

## Dude, calm down! De-escalating driving anger using in-car information

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### Abstract

Aggressive driving is cited as a major cause for road accidents. Previous research has singled out driver's anger as a key antecedent for aggressive driving behaviour. This ongoing research project investigates how technical devices can be used to de-escalate drivers' anger. In a driving simulator experiment we explore different ways of in-car information with regard to their ability to reduce driver's anger. The simulated drive was designed to elicit driver's anger by inhibiting their progress and comprised a traffic jam, a tailgater, and a slow driving car in front with sections of unimpeded driving in between. In-car information was either designed to distract driver's attention from the anger eliciting aspect of the event (distraction) or to change the appraisal of the anger-provoking event (reappraisal). At 9 predefined route sections participants were asked about their amount of experienced anger. Driving parameters were measured during the whole simulated drive. Preliminary results indicate that in-car information may be able to modify driver's anger.

### Introduction

*Imagine yourself on your way towards a very important meeting. 'You are late due to an unexpected phone call but you know the route and last time you drove it it did not take you more than 30 minutes to arrive at the designated location. You just survived a slow driving car in front but subsequently you are stuck in a traffic jam. You can already feel the time pressure in your chest and you mentally start to blame all the Sunday drivers for their inability. Anger arises!*

Recent research has extensively examined driver's anger and investigated different strategies for anger regulation. Mainly two anger regulation strategies have been suggested: reappraisal and distraction. Research on reappraisal has found that reappraisal is positively associated with anger regulation. For example, Deffenbacher et al. (2002) explored the effects of cognitive behavior therapy on reducing driving anger. In their study they taught drivers several cognitive relaxation and coping skills to reappraise driving situations. In their study they found that reappraisal reduces anger and risky driving behavior in subsequent driving simulator drives (Deffenbacher et al., 2002). Similar effects have been found by others (Deffenbacher, 2009; Deffenbacher, Filetti, Lynch, Dahlen, & Oetting 2002; Deffenbacher, Huff, Lynch, Oetting, & Salvatore, 2000). Furthermore, reappraisal has been found to be a particularly useful strategy in frustrating driving events (Harris & Nass, 2011).

Recently researcher compared reappraisal and distraction, which is known to down-regulate negative emotion. They found, that distraction seems to have some benefits in regulating negative stimuli compared to reappraisal. Sheppes (2008) for example found, that distraction impaired memory encoding about emotional situations, and further lead their participants to disengage from negative stimuli with a high-intensity (Sheppes, 2011). However, in traffic or road safety research distraction is considered as a main cause for accidents (National Highway Traffic Safety Administration, 2010). Nevertheless, Chan & Singhal (2013) found, when a positive stimulus was used as a distractor participants drove slower in comparison to non-emotional stimuli. Taken together the findings on distraction may lead to the conclusion, that distracting-information could positively influence driving behavior, and even stronger if information has a positive valence.

Taken together these findings suggest that both distraction and reappraisal have a positive effect on anger regulation with individual strengths. However, little is known about the experience of driver's anger when being distracted in a frustrating situation by e.g. non-driving related information. Yet, transferring these insights to understand the effect of in-vehicle communication on driver's anger may yield relevant insights to increase road safety.

This research contributes by examining the following three research questions in relation to distraction and reappraisal in in-vehicle communication:

Question 1: Does distracting-information cause stronger anger regulation in frustrating events, which have a high-impact on anger intensity (high-intensity events) in comparison to reappraising-information and no-information?

Question 2: Does reappraising-information cause stronger anger regulating in frustrating events, which have a low-impact on anger intensity (low-intensity events) in comparison to distracting-information and no-information?

Question 3: Do distracting-information cause safer driving behaviour in later driving situations compared to reappraising-information and no-information?

By addressing these research questions, our study will make the following two contributions: First, by examining the effect of distraction and reappraisal in in-vehicle communication, this study offers practical implications for the design of in-vehicle communication systems. Second, by comparing the effects of both strategies systematically in varying situations, this research may shed light on the superiority of a strategy in in-vehicle anger regulation.

## **Method**

### ***Participants***

55 students (61.8 % female, age from 18 to 37 years with a mean of 22.04 years) participated in the study. All participants held a current driving licence and drove on average 57.74 km per week and 5,172 km per year. All participants were recruited on the university campus and obtained credits as part of their study requirements. Furthermore, participants automatically took part in a lottery for an amazon voucher.

### ***Measure***

*Anger Rating:* Event-specific anger ratings were requested from all drivers at nine predefined points throughout the drive. Anger ratings were requested after an adequate period of anger-induction and anger-regulation again after an adequate period of uninterrupted driving resulting in 9 evaluations (plus four baseline ratings). Participants gave verbal ratings of their current level of anger, annoyance and emotional arousal on a 7-point scale with 1 does not apply at all, 4 applies in a moderate amount, and 7 totally applies. Ratings were prompted by the sound of a bell.

*Speed:* Speed was measured with a driving simulator running with STISIM Drive®. The driving simulator has a Volkswagen Golf cockpit with original steering wheel and instrument panel. The driving simulator was further equipped with three projectors which presented the traffic situation onto three wall screens with a 180° field of view. During the simulated drive speed was recorded continuously.

### ***Procedure and Materials***

The experiment took place in the above-mentioned driving simulator, which was located in the

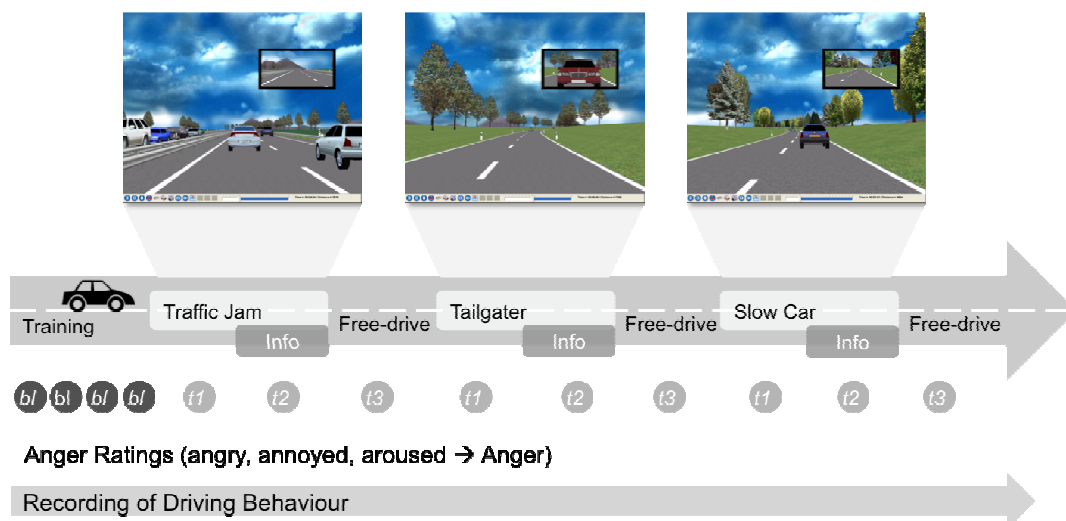
LueneLab laboratory Lüneburg, Germany. As soon as the participant arrived they were randomly assigned to an experimental condition and started with two familiarization driving session. The first session aimed at familiarizing the participant with the driving simulator. The second drive familiarized the participants with the questions concerning the anger ratings. After both test drives, we answered all remaining questions regarding the driving simulator and the experiment.

We instructed the participants with the following instructions to induce time pressure: Each participant was told that they are on their way to a job interview of their favourite company and that the drive would take – under good conditions – approximately 30 minutes to complete. They were told to be late due to an unexpected phone call but they would take part in a lottery if they would arrive within 30 minutes.

The experimental drive was designed to elicit anger by inhibiting drivers’ progress. The driving route comprised a traffic jam, a tailgater, and a slow driving car in front, separated by sections of free driving. Each driving event comprised a distinct section of anger-induction and a distinct section of anger-regulation and lasted for approximately four minutes. Within the anger-induction section (first two minutes) participants were stuck in e.g. a traffic jam without listening to any in-vehicle information. After two minutes, the anger-regulation section started and in-vehicle information was presented while participants were still stuck in the traffic jam for another two minutes. The control group drove both sections without any regulation treatment.

After every driving event participants drove a free section for approximately one minute. The free section was implemented to prevent an overlap of emotion from one event to another one. To examine the effect of in-vehicle information on a specific cause of driving frustration, event-specific anger ratings were recorded, whereas driving speed was recorded continuously. After participant finished the experimental drive (described above) - which was presented in a random sequence for each participant – they finished another questionnaire comprising demographic questions as also ratings about the experienced time-pressure (see figure 1).

**Figure 1: Procedure**



**Analysis**

Statistical analyses were conducted using SPSS 20 for Mac. As outlined above, subjective ratings of anger were analysed as indicator of anger regulation and speed as a measure of long-term anger response. For the anger ratings an aggregate score was calculated as the mean response to the three anger-items ‘angry’, ‘annoyance’ and ‘arousal’ for every drive section (Induction, Regulation and

Free-drive). Further, gain scores ( $D = Y2 - Y1$ ) were calculated for every dependent variable as indicator of anger regulation (anger ratings) and long-term response (speed) and represent the dependent variable in all ANOVA comparisons (Dimitrov & Rumrill, 2003). Low- and high-anger-intensity events were defined separately for each participant.

We compared the anger ratings from each induction section (t1) and labelled the event with the lowest anger rating as low-intensity event and the event with the highest anger rating as high-intensity event. We computed two-way mixed ANOVAs with repeated measurement on event (low-intensity vs. high-intensity event) and information-type (distraction, reappraisal and no-information) as between-subject factor. If violations of sphericity occurred it was checked if conclusions change after Greenhouse-Geisser corrections. If assumptions of homogeneity were violated Bonferroni corrections are reported.

## Results

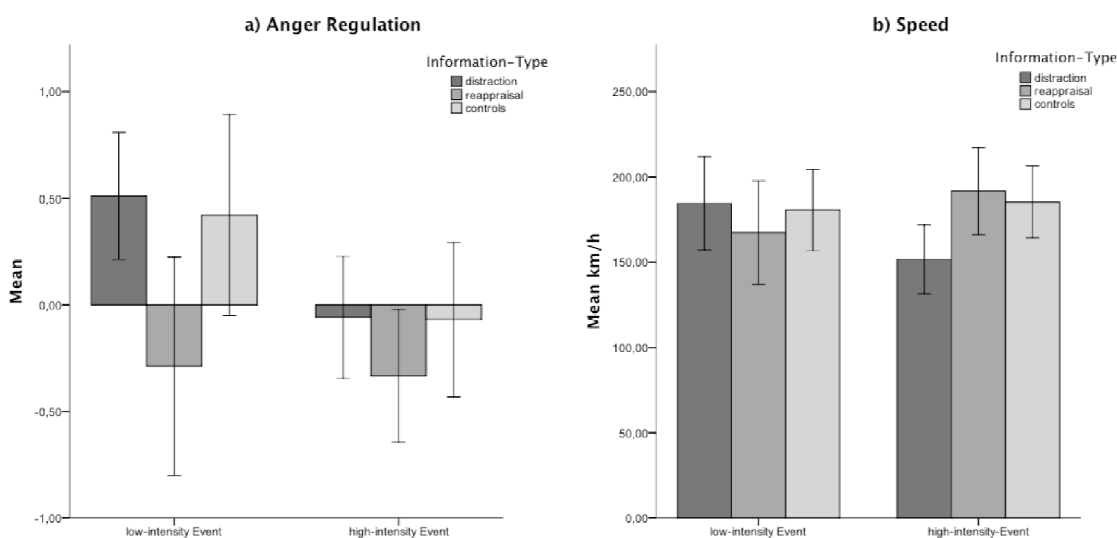
### Manipulation check

We computed a one-way ANOVA with repeated measurement for drive (practise-drive vs. test-drive) to analyse whether the test-drive elicit drivers' anger. The ANOVA revealed a significant difference between the test-drive and practise-drive  $F_{(1, 70)} = 417.88$ ,  $r = .93$ . This significant difference indicates that the test-drive elicited higher anger-ratings in comparison to the unimpeded practice-drive.

### Anger Regulation

There was a significant effect of event-intensity on anger ratings ( $F_{(1, 48)} = 5.64$ ,  $p < .05$ ,  $\omega = .31$ ). This indicates that anger regulation was different in low-intensity vs. high-intensity events. Anger regulation is stronger when in high-intensity events compared to low-intensity events ( $M_{\text{high}} = -1.4$ ,  $M_{\text{low}} = 0.24$ ). There was no significant interaction effect between event-intensity and information-type ( $F_{(2, 48)} = 1.04$ ,  $p = .361$ ). However, post-hoc tests revealed that anger ratings decreased significantly after listening to reappraising-information in comparison to distracting-information ( $p = .034$ ), and furthermore decreased when compared to no-information ( $p = .054$ ).

**Figure 2: Dependent variables as a function of in-vehicle information**  
(Error bars indicate standard errors)



### Speed

There was no significant effect of event-intensity on long-term speed, indicating that low vs. high-intensity produce the same speed in free-drive ( $F_{(1, 46)} = 0.12, p = .913$ ). There was also no significant effect for information-type on speed in the free-drive section. Furthermore, there was no significant effect between event-intensity and information-type ( $F_{(2, 46)} = 1.97, p = .151$ ). However, the graph reveals that speed was higher after listening to distracting-information in low-intensity events compared to high-intensity events ( $M_{\text{low}} = 184.52, M_{\text{high}} = 151.67$ ). This was the other way around after listening to reappraising-information: speed was higher after high-intensity events compared to low-intensity events ( $M_{\text{low}} = 167.36, M_{\text{high}} = 191.63$ ) (see figure 2b).

## Discussion

Our goal of this research project was to examine the influence of distracting and reappraising-information on anger regulation. It was assumed that distracting-information cause anger regulation in highly frustrating driving events and thus improves long-term driving behaviour. Furthermore, it was assumed, that the reappraising-information elicit stronger pattern of anger regulation in driving events with lower frustration intensity. The results suggest that reappraisal has a significant effect on anger regulation. Distraction had no significant effect on anger regulation but showed some effect on long-term driving behaviour.

This study contributes to our understanding of in-vehicle information and anger regulation as follows. First, Previous research has highlighted the influence of reappraising-information on emotional states. However, the actual ability in changing a driver's anger has not been examined by these studies. By directly observing the effect of distraction and reappraisal on anger regulation within an experiment we gain a more complete understanding of anger regulation. Second, previous research has mostly asked participants about their emotional state after the drive. In contrast, in this study we asked the participants in the actual situation about their emotional state which has been suggested to yield more appropriate results in emotion research. Therefore, this study may provide a more comprehensive understanding of the effects of in-vehicle information in different driving situations than previous studies.

Our study is not without limitations. First, although we tried to match the content of in-vehicle information with drivers interest, the results suggest, that our manipulation may have been flawed. Second, although we believe that our approach to ask participants during their drive has main advantages over asking participants after the drive, one may question whether the question itself has a regulatory effect on emotion. Third, in our study we did not control for individual differences of participants. Our future studies will address these topics to gain a better understanding of anger regulation using in-vehicle information. Nevertheless, we think that the results contribute to our theoretical understanding of in-vehicle information. Furthermore, our study may have practical implications for companies who develop in-vehicle communication systems.

## Practical Implications and Conclusion

This study may have implications for companies interested in improving car safety. Recently, the automotive industry started a discussion about "talking cars". The indicated future car there will not only gather information about other cars and the environment – which is already a fact – it will share information with them. Thinking a step further, the information will soon be available for the driver, too. But: Which information should be given to him? In which driving situation should be information presented? When does an information may increase negative impact of a frustrating situation? Our study suggests that by presenting information, which contains information about other driver's behaviour in frustrating driving events, helps to calm drivers down. Thus, this study provides empirical evidence for a positive association of in-vehicle information and anger regulation, which may help to develop in-vehicle communication systems accordingly.

In conclusion, previous studies have provided rich insights on the influence of distraction and reappraisal strategies on anger regulation. We drew on these insights to investigate how reappraising-information and distracting-information is associated with driver's anger. The results suggest that reappraising-information is an appropriate mean to reduce driver's anger in various frustrating driving events. Future research should further investigate this relationship by taking the moderating relationship of individual differences into account.

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