The Car as a Personal Space to Improve your Health

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Abstract

Fueled by the "post-pandemic" zeitgeist, health is an ongoing trend affecting developments in industry and academia. Under the heading of "Automotive Health", health is viewed through the lens of the automobile. Automotive Health deals with the questions of how health data can be sensed and interpreted in the car, and how this information can be used to enable measures taken to maintain, restore, or strengthen occupants' wellbeing, (medical) health, and safety. With a special focus on mental health, we conducted a field operational test (N = 41) aimed at investigating the usage, effectiveness, and user experience of mindfulness exercises while driving. For this, participants drove in their private car for three consecutive weeks, equipped with a smartphone application that allowed them to play different audio-guided mindfulness exercises, record physiological data, and answer questions on their wellbeing and the exercise. The paper summarizes the most significant results, and gives an outlook on a guideline for designing in-car mindfulness exercises.

Keywords

Automotive Health, Mindfulness, Health Data, Health Behavior Change.

1. Introduction

Nowadays, the car is mainly a means of transportation. Even if there are technology solutions attempting to make that journey as pleasant as possible for drivers and passengers, such as on-board entertainment, massage seats, or ambient light, driving is a waste of time for many people. Therefore, car manufacturers are looking for innovations that help people make better use of their time in the car, and satisfy needs that go beyond coming from a to b.

One of the most basic human needs is to be physically, mentally, and socially healthy [1]. That need is fueled by the "post-pandemic" zeitgeist, making health an ongoing trend that affects our everyday life, as well as developments in industry and academia. Under the heading of "Automotive Health", health is viewed through the lens of the automobile. Automotive Health deals with the questions of how health data, referring to any data related to health conditions, diseases, death and reproduction, or quality of life, can be sensed and interpreted in the car, and how this information can be used to enable measures to maintain, restore, or strengthen occupants' wellbeing, (medical) health, and safety [2, 3, 4]. Applications in this field move in a continuum between protection of human life, diagnostics, health monitoring, promotion and prevention, up to mental health, having an impact on different health issues linked to transportation, such as traffic safety, air pollution, physical activity, noise, comfort, or travel satisfaction [2, 5].

With a special focus on mental health, this paper presents the results of a field operational test, aimed at investigating the usage, effectiveness, and user experience of mindfulness exercises that were designed to be practiced while driving a car. Mindfulness can be described as a process of bringing greater attention to and fostering the awareness of the present moment experience. Most practices to achieve a mental state of mindfulness are similar in their basic procedures and goals, for example, involving deep breathing, awareness of body sensations and emotions, mental images and thoughts, or sensory perceptions [6, 7]. With this in mind, it might be assumed that

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mindfulness practices can also be used to increase drivers' attention and awareness in a given traffic situation, and thus promote driving safety.

2. Related Work

Even if empirical studies have examined the construct of mindfulness for almost 40 years, it is rarely examined in the automotive context [6]. If so, most works deal with mindfulness programs that are done outside the car [8]. There are hardly any studies investigating the practice of mindfulness while driving, which is explained by the fact that the driver—as long as she drives manually—should be fully focused on the driving task. However, studies addressing this question show that mindfulness exercises can help drivers to reduce stress and being more alert, without causing driver distraction. Especially breathing exercises [9], or simple movements [10], are practical interventions that can be done while controlling a car.

Noteworthy, Koch et al. [11] addressed the question of when drivers interact with in-vehicle well-being interventions in a two-month longitudinal study on public road. They provided ten participants with a study car for their daily driving needs that was equipped with a smartphone application delivering two types of intervention: a mindfulness and a music intervention. The mindfulness intervention was based on the concept of passive mindfulness, in which the listeners are guided to perform activities more consciously and to increase their awareness of the present. The exercise contained environment-centric elements that aid drivers to focus on the driving task, the car, and the surrounding traffic, and self-centric elements that support drivers to reflect on their emotions. Data collection included participants' driving behavior that was recorded via the cars' internal bus communication, self-reports of their affective state as a proxy of well-being (before and after the drive), and feedback on the interventions (directly after the intervention), both collected via the app. At each trip, participants were randomly assigned to receive the mindfulness intervention, the music intervention, or no intervention. The authors found that several pre-trip characteristics (e.g., trip length, traffic flow, and vehicle occupancy), the participants' pre-trip affective state, and situational driving characteristics (e.g., road type, average speed, and brake behavior) have significant impact on drivers' responsiveness to the interventions. Comparing trips with and without intervention, it is shown that both interventions have no negative effect on driving behavior (e.g., lane deviations, speeding, or sudden braking). However, there is also no improvement of the participants affective state caused by the interventions, comparing the pre- and post-trip self-reports.

The work of Koch et al. [11] focusses on factors occurring before the trip that determine the use of the mindfulness intervention, as well as its impact on driving behavior and affective well-being. Building on these findings, the following research questions were formulated:

RQ1: Do mindfulness exercises that can be done while driving a car affect drivers' subjective and objective well-being?

RQ2: What are factors under which drivers start a mindfulness exercises, referring to their well-being and the current driving situation?

RQ3: How should mindfulness exercises that can be done while driving be designed to reach user acceptance and avoid driver distraction?

3. Study

The present study was designed as a three-week study on public road. In total, 41 participants took part in the study (19 female; age: M = 39.63, SD = 9.00; hours of driving per week: M = 10.13, SD = 3.40). To create the most naturalistic context of use, they drove in their private car as their everyday life required. They were provided with an app developed for the purpose of the study, and a mobile phone holder that was fixed in the center console. With the

app, participants could (i) freely select, start, and stop different mindfulness exercises (within-subjects design), (ii) provide self-reports about their subjective well-being, operationalized through the dimensions affective valence (positive-negative), affective arousal (calm-exited)), and focus (attentive-distracted) in the morning and in the evening, as well as directly before and after the drive, (iii) give feedback on the exercise and the given driving situation, and (iv) record their health data as an indicator of their objective well-being, for which the app was connected to the participants private wearable (i.e., a smartwatch or a smart wristband). In the background, the app tagged when both the trip and the exercise was started and ended. After the field phase, ten selected participants took part in a post-interview, discussing the design of the exercises in more detail.

Before the study, participants provided their consent to take part in the study and to use their data for this purpose. During the study, they were repeatedly reminded that traffic safety has the highest priority, and that they should only use the app and the exercises if the traffic situation as well as their mental state allow it.

3.1. Mindfulness Exercises and Smartphone Application

In total, six different types of audio-guided mindfulness exercises were designed by experts from the field: energy, relaxation, concentration, fantasy, morning, and evening. For energy, relaxation, morning, and evening, a short and a long version was produced. Overall, the session lasted between 2 and 11 minutes. The exercises were available via the smartphone application.

In order to ensure safety at all time, several design principles were applied when designing the exercises and the app. First, the app design follows common driver distractions guidelines (Campbell et al., 2016). For example, the word count as well as the number of distinct information presented was limited, interaction elements were large enough to easily use them from the driver's position, no animations or alarming colors were used, and users were never put under pressure to provide input. Second, both when starting the app and before starting the exercise, participants were informed to continue only if the driving situation and their mental state allow it. Third, unlike classical mediations, the exercises never asked participants to close their eyes. Instead, they were explicitly guided to direct their gaze to the street by including mainly environment-centric elements. Fourth, the exercises could be canceled at any time with one click.

4. Results

A total of 843 trips were tracked via the app, with the participants starting a mindfulness exercise in 65.4 percent of the cases. Concentration (14.3 %) was used most frequently, followed by energy (short version; 13.8 %) and morning (long version; 12.2 %).

Running a linear mixed model analysis to address RQ1, it shows that the execution of a mindfulness exercise has a significant positive main effect on participants subjective wellbeing in terms of affective arousal and focus, indicating that the exercise made them calmer and more focused. However, there were no significant effects on participants affective valance or objective wellbeing, comparing the data collected before and after the drive. Regarding the latter, the analysis focused on the heart rate, since this parameter was validly measured by all wearables, independent of their brand and model. Considering RQ2, it can be said that a more positive affective state before the drive, a lower heart rate before the drive, better sleep quality in the previous night (well-being factors), the absence of passengers, and the absence of congestion (driving situation factors) have a significant positive effect on the usage of mindfulness exercises. Finally, answering RQ3, the interview data were analyzed, resulting in four different categories of design recommendations: content, voice, length, and others. Most significant, participants highlighted the importance to adapt the content to the driving situation (content), to offer a large selection of exercises as well as different lengths (content, length), and to use a non-monotonous voice.

5. Discussion and Conclusion

The result presented give a first indication of the effectiveness of mindfulness exercises that can be done while driving a car, and provide inspiration for a guideline for the design and delivery of such interventions. Even if there is evidence for the positive effects of in-car mindfulness on a subjective level, no physiological effects were found. That can be explained by the data collection approach using wearables in a non-laboratory setting, which might have caused a lack of data validity. Even if a more standardized study design is necessary for the examination of physiological effects, wearables will be a relevant data source when it comes to the market launch of Automotive Health features, since they will be more and more common in people's everyday lives in the future. Similar assumptions can be made for the topic of mental health, which should motivate industry and academia alike to put these topics on their agenda to make the car a personal space to improve peoples' health.

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