Everyday Commuting: Prediction, Actual Experience and Recall of Anger and Frustration in the Car

Daniela Wurhofer¹, Alina Krischkowsky¹, Marianna Obrist², Evangelos Karapanos³, Evangelos Niforatos¹, Manfred Tscheligi¹

¹Christian-Doppler-Laboratory “Contextual Interfaces”, Center for HCI, University of Salzburg, Salzburg, Austria
²School of Engineering and Informatics, University of Sussex, UK
³Madeira Interactive Technologies Institute, Funchal, Madeira, Portugal
⁴Faculty of Informatics, University of Lugano, Lugano, Switzerland
¹firstname.lastname@sbg.ac.at, ², ³, ⁴obrist marianna, e.karapanos, niforatos@gmail.com

ABSTRACT
This paper presents insights on driver’s User Experience (UX) in terms of systematically investigating predicted experience, actual experience, and recalled experience. By conducting a three-week field study with car commuters in two countries, we studied how frustration and anger differentiate in prediction, actual experience, and recall. Our results show that commuters accurately predict their upcoming anger or frustration in a traffic congestion, however, lower their experienced frustration when being recalled. Moreover, unexpected traffic congestions (in contrast to expected ones) are prone to higher levels of anger. We further found that time of day is related to the prediction of anger, and mood is related to the prediction of frustration. With our study we provide a holistic view on commuters’ everyday emotions and experiences – not only when being on the road, but also before and after the trip.

Author Keywords
Car; commuting; frustration; anger; user experience.

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

INTRODUCTION & MOTIVATION
On average, commuters lose up to 52 hours in road congestions per year [17]. Commuting and the associated traffic congestions are often considered negative experiences. Next to physical and mental fatigue [13], commuters often experience stress, anger, or frustration, which can have a long-term impact on their health and emotional wellbeing [4]. Moreover, negative emotions associated with commuting can reduce driving safety [8, 9] and influence a commuters’ subsequent behavior, such as performance at work [7]. All of these aspects do not paint a positive picture of commuters and their everyday experiences on the road. In addition, research has revealed that commuting-related stress is amplified through the prospect of encountering congestion, as well as the occurrence of unpredicted traffic congestion [3]. As a result, commuting has been strongly associated with stress, frustration, or anxiety [23]. Consequently, a number of researchers have recently stressed the importance of studies that systematically look into the anticipation of driver frustration and prevention strategies (e.g., [6, 20]).

In this paper, we establish an understanding on prediction, actual experience, and recall in the automotive context. By providing an understanding of preceding activities, expectations, and choices, we establish a holistic view on commuters’ everyday emotions and experiences and thus extend the design space for the automotive context. Therefore, we conducted a study exploring the temporal characteristics of commuters’ experiences and investigated the differences between commuters’ predicted (before the start of the commute), actual (momentary), and recalled experience (at the end of the commute). A special focus was placed on the participant’s predicted, experienced, and recalled level of anger and frustration. The three-week field study was performed in two European cities (Salzburg and Funchal), involving regular commuters. Our findings show the influence of different parameters (e.g., time of the day, mood of the commuter, unexpected events on the road) on the commuters’ ability or inability to make good predictions and recollections of their commuting experience.

With this paper, we contribute (i) empirical insights to the interrelationship between the three stages of commuting: prediction, actual experience, and recall. We also (ii) generate insights into the individual temporal stages, taking parameters such as mood, time of day, and unexpected events into account. With a more precise understanding of temporal aspects of the driving experience, we (iii) aim to inspire the development of future automotive interfaces and systems. Thus, our work provides a holistic view on commuters’ everyday emotions and experiences – not only when being on the road, but also before and after the trip.
RELATED WORK

Frustration and anger

The driver’s emotional state is an important issue for automotive safety [4]. A number of driving behaviors are negatively affected by emotions, linking anger or aggression to accidents (e.g., [9]). Harris and Nass [6] point out the importance of anticipating driver frustrations in order to increase road safety. Taib et al. [20] attempted to study frustration detection with posture sensors in the car and helped to detect dangerous levels of frustration, focusing on the general experience of commuting.

Berkowitz [2] defines frustration as “a barrier to goal attainment”. Frustration can be distinguished from anger by the degree of negativity and arousal. Being closely related to frustration, anger is also a regularly occurring phenomenon with regard to driving behavior (e.g., [19]). According to Potegal et al. [15], anger has been associated with a sense that the self has been offended or injured, with the belief that another person was responsible for the event. In summary, anger is related to a specific source often linked to a social context (e.g., “the driver behind pressing me”), whereas frustration is more unspecific than anger often linked to environmental circumstances that impede a person in his/her actions (e.g., “red traffic lights”).

Prediction and recall

Research on prediction and recall of experienced affect can provide valuable insights into the nature of commuting. Studies show that there is an influence of the predictability of traffic congestion on the commuters’ experience of stress [3]. In those situations where traffic congestion during commute was not anticipated, commuters felt greater levels of stress [3]. Thus, one reason for negative commuting experiences is unpredictability. However, the anticipation of traffic congestions in itself can lead to negative emotions [23] and influences one’s behavior and emotions later on [7].

Humans have exceptionally weak skills in predicting the amount of positive and negative affect to be experienced in future events (i.e., affective forecasting) [1]. Van Dijk et al. [22], for example, demonstrated that people overestimate the duration and intensity of anger and sadness. Similarly, other studies provide evidence for the “rosy retrospection effect” or “rosy view”, where people recall past events and experiences in a more positive way as they had actually been [11].

In addition, people’s prediction about their future feelings (i.e., their anticipated affect or emotional state regarding a specific event or situation), is often considered as “affective forecasting” [24]. This, in turn, influences people’s preferences, decisions, and behavior. When it comes to forecasting accuracy, research has shown that people overestimate the intensity and duration of their future emotional reactions [22]. Wilson and Gilbert [24] termed this overestimation “impact bias”. Mitchell et al. [11], examined people’s anticipation of emotions regarding meaningful life events (e.g., a trip to Europe). The authors found that vacationers anticipate greater enjoyment for upcoming trips than they expressed during their actual trips. Van Dijk et al. [22] also showed an impact bias regarding the overestimation of future anger and sadness, showing that the predicted intensity of anger and sadness was higher than what was actually experienced.

User experience over time

The inconsistency in people’s ability to judge and recall experiences accurately at different points in time has also been discussed within HCI (e.g. [8]). Norman [12], for instance, highlighted that the memory of an experience can also be a design goal in itself; rather than trying to optimize the actual experienced event, one might optimize the memory of the experience.

The role of anticipated experiences has been investigated for example by Yogasara [25]. In the automotive domain, Trösterer et al. showed that drivers’ expectations play a crucial role when providing assistance in the car [21]. While there is an increasing body of research, we still miss a systematic analysis of the differences and influences across the different phases of a user experience. In particular, we lack research on affective forecasting in an automotive context that takes all three stages (e.g., predicted, actual, or recalled experiences) over time into account. Such a holistic view, however, is particularly relevant to study with respect to everyday behavior and routines of regular commuters, who might apply affective forecasting in another manner as irregular drivers.

FIELD STUDY

Pre-study

In order to better get to know our research context, we conducted a contextual inquiry [13]. The contextual inquiry was conducted with three female commuters (25, 26, and 49 years old). The researcher joined every commuter for one day on the way to work (morning) and the return home (evening). Before and after each trip, the researcher conducted a short interview focusing on the participants’ expectations on the traffic situation (before the trip), as well as on their mood and experiences in relation to the congestion (after the trip). The pre-study informed us, for example, about reasonable time intervals for triggering questions during the commute. Further, the qualitative insights gained in the pre-study [13] helped us to interpret the quantitative results from the field study (see subsection “Overall insights on commuting experiences”).

Field study design

Our overall research question was: How does the level of anger and frustration change with regard to different phases when commuting (i.e., predicting, actual experience, and recall)? Further, we were interested in the question of how participants’ mood, time of day, and the predictability of congestions relate to commuters experienced level of anger and frustration?
Overall, we collected data from 10 commuters over three weeks, each week covering one specific stage in the daily commute: predicting, experiencing, and recalling. We designed a within subject study, where each participant was assigned to each of the three conditions at one point in time. Each condition lasted for 5 working days, with two trips being monitored every day (in the morning and evening). While the three conditions represent our independent variables, the experienced anger and frustration are the dependent variables. The sequence of conditions was counter balanced across participants (see Figure 1).

We defined the following two hypotheses:

H1: Commuters’ predicted frustration and anger in an upcoming traffic congestion is higher than the actual frustration and anger they experience during the congestion.

H2: Commuters’ recalled frustration and anger from a recent traffic congestion is lower than the actual experienced frustration and anger they experienced during the congestion.

To capture the actual experience while commuting, we used the Experience Sampling Method (ESM), an in-situ method that allows the collection of data as they happen without a researcher being present [10]. In particular, we applied event-based sampling, as our focus was on particular discrete events in participants’ lives [18], e.g., traffic congestion. The data collection was done via a smartphone.

We developed an Android ESM application, named eMotion, triggering questions at specified moments (e.g., when the car has just stopped or when it is moving slower than 5 km/h; see Figure 2). We used the eMotion app not only to capture the data on the actual experiences during a commute, but as overall data collection tool for predictions and recall throughout the whole study. The eMotion app was available in two versions, German and English. All collected data was anonymized and automatically uploaded from the eMotion app to an online MySQL database whenever an Internet connection was available.

Anger and frustration were measured through single measures derived from van Dijk et al. [22] and based on Roseman [16], using the eMotion app. The two single items were “To what extent do you feel frustrated?” and “To what extent do you feel angry?”; a five-point Likert scale was used, ranging from 1 (not at all) to 5 (very much).

Additional questions were asked at the beginning and at the end of every trip across all conditions including general question on the persons’ mood using a five-point Likert scale (i.e., “How do you feel today?”), ranging from 1 (very bad) to 5 (very good). Finally, upon every arrival, participants were instructed to end the study session and answered one more question about any unexpected congestions during the journey (“Was there any congestion you did not expect before?”).

Study procedure and conditions
The study was divided into three main phases:

Prep phase – Briefing & Test Drive: Within this phase, the participants were invited to the respective research institute with their car and introduced to the study. They received a mobile phone with the preinstalled eMotion app, a booklet with instructions, and an individual study plan. The researcher explained the study procedure and accompanied the participant during a test drive to try out the application and give further instructions for its usage.

Main phase – Field study: During the actual field study, participants carried the mobile device in their cars and filled in questions on the eMotion app when commuting between home and work. Participants only had to press a start button when starting the commute and an end button at the completion of the commute. The questions on their experienced levels of anger and frustration were asked in accordance to the conditions the participants were assigned to at that specified point in time: A) before turning on the car; B) during the trip; C) immediately upon arrival.

Post phase – Debriefing: After the three weeks field phase, participants returned the mobile phone. We concluded the study with a demographic questionnaire and a short interview to get feedback on the study and the eMotion app.

Data collection tool
Every participant received a mobile phone with the preinstalled eMotion app, along with a windshield mobile phone holder, and was instructed how to set and use the device (see Figure 2). Upon departure, participants were instructed to select one of the three available options depending on their individual study plan. In option A (predicting), participants were asked to estimate how angry and frustrated they will be at the end of their commute (see Figure 3). Contrary to A, option C (recalling) asked participants upon arrival to their destination to recall how angry and frustrated they were during the trip. In option B (experiencing), questions were asked during the trip.

![Figure 1. Schematic representation of the study set up (within subject approach with three conditions).](image-url)
The app was tracking plausible traffic conditions and when they were met, the app prompted the participant to reflect on his/her current anger and frustration levels. For a congestion criterion, we set a period of 1 to 2 minutes with a driving speed below 5 km/h. Audible notifications were used to inform participants when a question appeared. Questions disappeared when more than 30 seconds had elapsed without receiving an answer. At this point, it is important to note that participants were specifically instructed to avoid answering if they felt that there was any safety risk involved.

**Participants and data analysis**
All gained quantitative data was preprocessed and analyzed with IBM SPSS Statistics 21. Overall, 10 commuters from two different countries (6 male from Austria, 4 female from Madeira) took part in the field study. Their mean age was 26.5 years, ranging from 23 to 31 years. One of the participants (female) quit the study due to health reasons and was thus excluded for the data analysis. In total, we collected data from 225 commuting episodes (127 in Austria, 98 in Madeira). Due to different reasons (e.g., sickness, neglect, stress), we were unable to receive data from every commuting episode (a total of 300 possible episodes). On average, participants had a trip distance of 24 kilometers. Their average trip time was 27 minutes and average speed was 52 km/h.

**FINDINGS**

**Description of dataset**
The relationships between trip duration, trip distance, and self-reported ratings of anger and frustration were assessed using Pearson’s product-moment correlation. Overall, we found a significant positive correlation between trip duration and anger ($r = 0.41, n = 224, p < 0.01$), as well as between trip duration and frustration ($r = 0.33, n = 222, p < 0.01$). We found a moderate positive relationship between trip distance and anger ($r = 0.36, n = 224, p < 0.01$), as well as frustration ($r = 0.27, n = 222, p < 0.01$). This means, the longer the trip lasted and the longer the distance was, the more anger or frustration was indicated by participants.

We further explored if time of the day had an influence on users’ experienced frustration and anger. With respect to time of the day, no relation was found. When distinguishing between the three conditions, we found no relation for time of day and experienced or recalled anger. We found a weak negative relationship between time of day and predicted anger, $r = -0.26, n = 63, p < 0.05$. This result suggests that the prediction of anger is linked to the time of day. The earlier in the day (morning), the more anger is expected due to congestion, which could be explained by the fact that being late interferes with the planned course of the day.

Further, we explored how one’s mood before the start of the trip affects the experienced stress and anger during the trip. A Pearson product-moment correlation coefficient was computed to assess the relationship between mood and ratings of anger and frustration. When distinguishing between the three conditions, we found a negative relationship between mood (indicated at the beginning of the trip) and predicted frustration, $r = -0.25, n = 62, p < 0.05$. This result suggests that the predicted level of frustration is linked to the actual mood of the participant. The better the mood, the less frustration was expected due to traffic congestion, indicating that mood acts as a moderator lowering expected frustration.
the actual experience condition, anger was experienced higher in Austria (M = 2.29, SD = 0.89) than in Madeira (M = 1.77, SD = 1.17); t99 = 2.34, p < 0.05. When being recalled, frustration was also higher in Austria (M = 1.94, SD = 1.03) than in Madeira (M = 1.46, SD = 0.81); t62 = 2.17, p < 0.05.

Figure 4. Mean ratings of anger and frustration for each condition (significant differences are in brackets). Scale ranging from 1 (“not at all”) to 5 (“very much”).

An independent-samples t-test was conducted to compare ratings of anger and frustration in expected and unexpected traffic congestions. We found a significant difference for anger in expected and unexpected traffic congestions in actual congestion experiences, with higher levels of anger (M = 2.80, SD = 1.03) in unexpected congestions than in expected congestions (M = 1.95, SD = 1.04); t85 = -2.44, p < 0.05, d = 0.82. A Pearson product-moment correlation shows a positive relationship between anger and unexpected traffic congestion, r = 0.26, n = 87, p < 0.05. During recall, we found a significant difference for anger in expected and unexpected traffic congestions, with higher levels of anger (M = 3.13, SD = 0.81) in unexpected congestions than in expected congestions (M = 1.52, SD = 0.94); t66 = -6.17, p = p < 0.001, d = 1.83. A Pearson product-moment correlation showed a positive relationship between anger and unexpected traffic congestion, r = 0.61, n = 68, p < 0.001.

For frustration, we did not find significant differences regarding expected versus unexpected traffic congestions in actual experienced congestion. However, we found that during recall, significantly higher levels of frustration were reported for unexpected (M = 2.88, SD = 0.62) than for expected traffic congestions (M = 1.50, SD = 0.85); t34 = - 7.06, p < 0.001, d = 1.85. A Pearson product-moment correlation showed a positive relationship between anger and expectation, r = 0.59, n = 68, p < 0.001. Our results suggest that unexpected congestions induce higher levels of anger in actual, as well as recalled traffic congestions. Unexpected congestions are also related to higher levels of frustration when recalled. Another interesting point is that unexpected congestions do not seem to increase the level of frustration in actual congestion situations.

**Hypothesis Testing**

In order to test our hypothesis (H1 and H2), we conducted between-subjects analysis, aggregating data across participants. Bonferroni correction was used for post hoc tests. Although within-subject analysis (e.g., repeated measures ANOVA) seems reasonable to investigate within-person variations in experience over time, we did not conduct it for the following reasons: First, we have to assume carry over and recall effects given that the distance between any two judgments is small. This means that earlier responses influence later judgments (i.e., tendency to give the same score by recalling what was responded recently). Further, our sample seems to fail the assumption that it is homogenous. This is reflected in the facts that we found higher levels of anger and frustration for Austria. Finally, due to the small sample size and missing data points, time points were not comparable and repeated measures ANOVA was not reasonable.

By conducting between-subject analysis, we took an alternative perspective that puts the focus on the differences between subjects. According to Shiffman et al. [18], aggregated ESM data might be used to quantify subjects’ characteristics at different time points (before, during, and after the commute in our case). Aggregated ESM data are expected to provide more reliable (because of aggregation) and more valid (because of avoidance of recall bias and ecological validity) assessments of individuals.

**Hypothesis 1**

In H1 we stated that “Commuters’ predicted frustration and anger in an upcoming traffic congestion is higher than the actual frustration and anger they experience during the congestion”.

To test if the predicted anger was higher than the actually experienced anger, we conducted a one-way between subjects ANOVA with prediction and experience as the independent variables and anger as the dependent variable. We found no significant difference between prediction and experience with respect to anger ($F_{2,221} = 0.71$, $p = 0.493$, $\eta^2 = 0.006$).

In order to test if the predicted frustration was higher than the actual experienced frustration, we conducted a one-way between subjects ANOVA with prediction and experience as the independent variables and frustration as the dependent variable. We found no significant difference in the level of frustration between prediction and experience ($F_{2,220} = 4.52$, $p = 1.000$, $\eta^2 = 0.04$).

In summary, there was no significant difference between predicted and actual anger or frustration (see Figure 4). These results do not confirm hypothesis 1, suggesting a
difference between predicted and actually experienced anger or frustration in an upcoming commuting episode.

**Hypothesis 2**
In H2 we stated that “Commuters’ recalled frustration and anger from a recent traffic congestion is lower than the actual experienced frustration and anger they experienced during the congestion”.

To test if recalled anger was higher than actual experienced anger, we conducted a one-way between subjects ANOVA with recall and experience as the independent variables and anger as the dependent variable. We found no significant difference between recall and experience with respect to anger ($F_{2,221} = 0.71, p = 0.493, \eta^2 = 0.006$).

Proving if the recalled frustration was lower than the actual experienced frustration, we computed a one-way between subjects ANOVA with recall and experience as the independent variables and frustration as the dependent variable. We found a significant difference between recall and experience with respect to frustration ($F_{2,220} = 4.52, p < 0.05, \eta^2 = 0.04$). Post hoc tests, using Bonferroni correction, indicated that recall ($M = 1.77$, SD = 0.98) was significantly lower than experience ($M = 2.19$, SD = 1.04).

In summary, there was no significant difference between recalled and actual anger, implying that individuals can accurately recall their experienced anger of a past commuting episode (see Figure 4). With regard to frustration, we could show that participants’ memory is systematically biased, with participants recalling the experienced frustration as significantly lower than what they actually experienced during the traffic congestion. With respect to our hypotheses, we can confirm hypothesis 2 with regard to frustration, saying that recalled frustration is lower than actual experienced frustration.

**Overall insights on commuting experiences**
Below, we summarize our findings and complement them with qualitative insights gained in the pre-study.

**Influences**
Our findings suggest that unexpected congestions are related to higher levels of anger compared to the expected ones (i.e., experiencing condition). We found, however, no difference for frustration. This is similar for the recall condition: unexpected congestions are related to higher levels of anger and frustration when being recalled. This is aligned with reports from our participants in the pre-study, indicating that unexpected congestions led to more negative emotions than expected ones. One participant, for example, stated that (s)he is “not surprised about the congestion in the city around 4 o’clock because there is always one at that time” [P2]. Even the prospect of being stuck in traffic is associated with anger. As one participant stated: “Hopefully, they will not be working at the construction site, otherwise I will get angry!” [P2]. This prospect of anger already before the start of the commute can be further linked to our finding showing a correlation of time of day and a persons’ prediction of anger. The earlier the day, the more anger is predicted due to traffic congestion.

**Consequences**
Insights from the pre-study indicate that being stuck in traffic elicits thoughts about personal consequences due to being late because of congestion (e.g., job-related or spare-time related consequences). One participant reported about job-related consequences when being in road congestion; “[...] and right after the moment I realized that I’m stuck, my thoughts start to revolve about; do I have to be on time at work; do I have important appointments; do I have to call someone from work to let them know that I’m stuck and that I’m late” [P1]. Further, participants associate waiting times as a waste of time and do not like the feeling of not progressing. This, in turn, leads to negative emotions like anger. Two participants mentioned wasting time in relation to losing spare-time. P1 highlighted the feeling of not progressing as negatively affecting his/her emotions: “I’m angry when being in road congestion, yes basically angry because when I’m driving, I usually want to go somewhere and I want to arrive quickly and be there in time. This is what makes me angry, when I’m standing there [road congestion] and it is just stop-and-go” [P1]. In relation to wasting time, participants reported about individual strategies, like entertainment or distraction, to make use of this lost time. P3 argued that when stuck in traffic, (s)he is calling someone just to overcome the feeling of wasting time and to make the time flow faster.

**Loss of Control**
People associate a loss of control about the situation when being in road congestion. They feel that they ‘cannot change anything about the situation’. P1 stated: “[...] and I take it as it comes, cause I just can’t escape from the situation, that’s a fact” [P1]. Further, uncertainty about the current situation was also mentioned. In relation to this, the wish for information about the current situation/congestion was expressed. Moreover, one participant [P2] stated that (s)he wants to decide when to get this information; “I want to be able to get this information [meaning information about road congestion situation] when I want to, not that this information is imposed to me [...] here, I want to get individualized information, such as expected time delays as well as the length of the congestion” [P2]. In addition to provided information about the congestion, P3 would like to have further information about potential detouring routes, as well as information about the causes (e.g., car accident, construction sites) for the current road congestion.

**DISCUSSION**
With this paper, we shed light on how commuters predict, actually experience, and recall their negative emotions (i.e., anger and frustration) on the road. We extend the current state of the art by providing a comprehensive temporal view on everyday driving experiences, including preceding activities, expectations, choices, and memories. Overall, our study showed that people lower experienced frustration in memory. We further found that time of day influences
the prediction of anger, which is predicted higher in the morning than in the evening. Our results show that mood is related to the prediction of frustration. The better the mood, the less frustration is predicted. These differences could be explained by the fact that anger is directed towards a specific person in a concrete situation [15] and thus less influenced by individual issues like mood.

Our results differ from previous work with regard to the specific emotions (i.e., anger and frustration), which may be explained by the fundamental differences of these two constructs. While frustration is often considered as a “barrier to goal attainment” [2] anger, in contrast is directed towards a specific person and/or event [15] and leads to higher negative arousal. With regard to road congestions, frustration is connected to impeding the aim of getting somewhere (i.e., getting to work or home), whereas anger is related to the behavior of specific persons in traffic. Based on this, frustration may occur more often than anger. In general, our findings show that the level of experienced personal control is a key issue with regard to driving experiences in road congestions. Hereby, the level of personal control in congestion situations is especially low due to external factors that cannot be influenced. This implies a feeling of “not being able to get out and actively change a situation”. This, induces a feeling of frustration, as the respective person is inhibited in his/her goal of getting somewhere (e.g., due to not progressing on the road).

Throughout the qualitative analysis, the feeling of losing personal control over the congestion situation and having no chance of changing the current situation have also been identified as critical factors that negatively affect the drivers’ experience. Our findings confirm prior work, suggesting that the occurrence of unpredictable events is positively related to negative driving experiences (e.g., [3]). Design may respond to user’s feeling of control loss by overcoming uncertainties of what to expect from an upcoming road congestion.

As stated, mood is related to the prediction of frustration, acting as a moderator. This means that better mood decreases the expected level of frustration, i.e., non-attainment of goals seems to be less relevant with better mood. The time of day influences the prediction of anger, which is predicted higher in the morning than in the evening. This finding can be explained by the consequences of being late especially in the context of work (e.g., missing appointments, less time for accomplishing tasks). In contrast, in the evening the consequences are perceived less severe. These findings have certainly to be seen in the context of everyday experiences like commuting; thus, it would be interesting if this would be the same for other everyday experiences that similarly provoke anger and frustration. Further, effects like temporal distance would be interesting to explore in future research.

Our results do not show an impact bias [24] with regard to the prediction of anger and frustration. This is in contrast to prior work that demonstrates that the intensity and duration of specific emotions (i.e., anger and sadness as reported in the work of van Dijk et al. [22]) are higher when predicted than actually experienced. We think this difference could be explained by our study context, dealing with the repeating, daily experience of commuting. In contrast, prior work has mainly dealt with more rare “meaningful life events” (e.g., a trip to Europe [11]).

We came to understand that participants seem to be susceptible to a rosy retrospection bias when asked to recall the experienced frustration at the end of the trip. This aligns with Mitchell et al. [11], who state that subsequent recollections of a negative event are more positive than the actual experience during the event itself. Overall, it seems that people are good in predicting anger or frustration in their everyday experiences like commuting; however, they tend to lower and regulate negative experiences (i.e., frustration) in retrospect.

Regarding limitations of our approach, we acknowledge that a larger sample size is needed to further deepen our findings. However, the presented study provides a valid starting point for understanding everyday commuting experiences, in particular the relation between prediction, the actual experience and recall of experienced anger and frustration in the car.

We are also aware about the possible limitations of the method used (ESM) requiring a high commitment from participants, taking part in a three week study, being asked input twice a day, five days a week. While ESM is a valuable approach to gain rich in-situ data, it requires participants’ engagement over time, which is not always easy to sustain (we collected data for 75% of possible commuting episodes). Although a three-week field study requires a lot of effort and compliance of participants, this study design has the advantage of providing high ecological validity (i.e., data collection integrated in the daily routines of participants).

CONCLUSION

Overall, we provided a systematic investigation of predicted and recalled experience in comparison to actual experience in the context of driving experiences. To the best of our knowledge, no such study exists to date. With these insights provide a holistic view on commuters’ everyday emotions and experiences – not only when being on the road, but also before and after the trip. Thus, we extend the design space for the automotive context. We are confident that the presented study is a first step towards investigating driving experiences from a comprehensive (temporal) perspective, providing valuable insights and inspiration for the development of future automotive systems.

ACKNOWLEDGMENTS

The financial support by the Austrian Federal Ministry of Science, Research and Economy and the National Foundation for Research, Technology and Development is
gratefully acknowledged (Christian Doppler Laboratory for “Contextual Interfaces”). Further, the authors acknowledge the financial support of the Future and Emerging Technologies (FET) programme within the 7th Framework Programme for Research of the European Commission, under FET Grant Number: 612933.

REFERENCES
12. Donald A. Norman. 2009. The way I see it: Memory is more important than actuality. Interactions, 16(2), 24-26.