Traeddy - A Stress Sensitive Traffic Jam Companion for Car Commuters

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ABSTRACT

Commuting by car can be stressful, especially unexpected traffic jams may result in feelings of loss of control and social disconnectedness. In this paper, we present Traeddy, a teddy bear augmented with embedded technology, which serves as a wellbeing companion for car commuters in case of traffic jams. Traeddy is capable to help, for example by notifying relevant contacts about traffic jams and potential delays. We describe in detail the design process, including 20 contextual inquiries and report the evaluation of Traeddy through an online survey with 102 participants and a field study evaluating Traeddy with three commuters and two contacts in the field. The results of the field study indicate that Traeddy has a positive impact on the relationship between the commuter and the notified contact. Furthermore, the majority of the online participants anticipated Traeddy to be useful and to support their wellbeing in traffic jams.

CCS CONCEPTS

• **Human-centered computing** → *Interactive systems and tools*; Field studies;

KEYWORDS

Commuting, Positive Computing, Wellbeing

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1 INTRODUCTION

Many people commute despite the fact that commuting causes stress [4]. In order to understand commuters needs and desires, we conducted multiple contextual inquiries, finding that for car commuters the main reasons for stress are unexpected traffic jams and the "inability" to contact people about a delay despite important social conventions to do so. In many countries using a phone to send a message is illegal while driving. For example, according to the German StVO §23 (1a) [8] it is allowed to interact with an electronic device only if the user does not hold it and the user looks at it only for a very short moment[1]. In order to support car commuters during traffic jams, we developed an application, which automatically notifies previously defined contacts. The user interface is realized as a stuffed bear; i.e., a traffic jam companion, which we refer to as Traeddy. The focus of Traeddy is less in increasing efficiency or effectiveness but the commuter's wellbeing.

In this paper we describe in detail the "commuter-centered" design process, which resulted in the development and consequent evaluation of Traeddy. The design process follows a *Positive Computing* [9] approach, which means that relevant wellbeing determinants were identified and used to inform design decisions throughout the process. Calvo and Peters [9] provide multiple wellbeing determinants in their book and some of them are also available as design cards on the positive

[1]The *Straßenverkehrsordnung*, short *StVO*, organizes what is allowed and what is not allowed driving a car in Germany

computing website (i.e., www.positivecomputing.org). The design cards aim to support developing wellbeing sensitive software. Through contextual inquiries and semi-structured interviews, we identified *Autonomy* and *Relatedness* as two of these factors, which are most relevant for commuters stuck in a traffic jam.

We evaluated Traeddy considering the determinants *Autonomy* and *Relatedness* through an online survey with 102 participants utilizing a concept video and through a field study with three commuters. The results show that Traeddy has the potential to improve the mood of a commuter in a traffic jam situation and may impact commuters wellbeing in a positive manner. For example, the online survey participants found the automated sending of delay notifications very useful and anticipated to feel more related to their contacts.

Following contributions are part of this paper:

- An Android application that communicates with Traeddy over Bluetooth to simulate that (i) the user is in a traffic jam and (ii) whether they wish to send an email to the predefined contact.
- Traeddy, a stuffed animal with a Raspberry PI embedded inside, which interacts with users via speech output and via two input buttons. If the Android app detects a delay situation, Traeddy asks the user whether an email should be send and users can answer by pushing a button embedded in Traeddy's paws.
- Results of studies (i.e., a field study with Traeddy and an online survey with a video demonstrating a use case of Traeddy) demonstrating the feasibility and meaningfulness of the idea of a traffic companion to address wellbeing of commuters during traffic jams.

Before presenting Traeddy in detail, we provide in the next section information about commuting and *Positive Computing* in general and summarize related work.

2 BACKGROUND AND RELATED WORK

Background in Commuting

More than 18 million people are commuting in Germany every day [3]; 65.9% of them are commuting by car [1]. Especially in rural regions most people use the car because there is often no public transportation [2].

Commuting stress has multiple sources and effects on commuters. One main source is actual loss of leisure time, which could be spend with beloved ones or for hobbies; an other source for stress are uncertainties, such as whether unexpected traffic jams will occur or whether the train will be late. The effects of stress on commuters and their environment are, for example sleep problems, concentration problems, irritability, motivation problems, and anxiety [4].

The paper *Stress that Doesn't Pay: The Commuting Paradox* from Stutzer and Frey [19] discusses the benefits and costs of commuting and whether it pays off for commuters. They interviewed people who changed their workplace to determine in which way their wellbeing has changed. They came to the conclusion that the costs outweigh the benefits of commuting. For that, costs were defined as stress, interventions in the relationship with the beloved ones and the commuters' work. Benefits of a longer commute were, for example the ability to live in a superior or cheaper house.

Chatterjee et al. [11] have examined in a large study the impacts of commuting on wellbeing. They carried out a survey of 26,000 people living and working in England between 2009 and 2015. They found out that a longer daily commuting way reduces the job satisfaction. Considering public transportation they report that commuting by bus has the worst impact. But overall car commuters report the highest level of stress.

Background in Positive Computing

Positive Computing [9] is about the development of technologies designed to support wellbeing, wisdom and human potential. Positive Computing is based on previous interdisciplinary research, including research in affective computing and user experience. *Positive Computing* factors can be divided into three groups: First, the ones affecting the person themselves and their self awareness, second, the factors describing the interaction with people in their circumstances and third, the ones about relationships with people, which are not from their direct environment.

In this paper we focus on the following two factors which we came to understand to be most relevant for commuters after conducting multiple contextual inquiries and semi-structured interviews.

Autonomy This is a determinant affecting the person itself. It describes whether the person has the feeling to have the power to influence the outcome of an experience. Therefore, it is about whether the experience is self-endorsed and congruent with own values and interests. To improve the autonomy of a person, you can support their decision making and give them the feeling of controlling a situation. Autonomy can be improved by offering the user a choice of what should happen next.

Relatedness This factor deals with users' social relationships and social environment. It describes the belongingness and connectedness to others. To strengthen the relatedness of a person, one can enable the person to stay in contact with friends and family members and thereby foster meaningful and positive relationships.

Similar psychological dimensions/factors were developed by Ryff and Keyes [18]. In their paper *The Structure of Psychological Well-Being Revisited* they discuss the influence of age and sex on wellbeing. There they define the related dimensions *Autonomy*, *Environmental Mastery*, *Personal Growth*, *Positive Relations With Others*, *Purpose in Life*, and *Self-Acceptance*.

Related Work

Krome et al. developed two applications regarding commuting by car: the *AutoGym* [14] and the *AutoJam* [13].
With *AutoGym*, the driver/passenger of an autonomous car can physically exercise while stuck in a traffic jam. The second application, *AutoJam*, is based on listening to music, a common activity while driving. With a touch sensitive steering wheel cover, the commuter can practice the basic drum-rhythms of the song.

Traditionally, there are many mobile navigation assistants, which aim to support travelers going from location A to location B. Some of these systems are multi-modal and aim to assist users by providing additional services, such as shopping and dining while traveling as a tourist [7].

Especially, in-car interfaces have focused on performance and interaction modalities to decrease eyes-off-the-road and hands-off-the-wheel times (e.g., [6]). In contrast, Paredes et al. propose in their project *The Mindful Commute* [16], that within autonomous cars the commuter can learn and do exercises to change their sustained behavior. They explore virtual reality, full body interaction, multimodal agent interaction and a mindset of value based system to improve the mental and physical health of the commuter. Others have argued that the use of tangible interactions is appropriate for stress-reduction practices including the use of stuffed animals for mindfulness related breathing exercises (e.g., [5, 15]).

3 DESIGNING TRAEDDY

The design process consisted of brainstorming, conducting interviews, creating personas, and converging on a design idea and prototyping the identified idea.

Brainstorming

One goal of the brainstorming phase was to get familiar with *Positive Computing* factors and the problems and difficulties faced during commuting. The first brainstorming session resulted in collections of phrases like *crowds*, *stress*, *daily*, *work on the way* and *being alone* and combining these phrases with a arbitrarily *Positive Computing* factor, which were used as a basis to create multiple ideas. For example, one idea was an application in which people could establish carpools based on their preferred music.

Interviews

The identified ideas during the brainstorming sessions were only based on the team members' experience. So, in the next step, we conducted semi-structured interviews with commuters trying to understand real commuters' problems and desires.

Participants and Procedure. We interviewed 20 (3f, 17m) commuters between 20 and 69 years of age. Nine of them were train commuters, eight car commuters, three used both, car and train for commuting. Participants stated that they commuted three to five times a week, each 20 minutes to 1,5h. Most of them have been commuting for many years. We asked them questions, such as how long or how often they commute, what stresses them while commuting, and how they use their time while commuting.

Results. The train commuters stated that they use the train because it is comfortable, cheap, fast or because they do not own a car. The car commuters argued that commuting by car is faster and more flexible. As exemplary positive experiences the train commuters mentioned meeting other people, punctuality and having offered a seat to people in need. The ones commuting by car named as an exemplary positive experience waving to other people/travelers. The negative experiences on the other hand are for train commuters associated with cancellations, problems with fellow travelers. For car commuters bad car drivers and traffic jams were mentioned as exemplary negative experiences.

Both types of commuters described major negative experiences with delays. The train riders interact with other people by talking or writing via instant messaging applications while car commuters prefer to make phone calls in order to deal with delays. The most disturbing and stress generating things are not finding a seat and overcrowded trains in general, unskilled car drivers, traffic jams and delays. Train commuters though a better traffic network, reliable information or wireless Internet access would improve commuting for them. Car commuter argued that they would benefit from less traffic or autonomous driving. Most of the responders of both parties believed that technology could help to improve their commuting experience.

The results show that the problems commuters have to face do not differ much between the communing modalities car and train. For train commuters delays due to e.g. missed connections seem to be the biggest stress factors, while for car commuters delays due to traffic jams seem most stressful.

Ideation and Vision

To communicate design ideas clearly within the design team we created personas based on all interviews with commuters. In the ideation phase many issues that today's commuters

face and that impact commuters' wellbeing emmerged and were consequently discussed. In the end, we decided to focus on arriving late at work due to an unexpected traffic jam as an important issue and a potentially recurring threat. Early in the design process we came to understand that eliminating reasons for delays completely seemed impossible and that is why we focussed on supporting commuters' wellbeing during stressful times by, for example, enabling new and sensitive ways to inform contacts about potential delays and thereby implicitly communicating that the delay was unexpected and not the commuters' fault.

In addition, we decided that any potential design solution had to follow the German StVO §23 [8]. That is, it had to be an easy to use and easy to learn interface that the driver would not need to hold in their hands for the interaction. Furthermore, the design should fit into the interior (design) of a car and the interaction would need to be done with an interface that the driver does not need to look at for a long time to keep the eyes-off-the-road time low.

Figure 1: Image of Traeddy

The Prototype: Traeddy

In order to support car commuters' wellbeing during traffic jams and potential threads of arriving at work late we decided to create a social companion app and embed technology into a teddy bear, which should serve as a traffic jam companion. We chose a bear since some car owners have them as decoration or for sentimental reasons in their cars. We also though that since speech seemed an appropriate interaction modality it would be good mapping and metaphor to have an "anthropomorphic" embodiment for the companion. At first, we created story boards to identify potential issues in potential interaction scenarios and then we developed the prototype.

The final prototype consists of two parts, an Android app and Traeddy. Inside Traeddy is a Raspberry PI. Traeddy and the app communicate with each other through a client-server protocol and Bluetooth, as shown in figure 2.

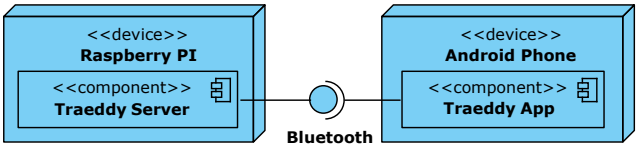

Figure 2: Deployment Diagram and Software Architecture

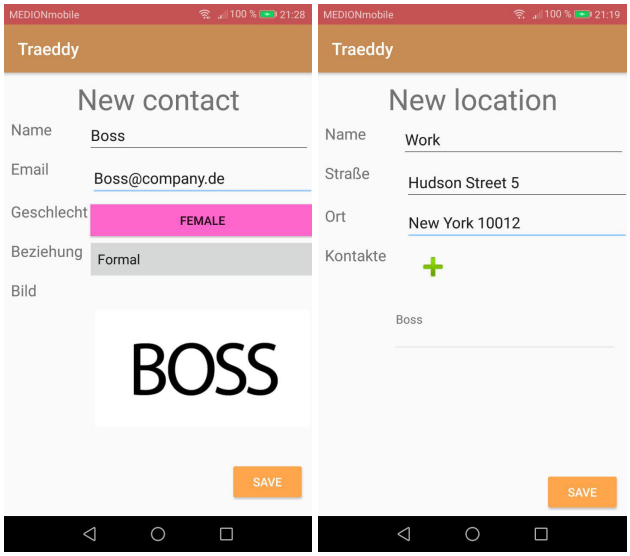

Figure 3: Configuration sceenshots of the Traeddy app

Android App. The Android app is developed with Android-studio. With the app, a user can define typical routes, declare who should be informed in case of a traffic jam. If the app detects a traffic jam, it communicates with the Raspberry PI, which is inside Traeddy. Traeddy then asks the driver via audio whether it should send emails to the chosen contacts. To realize the use cases, the app needs contacts and location information. A contact is a person, who should be informed about an unexpected delay. Therefore, name, gender, email address and a contact picture can be specified before a trip starts. Furthermore, the relationship to this contact can be set to either friend, beloved person or formal in order to adapt how the contact should be communicated with (e.g., formal or informal). Based on the provided information personalized

emails can be generated and send. A location is a possible journey destination. A location consists of name, address and place. Multiple contacts can be added to every location. In case of a delay, the persons to be informed usually depends on the target location. Therefore every location gets its own set of target contacts. An example location configuration can be seen in figure 3.

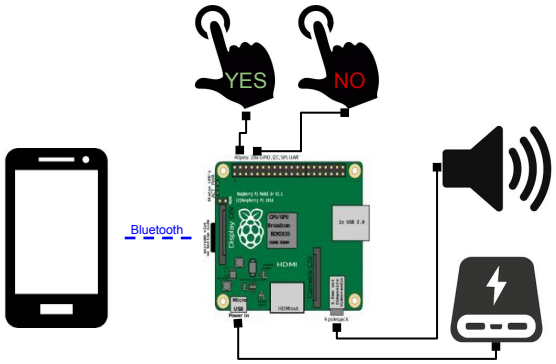

Figure 4: Hardware Architecture

Raspberry PI. The Raspberry PI manages the user interaction during the commute. It is connected to two hardware buttons and a speaker to interact with the user. The hardware configuration can be seen in Figure 4. The Raspberry PI is running a simple Bluetooth server, which offers the service to either play a prerecorded sound file or the send button information (i.e., which button was pressed) back to the app. The Raspberry PI, including the speaker, the buttons, and the battery pack are embedded in the teddy bear. The buttons are placed in the bears' paws, which are marked with green and red signs to symbolize agreement or disagreement.

4 USER STUDY

To evaluate Traeddy, we conducted two studies: a field study and an online survey. For both, the participants, the apparatus, the procedure as well as the results of the user study are explained next.

Field Study

Participants and Apparatus. Three commuters (2m, 1f) between 21 and 23 years of age participated in the field study. All of them were students who usually commute by car.

Procedure. To demonstrate feasibility and explore Traeddy in a realistic situation one researcher joined the participants on their usual commuting way. Since we couldn't expect that an unexpected traffic jam would occur, interactions with Traeddy were simulated during expected traffic jams, which would occur on the commuters regular commuting route. Both, direct interactions of commuters with Traeddy and the indirect effect of Traeddy's message on message-receivers were studied.

First test scenario: Interaction with Traeddy. The main part of the study took place in participants' cars, with one member of the research team taking the role of a passenger. Participants were shortly instructed on how to use Traeddy and had to choose their contacts and commuting goals on the Traeddy application before they started the journey.

The evaluation scenario consisted of the following steps:

(1) **Configuration and scenario start**
The participant configures their location, contacts and messaging types in the Traeddy application. Then, they activate Traeddy, by starting the intended journey in the app.
(2) **Begin of journey and first interview**
The journey starts and a first interview is done.
(3) **Begin of traffic jam situation and second interview**
The participant gets into an (expected) traffic jam. In this situation the second interview takes place.
(4) **Interaction with Traeddy during a traffic jam**
Traeddy application informs about the delay time and asks the participant via voice if they want to send a message. Traeddy would say *"Don't worry I am here with you. Do you want me to send a message to your contact and inform them about a possible delay?"* Then Traeddy would offer participants to answer yes or no by pushing one of Traeddy's paws.
(5) **Third interview and conclusion**
After the interaction the participant had to answer questions and comment about the usage of Traeddy.

Some questions were repeated in all three interviews, such as *"Do you feel you are in charge of your current situation?"*. Before and after the interaction with Traeddy we asked, for example *"How is your relationship to your contact?"*

The questions we asked were chosen from official well-being questionnaires [17]. We selected questions concerning environmental mastery and positive relations with others. We asked these questions multiple times, to evaluate a possible effect of Traeddy and the Traeddy app.

However, we also asked more general questions to evaluate participants usual habits and whether they need an application and companion such as Traeddy. We asked, for exmaple *"Do you usually inform people, if you have a delay during your journey?"*

The third interview concentrated on feedback and improvement proposals of participants, directly after usage. We asked, for example *"Would you use Traeddy again?"*

Second evaluation scenario: Delay message receiver. The second test scenario addressed the effect of Traeddy's message

on the receiver of the email. Traeddy's message stated that a student would be running late for the soon to begin lecture because of a traffic jam. Two lecturers were send messages without informing them about the study. After corresponding lectures, lecturers were briefly interviewed considering Traeddy's message. We asked, for example *"Do you like the idea of getting an email in such a case?"* The aim of these questions was to get an idea about what message receivers would expect and how they would feel to receive a message from Traeddy on behalf of a student.

Field Study Results

Direct interaction with Traeddy. All participants stated that they were in a "bad" mood at the time we conducted the first interview, because of the foreseeable commuting task. Their mood got worse at the time, when the traffic jam appeared. After the interaction with Traeddy all of them stated to feel better, because they seemed to have enjoyed listening to and interacting with Traeddy. Two of the three participants reported to feel more relaxed afterwards and all three participants stated that they do feel more in charge of their situation than before. Two of three mentioned, they are indeed glad they did not need to care about informing their contacts. The relatedness to the contacted person seems to improve after the interaction with Traeddy, because participants thought that they appeared more responsible using Traeddy. This was mentioned by two of the three participants. These two also said, they did feel less lonely, but only during the time of interaction.

Overall, participants' feedback was positive. They felt comfortable interacting with Traeddy and the Traeddy app. All participants stated that they would use Traeddy again.

In summary, it seems that Traeddy has indeed the potential to influence feelings of control and relatedness to other people. However, these feelings seem not to influence participants' self-awareness about their own competence. Participants are aware that Traeddy does not make them more reliable.

Participants stated that they care a lot about being on time and informing other people in case of a delay and that is why they enjoyed and liked Traeddy.

Delay message receiver. The lecturers who received delay messages did not have a close relationship to the students. But they also argued that they would not want frequent unmentioned delays by students. Therefore, they found it useful to receive a short notification in case a student was going to be late. One of the receivers was even amused about the emails content and the other one would have been more happy about another kind of notification, such as an instant messenger notification or an SMS.

Limitations of the study. Because of the small number of participants, we cannot guarantee overall validity of the results. Participants made some suggestions about improvements, which would result in a more flexible and capable traffic companion who does more than simple helping to notify contacts about delays due to a traffic jam.

In our study, we used students and notified lecturers, but because it is not common to always inform lecturers about delays the scenario was not perfect. But Traeddy had a positive effect on the participants and they seemed to like the notifications. We also didn't observe any issues considering the interaction modality with Traeddy. The interaction was minimal and didn't seem to distract drivers more than necessary.

Online Survey

In order evaluate Traeddy with more people, we conducted an additional online survey. The survey was published with Google Survey tool and filled by 102 participants.

Procedure. The questions asked in the online survey did not differ from the field study questions. We asked participants to imagine the situations we tested in the field. Instead of a real interaction, the participants had to watch a video, which showed the usage of Traeddy. Additionally the participants had the possibility to state reasons why they would or would not use Traeddy and how Traeddy could be improved. We combined the answers of the questions rating Traeddy in Figure 6 to an *Evaluation Score* for each participant. This score was calculated as the average of the answers for all these questions.

In addition, we asked questions to classify the participants with respect to the *Positive Computing* factors autonomy and relatedness. To this end, we took questions from the work of Weinstein et al. [21] and Ryff [17]. To calculate an autonomy and relatedness rating for each participant, we used the following procedure:

For each question, we shifted all answers so that the average over all participants was zero and then multiplied the value with a factor so that the answers would fit into the range $[-1; 1]$. We asked some negated questions, for example "It is hard for me to voice my own opinion"; therefore we multiplied the answers to those questions with -1. To obtain the final rating, we added up the values for the autonomy and relatedness questions.

Online Survey Results

In the following section, we point out relevant answers, show correlations between the answers and the *Positive Computing* factors and discuss limitations of our survey. An overview of the feelings and opinions of our survey participants in general and when stuck in a traffic jam can be seen in Figure 5.

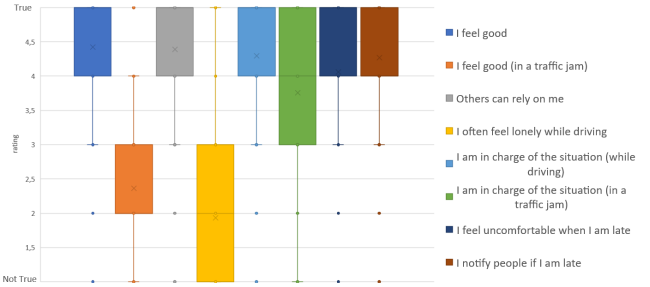

Figure 5: An overview of the answers given in the online survey of participants in general and considering traffic jams.

The results show over 80% of the participants reported that others can rely on them and that they are in charge of the situation while driving. However, when confronted with an unexpected traffic jam, only about 65% of the participants still reported that they would be in charge of the situation. About 75% of the participants stated that they would feel uncomfortable if they were late to an appointment. Most participants stated that they would text or call someone to notify them about the delay.

Figure 6 depicts the answers of participants after showing them a video, which explains the functionality of Traeddy. 72% of the participants reported that the delay message would be useful to the recipient. Only very few people agreed that Traeddy would reduce loneliness during the commute. Still, about a fifth of the participants would want to use Traeddy, and a third stated to be uncertain wether they would want to use it or not.

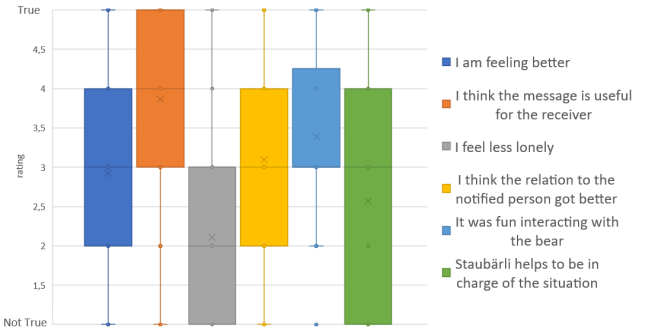

Figure 6: An overview of the answers given in the online survey on how the participants would feel after interacting with Traeddy

However, when we examined the correlations between the different questions and compared the answers with the autonomy and relatedness ratings, we could find following insights. There is a positive correlation (r=0.23, n=102, p<.001) between the relatedness rating of a participant and the fun of using Traeddy. There was also a positive correlation (r=0.23, n=102, p<.001) between the relatedness rating and the likelihood that they would use Traeddy.

The evaluation of Traeddy was higher (i.e., the *Evaluation Score*) for participants who reported high relatedness rankings (see Figure 7). However, self-reported high autonomy rankings had no correlation on the evaluation of Traeddy. Consequently, participants with a high self-reported autonomy may expect less benefit from using Traeddy.

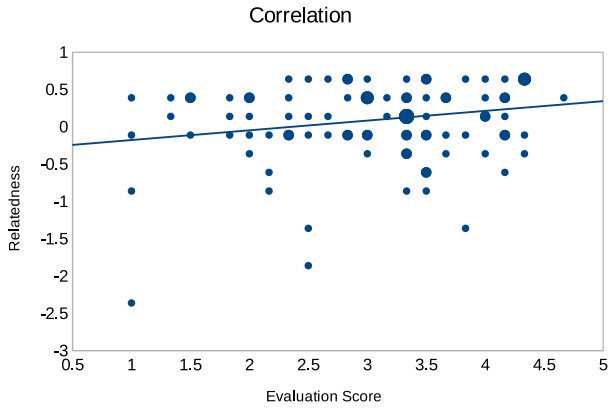

Figure 7: Showing the correlation between relatedness and the evaluation of Traeddy

Most people that agree with *"I often feel lonely while driving"* in the first section also agree with *"I feel less lonely"* after the interaction with the Traeddy. Those questions have a positive correlation (r=0.43, n=102, p<.001). It seems that Traeddy may be able reduce their perceived loneliness while commuting. Surprisingly, there is no correlation between loneliness and the willingness to use Traeddy. A possible interpretation of this result is that only very few people feel alone, and only very few agree that Traeddy reduces their loneliness. Participants who feel uncomfortable if they are late for an appointment tend to like the Traeddy more than others. The correlation between the answers to *"I feel uncomfortable when I am late"* and the "Evaluation Score" is shown in figure 8.

The free text fields of the survey helped us to gather more information on reasons and motivations of the participants. A major point of critique was the semi-automatic contact selection per journey target. The participants wrote that they did not like the pre-configuration before each commute, but neither did they prefer a fully automatic selection of the contacts. Some participants argued that they would not use Traeddy because they would rather use just an Android or iOS app. Others complained about the teddy bear's size, some would like Traeddy to be smaller, some would like it to be larger. Furthermore, a few voiced privacy issues, and

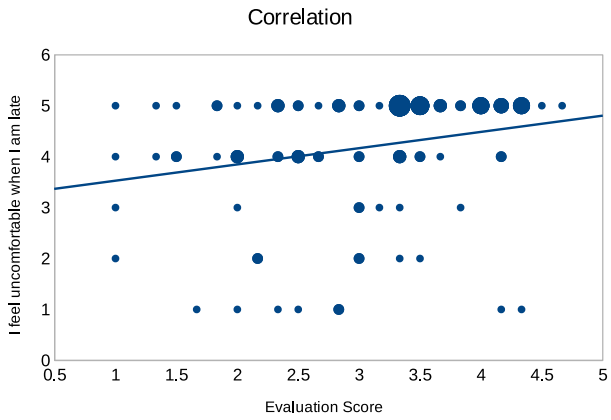

Figure 8: Showing the correlation between "I am feeling uncomfortable when I am late" and the evaluation of the Traeddy

some complained about the "childish" interface. There was a lot of positive feedback as well: Many participants said it was handy that they do not need to worry about their delay; some others simply liked the bear.

The major limitation of our online survey is the missing interaction with Traeddy. Because the participants did only watch a video of the interaction with Traeddy, they could only anticipate how it would feel. An additional limitation is that we could not evaluate any long-term effects.

5 DISCUSSION

As indicated by the study results Traeddy seems to cause positive emotions and may help in reducing stress.

Traeddy is an early prototype, but our research has shown the potential benefit of a traffic companion and how a main source of stress can be addressed by a simple idea. Indeed, we think that the idea of traffic jam companion can persist in other forms. For example, a teddy bear is obviously not everybody's design preference. For users, who do not benefit from a tangible interface and an embodied agent, the speech interface could be run on the smartphone and be directly integrated into the entertaining system of cars.

It would also be interesting to examine the impact of the notification forms. A study might investigate which information increases *Relatedness* of commuter and message receiver most. Another possible extension is that the receiver could get live geographic data from the application, so that they can estimate how long it will take until the commuter arrives. Also notifying contacts depending on the delay time would make the design more convenient. For example, one's boss could be informed if there is a delay of 5 minutes, while a friend is only messaged if the delay would be greater than 15 minutes. Furthermore, the idea of Traeddy could be transfered to commuting by train. Traeddy could be triggered by the train provider to verify the delay as unexpected. Then all travelers can decide whether their contacts will be informed. The German train company *Deutsche Bahn* already has a widely used app in which this functionality could be added.

Additionally, interaction technology has to be used with caution in cars to not distract the driver. However, we believe that sensing technologies for automatically recognizing stress, and classifying emotions and activities (e.g., [10, 12, 20]) could improve a traffic companions impact on wellbeing. Also addressing other *Positive Computing* factors could help to increase wellbeing. For example, methods to increase *Resilience* could be used before the ride for training with the intend to not get too easily stressed. Another factor which technology could address *Gratitude*, helping the commuter to bear in mind why they are accepting the long journey every day.

Limitation

The main limitation of our research is that while we designed for commuters wellbeing, we didn't study the the design's long-term impact on wellbeing. A long term study might require a prototype which is nearly the finished product.

Through our user study we came to understand that there are a few issues, which would need to be solved for anyone to develop a realistic product. We beleive that these are:

(1) Traffic jams are an exception. Therefore, managing trips in the app every day is an overhead. The app should start the correct trip automatically when the user starts driving.
(2) If someone receives a Traeddy message it is quite charming, but only at the first few times. If delays happen too often and the receivers get regularly an email about an unexpected delay, the trust in Traeddy will diminish.
(3) If someone is stuck in a traffic jam they might just phone someone directly through the hands-free car kit. Thus, Traeddy should be integrated into the kit or vice versa.
(4) If the destination of the user varies the configuration is quite complex. An easier process would help. It would also be possible to connect the Traeddy with a navigation application, so just one app has to be started.

6 CONCLUSION

One of the most stressful situations for car commuters are unexpected traffic jams. At the beginning, we argued that we could improve the wellbeing in these situations through *Positive Computing*. *Positive Computing* proposes to address different factors like *Autonomy* or *Relatedness* throughout

the human-centered design process. We presented Traeddy, a traffic jam companion, which was developed following a *Positive Computing* approach.

In order to increase *Autonomy* Traeddy provides the user an option to send a notification about their delay to the ones awaiting their arrival. However, we found that Traeddy did not increase the feeling of being in control, since Traeddy only helps with the communication. Traeddy aims to support *Relatedness* through the delay notification itself, which we found in our studies has an effect on improving the relation with the receiver. Most participants liked Traeddy and said it was fun to use and it was also rated as useful and stress reducing.

We also found that people with a high *Relatedness* score liked our prototype more. This seems to mean that *Positive Computing* factors influence different people with a different intensity, which we have to take into account in our future work. It may help in addressing users and their individual wellbeing more efficiently.

We hope that our results will inspire fellow researcher in studying technology enabled human-habitat interactions, which aim to improve users' wellbeing. We also hope that the detailed insights that we provided into the design process will inform others who aim to adopt a *Positive Computing* approach.

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