opponents; *feedback* is given by 'powerstrips' on the road for driving faster, a grassy and sandy bank at both sides of the road for driving slower and, exclusively in the high-arousal condition the current rank number in the upper right corner of the screen, sound effects and a rumble controller.

The game was played on a Nintendo Wii, controlled with a Nintendo GameCube controller and displayed on a television screen. The track, number of laps, character and kart were for both groups similar. Yet, some differences were adopted. Depending on the condition participants were assigned to, they played the game against hard computer players (high-arousal) or individual (low-arousal). Other settings being disabled in the low-arousal condition and enabled in the high-arousal condition were: 150 cc class (fast gameplay), presence of power ups, music and sound effects, rumbled controller and power slides (a technique to obtain a turbo boost by taking a sharp bend).

Memory. Two memory tests were administered, both printed questionnaires. The first query sheet consists of 6 questions (open-ended and multiple-choice) concerning the game (from this point called gametest). Examples are: 'How many laps did you drive?' and 'What did the banner at the finishing line read?'. Each correct answer was worth one point (sometimes, an answer was partly correct, which earned 0.5 points). In the gametest, a maximum score of 6 points could be obtained. The second questionnaire (from this point called producttest) asked to freely recall two aspects of the pictures that were shown to the participants by means of a slideshow before playing the game. These two aspects are: type of products and brands. The slideshow was developed for this study and contains 20 pictures of products. The types of products were diverse and all were clearly labeled with a brand (for a complete list of the products, see appendix 2). Some brands were well-known, like Snickers and Nike, whereas others less well-known, such as Kwatta and Prockey. Each correct named product is worth one point; each correct named brand is worth two points. In the producttest, a maximum score of 60 points could be obtained.

Procedure

The experiment took place in an office room of the University of Twente for a period of 3 weeks. A session had the duration of about 25 minutes. Upon arrival of the participant, the experiment started with filling out a short form to obtain information about age and gender as well as game experience and the arousal level at that moment. After having filled out this form, subjects watched a slideshow containing 20 pictures of products, displayed on a 19-inch TFT-screen. Every picture was shown for 5 seconds. The sequence in which the products appeared was identical for all subjects. None of the products were in real appearance present in the room and no instructions were given to memorize the pictures.

After viewing the products, a short instruction about the controls was presented on the screen. The researcher explained the same information by presenting the controller and verified that the subject understood how to control the kart. In the high-arousal condition, participants were also shortly introduced to the power-ups and how to use them. The instruction part took approximately 1 minute and was followed by playing the game. Seated in a chair in front of the television, the participant drove 3 laps of the relatively easy track called Luigi's circuit. When the finishing line is reached, the participant receives respectively the game questionnaire and the product questionnaire. Including the game questionnaire was the second SAM-scale and the request to rate one's own race performance. While giving the final test, participants are told they have plenty of time, that is, 10 minutes, to recall as many products and brands as they remember.

RESULTS

Because the slideshow of products was developed for this study, it has not yet been validated. The type of product remembered the best was car (79.0 %) and shampoo and toilet cleaner the worst (25.8 %). Concerning the brands, the first three and the last brand were remembered the best, respectively Snickers (90.3 %), Landrover (69.4 %), Pepsi (61.3 %) and Nike (53.2 %), suggesting a primacy effect. The generally unknown brands Prockey (6.5 %) and Kwatta (11.3 %) indeed proved to be unknown to participants.

In analyzing the results, it is important to verify if the control group (low arousal) differs statistically from the experimental group (high arousal) in the scoring of SAM. Did the subjects who raced against computer players get more aroused than subjects who raced a time trial? On average, participants scored nearly 1 point higher on the second SAM-test ($M = 0.92$; $SD = 1.73$). However, the significant correlation found is relatively low ($r = .45$, $p < .001$), so an independent samples t-test was conducted to see what the differences between the high arousal and low arousal groups might be. This test showed that there is a difference between SAM 1 and SAM 2, but the difference is not significant: $t(60) = 1.41$, $p = .17$.

It is interesting to see that with a significance level of .05 there seems to be a correlation between game-experience and gender ($r = -.63$, $p < .01$), with more game experience for males ($M = 2.33$; $SD = 0.78$) in comparison with females ($M = 1.32$; $SD = 0.47$), whereby gaming over 5 hours per week scores 3 points, gaming 1 hour per week scores 2 points and never gaming scores 1 point. Furthermore, as expected, the better the racing time and end position was, the higher one scores his own racing performance.

No significant correlation was found between scores on game experience and scores on memory recall.

Looking at the gametest, it makes a difference whether one played the game in the high-arousal condition or the low-arousal condition: high-aroused participants remember fewer details ($M = 2.24$; $SD = 0.95$) compared with low-aroused participants ($M = 2.73$; $SD = 0.91$), $t(60) = 2.05$, $p < .05$.

On the producttest, the low-arousal group scores approximately the same ($M = 22.97$; $SD = 8.40$) as the high-arousal group ($M = 24.71$; $SD = 9.23$), pointing out a non-significant difference: $t(60) = -.78$, $p = .44$). Apparently, the short-term memory to remember products was not influenced by the level of arousal. Over all, participants scored very well on this memory test, most of them remembering 9 products and brands, or even more.

The time between playing the game and answering the questions of the memory tests was at most 30 seconds for the gametest and about 180 seconds for the producttest. On average, the game was played in about 100 seconds. Taking this short periods all together makes a period of about 5 minutes between seeing the last picture of the slideshow and recalling the products in the memory test. Even though elicited arousal decays relatively slowly (Zillmann, 1971), the time interval between the stimulus and recall of memory of products is quite large.

DISCUSSION

Collecting arousal data at two moments, namely before and after the participants played the videogame, made it possible to analyze the differences and to give an answer to the question if the game really heightens the arousal level. As the results show, the effect was only small and not significant, which emphasizes that assumptions always should be (pre)tested. In this study, only the arousal aspect of emotion was measured. Although the valence aspect was neglected, it had been possible to collect valence data using a similar SAM-scale. The data would not have given expectations of finding significant differences because a delicate pretest had been absent and the number of participants had been too low (explicated in the introduction section), but by giving attention to the valence images it would have been more clear to the subjects how to interpret the arousal scale of SAM; a few subjects didn't understand the meaning of the images at once.

With regard to the low-arousal condition, two remarks should be mentioned. First of all, participants were still able to use power-ups, although the settings made no power-ups appear on the road. In the time-trial, the player automatically obtains 3 turbo power-ups from the start. Fortunately, in practice only one subject really used the power-ups, others ignored the given power-ups, so that probably no distortions of the data occurred (supposedly the power-ups were not used because the subjects didn't get instructions how to use them). Secondly, another difference between a 'time-trial' and 'versus play' is the absence of an introducing clip, which shows some views of the track, in the 'time-trial'. This small dissimilarity might have influenced the scores of the gametest. In repetition of this experiment, it is suggested to use the 'versus mode' not only for the high-arousal condition, but as well for the low-arousal condition (instead of the time-trial) and change the settings to no opponents and no power-ups. In similar future studies with a different videogame, it is important to critically observe all the differences between the conditions.

During the recall task of products, after roughly 5 minutes many people declared to have written all they could remember. Nevertheless, when told they have still 5 more minutes and stimulated to think harder, nearly everyone did remember a couple of more products. Evidently, people are able to remember more than they assume. The subjects remembered the products and brands very well, most of them 9 or more. A possible explanation might be that the coupling of product and brand has a positive effect on the memory. When someone has forgotten the product, but remembers a brand, he automatically makes a link to the forgotten product. Vice versa is possible as well: remembering a product gives the opportunity to make a guess which brand it could have been.

Already mentioned briefly in the results section, the time interval between playing the videogame and recalling the learned products is large. In fact, that period takes longer time than the duration of gaming. Thus, time (decay) should be seen as an interfering variable. On the other hand, a

distinguished part of the period is used recalling details of the game and can be seen as one part of a complete memorytask (gametest plus producttest).

It remains unclear what the effect of computer game-induced arousal is on short-term memory, because with a relatively small number of participants only small effects were found. An interesting finding is the tendency of low-aroused gamers in remembering details of the game better in comparison with learned information preceding the game. This discovery recommends to use the application of in-game advertisement. When a gamer plays a game level in a relaxed state (at least not high-aroused), he is aware of the digital environment in which he is moving. Seeing an advertisement could be remembered as well as other environment aspects. Note that a brand should not been hided in a place where it can never been found or where the player sees it only for a short moment. Finding a dedicate place is very important, but also very difficult, as a company does not want to annoy the consumer. To the question whether remembrance can be reached (and irritation can be avoided) by placing an ad before the player starts the game or after he finished it, for instance to implement a brand in a loading screen, this study gives no answers nor suggestions. Further research is needed to enlighten this research topic.

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Appendix 1: Summary of similarities and differences between the two conditions

		Low-arousal (time-trial)	**High-arousal (versus mode)**
similarities	Track	Luigi circuit	Luigi circuit
	Number of laps	3	3
	Kart	Standard	Standard
	Character	Luigi	Luigi
	Controller	GameCube	GameCube
differences	Power-ups	No*	Yes
	Music and sound effects	No	Yes
	Rumble	No	Yes
	Class	unknown	150 cc
	Opponents	No	Yes (15 computer players; difficulty: hard)
	Power slides	No	Yes**

* 3 turbo-boosts were given, but not used (see discussion section).

** Although power slides were enabled, hardly anybody used this technique (see results section).

Appendix 2: Products used in the slideshow

Product	Brand
1. Candybar	- Snickers
2. Car	- Landrover
3. Coke	- Pepsi
4. Toothpaste	- Elmex
5. Bicycle	- Batavus
6. Shampoo	- Head & Shoulders
7. Notebook	- Dell
8. Radio	- Sony
9. (Potato) Chips	- Croky
10. Mobile phone	- Alcatel
11. Marker	- Prockey
12. Sports shoes	- Puma
13. Washing-Up liquid	- Klok
14. Batteries	- Panasonic
15. Toilet cleaner	- Glorix
16. Washing machine	- Bosch
17. Beer	- Leffe
18. Paint	- Gamma
19. Chocolate sprinkles	- Kwatta
20. Pullover	- Nike