Enjoyable Stress Reduction: Approaching A Design Space For The Piloted Driving Context.

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ABSTRACT

In this paper, we portray ongoing work aiming to define a design space for enjoyable, playful interactions in the context of a piloted driving situation. Towards this purpose, we identify constraints in the general context of piloted driving, the car's interior and controls as well as the car manufacturer's safety recommendations. Furthermore, we align the identified constraints with proposed stresslessness-strategies for rear-seat passengers in order to anticipate conflicts and choices in the design of stress-reducing interactions for the piloted driving context.

Categories and Subject Descriptors

H.1.m [Models and Principles]: Miscellaneous.

General Terms

Design, Human Factors.

Keywords

Stress, Design Space, Piloted Driving, Autonomous Car.

1. INTRODUCTION

For many people assisted or piloted driving systems such as a Traffic Jam Assistants (TJA) will be the first real-world encounter of autonomous car technologies [1]. Audi's TJA, as presented at the CES Las Vegas, is an adaptive cruise and steering control technology that lets the car take over control in traffic congestions below 60km/h. Audi's communicated goal for piloted driving is to relieve the driver from undesired or stressful traffic situations such as traffic congestion, monotonous long-distance drives or parking the car [2]. This means that the first encounters of piloted driving technologies will take place in rather undesired traffic situations in which the drivers as well as the passengers may be already in a stressed or aggressive state. This stressful situation applies in particular to TJA. In order to develop an enjoyable experience with the new technology in the undesired situation of a traffic jam, we identify constraints that define the challenges of a design space of piloted driving in traffic congestions: stress and aggression, safety and driver awareness, control and interactions, and time frame and social context.

In recent years, games and gamification within the automobile and traffic context have been met with increasing interest. Researchers and designers have been focusing on two areas: First, the development of persuasive games and gamification approaches for the driver in order to influence the driving style or traffic behavior such as eco-drive gamification or anti-speeding reward systems [3,4,5]. There, the most important design challenge has been to integrate game elements and dynamics into the driving activity in a meaningful and safe way. A second focus has been the exploration of passenger-based games and entertainment. For the passenger, the safety constraints are less restrictive so that a much wider range of interaction becomes available, e.g. the implementation of context or location-based elements into the gameplay [6].

1.1 Approach

Within our research, and in the context of the autonomous car, the inactive driver can be much more involved in external activities than the regular driver. However, at least for the transition phase to a fully autonomous car, safety regulations will require that the drivers have to take the responsibility for the car, i.e. the driver has to keep an eye on the road and the traffic. From the perspective of game/interaction design, the piloted driving situation contains several challenges that have to be addressed. This involves not only identifying design issues but also analyzing the conflicts and constraints of the social and physical contexts of the driving situation. Our final goal is to develop a design space for stress-reducing strategies in piloted driving and automotive automation technology in general.

1.2 Literature Review

In the following, we give an overview of the four key-challenges, (1) stress and aggression, (2) safety and driver awareness, (3) controls and interactions, (4) time frame and social context, identified by literature review. In order to articulate the design challenges, we organized our review by clustering conflicts and constraints in the context of the driver and the perspective of car manufacturers.

(1) Stress and aggression: The question to what extent traffic jams contribute to the driver's stress level is widely debated. Hennessy & Wiesenthal [7] and Gulian et al. [8] argue that traffic congestions can have a very strong effect on the driver's and passenger's stress and wellbeing. However, recent research on daily commuters could not find a correlation between stress and aggression and traffic jams; at least not in urban areas with strong prevalence of traffic congestions [9]. We conclude that traffic jams can be a strong contributor to the driver's stress depending on the situation and the driver's disposition. Besides the stress induced by the traffic situation, automation technology such as piloted driving applications may contribute to the driver's stress. The experience of the new technology, in particular the transfer of the steering task to the car, may generate an uncomfortable, even stressful feeling of losing control over the car itself. Studies on the role of automation in reducing stress in the automobile context show that research in real driving situations is required [13].

(2) Safety and driver awareness: We assume that car manufacturers will demand that the drivers still need be aware of the traffic situation while using a TJA. In other words, the driver is requested to observe the situation and be alert despite the fact that the TJA is controlling the vehicle. The driver may need a new challenge in order to experience her/his new inactive role as enjoyable. This upcoming challenge is similar to the introduction of cruise control applications and their evaluation [15,16].

(3) Controls and Interactions: The design space of the car's interior is complex and safety critical. The physical design space of the driver's input and output controls can be differentiated on three levels depending on the contribution to the driving task [10]. (A) Primary controls are essential to maneuver the car such as the accelerator or steering wheel. (B) Secondary controls such as headlight controls or windscreen lever are contributing to assist the primary driving task. (C) Tertiary controls such as the a/c controls or an entertainment unit are for entertainment and comfort purposes. Which control-units and interaction levels can be used for a game or interaction system in the context of a TJA depends on the car manufacturer's requirements. For example, it may be rather unlikely to design for (A) level controls because of safety concerns. More research is necessary to define or create a set of controls to enable a gameful experience.

(4) Time frame and social context: The contextual constraints may essentially influence the design of traffic jam games or gameful interventions. As contextual constraints, we subsume the time frame of the traffic congestion and the social situation regarding drivers, passengers as well as communication with other cars within the traffic encounters. Traffic congestions, and in particular the use of a TJA, have a fluent and varied beginning and end. However, traffic jams produce a rather concentrated social sphere. Hereby, the challenge may be to exploit the social dynamics of traffic jams as well as in the social situation in the car [11]. On the other hand, we can also think of traffic jams as resources for games and gameful interventions, e.g. in that a certain pace or time spent idling triggers a game event.

2. DISCUSSION

In an earlier paper, we suggested four strategies for enjoyable stress reduction within the context of the automobile: (a) *to build self-awareness*, (b) *to reduce distraction*, (c) *to initiate an abreaction* and (d) *to reframe a situation* [12].

In order to identify potential challenges and conflicts in the design of stress-reducing games, we compare the constraints against the stresslessness-strategies. Both, the stresslessness-strategies and the constraints are rather structural definitions for setting up an overall design space that does not include the design elements in detail. However, in this early research phase and with theoretical reasoning, we are able to identify several conflicting areas. In particular the strategies may conflict with driver awareness and safety demands by the car manufacturers. Depending on the type of game, immersiveness may also conflict with the timeframe of the traffic situations.

In the TJA context, pursuing an *initiate abreaction* strategy seems to be more promising than a strategy that reduces distraction from the driving context. A TJA implies already a reduction of interactions (at least from the driver's point of view). One potential conflict for pursuing an *initiate abreaction* strategy may be the implementation of an additional controller or design element. For example, to enable a physical abreaction the driver seat could provide an armrest option with stress-toy capacity based on the availability of the TJA. Pursuing a *self-awareness* strategy seems to be very promising as well. Besides the focus on driving such as eco-drive gamification approaches, the context of traffic congestion may encourage the driver to be more concerned with personal data such as stress level, heart rate or mood. The biggest challenge will be to embed the health critical data into the traffic context, and vice versa. Since car-based health checks are already in development [14], the capacity for more engaging interactions with health data seems very promising. Reframing the stressful traffic situation with the help of games or gameful elements might be a very rewarding experience for the driver. In the context of traffic jams, an exergame can motivate the driver to do in-car exercises such as stretching. Furthermore, the constraints of the time frame could be beneficial to recuperate the driver for the upcoming free driving part of the trip. Additionally, an exercise program may be structured in accordance with pre-defined flow levels of traffic congestions i.e. the heavier the congestion, the more intensive the exercise.

3. CONCLUSION

The identified design challenges provide a very early approach on the development of a design space for exploring pleasurable interactions in the context of piloted driving. This suggested approach is primarily based on literature review, public information by car manufactures and thinking about the stress situation as a designer. The major shortcoming is that our stresslessness-strategies have not been empirically evaluated yet. In addition, the limitations of the proposed model are not clearly defined. However, the model-driven approach allows framing the elements of an upcoming design space for enjoyable, interactive stress reduction. It may lead to further research activities, as well as prototyping and user testing, in the context of traffic congestions and piloted driving.

4. ABOUT THE AUTHORS

Sven Krome is doctoral researcher at GEElab Europe. From an interaction designer's angle he is re-thinking the driver's and the passenger's experience in the context of autonomous cars. Thereby he is researching on the potential of enjoyable, playful interactions for stresslessness and well-being purposes.

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5. REFERENCES

[1] Ford, J. (2013). Traffic jam technology is step towards autonomous motoring.

http://www.theengineer.co.uk/news/traffic-jam-technology-is-step-towards-autonomous-motoring/1015532.article.

[2] Audi CEO Rupert Stadler (2013). "Piloted driving will become reality this decade". http://www.audiusanews.com/newsrelease.do;jsessionid=0408E3BDB65E9F50FC30C239D22E6E00?&id=3332&mid=1.

[3] Shi, C., Lee, H. J., Kurczak, J. and Lee, A. (2012). Driving Infotainment App: Gamification of Performance Driving. In Adjunct Proceedings of the 4th International Conference on Automotive User Interfaces and Interactive Vehicular Applications, Portsmouth, NH, USA.

[4] Gitlin, J.M. (2011). Is gamification of driving the answer to urban speeding? http://arstechnica.com/gadgets/2011/11/is-the-chevy-volt-the-answer-to-urban-speeding/.

[5] McCall, R., Koenig, V. (2012). Gaming concepts and incentives to change driving behavior. Ad Hoc Networking Workshop (Med-Hoc-Net), 2012 The 11th Annual Mediterranean Ad-Hoc Networking Workshop, IEEE, pp. 146-151.

[6] Juhlin,O. (2010). Social Media on the Road. The Future of Car Based Computing. Springer Verlag, London, GB.

[7] Hennessy, D. A., Wiesenthal, D.L. (1999). Traffic Congestion, Driver Stress, and Driver Aggression. In: Aggressive Behaviour, Vol. 25, p. 409-423.

[8] Gulian, E., Glendon, A.i., Matthews, G., Davies, D.r. and Debney, L.m. (1990). The stress of drving. A diary study. In: Work & Stress, Vol. 4, p 7-16.

[9] Lajunen, T., Parker, D., Summala, H. (1999). Does traffic congestion increase driver aggression? Transportation Research Part F: Psychology and Behaviour, Vol.2(4), p. 225-236.

[10] Tönnis, M., Broy, V., and Klinker, G. (2006). A Survey of Challenges Related to the Design of 3D User Interfaces for Car Drivers. In Proceedings of the 1st IEEE Symposium on 3D User Interfaces.

[11] Tan, H., Zhao, J., Wang, W. (2012). Exploring Car-to-Car Communication in Traffic Jam: Contextual Design and Practice. In Adjunct Proceedings of the 4th International Conference on Automotive User Interfaces and Interactive Vehicular Applications.

[12] Krome, S., Walz, S. P. (2013). Pleasurable Passenger Experiences: Towards A Design Space For Rear-Seat Stresslessness. Workshop on Entertainment Technology in Transportation against Frustration, Aggression and Irrationality, MobileHCI'13, Munich.

[13] Cottrell, N., & Barton, B. (2013). The role of automation in reducing stress and negative affect while driving. *Theoretical Issues in Ergonomics Science*, *14*(1), 53–68. doi:10.1080/1464536X.2011.573011.

[14] Gadget Gimmicks. (2013). A Health Check-Up As You Drive On The Go: Cars With Health Sensors Help Keep You In Shape. http://gadgetgimmicks.wordpress.com/2013/04/20/a-health-check-up-as-you-drive-on-the-go-cars-with-health-sensors-help-keep-you-in-shape/.

[15] Stanton N. A., Young, M. S. (2005). Driver behaviour with adaptive cruise control, Ergonomics, 48:10, 1294-1313.

[16] Xiao, L., Gao, F. (2010). A comprehensive review of the development of adaptive cruise control systems, Vehicle System Dynamics: International Journal of Vehicle, Mechanics and Mobility, 48:10, 1167-1192.