Learning Racing Emotions

Empowerment of risk perception while playing racing videogames

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Abstract. The present study explores how drivers and non-drivers interact with racing videogames. Subjects were asked to play two type of racing videogames while their driving behavior, arousal activation and facial expressions were recorded. Representations about driving, risk perception, and user evaluation of videogames were also collected. Results showed significant differences between drivers and non-drivers in: heart rate activation and negative emotions for the two different types of racing videogames. In particular the drivers seemed to be more aware of the risky driving situations they were facing in the game, while non-drivers didn't seem to have the same emotional activations towards risk. It should be questioned how and at what condition a ludic driving simulation could interact in a constructive way with young non-drivers that haven't yet developed a complex hazard system to explore the road.

Keywords. Risk Perception, Emotions, Driving, Racing Videogames.

1 Introduction

Historically road accidents used to be considered as inevitable events: something inbuilt in modern road transportation, that could accidentally happens [1]. The word "accident" in itself seems to suggest the involvement of fate and casualty, upon which there is only little space to step in. Today road accidents are seen under completely opposite premises. They are considered as problems, and are faced with an appropriate system analysis, by interventions of preventions that take into account multidisciplinary knowledge and technologies [2]. To underline the fact that road crashes are not casualties, it's important to note that there's a class of road users that is significantly more involved in road accidents: male adolescents and young adults represent more than half of the road user involved in traffic accidents (age 15-44) with a peak among 15-29 years old, with rates of mortality from 18 to 30% for adolescents and young men (15-24 years old) [3]. Why young men are more exposed to road accidents? And how to set up an efficacy prevention? The Psychological literature suggests four key explanations: attention, experience, risk perception and personality traits [4].

Despite alcohol and drugs are usually regarded by the media as the main causes of road accidents among young drivers, distraction and lack of experience are the real cause of 80% of the crashes that take place every day in our roads [5].
A proper risk perception is crucial to avoid distractions, and it needs a proper activation and modulation during driving. Risk perception is a process that is sensitive to emotions and attentive resources available for the driver. It changes in relationship with the difficulty of the task and the psycho-physiological state of the subject. [6].
In particular new drivers find hard to handle a complex model of the traffic system.
They seem to not correctly foresee the interaction with other road user, and they have difficulties in promptly detect the concrete potential hazards approaching the road intersections [7]. These mental models of road interaction with other road users are created by years of direct driving experience, but they could be improved if the driver undertake specific training on risk perception [8].
The quality of the experience made by drivers is a crucial factor for preventing road accidents. As traffic psychologist we are interest in knowing if the recreational experience of a racing videogames could interact with risk perception in young drivers. In literature there are different studies that point out some variables important for the building of a correct driving experience and risk perception. What makes a driver an experienced driver is the fact that he has faced different driving situations, and has built a complex mental model suitable for an optimal management of our limited cognitive resources [9]. Novice drivers tend to not differentiate among the different traffic situation, facing them with a monolithic approach, underestimating the hazards [10] [11] [12] [13] while overestimating their driving abilities [20] [21] [22] [23].
Emotions play a fundamental role, affecting directly and in an automatic way the assessment of a risky situation. There is an optimal level of emotional activation while driving, that allows the driver to keep focused on the driving task and alerted towards potential hazards [14], and yet not being overwhelmed by high levels arousal (e.g. fear, anger) nor being soothed by low levels or arousal activation [15] [16].
Being able to keep constant that emotional level is sometimes hard for novice drivers, and that could explain the failures of risk perception while driving causing distraction or reckless driving maneuvers [17] [18] [19].
For these reasons it could be interesting to study how such an emotional tool as a videogames can recreate a traffic situation and how those driving situations could interact with risk perception of videogamers.
However there aren't many studies talking this issue, and even the two main content rating systems for videogames (PEGI in Europe, end ESRB in North America) do not point out potential risky content related to driving behaviors, deadly car crashes, or hazardous road situations that children or young men could act and experiment in videogames.
The aim of the present research is analyze commercial racing videogames in order to understand how they are used by videogamrers and what kind of effect they may have in terms of risk perception. In particular we will focus our attention on the representations and emotions activated while playing two different types of racing videogames, in a group of young non-drivers, but close to receiving a driving license, compared to the group of expert drivers videogamers.

2 Methods

In order to answer these questions we worked in two directions. At first we analyzed the main commercial racing videogames sold in Italy[1]. We tried to point out the elements and structures of the traffic system built by each videogames, that interact with the gamers. We set up an observation grid in order to categorize: the realism of driving environment, the realism of the driving simulation, and the realism of car crashes.
With the scores of the grid, we created a benchmark of the accuracy of the overall traffic simulation created by all the videogames.
Then we selected two different videogames[2] (*Race07* for high driving realism, and *CrashTimeII* for low driving realism) and we used them as different stimuli in order to measure the behaviors and reactions of videogamers at play.
In order to measure the direct and indirect assessment of the videogames made by each gamer during the gameplay, we used physiological activation i.e. Heart rate (ECG), skin conductance (GSR) and breath [24] [9].
To contextualize the information taken from the physiological data and gain a better insight into the gaming experience of the subjects, we recorded their driving behaviors in videogames (i.e. number of accidents) and their facial expressions (Facial Actions Coding System) using the software Noldus Observer XT.
We also collected information about: their risk perception, using the Arnett Inventory of Sensation Seeking (AISS); their opinion about the two videogames (Ad Hoc questionnaire) and their attitudes toward driving and violations (DBQ).

2.1 Participants

Twenty male subjects (N=20) were involved. The gender of the subject was reduced only to male as they are more exposed to road accidents according to the literature. Ten (N=10) were licensed driver between the ages of 25 and 30 (M=26,6), with at least 5 years of driving experience, using the car almost every day in the past year, and 50% of them had high scores in the AISS scale.
Ten (N=10) were young non drivers between the ages of 15 and 18 (M=16,8) without any kind of driving license, and 50% of them had high scores in the AISS scale.
All the twenty subject were regular videogames user, and asserted to play racing videogames at least twice a week, for more than one hour per session.

[1] For this study we considered the most sold eleven racing videogames published in Italy between January 2007 and December 2008. All videogames were regularly on sale and rated suited for all adolescents (12+). They were: Burnout Paradise Ultimate Box (EA, 2008); RaceDriver GRID (Codemaster, 2008); Need For Speed Undercover (EA, 2008); FlatOut Ultimate Carnage (Bugbear Entertainment & Empire Interactive, 2008); Test Drive Unlimited (Atari, 2007); Need For Speed Pro Street (EA, 2007); Race 07 Official WTCC Game (Atari, 2007); Overspeed High Performance Street Racing (City Interactive, 2007); Juiced 2 Hot Import Nights (THQ, 2007); Crash Time 2-Cobra 11(RTL, 2008); rFactor (Image Space Incorporated, 2007).

[2] For more information about the methods and the results of the benchmark of the videogames see [25]

2.2 Procedure

Subjects were required to read and sign an informed consent in order to participate to the research. The experimental setting of a driving station was set up in a isolated room. A steering wheel with Force Feedback system, brake and throttle pedal were placed in front of a 24-inch monitor with a lateral bulkhead in order to ease the immersion in the gameplay and hide to subjects the other experimental device needed for recording data. Videogames were launched on a Acer Aspire 5930G (Intel Core Duo 2.26GHz, 4 GB DDR2 e NVIDIA GeForce 9600M GT 512 MB dedicated RAM) directly linked with the main monitor in front of the driving station. Physiological data[3] were recorded on a Sony Vaio using a BIOPAC SYSTEM MP100, Goleta, CA programmed with the software E-Prime, in order to leave the subject completely alone during the gameplay, while the experimenter was monitoring the performance from outside.
The gameplay was divided in two different moments: 15 minutes for each videogame[4], that consisted in: 10 minutes of free use of the game, and 5 minutes of race in a specific circuit with the explicit task of winning the race.
The sessions were recorded by a Sony digital video camera, placed on a tripod in order to record facial expressions and at the same time the behaviors of the subjects in the videogames thanks to a mirror placed behind the back of the subjects.
At the end of the gameplay subjects were asked to rate the videogames, and fill in the AISS and DBQ questionnaire.

3 Results

Generalized Linear Model 2x2x2 was used in order to find out statistical differences between drivers and non drivers. The repeated independent variables were Videogame (*Race07* vs. *CrashTimeII*) and Gameplay (free vs. race). The dependent variables were the heart rate (NN Intervals), the number of accidents made during the gameplay, Facial Action Units, and the answers to the questionnaire.
Both drivers and non-drivers stated that their behaviors in videogames were dangerous violation of the highway code (i.e. do not stop at red traffic light, speeding, do not give priority at the crossroads…), and the analysis of variance did not point out statistical differences in the overall number of accident (Rate per Minute) made during the gameplay by the two groups ($F= 0{,}81$, $p >.779$).
However there were significant differences in the physiological activation. Experienced drivers had a higher Heart Rate variation then non-drivers ($F=11{,}584$ $p< .004$).
In particular the game with low driving realism but an accurate crash details (*CrashTimeII*) activated experienced drivers more ($F=11{,}866$ $p= .003$), while non drivers

[3] In order to avoid interferences caused by the movements of the arms and feet during the gameplay, the ECG electrodes were placed on the neck and on the breast of the subjects.
[4] The order of the videogames was randomized in order to avoid sequences errors or bias.

did not seem to be impressed by a frequent exposure to accurate car crashes, as they are activated in the same way while playing the two videogames. (Fig.1)

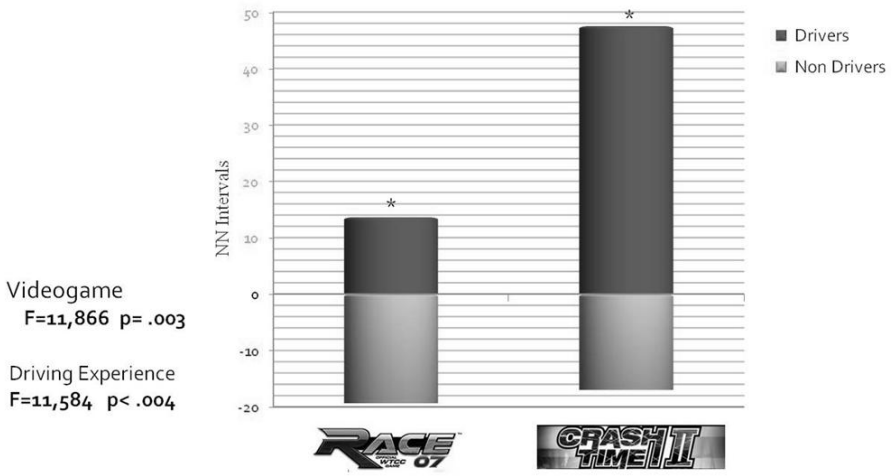

Fig. 1. Heart rate activation of expert drivers and non-drivers while playing the two games

The different physiological activation is also more evident in the "Racing" condition then the "Free use" condition (F=11,838 p= .003) especially for the videogame *CrashTimeII* (F=11,866 p= .003) in which all the subjects are involved in more car crashes then in *Race07* (M=11,5 car crashes per minute in *CrashTimeII* vs. M=6,9 crashes per minute in *Race07*).

The heart rate activation is correlated with the evaluation of the games made by the subjects in the self-report. Experienced drivers heart rate while playing the game *CrashTimeII* directly correlate to the points assigned to the word "Disturbing" (r= ,764*) and "Anxious" (r= ,834*) while non drivers find the games just "Challenging" (r= ,724*).

The analysis of the Facial Action Units confirms that non-drivers show less negative emotions (A.U. 1+4+15; 9+15+16) while being involved in driving accidents, then experienced drivers. Moreover non-drivers do not recognize the different driving system created by the two videogames, rating both as realistic in the driving simulation and driving environment. They also agree more than expert drivers with the sentences that "driving in videogames can make you a better driver" and "being skilled in videogames, makes you skilled also in real driving". (F=13,564 $p < .000$).

4 Conclusions

Videogames are ludic simulations, yet not all the simulations are the same.
Every title and type of game structure convey different levels of realism that impact in different ways with the driving experience of the gamers.
All subjects enjoy using the games and they apparently behave and play in similar ways. But there are significant differences regarding negative emotions related to being involved in severe car crashes, or being exposed to driving situations normally perceived as dangerous. Young non drivers do not seem to feel negative emotions as they don't have, yet, a proper perception of risk while driving. A correct level of emotional activation while driving is built only by real driving experience, and non-driver do not seem to fully understand if a driving simulation is accurate or not, neither if their "virtual driving" abilities could be suited for real driving.
Without a proper automatic level activation of emotions and risk perception in potential dangerous situations, drivers are more exposed to accidents. Past driving experience is a key variable in order to involve gamers in a functional way, as experienced drivers are fully aware of the dangerousness of the situations that the videogame simulate, while non drivers know that they are acting dangerously, but are not properly alerted about the risk that they are facing.
At the same time gamers rate and enjoy the simulation of the game according to their emotions, and if the game elicits several negative emotions, it could fail in keep the gamer at play.
We can say that videogames have all the potentials to create a proper system of elements, meaning, interactions that can empower risk perception while playing racing videogames. Only not all these elements are present, so far, in one videogame at the same time. The aim of a videogames is entertain the gamer, but if a functional experience rooted on a proper emotional activation for driving could be implemented, playing videogames could offer to non-drivers some direct experience in a secure environment.
Considering the theoretical indications and some of the result emerged from research it could be possible to create specific training sessions for non-drivers in order to work with videogames on risk perception, in terms of prevention for road safety. At the same time it could be possible to supply interesting information about psychological variables that play an important role in the driving experience that can interact with the virtual traffic systems designed by videogames, in order to induce positive emotions to both experienced or novice drivers.

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