Cyber Sick but Still Having Fun

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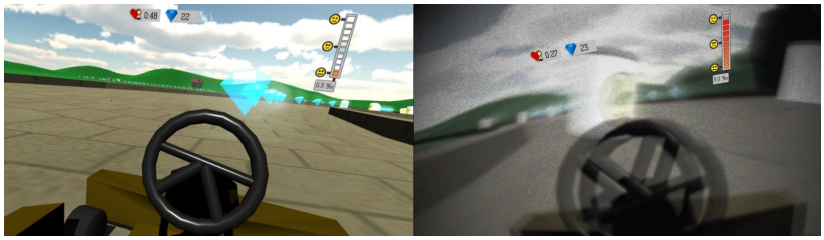
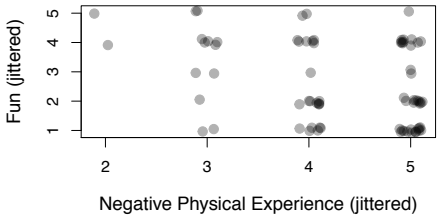


(a) *Left: Good times, picking up diamonds. Right: Bad times, driving and being drunk.*



(b) *Some users experience the game as sickening but enjoyable.*

Abstract

In this paper, we present our efforts towards creating a deliberately sickening virtual reality (VR) game. Based on a considerable number of tests, we can show that games can be enjoyable despite experienced adverse effects that arise from frequent acceleration in VR and additional post-processing distortions of the rendered scene. We briefly explain the rationale that drove us to take these measures, details about their realisation and results from a questionary-based user evaluation.

Keywords: VR Sickness, Motion Sickness, Simulator Sickness, Locomotion, Driving, VR

Concepts: •**Human-centered computing** → **Empirical studies in HCI;** •**Computing methodologies** → **Graphics systems and interfaces;** •**Applied computing** → *Education;*

1 Drunk Driving

The game Drink & Drive (D&D) teaches the effects of drunk driving without being patronising. It is a kart racing game that rewards fast laps and collected diamonds (Figure 1a, left) and punishes drunk driving that results from picking up alcoholic beverages from the race track (Figure 1a, right). The latter leads to a rising blood alcohol content (BAC) which reduces the playability of the game [Gaibler et al. 2015]. Based on an average young (male) physique, a can of beer raises the BAC by about 0.3‰ and the effects are well-documented. Vision and reflexes take a first hit after one can of beer. Not even having finished the second one (at 0.5‰), speed is miscalculated, vision degrades further as does hearing. The senses and reaction times keep deteriorating with each ‰ BAC. Additional effects come into play such as tunnel vision, prolonged reaction time, balance disorder, disorientation, narrow-mindedness, memory gaps, and, eventually, muscle relaxation, vomiting, weak breathing, loss of reflexes, paralysis, coma, and possibly even death [The Drinkaware Trust 2015]. In order to realise the destructive effects of alcohol poisoning, we darken the colours, reduce the contrast, deploy Gauss, vignette, fisheye and twirl post-processing filters on the rendered image. We muffle the audio channels by applying a low-pass filter, and we emulate the degrading reaction time of the player by processing his input with according delays. A heads-up display (HUD) shows the achieved score, the BAC, and the time the player has left for completing the current lap. The time limit urges the player to drive fast. At the same time, he needs to drive slowly to avoid beer cans. This challenges is all the harder as the player needs to pick up as many diamonds as possible to achieve high scores. Over time, we increase the challenge by switching from day to night time and adding other karts on the track. The possibility of intensifying not only the gaming experience but also the learning experience motivated us to create a VR version of the title [Dede 2009]. In Section 2, we discuss design aspects that—according to the current state-of-the-art in cyber sickness research—our game does wrong. Afterwards, in Section 3 we present our user study that will stress appreciation by the players despite all the obvious shortcomings. Which leaves us to conclude with an appeal not to take cyber sickness too seriously, especially if it does not pose a real, legitimate risk (physically or in terms of interfering with the conveyed contents) in Section 4.

2 Cyber Sickness

Immersed into the virtual environment of a static simulator like D&D, the discrepancy between perceived locomotion and physical steadiness can cause sickness [Hettinger and Riccio 1992]. While the reasons are still subject to speculation (e.g. conflicting information from the visual cortex and the vestibular, an evolutionary reaction to a presumed poisoning incident, or the prolonged urge to maintain a stable posture [LaViola Jr 2000]), symptoms can be captured by the simulator sickness questionnaire (SSQ) [Kennedy et al. 1993]. Not unlike the effects of drunkenness, it lists symptoms from general discomfort, fatigue and headache over nausea to difficulty to concentrate and impacts on the vision system. These symptoms grow more severe over time [Jaeger and Mourant 2001]. An outstandingly long run of our game may take about 10min but most games end after less than five. Therefore, this is one factor that we keep in check. Technical issues, such as latencies, flickering or tracking errors may also contribute to cyber sickness [LaViola Jr 2000]. Although we could not rely on the latest generation of VR systems for our experiments, which might promote cyber sickness merely due to the lower resolutions [Potel 1998], we can rule these aspects out as we extensively tested the game and we could neither observe low frame rates nor any other technical deficiencies. The

VRST '16, November 02-04, 2016, Garching bei München, Germany
ISBN: 978-1-4503-4491-3/16/11
DOI: http://dx.doi.org/10.1145/2993369.2996349

majority of our testers were males but considering averages, we could not determine different effects based on gender as suggested by literature. As our test group was mainly comprised of young students, we could not verify the impact of different age groups, either. It has been suggested that cyber sickness decreases with a growing age [Reason and Brand 1975]. Yet, our game seemed less challenging to young participants—but this might have also been due to their familiarity to video games as a whole. As the user is in control of our simulator game, he might be less susceptible to cyber sickness as opposed to passive observers [Lackner 1990]. We have to assume that the post-processing filters we deploy to emulate drunkenness likely increase the severity of cyber sickness. Yet, the narrowing field of view that is established due to increased BAC might actually alleviate the issue [Fernandes and Feiner 2016]. In addition, parts of the kart can be seen by the player, thereby providing a point of fixation which may reduce the experienced degree of cyber sickness [Ji et al. 2009].

3 User Evaluation

For our first experiments, we expected a large number of participants within half a day. Therefore, we developed a rather short questionnaire. We seated the player, assisted in using an HMD (Oculus DK2), headphones and a gamepad (Xbox controller). We further briefly explained the goal (avoid beer cans, complete track in time, collect diamonds) and showed the player how to control the kart. After one game, the player was asked to fill out the questionnaire. That day, 64 persons (89,7% males, mostly younger than 29yrs) provided feedback. We asked about the game experience (five-point Likert items ranging from *1 - Not at all* to *5 - A lot*), about any negative side effects such as dizziness and we provided space for additional feedback. The game was rated fun (4.36 out of 5.0), accessible (4.47), and its control intuitive (4.41). On average, the participants felt they had experienced something new or improved their knowledge about drunk driving at least "a little bit" (3.68). On average, negative side effects were not huge (2.48) but the experiences varied quite a bit: 21 participants said they experienced no side-effects, 17 hardly, 4 moderate, 18 a little bit, 4 a lot. Negative experiences often occurred after taking off the headset (18 participants), whereas 6 persons experienced negative effects when turning their heads, 11 when moving in VR, 1 when the kart accelerated. Other reasons mentioned were a missed opportunity to properly adjust the left lens of the HMD and the distortion due to BAC emulation. Motivated by written feedback such as "very cool", "good simulation" and "more!!!", we decided to further investigate the relationship between the experienced degree of cyber sickness and fun. Therefore, in a second study (10 participants, 80% males, mostly younger than 29yrs), we determined a significantly positive correlation ($cor = 0.7021608$, $p = 0.02358$, Pearson) between the provided Likert-score on "Negative Phyiscal Experience" (NPE), which we had already inquired about in the first experiment, with the users' average scores on the Cybersickess Questionnaire [Kennedy et al. 1993]. Combined, the two studies (74 participants) yielded a negative significant correlation between fun and NPE ($cor = -0.3266156$, $p = 0.004509$, Pearson). However, it also became evident that users experience fun despite suffering from NPE during and after the VR gameplay (Figure 1b). Notice that we added jitter to the plot in order to avoid masking the multiplicity of value pairs.

4 Conclusion

Cyber sickness is a tremendous challenge that VR researchers, enthusiasts and the VR industry are working hard to resolve. As 2016 has been touted the year of VR entering the mass market on multiple occasions, the tension emerging from the unsolved problem of cyber sickness keeps growing. Our study does not contribute to unearthing new facts about its emergence nor does it narrow down its symptoms or provide a novel approach to its mitigation. Rather, it shows that players may still enjoy VR games despite their negative experiences that result from rendering distortions together with frequent accelerations and relative low-lech resolutions. Cyber sickness does not necessarily take away the fun in games—it may be part of it. Instead of building up anxieties about dropping user acceptance in case of discomforting VR experiences, we postulate that (a) the fun and the benefits of VR technology outweigh its possibly negative side-effects, (b) the users/players should be given the freedom to decide whether or not they want to use/play possibly (harmlessly and temporarily) sickening titles, and (c) more studies should be conducted that provoke cyber sickness (of course, in mutual agreement by the users) to get a better grip on its causes and mitigation strategies. To this end, we would like to answer questions such as "Might fun lead to greater immersion and thereby to an increase in cyber sickness?" or "How can we identify players who do not mind physically challenging VR experiences?".

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