

EgoFlecto: Stimulating Being Calm and In Control Through Self-Reflection In the Context of Driving

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ABSTRACT

The car has for a long time been an essential part of a household and has different meanings for the individual. Some experience their car simply as a practicality, while others are far more attached to it. In this project we investigate the notion of being *calm and in control* in the car while commuting and propose a concept for enhancing this notion. Based on an iterative design process, we have developed a platform to test different ways of enhancing self-reflection in the car. The concept *EgoFlecto* is based on a seductive design strategy that aims to alter people's behavior simply through self-reflection and not through a forceful design. The design tries to present the driver with their actions, without requiring different forms of interactions, but by letting the driver interact with the car as usual.

Categories and Subject Descriptors

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous

General Terms

Design, Human Factors.

Keywords

User Experience, User-Centered Design, Cars, Automobiles.

1. INTRODUCTION

Different internal and external aspects of a car influence purchasing choice and driving experience. As a result, a car's design, brand, and cost do not go unnoticed, which the car industry is well aware of. Each car brand today has its own recognizable image, and most people will have an opinion about them. The car industry is a conservative one as changes are not adopted very quickly and companies are cautious of implementing new designs too rapidly. This is also partly caused by the fact that car companies must remain loyal to their own brand and design and thus must keep certain car characteristics unchanged. Introducing frequent changes might result in the brand losing its credibility and name.

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AcademicMindTrek'15, September 22 - 24, 2015, Tampere, Finland
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DOI: <http://dx.doi.org/10.1145/2818187.2818276>

The project discussed in this paper was done in collaboration with Volvo, and focuses on enhancing commuters' driving experience due to its rather monotonous nature. The theme of the collaboration was to understand what being *calm and in control* entails, both in the context of driving, and for people in general. We conducted a series of studies aimed at understanding the notion of being *calm and in control*, which later resulted in a design concept and prototype. Integrated to the car's steering wheel and dashboard, *EgoFlecto* provides awareness to drivers on their stress level and speeding behavior by measuring the pressure that is put on the steering wheel through the grip, and by providing feedback in the form of a breathing motion.

This paper is structured as follows. First, we introduce a series of user studies that form the basis of our research. Then, we describe the conceptual design, followed by three design iterations with their corresponding evaluations. Finally, we present the discussion and conclusion sections.

2. USER STUDIES

The main research question was: *what is people's understanding of being calm and in control in relation to the driving experience?* Questionnaires, interviews, commuting observations, and cultural probes brought us closer to answering this question.

2.1 Questionnaires

We wanted to investigate if notions of being *calm and in control* would naturally appear when drivers refer to their driving experiences. The chosen method was inspired by Tuch et al.'s [15] work with narratives as key components of remembering and making sense of an experience, highlighting the importance of focusing on both positive and negative experiences [8]. To investigate people's experiences while driving, car club members and university students were asked to fill-in a questionnaire.

2.2 Calm and In Control Interviews

An interview aimed at understanding the potential users' perceptions of the notion of being *calm and in control*. The interview consisted of four parts aimed at exploring: 1) the notions of being calm, 2) in control, 3) the interrelation of these two and what brings them into that state, and 4) their driving experience in relation to these notions.

We took inspiration from Körber [8] and the activity theory, focusing on Do-goals (i.e., the outcome of the users actions), Motor-goals (i.e., actions to perform Do-goals) and Be-goals (i.e., psychological needs). We did this by trying to reveal both the narratives of being in control/not in control and calm/not calm, and the reasons behind those stories. We also tried to understand what people do actively to reach certain (positive) psychological states both in the context of driving, and beyond the car. Six people participated in the interview. Data analysis was conducted using a color-coding scheme along the four main interview topics, which allowed us to find the essence of what being *calm and in control* entailed.



Figure 1. A participant of the commuting observations.

2.3 Commuting Observations

We organized three commuting observations, including one pilot study (Figure 1). The purpose of these commuting observations was to gain an understanding of the actual experience of commuting. Also as stated by Blomberg and Burrell [2] people often do not realize what they are doing, which is why what they say they do might not be what they actually do. The commuting observations explored the theme of being *calm and in control* by looking at how people currently interact, use, and experience the car environment. We were also interested in driving situations that directly or indirectly influence the driver's state of mind, behavior, and driving experience. We had two participants, a man aged 29 who worked for a large company, and a female student aged 24. The video material from the field studies was analyzed by documenting observations on sticky notes.

We found differences between the commuting experience and other driving experiences. People understand their regular commute as a practicality, an integrated part of their daily lives where the mere act of driving does not bring much joy to them. We found that certain aspects that characterize the commute are influenced by the destination (i.e., work or home). When going to work in the morning, drivers acted in a rather calm fashion and were acting semi-automatically. The explanation for this was that people go to work each morning at the exact same time, having pre-calculated the time that the commute will take. On their way home we observed that drivers were impatient and drove more aggressively, which was reflected in the whole traffic, as it seemed more chaotic than in the morning.

2.4 Cultural Probes

A cultural probe kit (Figure 2) [3][6] was created as inspiration for design. A probe kit allows researchers to enter intimate and personal closed spaces [9], such as the interior of a car. We wanted the probe to capture the experience momentarily, since time can change people's perceptions of the experience. Another aspect was the wish to triangulate our earlier findings. We then framed different questions to be answered through the designed materials. Four materials were designed :

Road Map (Figure 2a). This material consisted of a map of their route, along with certain themes and small sticky notes to place on the map. The purpose was then to place the themes (traffic, environment, etc.) along the route and comment on them.

In-Car Tool (Figure 2b). This material was placed in the car. It was designed for the participants to draw a trajectory [1] of how calm and in control they were during their commute. One line had to represent how calm they were while the other how much in control they were.

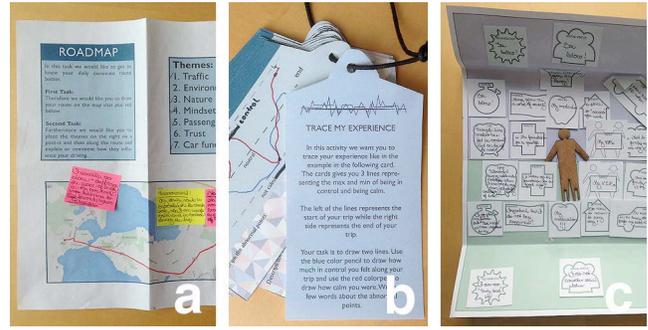


Figure 2. Probe kit. a) Road Map of their route, b) In-Car Tool to draw a UX trajectory of their commute, and c) Tangible Reference to define objects as calm or in control.

Picture-it. Participants were asked to take pictures of what they liked most about their car, what they liked the least, and something that they desired in their car. In addition, participants also received a daily reminder through an SMS to take a picture of something that made them feel calm or in control that day, along with three descriptive keywords.

Tangible Reference (Figure 2c). This material consisted of an A3 sheet of paper divided in the middle where one half represented the area of being calm and the other represented being in control. In the middle there was a human figure along with a stack of cards that had symbolic shapes. The participants were then asked to place the different objects according to how much they associated them with being calm or in control. Furthermore, they were asked to write their associations with the symbols on the cards.

When designing probes we realized the importance of clearly stating what we want to obtain while leaving space for participants to be surprised. We were not purely after understanding the nature of commuters, but wanted to gain insight into people's experiences inside their cars. Participants' stories became inspiration for design.

2.5 Affinity Diagram

In order to make sense of the gathered data, an affinity diagram [11] was built. All findings from our previous studies were written down on 480 sticky notes that were put up on a wall. Notes were moved from one wall to another, forming 18 note clusters, which were later narrowed down to three main themes or preconditions for the drivers to be *calm and in control*.

First, *communication* was separated into the aspect of information, meaning how the driver could receive and give information, and the importance of being able to do this effortlessly. The other was the social aspect, meaning people's need to be able to communicate with others in a social manner and feel relatedness. Second, *supporting independence* relates to self-reflection. In order for people to be independent they need to be confronted with their own behaviors, needs, thoughts, be able to reflect upon these, and act upon them. Another aspect was choices, since people need to be able to make their own choices and be offered different alternatives to act upon. Finally, *emotional and physical needs* consisted of mental needs (such as intimacy, attitude, etc.) and the physical needs (such as the ergonomic needs and design that represents quality, etc.)

3. CONCEPTUAL DESIGN

Having analysed the data from previous studies, a foundation for an ideation session was in place.

3.1 Self-Reflection and Intimacy

Initial brainstorming and sketching sessions led to two concepts. *Self-reflection* emerged in ideas related to expressing information in a new and experience-based manner. Currently, modern cars display warnings when people’s safety is at stake, instead of encouraging drivers, or passengers to reflect on their actions. Regarding creating *intimacy*, the car was perceived as a place where people could dedicated themselves to their activities and thoughts. This theme focuses on the relationship between the driver and the car, as well as emphasizing and personalizing it by giving the car human attributes. Other themes were not discarded, as they presented important arguments which lead to creating a calm state or providing users the feeling of being in control. Therefore, we considered them as means or aids in expressing *self-reflection* or *intimacy*.

3.2 PLEX Cards Workshop and Acting Out

We wanted to explore designing for playful experiences in the car in order to enhance the overall experience. We organized a workshop using the PLEX Cards [10] to stimulate thoughts about playful experiences in the car. Both concepts (i.e., self-reflection and intimacy) were presented to the participants as questions: *How can we make drivers reflect on their driving behavior? How can we create an intimate space for the driver?*

Participants consisted of eight students, four of them from interaction design, who were interested in creative approaches. First of all, the students used the PLEX Cards¹ to brainstorm new ideas, which they later used to create a mock-up of a future car. They were given a paper template and a car set-up to create the mock-up. Afterwards, the students were asked to act out their ideas and reflect upon them to instigate discussion (Figure 3).

Applied theatre can be used to inspire and explore ideas, communicate user scenarios or technology, or create empathy. Participants could genuinely situate themselves as users as they were all drivers and potential users, while also being open to try “silly” things. Unlike Howard et al. [7], our participants could simply improvise contextual scenarios as they did not need any specific information about their characters since they were acting as themselves. We put emphasis on not influencing the scenarios or the probes used, as we explicitly wanted to leave space for them to “play” in. We only put an effort into communicating findings to inspire the design. Based on the results from the workshop, we decided to focus on the concept of *self-reflection* since there was a more positive reaction to it.

3.3 Self-Reflection

Three aspects further refined the concept of self-reflection. First, gamification [4] was related to self-reflection through play by rewarding good behavior in a game and punishing for bad behavior. Second, expressions was related to how the car could communicate the driver’s behavior through expressive and abstract behavior in order to stimulate self-reflection. Third, providing the car with human attributes consists of assigning a heartbeat to driving and it could lead to growth in the car. Having these three design aspects, questions arose regarding how to design for these different experiences. It was unclear what and how to measure a driving behavior. Another question was how the car could express a drivers’ behavior, and whether the driver should be able to respond to these expressions through interaction.



Figure 3. The workshop participants acting out the contextual scenario with the designed probes.

4. FIRST DESIGN ITERATION

We developed an installation that is a part of the car (rather than being an external part), which consists of a steering wheel that responds to the tension put on it by the drivers through their grip and a dashboard cover that moves according to driving behavior.

The steering wheel was designed so that the driver would not perform actions directly on it. The steering wheel has pressure sensors on its surface to detect the usual pressure that the driver exerts to it. A transparent section on the steering wheel allows different light patterns and colors to reflect the pressure level (stress level), since we saw a difference in the way people grabbed the steering wheel in different situations.

We envisioned the moving artifact to be an integral part of the car rather than an additional feature, therefore subtlety would play an important role. To provide the car with human attributes, we came up with a very soft organic surface that resembles bubbles, which blends with the interior of the car. The movement was chosen to be a simple vertical motion as it aimed to be easily mapped to the user’s action, while trying to avoid a high level of distraction, which might be associated with other more complex, attention demanding motions. We chose to work with a single bubble or sphere on the dashboard cover so as not to distract the driver.

4.1 Evaluation

In order to perform an evaluation, a prototype was built which included a steering wheel with lights, an acceleration pedal, the moving artifact and a dashboard cover. The size allowed two participants to test the concept in the position of the driver and the co-driver. The user’s overall understanding and mapping of the concept was observed with great interest.

The prototype was placed on a table in front of a large computer screen on which a driving route video was played (Figure 4). The aim was to simulate a driving experience by placing the participants in the driver’s seat. Five participants (3 female, 2 male) tested the prototype, both in pairs and individually. At the start of the evaluation, participants were only informed about the pedal, the video and the steering wheel, which involved keeping their thumbs on specific places (i.e., above two buttons triggering the lights). The participants were presented with one calm and one stressful scenario. Each session lasted 20 minutes, which included a discussion related to their perception and experience. All sessions were video recorded by placing a camera directly on top of the screen, capturing facial expressions and reactions.

While watching the video material we documented possible factors of the concept that influenced the participant’s behavior, either directly from their actions and reactions or during the discussions. Based on [14], the notes were placed on a diagram

¹ funkydesignspaces.com/plex/

with four possible design strategies that a product, service or a design can aim for, when it tries to affect or alter human behavior: *Coercive* involves explicit design that provides a strong force in changing behavior. *Decisive* involves a more implicit design, but it still provides a strong force in changing behavior. *Persuasive* involves explicit design, but using a weak force to change behavior. *Seductive* is similar to persuasive, but the design is implicit, the change in behavior is perceived as being internally motivated. The notes were placed in each of these areas. Analyzing the current influence of the concept, this helped us understand what design strategy we were aiming for.

4.2 Findings

Surprise was the main reaction from the participants as they pressed the pedal for the first time and the artifact's motion occurred. The motion from the artifact captured their attention, as they tried to map its behavior to their actions. As a result, the video was ignored and it took an even longer time for them to notice the lights, as they placed their hands naturally on the steering wheel instead of keeping their thumbs on the buttons. Despite the difficulties this created during testing, their hand placement stresses the importance of capturing the drivers' natural behavior instead of forcing them to perform new actions.

When asked about the slow motion of the artifact, the users associated it to a relaxing breathing motion, a behavior that they would get used to. However, the sudden stop of the artifact, which occurs when speeding over the limit, was either not understood or perceived as a warning. The artifact was also associated to a living being. When the artifact stopped, a participant sitting next to the driver reacted by saying "you killed it" thus further resonating with our attempt to resemble a human-like behavior in the car. However, some participants perceived the continuous instant feedback provided by the artifact's motion as "annoying" and they mentioned that this annoying experience should occur only when speeding over the limit.

The steering wheel's red color was perceived as a warning light that appears when one is too stressed and might grab the wheel too tight. After noticing the change in the steering wheel lights, one participant mentioned that "I would probably react to it when it becomes red."

5. SECOND DESIGN ITERATION

A new design strategy diagram was made to describe aspects that were desired and not desired in the design. First, regarding the *coercive* strategy, the change in behavior should not be a necessity, but a desire, thus not forcing users to perform certain actions. Furthermore the *coercive* strategy, as described in the paper, is mostly used for momentarily changing behavior, while we aimed for an evolution of behavior. Second, regarding the *decisive* strategy the design should trigger human tendencies, as we have an inclination towards aesthetically pleasing lights, patterns, shapes, etc. We saw an opportunity of implementing this notion in both the steering wheel lights and the breathing motion of the artifact. Third, when referring to the *seductive* design strategy we had the idea of creating optimal conditions, which would enhance the senses while the good behavior is present. These optimal conditions would be "taken away" from the drivers when bad behavior occurs. Lastly, the *persuasive* strategy helped us in realizing that the concept should not provide the arguments for changing behavior in a very direct way, as people dislike the notion of being commanded and might trigger bad behavior for breaking those rules.



Figure 4. Evaluation setup for the first iteration including a steering wheel with lights, the moving artifact, a dashboard cover and a computer screen playing a driving route video.

In addition, we observed that the area between the seductive and persuasive strategies contained notions, such as triggering emotions and providing different motivations for achieving the same behavior, that were already active aspects in the concept. From the testing, it was noticed how the concept triggered relaxation, stress, or frustration, and it was perceived as an additional channel of information to the existing gauges (e.g., speed, fuel, etc.). Furthermore it was observed how people during the testing session adjusted the pedal in order to explore different motions of the artifact.

5.1 Evaluation

For the next testing session, we developed four different modes for the prototype. Each mode describes a mapped pair of behaviors for the artifact and the steering wheel lights. The first mode involves the usage of what the users perceived as annoying (i.e., blinking lights and fast continuous artifact motion) whenever bad driving behavior occurs. The second mode creates the optimal conditions for the users, by slowly fading in a blue light in the steering wheel and by using the motion of the artifact perceived as relaxing by the participants during the testing session. When the driver would be stressed or bad behavior occurs, these optimal conditions would be stopped. Oppositely, the third mode involves the breathing motion of the artifact only after the speed limit was exceeded, while the lights would be turned off if the steering wheel was tightly grabbed. The fourth mode explored the idea of increasing the intensity of the steering wheel lights and the height of the artifact, as the user's actions are closer to a bad or stressed behavior.

The setting of this evaluation was similar to the first evaluation. We started by letting participants freely explore the behaviors, followed by open questions about their perception of the system. We put emphasis on what the participants understood from the responses from the artifact, the steering wheel motions and patterns, and if and how the modes led to an altering behavior. Four participants took part in the evaluation (3 female, 1 male).

5.2 Findings

The aspects of the design proposals that were tested, which we did not see as fitting with the set design strategy, were mostly concerning how explicit and forceful they were. Some of the designs were too aggressively expressive through lights and movements, which to a greater extent stimulated nervousness, annoyance and frustration. This led to a forceful behavior from the design, which takes away the control and the free will of the driver. One of the most important points about the set strategy, was the fact that the drivers should want to change the behavior through self-reflection, and should not change the behavior

because the car is behaving in a way that is negatively stimulating them. The design should therefore be in the seductive/persuasive area though more in the seductive hidden area. Whenever they reach the danger zone, it steps towards a persuasive design, as it triggers more explicit arguments to why you should change behavior. However, as before it does not force the drivers into changing their actions immediately, but aims for triggering an internal motivation.

6. FINAL DESIGN: EGOFLECTO

In the following the function and design of the concept *EgoFlecto* (Figure 5) will be articulated and later supported by the research, design strategy, evaluation and literature.

The *EgoFlecto* assigns the car human attributes, which react on the driver's driving behavior. It consists of two parts and aims to bring awareness to the driver's stress level and speeding behavior. The first part is integrated in the steering wheel and is designed to measure how stressed the driver is, by the pressure that is put on the steering wheel through the grip. It was observed, during the field studies how, when the drivers were relaxed, they tended to grab the wheel loosely with one or two hands. Though while they were pressured, concentrated or captivated by something, the steering wheel was grabbed more tightly. The steering wheel works in the following way: when drivers put their hands on it, it lights up in a subtle blue color. As they apply greater pressure, it gradually changes from the blue color towards a red color to inform and make you aware of your stress level.

The other part consists of an artifact, which is integrated in the dashboard and reflects their speeding behavior. It is based on the optimal conditions design mentioned above, in which the artifact will imitate the motion of breathing when the driver is within the limit and the acceleration is small. Once they accelerate too aggressively or exceed the speed limit it stops the breathing motion and stays at its last position. The artifact moves again, once they decrease the speed or are within the speeding limit.

7. DISCUSSION

The concept is called *EgoFlecto* and has been developed through the findings of the research along with our design strategy. The purpose of the concept is to stimulate self-reflection in the car. The concept aims to mirror the driver's behavior directly with their actions rather than translating these actions into alerts or warnings, which are already present in multiple areas of a car. Using the seductive design strategy, we aimed for obtaining a voluntarily altered behavior by the driver, when being presented with their driving styles. One of the findings was how it was important for our potential users to have knowledge about themselves and their own limits, while another aspect was related to their desire to be able to identify with their car and have it personalized. We were inspired to a great extent by one of our interview participant's words: "*I wish that the car could feel what I feel.*"

EgoFlecto is therefore not an external part of the car, but it is simply *the* car. In the field studies, we found that drivers had a certain relationship to their cars, some even named them and talked to them, therefore we were inspired to emphasize this connection through the concept's human-like reactions. This is also seen in the paper by Ramm et al. (2014) who investigate the notion of naturalness of interaction in the car (NOI). In the paper, the interviewees discussed how they welcomed human attributes like a "soul" in the car. They discuss how it would be nice if the car could communicate with them with a more human-like and complex behavior.

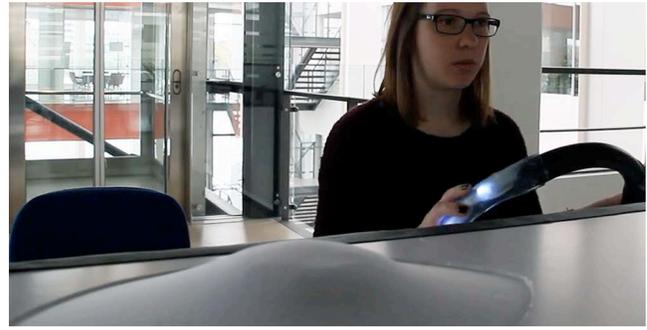


Figure 5. The prototype embodying the concept *EgoFlecto*.

EgoFlecto should require to be treated nicely in order for it to behave nicely as well. Saying this also leads to the findings of Eckoldt [5] who emphasizes the importance of the car addressing the driver's emotions, which relates to our design strategy that was primarily seductive. Another important aspect is that the driver should not have to interact any differently than they would normally with the car, and the *EgoFlecto* should not make it more difficult to drive. It should rather reflect the natural behavior of the driver and not enforce new behavior in the car, as it will no longer be self-reflection on the true behavior.

An additional important finding concerns the information access as the users expressed how it was important to have "*the right information at the right time.*" This is aimed for, through the design, as there is a direct relationship between what the driver does and how *EgoFlecto* responds without any delay.

Meschtscherjakov et al. [12] present concept cars for the future in a paper, which were then evaluated. The overall ideation process relates to an ecological driving behavior and the authors argue how the designs, which were rather rewarding and playful when the driver behaved nicely and were visually pleasing, led to far more long-term behavior changes. This is exactly the case with *EgoFlecto* as we are aiming for a long-term change in behavior, through a rather playful design.

The final concept has not yet been tested, which means that a further study requires elaborated testing sessions. In this case an improved prototype would be needed in order to perform the testing in the real environment, to see how it might affect the actual driving situation. Additionally the concept could be further explored with reference to our research findings, by investigating how such a system can adapt to the different situations that were found to be affecting the driving experience.

8. CONCLUSION

Through an iterative design process we have gained great insight into the lives of commuters and obtained an understanding of the nature of commuting. There are many aspects, which influence the driving experience for commuters and that highly depend on whether you look at the commute to or from work. The experience is influenced by the destination, namely what the driver has left behind and what they are going towards. This will to a great extent influence the state of mind and therefore also get expressed through the driving attitude. Other aspects were found to be influencing the driving experience like the environment, traffic, nature, passengers, rules and regulations and trust in one self and the other drivers. These different aspects influence the driving in different ways, highly depending on the nature of the departure and destination. This leads to the emphasis on the point that these factors are seen as being some of the preconditions found for the driver to be calm and in control in the context of driving

Based on our findings and through an iterative design process, we have created a concept mainly based on the aspect of self-reflection. *EgoFlecto* creates a space for reflection on one's behavior as it presents the drivers with their actions and attitudes. There are though many different aspects, which still need to be explored as *EgoFlecto* affects the driver differently depending on the situation. We do not know how it will affect the driver in an actual driving experience and whether it will enhance the experience and lead to an evolution of altered behavior. The question now would be to explore the feasibility of implementing this concept for future cars or whether this remains a critical design case. Our aim with this work was to explore a design space for in-car artifacts that promote self-reflection.

Future work includes implementing an improved version of the prototype, one that includes the most recent behavior of the concept and allows us to evaluate the concept in a real environment, to see how it might affect the actual driving situation. Such a setup would bring about new issues that we have yet to address such as participants' safety. Additionally the concept could be further explored with reference to our research findings, by investigating how such a system can adapt to the different situations that were found to be affecting the driving experience.

9. ACKNOWLEDGMENTS

We would like to thank our study participants for their time and dedication, as well as our colleagues Laurens Boer and Søren Top.

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