

Driving: The Emotional Experience and Automotive Design

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Conference Themes

- Emotion and Design
- Product as a Promise of an Experience
- Emotions and experience
- Tools and Methods for Emotion-Driven Design

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Abstract

This paper focuses on the experience design approach in respect to automotive design. The literature review indicates that eliciting appropriate positive emotions during interaction is central to experience design.

To investigate this, an exploratory study was conducted focusing on the driver's experience during interaction with the vehicle interface in a real driving situation. The study is based on a data triangulation approach including interviews, observations, and think-aloud protocol. Participants were asked to perform specific tasks while driving. During the drive they were video and audio taped. Also, they were interviewed before and after driving. The aim was to identify aspects of the driving experience that affected their emotions in a positive or negative manner.

The outcome of this study provides encouraging findings, identifying aspects of design that enhance and/or detract from the driving experience. Results suggest that context and situation have a dominant impact on the driving experience. It appears that any negative feelings are magnified if usability problems occur in high traffic situations. If this occurs driver perceives the entire experience as negative. However, if negative feelings arise when problems occur in low traffic situations, the overall experience is not affected. If no usability problems occur during the drive the overall experience appears to stay neutral.

The paper concludes with implications of the findings to future design of driving interfaces and outlines further study directions.

Keywords: design and emotion, automotive design, observational analysis, experience design

Introduction

“Car design influences the lives of millions of people throughout the world. Whether the car serves as merely a practical means of transport or as an extension of one’s personality, its design and brand will always attract comment.”

(Newbury 2002: 11)

Creating innovative designs no longer involves simply eliminating deficiencies in products to satisfy users (Fulton 1993); instead the aim is to design products that elicit appropriate positive emotions when experienced, both psychologically and physiologically, thus forming a powerful emotional attachment between the human user and the product.

In the contemporary world people spend large amounts of time interacting with their vehicle while driving; consequently cars design has a great influence on their daily lives. The available literature indicates that investigation within car design in reference to emotions has been conducted in relation to exterior styling (Desmet 2002) as well as social aspects of vehicles (Pelly 1996). More recently the smell of new vehicle interior is reported to affect human emotions (Jordan 2000). This has opened an opportunity to investigate the emotional connection between the driver and the vehicle interface during use in natural driving situations. It is seen to be an important aspect of interaction because emotional experiences with products are not only about visual or aesthetic response, but also about human’s interactions with them.

The aim of the research is to investigate emotions in respect to automotive design. The objective is to focus on the emotional experience of driving and the aspects that impact on its experience. It is important to consider this from a design point of view, as emotional experience will impact the interaction during use, as well as the memory of the interaction after use. From a marketing perspective, the emotional experience may have an influence on product purchase, product differentiation, brand recognition and may eventually lead to brand loyalty (Gobé 2001).

Experience Design

The term 'experience design' has been used to describe a design approach that aims to create appropriate positive experiences before, during and after user and product interaction (Philips Electronics 2001). Creating positive experiences is about targeting aspects of functionality, usability and pleasurability (Jordan 2000). Issues relating to functionality and usability have been investigated thoroughly in design. It can be argued that emotional aspects have also been considered in design. Nevertheless, it seems that designers previously applied this subjectively. This has led to the design of many emotional products; however the potential exists to explore and better understand the various aspects of emotional experience in design.

There are several reasons why emotions have not been considered previously in design approaches. Firstly, emotions are subjective and personal, whereby two people can have completely different feelings about the same event. Secondly, feelings can be directly influenced by context, including environment, time of day, place, weather and social situation. Thirdly, an experience can elicit a mixture of emotions making it difficult to identify how one feels about an event. Nevertheless, emotional and affective issues of design can be managed to a degree. The idea is not to control the experience or the specific emotion a user is going to feel; instead the intent is to design artefacts and systems that give users the opportunity to engage in experiences that are personal, engaging and enjoyable in a variety of contexts.

Identifying Emotions

To identify emotions within the context of this research it was determined to use Russel's (2003) model of Core Affect. Russel suggests that at a single moment the conscious experience of an emotion can be seen as a blend of two dimensions: pleasure – displeasure, which is a measure of feeling and, activation - deactivation, which is a measure of energy or mobilization. In addition feelings can be neutral, moderate or extreme. This model was used as a foundation to develop the Emotional Chart (Figure 1) used within this research.



Figure 1, Emotional Chart (after Russel 2003).

Figure 1 illustrates the modified version of Russel's model; the horizontal dimension, happy – unhappy, is a measure of feeling while the vertical dimension, excited - calm, is a measure of energy. The intensity of the emotion is divided into three levels; low, moderate or extreme. The more intense the emotion is, the closer it is to the outside edge of the circle. For example, to articulate the emotion *annoyed* on the Emotional Chart, it would be placed somewhere between 'neutral' and 'unhappy excited', depending on how strong the emotional feeling was. To articulate the emotion *content*, it would fall somewhere between 'neutral' and 'happy calm', again depending on the intensity of the emotion.

This Emotional Chart was used in the exploratory study and formed part of the questions asked in the interviews. The labels were used in the coding system during the analysis stage.

Framework for Experience

There is evidence to suggest that studies relating to the human – artefact relationship have previously been based on cognitive psychology (Hoff and Bjørkli 2002). This approach has been criticised for being too systematic whereby the human aspect and the context of the interactivity is overlooked (Nardi 1996). As a result, it has been argued that to design appropriate interfaces for interactive products, consideration must be paid to broader issues of context, situation, moods, emotions, social communication and value systems (Frascara 1999).

To better understand interaction between user and artefact during use, activity theory has been considered. Generally speaking, activity theory stands on the premise that artefacts are mediators for human experience and that interactions occur within a context. There are several issues from activity theory that are taken into account (Kuutti 1996):

- The need to focus on use/activity through time
- Use/activity occur within a context
- People are not merely agents in a system, they have motives/intentions/emotions

Thus when considering human experience, it is not solely about looking at what happens between the user and the product, instead it is about what happens between human, product and overall activity within a context (Figure 2).

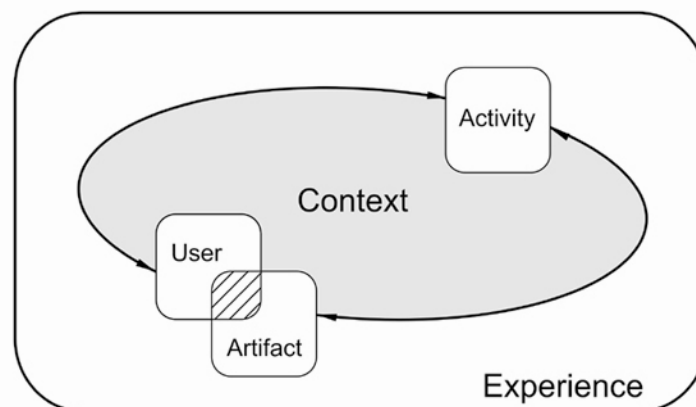


Figure 2, User – Artefact – Activity within context forms experience.

Figure 2 is a graphical representation of an experience. It conveys two ideas; firstly it shows how a human-artefact interaction does not exist in isolation but instead takes place within a surrounding context. Secondly it illustrates the artefact being a mediator between the users and their activities. The artefact in this instance is not the ultimate concern; it is just an agent that is used to perform an activity.

The study of the human-artefact relationship plays an important part in the research. This issue will be discussed in more detail in the conclusion.

Exploratory Study

An exploratory study was conducted to investigate the driver's emotions with a vehicle interface in a natural driving situation. The aim was to investigate the emotional experience of driving as well as identify unique aspects that influence the overall experience.

Participants

Eight subjects (three female and five male) participated in the study. All of them were full-time staff members of Queensland University of Technology (QUT). Every participant was screened to make sure they held a legal Australian driver's licence.

Equipment

The experiments were conducted using vehicles available at QUT (Toyota Corolla –seven experiments; Toyota Camry –one experiment). This was due to the available time and availability of vehicles. Although one experiment used a different vehicle, the interface the driver interacted with was the same.

To record the experiment two video capturing devices were used. A mini DV camera and tripod located on the back seat recorded the participant's activities in the vehicle as well as recording audio (Figure 3). In addition, a web-cam was located on top of the dashboard attached to a laptop, which positioned on the passenger seat (Figure 4). This camera was used to videotape the participant's facial expressions during the drive.



Figure 3, Mini DV camera and tripod set-up.



Figure 4, Web cam and laptop set-up.

Procedure

The study was based on a data triangulation (Denzin 1989) approach consisting of interviews, observation and think aloud protocol. Prior to the test the participants were given an information package which described the test, how it would be performed and the purpose of the study. To keep the study as consistent as possible, the test was performed between 11:00am and 2:00pm. Each participant was asked to follow a similar route to keep the context consistent between the experiments. The route took each participant around the central

business district of Brisbane, consisting of a low traffic zone, then a medium traffic zone and finally a high traffic zone. The entire journey took approximately twenty minutes.

Initial interviews

These interviews were primarily aimed at recording the participant's emotional state before the drive. There were questions based on gathering data relating to their driving experience and how they generally felt about driving.

Driving tasks

The participants were asked to drive a vehicle in real-time traffic conditions. During the journey, they were asked to perform specific tasks which they could perform in any order and at any time. The tasks were:

- Turning on the radio
- Tuning to 97.3fm
- Inserting a compact disk
- Playing song number 10
- Turning on the air-conditioning
- Washing the front windscreen with water-jet and wipers, and
- Washing the back windscreen with water-jet and wipers

Observation and think - aloud protocol

For the observation component of the study the participants were required to drive around the specific route, perform the tasks described and think - aloud during the task. In conjunction the participants were asked to verbally express how they felt about performing each of the tasks after completing them. For each of the experiments the experimenter was seated on the back seat of the vehicle to help the participants with directions or to prompt them when necessary.

Retrospective interviews

Immediately following the drive a retrospective interview was conducted. These questions were primarily aimed at gauging the participant's emotional state after the drive. They were

also asked to explain why they felt the way they did. Questions were also asked how they felt regarding each of the activities they performed.

Analysis

The experiments measured the emotional response by analysing the participant's bodily expressions in conjunction with their verbal descriptions of their feelings. The observation was used as the main source of information because it is widely understood that affective and emotional system can control human's facial and bodily behaviour, giving clues about the emotional state of the user (Picard 1997). The interviews and think - aloud protocol were used to support the observations. The information gathered was qualitative in nature.

The coding of the observations was supported by a professional behavioural analysis computer program called The Observer (v.5). The software allows the researcher to collect, analyse, present and manage observational data.

Since the purpose was to investigate emotional aspects of the experience while considering context, the coding system used was split into three categories called *Behavioural Classes*; Context, activities and emotions. Each of the *Behavioural Classes* contained what are called *Behaviours*, used to define each category into more detail. The Behavioural Classes and their Behaviours are shown on Table 1.

Behavioural Class	Behaviours
Context	Low Traffic Medium Traffic High Traffic
Activities	Correct interaction Incorrect interaction Indirect interaction (looking at interface) Driving
Emotions	Neutral excited (Concentrated) Happy excited Happy Happy calm Neutral calm (Calm) Unhappy calm Unhappy Unhappy excited

Table 1, Behavioural Classes and their corresponding Behaviours.

For example, consider an instance where a participant is driving in a high context area, they turn the radio on and a couple of seconds later they smiled contently as they hear the music coming through the speakers. An example of this coding sequence is shown on Table 2.

Time (hh:mm:ss)	Subject	Behavioural Class	Behaviour
00:12:35	3	Context	High Traffic
00:12:35	3	Activity	Correct interaction
00:12:37	3	Emotion	Happy

Table 2, Example of coding sequence.

The software codes the time at which something occurred, the subject (which is the same throughout the experiment), the Behavioural Class and its corresponding Behaviour.

The coding for each aspect of the drive was completed for each experiment employing the method explained above. This resulted in information that was both detailed and comprehensive. With this type of information it was able to construct a time-event table, which represents the coded information for each experiment in a chart format. Table 3 is an example of a time-event table produced by the analyses function of the software.

Start Time (hh:mm:ss)	Subject	Behavioural Class	Behaviour	End Time (hh:mm:ss)	Duration (hh:mm:ss)
00:05:35	2	Context	Low traffic	00:12:35	00:07:00
00:05:49	2	Activity	Indirect	00:05:59	00:00:10
00:06:05	2	Activity	Indirect	00:06:12	00:00:07
00:06:10	2	Emotion	Unhappy Excited	00:06:14	00:00:04
00:06:16	2	Activity	Correct Interaction	00:06:23	00:00:07

Table 3, Example of Time-Event Table.

The time event table shows the start time of a coded behaviour, the subject (which is the same throughout the experiment), the Behavioural Class and Behaviour coded, the end time of the specific behaviour and the overall duration of the behaviour. This information was then used to create Figures 6 and 7, which are user-friendly graphical representations of the same information.

Results

A number of interesting findings have been deduced from the analysis of the qualitative data. The results have emphasised two levels of interaction related to an emotional experience (Figure 5). On a micro level, issues relating to the specific interaction between the driver and the vehicle's interface were identified. In this case, the participant's emotions were a reflection of how they felt while driving. On a macro level, issues relating to specific interactions within particular contexts were identified. In this case, the participant's emotions were an indication of how they felt about the overall driving experience.

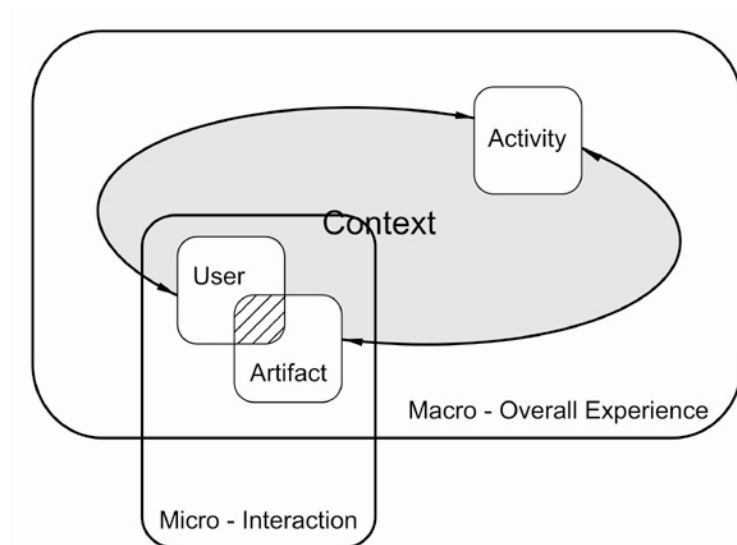


Figure 5, Macro and Micro levels of emotional experience.

On a macro level the context has a critical effect on the way the participant perceives and remembers the experience. In all experiments, the participants experienced a negative overall experience, or at best a neutral overall experience.

In instances where the overall emotion elicited by the experience was described as negative, the participants referred to specific instances during the high traffic zone where an error was made while performing some task (for example interacting with the radio interface). In cases where the experience elicited no change in their overall feeling, it was found that they did not refer to any specific instance of the drive; instead they described the drive in a general manner, even if several errors were made while performing tasks in the low traffic zone.

To illustrate this point two examples are given (Figure 6 and 7), which are a depiction of the driving experience for two participants. Each diagram reads left to right shown by the direction of the arrow. They focus exclusively on the low and high traffic contexts of the drive.

Small characters represent the participant's feelings before and after the drive. The coloured blocks represent different actions and their associated emotions within each context. The bottom is the *action* segment while the top is *emotion*. The sizes of the different elements are a percentage of the overall time within the context. For example, in Figure 7, within the high traffic context, the participant made correct interactions with the vehicle interface 5% of the time (depicted by the blue band of colour in the *action* segment). Within the same context they felt unhappy 5% of the time (depicted by the green band of colour in the *emotion* segment).

Figure 6 is an example of an overall negative experience, accompanied by the description of the drive by the participant. In their description of the driving experience the participant refers to a specific instance where they were experiencing difficulty with a task in the high traffic zone.

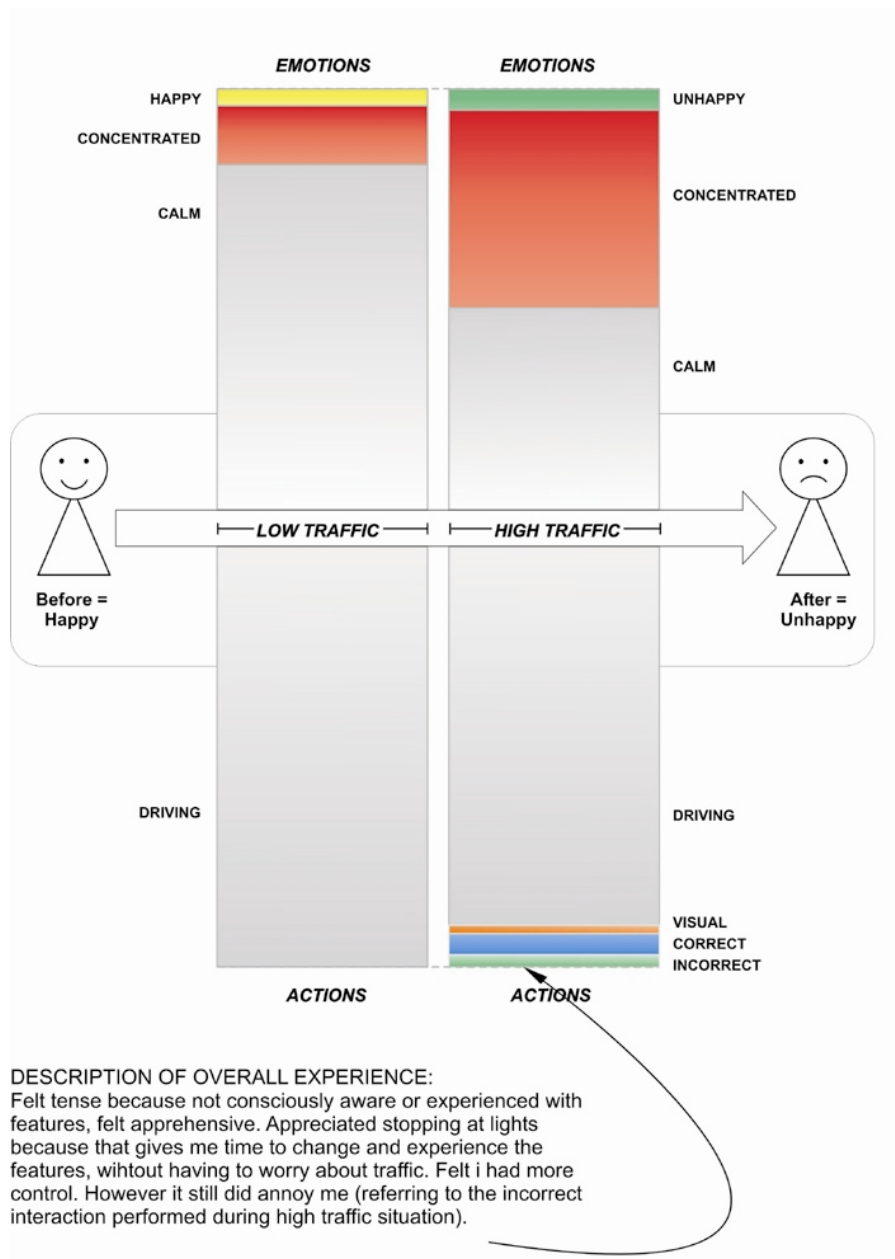


Figure 6, Example of overall negative emotional experience.

Figure 7 illustrates an overall neutral experience, accompanied by the description of the drive by the participant. Note that this participant did not make any errors during interaction in the high traffic zone and does not refer to any particular moment of the drive. In this instance even though the participant made no errors in the high traffic zone, it did not necessarily lead to an overall positive experience.

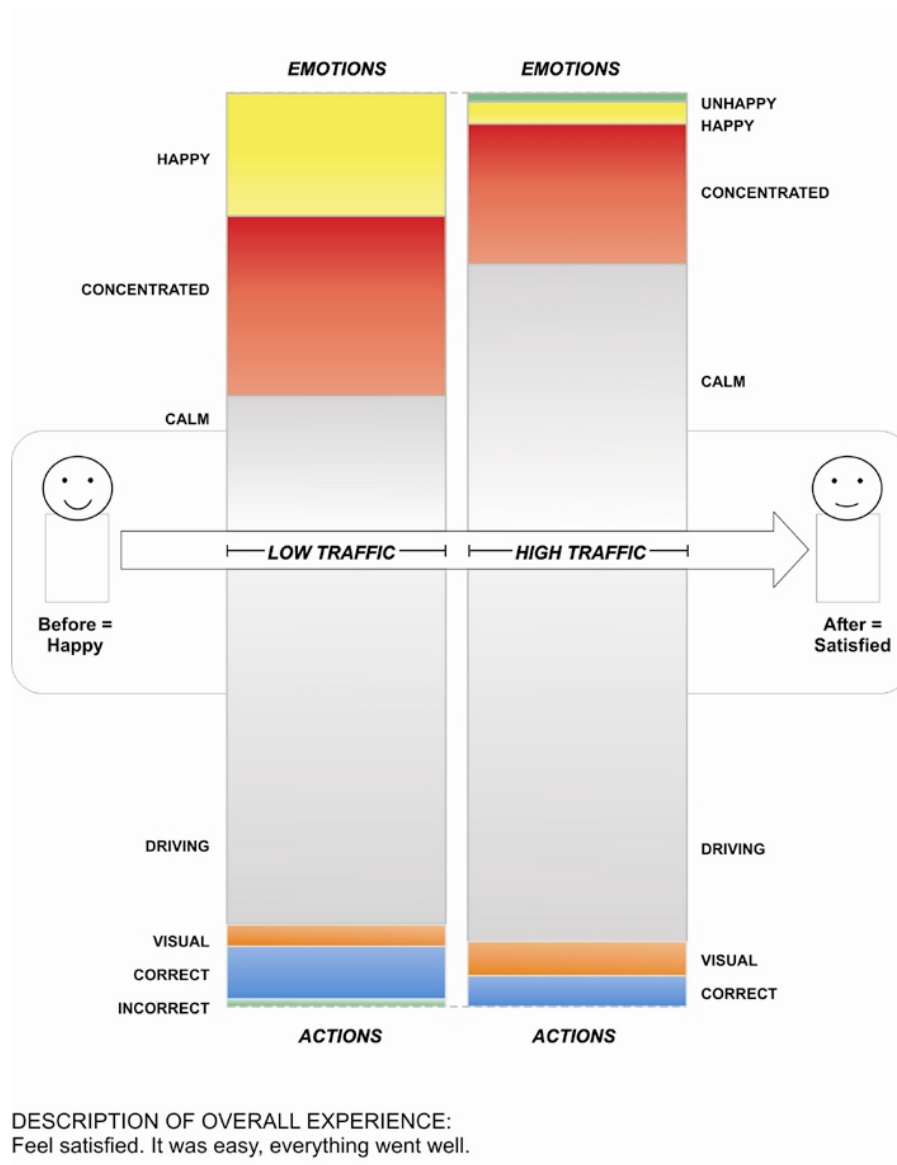


Figure 7, Example of overall neutral emotional experience.

These findings indicate two issues. The first is that if interaction problems occur within a high traffic area, the negative feelings associated with it are magnified. The same does not apply within a low traffic area. Secondly, simply because no interaction problems occur it does not mean that it will enhance the experience within a driving situation because it is the context in which these interactions occur that is the overriding factor.

On a micro level the emotions experienced by the participant fluctuated throughout the drive. They felt unhappy, calm, happy or concentrated at various times during the drive. However,

the patterns identified rarely gave an indication about how the participant felt about the overall driving experience.

The most interesting finding was that in most cases happiness was directly related to the amount of time spent performing tasks correctly, such that if the amount of time performing tasks correctly increased, the participant's happiness also increased within that particular context. However, this did not seem to have an effect on the overall experience perceived by the participant.

Conclusion

From the analysis of the research data two important points can be deduced in respect to the emotional experience of driving:

- Emotions associated with each particular action or task performed are in constant dynamic change. These specific emotions do not have an impact on the overall experience by themselves.
- Emotions associated with action/tasks within specific contexts seem to have an effect on the overall experience perceived by the individual.

These issues suggest context is the critical factor when considering overall emotional experience. It is so important that if incorrect tasks are performed in a high traffic zone, any negative feelings associated with it appear to be magnified and remembered thus having a significant impact on the overall experience perceived by the driver. The same does not apply when incorrect tasks are performed within low traffic zones.

This indicates that the micro level is not so important. However it becomes important when it is considered within high stress level contexts. Therefore the macro level, as displayed on Figure 5, is the conceptual space of most interest when considering the overall emotional experience of driving.

The implications for design suggest that the vehicle interface should be able to adapt or change according to the context. At this stage there are two envisaged suggestions:

- Within a high traffic zone, the interface should adapt to discourage major interaction, because if an incorrect interaction occurs this will have a substantial impact on the overall experience perceived by the user.
- Within a low traffic zone, the interface may be able to change to encourage interaction, because whatever type of interaction occurs during the low traffic area could have minimal impact on the overall experience perceived by the user.

The future implication of the research is on vehicle interface design applying these findings and to test whether this might affect positive emotional experiences or at least reduce negative emotional experiences while driving.

This exploratory study has opened an avenue of possibilities for further research in this area. For example, this particular study only focused on the driving experience within a city environment during the day. Other studies could be performed in a city environment during night time or in outside city environments. These different driving situations would provide additional knowledge on what affects emotions while driving.

References

- Denzin, Norman K. 1989. *The research act : a theoretical introduction to sociological methods* (3rd ed.). Englewood Cliffs, N.J.: Prentice-Hall.
- Desmet, Peiter. 2002. *Designing emotions*. The Netherlands: TU Delft.
- Frascara, Jorge. 1999. Cognition, "Emotion and Other Inescapable Dimensions of Human Experience." *Visible Language*, 33(1): 74-87.
- Fulton, Jane. 1993. "Physiology and Design: physiology and design." *New Human Factors. American Center for Design Journal*, 7(1): 7-15.
- Gobé, Marc. 2001. *Emotional branding ; the new paradigm for connecting brands to people*. New York: Allworth Press.
- Hoff, Øritsland, and Cato A. Bjørkli. 2002. "Exploring the embodied-mind approach to user experience." *Proceedings of the second Nordic conference on Human-computer interaction in Denmark*. New York: ACM Press.
- Jordan, Patrick. 2000. *Designing Pleasurable Products*. London: Taylor and Francis.
- Kuutti, Kari. 1996. "A Framework for HCI Research." In *Context and Consciousness*. Edited by Bonnie Nardi. London: The MIT Press.
- Nardi, Bonnie. 1996. *Context and consciousness : activity theory and human-computer interaction*. Cambridge, Mass: MIT Press.
- Newbury, Stephen. 2002. *The Car Design Yearbook 1: The definitive guide to new concept and production cars worldwide*. London: Merrel Publishers Limited.
- Pelly, Chuck. 1996. "Creative consciousness: Designing the driving experience." *Design Management Journal*, 7(4): 51-54.
- Philips Electronics. 2001. Experience Design at Philips Design. [Online] Koninklijke. Available from URL: <<http://www.design.philips.com/MIME/experiential/index.html>> [Accessed 1/04/2003]
- Picard, Rosalind. 1997. *Affective Computing*. Massachusetts: The MIT Press.
- Russell, James. 2003. "Core Affect and the Psychological Construct of Emotion." *Psychological Review*. 110(1): 145-172.