Designing CalmaStep: Exploring Office Dynamics Through Interactive Stress Relief

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ABSTRACT

This study introduces CalmaStep, a system designed to physicalize collective stress with an integrated notification feature. The prototype anonymously displays individual stress levels in a modular format, encouraging playful interactions and the exchange of subtle message within an office setting while accommodating preferences for emotional privacy. Quantitative methods have been used to measure changes of stress levels following notifications, while qualitative methods be used to investigate participants' interpretations of the notifications and the resulting social dynamics. The quantitative analysis showed no significant reduction in stress levels, while qualitative findings demonstrated CalmaStep's potential to promote discussions on common topics and enhance social dynamics.

Keywords

Collective stress; stress physicalization; social dynamics; office environment; employee wellness; industrial design; flexible interactive interface

1. INTRODUCTION

In the context of social activities, stress is a pervasive phenomenon. It originates from the mismatch between resources and needs (Selye, 1956) and can manifest in physical and psychological ways (Michie, 2002). People under stress can have an increase in heart rate, blood pressure, and can be perceived with changes in heart rate variability(HRV), which is the most commonly used parameter to identify stress states (Hernando et al., 2016).

When considering specifically the office environment, the term “collective stress” refers to collective coping responses to stressors (Lansisalmi et al., 2000a). Different from the stress mentioned in daily life, collective stress focuses more on the level of the working group and is also analyzed from a collective perspective. The stressors in this context can be competition among colleagues, impending work deadlines, etc. These will lead to the emergence of collective stress and have an impact on collective work efficiency, team atmosphere, and interpersonal communication (Festinger, 1954). A significant proportion of related research currently focuses on the visualization of collective stress data and the subsequent feedback from the tested groups, to study the impact of a more comprehensive understanding of collective stress. One innovative approach to addressing collective stress is through physicalization, which involves creating tangible representations of data to facilitate understanding and interaction. Physicalization offers unique opportunities to apply traditional individual stress relief techniques at the group level. For example, Ren et al. (2019) developed a physical artifact that visualizes collective stress through changing light patterns, which encourages fitness and relaxation exercises. The rationale for choosing physicalization lies in its ability to make abstract feelings more concrete and tangible, thereby fostering collective engagement and reflection. Research has shown that tangibility helps problem-solvers perform better, achieve higher learning gains, collaborate better, explore more alternative designs, and perceive problem-solving as more playful (Schneider et al., 2011).

This research aims to explore how a collective stress physicalization that invites people to interact impacts on stress feelings and social dynamics in the office environment. By physicalizing people's stress levels anonymously in a modular way, the installation designed in this study, called CalmaStep, ideally can be embedded in the ground near the entrance of the office. When people step on its flexible surface to relieve stress, a notification will be sent to the person associated with the bubble. This builds a stress-relieving connection among people working in or visiting this office and tries to make message flow between communities in a relatively safe and interesting way. A total of 24 participants were recruited into the experiment to complete two separate studies. The results of the research indicated that the effect of the system on stress was not statistically significant. On the other hand, the system had a positive effect on increasing participants' social interest, drawing attention to collective stress, and helping to inspire discussions around common topics.

2. RELATED WORK

2.1 Interventions for Collective Stress in work environments

Workplace stress is a significant issue that needs to be addressed to improve the mental health and overall well-being of employees across various industries and countries (Maulik, 2017). One effective strategy for reducing workplace stress involves using relaxation rooms equipped with auditory and visual stimuli, which have been shown to promote recovery after acute stress (Byun et al., 2022).

In recent years, there has been a growing interest in visualizing collective stress and studying its meaning and impact on the community. Many studies primarily focus on how to present and feed data back into the work environment, enabling employees to recognize and manage their stress levels more effectively. For instance, a shared display of individual stress-related physiological data, such as heart-rate variability, through collective visualization significantly increases awareness and understanding of both personal and organizational stress (Xue et al., 2019). Another practical application of visualization is the BallBounce system, a workplace biofeedback tool that anonymously visualizes collective stress data from office workers. This system aims to decrease physiological stress and inspire ideas for stress-relieving measures (Nkem & Xue, 2023). Studies also show that engaging office workers in co-constructing stories around their stress experiences has revealed six clusters of

benefits for collective stress visualization, enhancing well-being and productivity in their daily routines (Xue et al., 2023).

In the design of interventions related to physical interaction, PopStress effectively reduces collective office stress by turning it into energy for a popcorn machine, encouraging natural and entertaining social stress-relieving behaviors among office workers (Bao et al., 2023). Another design named LightSit comprises a sensor mat that can be embedded into an office chair for measuring a user's sitting posture and heart rate variability and a lighting display that is integrated into a monitor stand to present information unobtrusively, facilitating fitness and relaxation exercises during microbreaks(Ren et al., 2019).

Other emerging directions in workplace stress management include the use of virtual reality (VR) interventions. A scoping review of the available evidence has shown that VR might reduce workplace stress levels, although more quality research is needed to fully understand its unique contributions to stress management (Naylor et al., 2020). An example of such an intervention is Stressjam, a VR game using biofeedback, which shows potential in improving people's stress mindset (Maarsingh et al., 2019).

2.2 Designs for Relieving Stress

Designs for relieving stress encompass a wide range of approaches, emphasizing the importance of both emotional expression and physical activities. Simply expressing emotions and receiving empathy can provide comfort, which is a key factor in stress reduction (Ono et al., 2009).

Physical activities such as yoga and meditation are well-documented stress relievers. Yoga reduces stress through positive affect, self-compassion, inhibition of the posterior hypothalamus, and salivary cortisol (Riley & Park, 2015). Similarly, meditation practices lead to decreased physiological stress markers across diverse populations (Pascoe et al., 2017). Mindfulness meditation apps like Calm have been shown to effectively reduce stress and improve mindfulness and self-compassion in stressed individuals (Huberty et al., 2019).

One of the areas of interest in the field of physical intervention is the act of squeezing objects. This action helps individuals feel less stressed by reducing the perceived loss of control over their environment (Pickering, 2001). It can also activate the stress response system, involving neurochemical mediators like monoamines and cytokines, and engaging brain regions associated with emotion regulation (Gold, 2015). Interactive prototypes such as Squeeze-it, Marmoro, and Wigo provide tactile feedback to support stress reduction. These devices recognize stress-related behaviors and offer relaxation feedback, demonstrating the potential of tactile interaction in stress management (Bruns Alonso et al., 2012).

2.3 Summary

To sum up, current research on collective stress focuses on using visual methods to present data to arouse people's reflection. Intervention methods for collective stress therefore also rely more on the formation of reflection than on the design of a more physical interactive experience, which is often the case when intervening on individual stress. In addition, current intervention methods for stress tend to be narrowly focused on regulating individual physiological states. However, it is rarely considered from the perspective of inducing social interaction, which is an important factor in understanding the causes and effects of stress.

The exploration of the potential benefits of physical interaction in alleviating collective stress raises questions about its impact on emotional responses and the social dynamics of the office environment, taking into account factors including reflection on collective stress, social dynamics, and the diverse office environment. This design research thus aims to propose a system based on physicalization of collective stress to establish a bridge for information transmission in the office environment. This exploration seeks to provide guidance and reference for subsequent design interventions that address collective stress.

3. DESIGN AND IMPLEMENTATION

3.1 The ethical concerns about intervention for collective stress

Expressing emotions and receiving empathy reduce stress, but the comfort of having shared a message is a key factor in reducing stress (Ono et al., 2009). When exploring potential interventions, it is crucial to ensure the privacy of emotional information. This implies allowing the individuals for self-identity disclosure in a subgroup because people have different preferences of sharing their stress (Xue et al., 2022). This is particularly important given that dealing with collective stress inevitably involves social relationships.

3.2 The way to physicalize and assess the collective stress

The primary method of analyzing collective stress is to collate individual stress data. The existing research on assessing collective stress is relatively limited in scope. There is a method be proposed for frequently measuring group stress levels by generating estimation models based on body motion data (Tsuji et al., 2021), of which the effectiveness remains to be verified. Consequently, the present study employs a physicalisation approach, whereby the emotions of each individual are anonymously physicalised and collectively displayed. In subsequent experimental evaluations, attention is being paid to changes in individual stress.

3.3 Physicalization and system design

The prototype developed for this research is named CalmaStep. It anonymously physicalises people's stress levels in a modular format (Figure 2), with each module corresponding to an individual in the office without revealing their identity. When people feel stressed, the flexible interfaces on these modules inflate like bubbles. This process can be achieved by the PPG sensor detecting HRV and sending a signal. This design ensures the privacy of employees' emotional states. The prototype is designed to be embedded in the ground near the office entrance, with the number of modules matching the number of people working in the office. When entering or exiting the office, individuals can step on stress bubbles to relieve stress, equivalent to the act of squeezing plastic bubble wrap. Upon interation, a notification is sent to the person associated with the bubble and been displayed on the computer (Figure 1). This notification consists of two parts: visually, the computer screen of the associated person will display a popping bubble effect, and aurally, individuals will hear a popping sound through their earphones.

In the current prototype stage, the flexible interfaces are made using balloons and air pumps. For future iterations, the design could be improved by using silicone molds to create more durable and aesthetically pleasing modules.

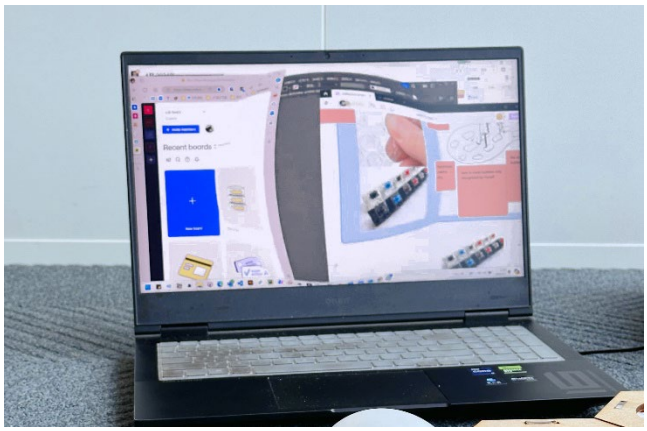

Figure 1 The notification will temporarily affect the working interface

Figure 2 The functioning prototype in context

4. RESEARCH DESIGN

The entire research is comprised of two experiments. The objective of Study 1 is to examine the influence of the designed system on the social patterns among those at work and their interpretation of the messages they receive, and the social decisions they may make. Study 2 will examine how individuals who interact with the prototype interpret the notifications being conveyed to those who are working, and their expectations of the response from the working groups.

Though divided into two studies and conducted separately in time, Study 1 and Study 2 can be considered as events occurring concurrently within the same scenario. Participants, in this scenario, respectively assume the roles of individuals engaged in workplace tasks in Study 1 and those interacting with devices in Study 2.

4.1 Participants

A total of 24 participants were recruited for the experiment, all of whom are from Eindhoven University and between the ages of 20 and 30, including nine males and fifteen females.

In Study 1, 20 participants were recruited. In Study 2, 6 participants were included, of whom two had previously participated in Study 1, while the remaining four had not. All participants have experience of working in an open space environment, with no heart or psychological diseases. Before the study, there will be a consent form provided to them.

4.2 Apparatus

To investigate the effects on two distinct groups of individuals – those experiencing stress in the workplace and those engaging in device interaction – within the same context, the environmental setups for Study 1 and Study 2 were designed to be similar.

Figure 3 The prototype at work in the experiment

A meeting room with a capacity of 4 persons was arranged for this study (Figure 4&5). Outside of the meeting rooms, the prototype would be placed on the ground, adjacent to the room with a power connection. The prototype in the experiment consists of 4 modules, corresponding to the number of people in the meeting room. The flexible interfaces of the two modules will be intermittently inflated during specific study phases (Figure 3), aligning with assumed increases in stress rather than real-time physical data collection. The meeting room's transparent glass walls allow participants to see the prototype, while those outsides can also observe the activities inside.

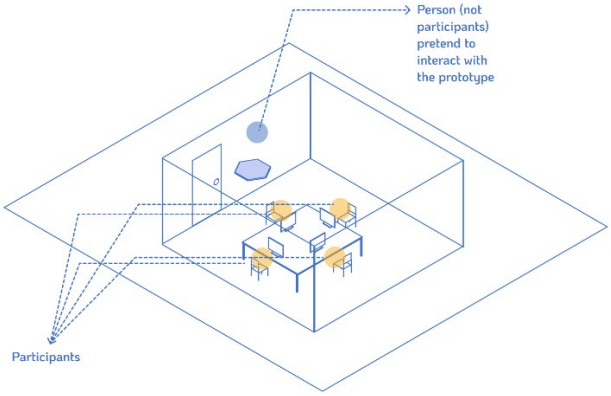

Figure 4 Settings graph for Study 1

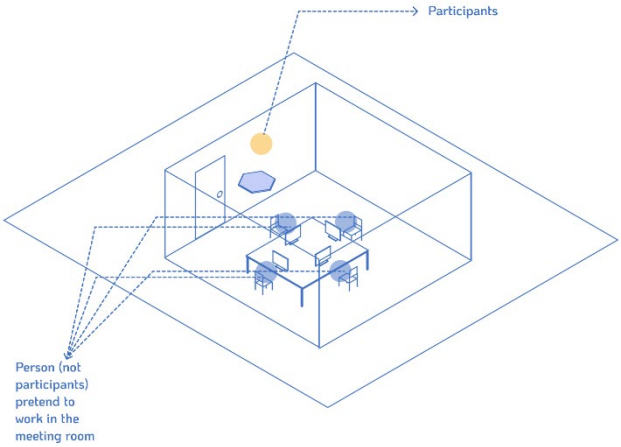

Figure 5 Settings graph for Study 2

4.3 Procedures for Study 1

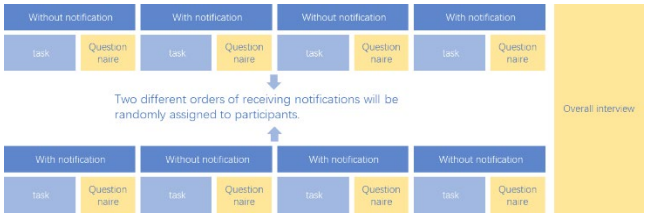

Figure 6 Procedures for Study 1

In Study 1, 4 participants who were acquainted with each other were assembled in a group setting to simulate the dynamics of an office environment. Upon the presentation of scenario information to participants, it was made clear to them that the prototype situated outside the room was linked to them. Participants were informed that they could discuss or exchange information throughout the entire process. It is required that each participant bring their computer, mouse, and earphones.

In the experiment, participants will be randomly assigned two different PowerPoint documents. The number of participants assigned to each file is equivalent. Each document contains two math question videos with notification effects and two static math question pages without notification effects. The difference between the two documents lies in the order of the videos with notification effects (Figure 6). The static pages and videos present the same sixty math problems, involving single-digit addition, subtraction, multiplication, and division, designed to induce a certain level of stress (Caviola et al., 2017). Participants used the pen tool within the PowerPoint document to write their answers on a full-screen canvas. This setup ensured that the notification effects were displayed without interruption during the test while preventing the video playback bar from appearing. This is designed to prevent direct control over the participants' computers while ensuring that the visual effects and the sound effects of the notifications can still be achieved on their computers, also enhancing the participants' immersion in the experimental scenario.

Corresponding to the design of the document, participants were required to complete four rounds of testing. The main purpose of conducting 4 rounds of tests is to reduce the participants' expectations and predictions about whether they will receive notifications in the subsequent round. In each round of the tests, participants will have 3 minutes to complete the 60 math equations.

Following each round of tests, participants will be required to fill in the stress self-report form. The participants are able to take a break while filling in the forms and to refresh themselves for the next test. After completing the four rounds of tests, participants will have an overall interview.

Study 1 lasts for about one hour.

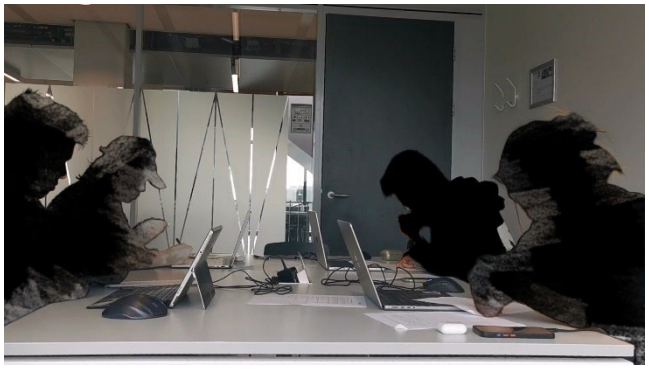

Figure 7 In Study 1, the task is being completed by the participants, who are working on their own computers.

4.4 Procedures for Study 2

In Study 2, four individuals were situated in the meeting room, simulating the working scenario for the participants (Figure 5), who were instructed to act as though they were engaged in personal work.

The participants were presented with a scenario introduction, which provided a brief overview of the research and explained how the prototype functions. Following this, the participants chose whether to interact with the prototype. After the interaction was finished, they were interviewed. Each participant was tested individually in this study, which lasted approximately 20 minutes.

4.5 Data collection methods

4.5.1 Stress self-report

State-Trait Anxiety Inventory (STAI) (Barnes et al., 2002) is used in Study 1 for participants to fill in after each round of tests.

4.5.2 Observation

Table 1 Observation list for each study

Study 1	Study 2
How many bubbles do participants interact with?	Whether participants look outside of the meeting room after receiving the notification
Other notable reactions	Whether participants talk with each other after receiving the notification or have eye contact with each other
	Other notable reactions

4.5.3 Interview

Table 2 Overall interview questions for Study 1

Overall interview questions	Aim to study…
How do you interpret the notification being sent to you?	User's interpretation of the notification
How do you perceive your stress/other people's stress when receiving the notification? How do you feel about the notification? Does this raise your curiosity about the collective stress of your group?	Awareness and reflection of the stress level
How did you react to the notification? Is there any further step you may take?	The social dynamics that arise
Did you talk with your workmates about the stress/notification/sound? What does this make you feel?	
What factors contribute to your interest in social events during this with-notification session?	The impact of factors that inspire social interests
Do you feel the notification makes any difference for you compared to a non-notification session while working in the office?	
How do you cope with stress in daily life while working in an office environment or an open space?	Additional background knowledge

Table 3 Interview questions for Study 2

Interview questions	Aim to study…
why do you choose to (not) interact with it?	The impact of factors that inspire social interests
What do you think is the meaning of the bubbles? What information do these bubbles deliver to you?	User's interpretation of the notification
How do you perceive the group stress level?	Awareness and reflection of the stress level
What reaction from those working people do you expect after you interact with the prototype?	The social dynamics that arise
What is the next step after the interaction? Why?	
Imagine you are with your colleagues; would you talk about the group stress or the prototype with him/her? Why?	

5. RESULTS

5.1 Quantitative analysis

In Study 1, 40 sets of data were obtained form 20 participants. It was assumed that the data were independent of each other. In order to ensure the reliability of the quantitative results, the analysis was performed on the original data (Notif, NoNotif) and on the data averaged from the same participants under the same experimental conditions (Notif-Avg, NoNotif-Avg).

To facilitate the subsequent analysis and discussions, the following abbreviations will be used.

Notif: Original data of experimental group with notifications.

NoNotif: Original data of control group without notifications.

NoNotif-Avg: Average of the data from the control group without notifications.

Notif-Avg: Average of the data from the experimental group with notifications.

Before conducting the comparative analysis, the normality of the data contributions for both conditions (original data and averaged data) was assessed using the Shapiro-Wilk test since the sample size of the research data is less than 50 (Kline, 2016).

Table 4 Normality Test results

Condition	Sample size	Mean	Standard Deviation	Shapiro-Wilk p-value
Notif	40	43.750	8.938	0.351
NoNotif	40	42.125	11.291	0.002
Notif-Avg	20	43.750	8.611	0.466
NoNotif-Avg	20	42.125	10.846	0.029

As indicated in Table 4, the data from the NoNofif and NoNotif-Avg group are statistically significant ($p < 0.05$), while the data from the Nofif and Notif-Avg group do not demonstrate significance ($p > 0.05$). This suggests that the NoNotif and NoNotif-Avg groups do not exhibit normality characteristics, while the Notif and Notif-Avg groups demonstrate normal distribution properties.

Given the non-normal distribution of at least one of the groups, it was deemed appropriate to employ a non-parametric test to facilitate a comparison between the Notifi(-Avg) group and NoNotif(-Avg) group. The Wilcoxon signed-rank test was chosen as it does not require the assumption of normality and is suitable for within-subject study designs (Rosner et al., 2003).

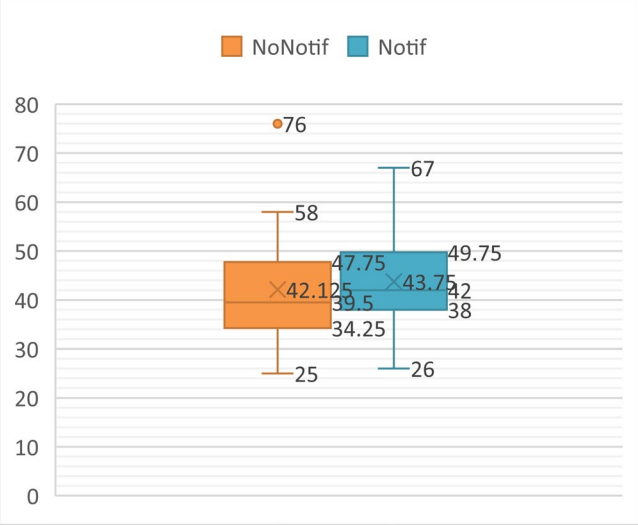

Figure 8 STAI results for original data

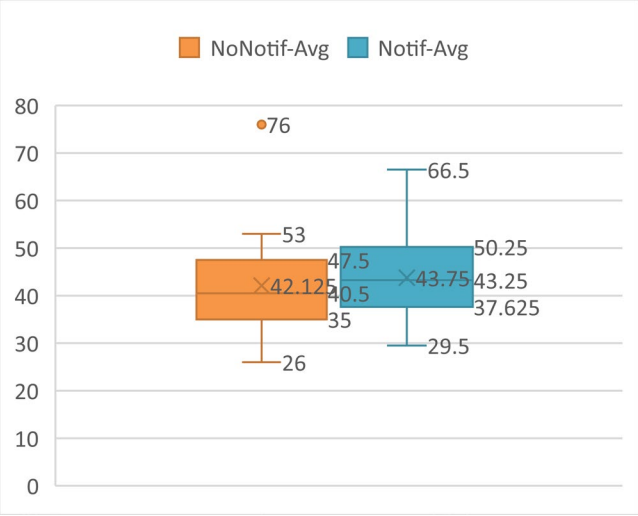

Figure 9 STAI results for the data averaged from the same participants under the same experimental conditions

The data presented in the box plots (Figure 8&9) illustrates a slight increase in median and average values for the Notifi(-Avg) group compared with NoNotifi(-Avg) group, suggesting that the notification received during the experiment tends to increase the stress levels of participants.

Table 5 the Wilcoxon signed-rank test results

Group Comparison	Paired Median M (P25, P75)		Median Difference (Pair 1 - Pair 2)	Z Value	p Value
	Pair 1	Pair 2			
NoNotif vs. Notif	39.500 (34.8, 47.3)	42.000 (38.0, 49.3)	-2.500	1.655	0.098
NoNotif-Avg vs. Notif-Avg	40.500 (35.0, 46.5)	43.250 (37.9, 48.8)	-2.750	1.382	0.167

However, the Wilcoxon signed-rank test results, as presented in Table 5, indicate no statistically significant differences between the two paired data sets ($p > 0.05$).

5.2 Qualitative analysis

5.2.1 The interpretation of the notification

In Study 1, the participants at work provided a notable divergence in their interpretation of the underlying meaning conveyed by the notifications they received. Eleven participants stated that they perceived the notification as a positive message that prompt them to pay attention to their stress and seek solutions. With the anonymity of the link between individuals and designed modules had been introduced, P7 remarked, “My first reaction was that this was someone I knew interacting with the device, trying to help me stop being anxious and go out for a walk and chat.” P9 commented, “I think It’s like someone is joking with us.” P20 noted, “The person interacting with the prototype may want to help us relieve stress.”

On the other hand, seven participants said that they did not think too much about other people's intentions when receiving notifications, simply regarded it as a reminder. P1 said, “I was startled and thought there was not enough time.” P3 noted, "I know this may be friendly, but I was stunned for two seconds and started to think about whether I was stressed just now."

In Study 2, all six participants unanimously stated that they chose to interact with the prototype because they wanted to convey kindness and care. P4 expressed, “I don’t want to disturb them directly, but I think I should do something to help them.”

5.2.2 The awareness and reflection of the stress level

In Study 1, most participants said that the notifications they received increased the awareness of their stress state. Regarding collective stress, or concern for the stress of others, five participants reported becoming more curious about the emotional states of others. P7 stated, “I pay attention to others because I don’t want to be the only one feeling anxious”, and both p11 and p12 said “I looked at the prototype outside to see what was going on about people’s stress.”

In Study 2, all participants confidently distinguished whether stressed individuals constituted the majority based on the device's output.

5.2.3 The impact of factors that inspire social interests

Among the elements of sound, visual effects, and timing of notification appearances, 6 out of 20 participants highlighted the

influence of the timing of notifications on their inclination towards socializing. For example, P3 remarked, “Because there is no great pressure, I want to take this opportunity to chat. But if it is very stressful, I will ignore it.” 10 participants mentioned that visual effects could disrupt their focus on work. P14 said, “I feel a little annoyed, and even fell like to go out and complain to person.” Additionally, 14 participants found soft sound effects enjoyable and conducive to relaxation.

5.2.4 The social decision has been made

Among the five groups in Study 1, three groups briefly discussed topics related to this notification. Among them, some participants in the G2 and G4 groups took the initiative to mention that they had received the notifications, while the topic in the G4 group started with a tactful inquiry, "What happened?" The G2 group displayed particularly active social engagement, seamlessly transitioning from notification discussions to more general topics. During interviews, P9 said, “Actually, I also want to say hi to the people outside there.” This sentiment was also shared by seven other participants. Moreover, ten participants indicated their intention to leave their seats, anticipating potential social opportunities.

In Study 2, following an understanding of the experimental context, all the participants chose to interact with the stress bubble that had been inflated on the prototype. Two out of the six participants attempted repeated interactions while observing reactions of the people presenting in the meeting room. When asked about their expectations for social events, four participants expressed a desire for simple forms of communication with people in the meeting room, such as eye contact, waving, etc.

6. DISCUSSION AND LIMITATION.

6.1 Design considerations about the prototype and notifications

In study 1, some suggestions about notification were collected and considered. Six participants noted that the current notification's bubble bursting effect on the screen was distracting and thus hindering the workflow. P14 said "It would be better if it could be shrunk to the corners of the screen."

In the design section, the anonymity of module-person associations was mentioned but lacked elaboration. For future iterations, randomly assigning individuals to different modules daily could enhance anonymity. Mutable associations can prevent participants from gradually discerning their link to the prototype, thus preserving identity transparency over time.

6.2 The impact of multiple factors on social dynamics

Firstly, while lab experiments provide valuable insights, real-world dynamics still can be different. Students accustomed to public spaces may not grasp the full extent of workplace collective stress. To enhance accuracy, future experiments could be conducted in authentic office settings, employing actual employees as participants.

Secondly, during the interviews, participants frequently speculated that their social decisions might vary if the task were less serious than math problems. This indicates the considerable influence of task nature on social dynamics. Concurrently, the observation of social interactions within Study 1 groups which comprised familiar individuals, revealed substantial differences in social dynamics. These variations could be attributed to diverse group norms or underlying factors such as cultural backgrounds. There are research shows that collective stress and coping mechanisms vary across cultures, with many coping mechanisms being collective, learned uniform responses to remove stressors or change interpretations of situations(Lansisalmi et al., 2000b).

6.3 The balance between emotional information protection and intervention methods

The unexpected outcome of the experiment was that no one mentioned the discomfort of being exposed to a certain degree of their own emotions. Furthermore, some participants took the initiative to communicate with others about their stress status after receiving the notification. When queried about their interpretation of notifications, the divergences observed in Study 1 were found to be closely related to the participants' preferences for processing emotions. All participants who perceived the notifications as a social invitation reported that they usually expressed their emotions to a greater or lesser extent to relieve stress. Some participants who are inclined to be reserved in expressing emotions perceived notifications as "reminders" rather than as "social invitations." This appears to create a buffer zone for the degree of disclosure of stressful emotions. When the design leaves room for user interpretation, people subconsciously interpret ambiguous information in a way that suits their preferences, thus achieving a certain degree of balance.

7. CONCLUSION

In this research, a physicalization of collective stress with notification system is designed. The prototype, which anonymously physicalizes people's stress levels in a modular way, aims to provide the affordance for interaction and attempts to implicitly convey information among people in an office environment in a playful way, which also leaves more room for interpretation of the notification, while at the same time raising the awareness of the stress.

In the experiment, quantitative methods are used to measure the changes in stress in participants at work after receiving the notification, and qualitative methods are used to explore how people interpret the notification they receive or send, as well as what kind of social activities that might raise after raising the awareness of stress. Although the effect on stress levels is not significant in quantitative analysis, the qualitative results highlight the benefits of CalmaStep in fostering discussions around common topics and social interests.

A series of discussions have been conducted on a range of topics, including design improvement plans, how participants interpret information, and automatically balancing emotional exposure and social decision-making through fuzzy information design. The results of these discussions will be useful for future implementation in real and diverse office environments and for intervention design for collective stress.

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Ethical Review Form

(Version 2.2)

This Ethical Review Form should be completed for every research study that involves human participants or personally identifiable personal data and should be submitted to ethics@tue.nl. For more information about how this process works please click here. Please check if you are using the correct form: Ethical Review Form (version 2.2). Please click here to obtain this latest version.

Part 1: General Study Information

1	Project title / Study name	Evaluation study of design concept about collective stress
2	Name of the researcher / student	Yunyin Lou
3	Email of the researcher / student	y.lou@tue.nl
4	Supervisor(s) name(s) *Additional explanation: Please write down the name of your direct supervisor. You can mention several supervisors if appropriate, but at least one supervisor should be mentioned.*	Jun Hu
5	Supervisor(s) email address(es) *Additional explanation: Please give the email address of the supervisor(s) mentioned in question 4.*	J.Hu@tue.nl
6	Department / Group *Additional explanation: Please specify group if relevant e.g. JADS or HTI*	Industrial Design
7	What is the purpose of this application?	☐ Scientific study ☐ Bachelor education. Course: FBP ☒ Master education. Course:……. ☐ Other (e.g. external, following external regulations):……..…
8	Research location *Additional explanation: Where will the data collection take place? On campus, in a company, in public space, online, etc.*	☒ Eindhoven University of Technology campus ☐ Other, name organization(s): At home ☐ Public space ☐ Online
9	Start date data collection *Additional explanation: Please state when your data collection will start. Please note that you do not have to provide information about your complete (PhD) project, but only on this particular sub-study that you are submitting for approval in this form.*	26-03-2024
10	End date data collection	29-06-2024
11	Does your project receive external funding (e.g., NWO, relevant for special regulations from funders)?	☐ Yes. Name Funder: ☒ No
12	Which internal and external parties are involved in the study? Think about sharing data or information between TU/e and other universities, commercial companies, hospitals, etc. *Additional explanation: Describe all internal and external parties that are involved in the study or project, including:* • *researchers or research groups at the TU/e who participate in the study;* • *(Researchers at) other universities/institutions that provide data/services, help analyzing the data, etc.;*	Internal parties • Researcher(s): • Supervisor:

Ethical Review Form

	• *(commercial) partners, companies, government bodies, municipalities, consultancy firms, hospitals or care institutions that provide data (e.g., contact details of participants, data for further analysis).* *Indicate which role each party plays: who defines the means and purposes in the study, who will supply the data (external parties?), who will process/handle the data, who will be able to access the data during and after research (only researchers at TU/e or also others)?*	External parties • Other universities/institutions: • Others: ……
13	Have any special agreements already been made with an external party, such as a Non-Disclosure Agreement (NDA) or a data sharing agreement?	☐ Yes, namely: ☒ No
14	Has your proposal already been approved by an external Ethical Review Board or Medical Ethical Review Board? *Additional explanation: For example, when you are collaborating with another university and the project has been approved by their Ethical Review Board, or when you received a WMO-waiver from a Medical Ethical Review Board.*	☐ Yes ☒ No
15	If yes: Please provide the name, date of approval and contact details of the ERB. Please also include the registered number for your project approval. Additionally, please send in the Ethical Review Form upon which ethical approval was granted together with this form.	
16	If you process personal data that are likely to result in high privacy risks for participants, you need to perform a Data Protection Impact Assessment (DPIA). Have you done this for this or a very similar project? ***Please read the information below: a DPIA is not the same as a regular privacy impact assessment. More detailed questions on privacy will follow in the section below.*** *Additional explanation: A Data Protection Impact Assessment (DPIA) is a formal document that must be drafted under the guidelines of the General Data Protection Regulation (GDPR). Think of research with vulnerable people, high-risk medical research,* *The Dutch DPA (Autoriteit Persoonsgegevens) and our website provides more information about a DPIA.*	☒ Not applicable (no high privacy risks) ☐ Yes (the form is attached to the application) ☐ No
Part 2: Medical study		
1	Does the study have a medical scientific research question or claim? *Additional explanation: Medical/scientific research is research which is carried out with the aim of finding answers to a question in the field of illness and health (etiology, pathogenesis, signs/symptoms, diagnosis, prevention, outcome or treatment of illness), by systematically collecting and analyzing data. The research is carried out with the intention of contributing to medical knowledge which can also be applied to populations outside of the direct research population. If your research contains questions about health and health related parameters (such as well-being, vitality, feelings of anxiety or stress) but your research question is not primarily medical, then you can answer 'no' to this question.*	☐ Yes* ☒ No *If yes or in doubt, please contact Susan Hommerson via s.m.hommerson@tue.nl

Ethical Review Form

Part 3: Use of (medical) devices in the study		
1	Does your research include a device? *Additional explanation: A device is a complete piece of physical hardware that is used to compute or support computer functions within a larger system. Devices can be divided into input-, output-, storage-, internet of things-, or mobile device.*	☐ Yes, not self-made ☐ Yes, self-made ☒ No
2	Please describe your device or link to an online description of the device	
3a	Will you use a device that is 'CE' certified for **unintended use** (meaning you will use existing CE certified devices for other things than they were originally intended for) or use a device that is not 'CE' certified? *Additional explanation: You can find more information about CE certification here*	☐ Yes ☒ No ☐ ☐
3b	If no: Please explain to what extent the device was assembled according to relevant standards and provide a risk assessment *Additional explanation: You can find more information about a risk assessment here*	I will not be using a device
3c	If yes: Do you use a device or software that has a medical purpose such as diagnosis, prevention, monitoring, prediction, prognosis, treatment or alleviation of disease or injury?	☐ Yes, my device or software currently has a medical purpose ☐ Yes, my device or software could have a medical purpose in the near future ☐ No ☐ I'm not sure
Part 4: Information about the study		
1	What are your main research questions? *Additional explanation: You need to provide at least one clear research question.*	Could a visualization that invite people to interact with have positive influences on collective stress and office social dynamic?
2a	Please check the box that indicates the relevant study population *Additional explanation: Please select which persons are eligible for your study.*	☐ Students ☒ General healthy population ☐ General population that deal with body focused repetitive behavior(s) (picking skin, pulling hair, biting nalis) ☐ Patients, specifically …….... ☐ Other, specifically ……
2b	Age category of participants	☐ Younger than 12 years of age ☐ Older than 11 and younger than 16 years of age ☒ 16 years or older
3	Description of the research method (select all that applies)	☒ (Semi-structured) interviews ☐ Surveys

Ethical Review Form

	Additional explanation: Please specify your research method. Note that you need to provide information about the research method in an additional file that you attach to the ERB form. E.g., for interviews you provide the interview questions, for surveys you provide the survey questions, etc.	☒ Group workshops/roundtable discussions ☐ Diary studies ☒ Behavioral observations ☐ Building sensor data ☐ Wearable device (e.g. Fitbit watch, on-skin sensors) ☒ User testing ☐ Pilot study ☐ GPS tracking/location data ☐ Living Lab ☐ Other
4	Description of the measurements and/or stimuli/treatments *Additional explanation: Think about your outcome measures and the variables you will be collecting and describe them in a way such that another person understands what the participant will experience. For example: Participants will perform task A and see pictures from database B, and we measure validated Scale 1.*	Participants will listen to the introduction about how the concept works and then give feedback on does the concept works for them. Only the answers to the questionnaire and interviews will be collected.
5	Describe and justify the number of participants you need for this study. Also justify the number of observations you need, taking into account the risks and benefits. *Additional explanation: Think about if you need 3 or 30 participants for example, and why? Do they need to provide their input once, or several times, and why? If relevant, specify the duration of the study per participant and the compensation that is needed for the study.*	I will need 4 participants in this study for a group context. They need to give feedback on how the concept works and this study will last for about 1 hour.
6	Explain why your research is societally important. What benefits and harm to society may result from the study? *Additional explanation: What benefit will the results of your study have to society in general?*	The study can help in building a better concept when designing a collective-stress-related prototype, and will result in reducing the average stress level in office context and also positive influence on social dynamic
7	Describe the way participants will be recruited *Additional explanation: How will you recruit participants for your study? For example, by using flyers, personal network, panels, etc.*	☐ Survey link posted online, e.g., social media platforms ☐ On campus flyers ☒ Personal network ☐ Via a company, namely …….. ☐ Via a hospital, namely …….. ☐ Via an organization …… ☐ By a Consortium Partner, namely ……. ☐ Other, I am the only participant
8	Provide a brief statement of the risks you expect for the participants or others involved in the study and explain. Also take into consideration any personal data you may gather and associated privacy issues. *Additional explanation: Risks for the participants can be anything from risk of data breach to risk of safety or well-being (think about stress, extreme emotions, visual or auditory discomfort). Describe these possible risks and describe the way these risks are mitigated.*	There are few risks for participants.

Ethical Review Form

Part 5: Self-assessment checklist

	Note: answers in the blue boxes indicate that your research is eligible for fast-track approval	Yes	No
1a	Does the study involve human material? (e.g., surgery waste material derived from non-commercial organizations such as hospitals)		no
1b	Will blood or other (bio)samples be obtained from participants? (e.g., hair, sweat, urine or other bodily fluids or secretions, also external imaging of the body)		no
2	Will the participants give their consent – on a voluntary basis – either digitally or on paper? Or have they given consent in the past for the purpose of education or for re-use in line with the current research question?	yes	
3	Are the participants, outside the context of the research, in a dependent or subordinate position to the investigator? Additional explanation: Think about doing research on your own students or on your own employees. When there is a dependency or power imbalance between you and the research participants, you need to answer 'yes' to this question.		no
4	Does the study involve participants who are particularly vulnerable or unable to give informed consent? (e.g., children (<16 years of age), people with learning difficulties, patients, people receiving counselling, people living in care or nursing homes, people recruited through self-help groups)		no
5	Will participating in the research be burdensome? (e.g., requiring participants to wear a device 24/7 for several weeks, to fill in questionnaires for hours, to travel long distances to a research location, to be interviewed multiple times)?		no
6	May the research procedure cause harm or discomfort to the participant in any way? (e.g., causing pain or more than mild discomfort, stress, anxiety or by administering drinks, foods, drugs, or showing explicit visual material)		no
7	Will financial inducement (other than reasonable expenses and compensation for time) be offered to participants? Additional explanation: For an explanation of what is considered a reasonable compensation, see the topic participant fees from the HTI group		no
8a	Will it be necessary for participants to take part in the study without their knowledge and consent at the time? (e.g., covert observation of people)		no
8b	If yes: Will you be observing people without their knowledge in public space? (e.g. on the street, at a bus-stop)		no
9	Will the study involve actively deceiving the participants? (e.g., will participants be deliberately falsely informed, will information be withheld from them, or will they be misled in such a way that they are likely to object or show unease when debriefed about the study)		no
10	Will participants be asked to discuss or report sexual experiences, religion, alcohol or drug use, suicidal thoughts, or other topics that are highly personal or intimate? Additional explanation: Think about your research population. For some participants, particular topics can be considered sensitive or intimate, whereas the same topics will not be perceived as such by other participants.		no
11	Elaborate on all boxes answered outside of the blue boxes in part 5. Describe how you safeguard any potential risk for the research participant.		

Ethical Review Form

Part 6: Self-assessment on privacy

The following questions (1-11) concern privacy issues, as laid down in the General Data Protection Regulation (GDPR). The Data Stewards and – if necessary – privacy team of TU/e will assess these questions. In some cases, more information is required to assess the privacy risks. If this is the case, you will be notified that the Data Stewards team will contact you.

The GDPR defines 'personal data' as any information relating to an identified or identifiable natural person ('data subject'). Personal data also includes data that indirectly reveals something about a natural person. Personal data can lead to the physical, physiological, genetic, mental, economic, cultural or social identity of a natural person. There are two main categories of personal data: regular personal data and special category personal data.

If you are not sure whether some of these questions below should be answered with a Yes or No, please contact a Data Steward first through rdmsupport@tue.nl.

	Note: answers in the blue boxes indicate that your research is eligible for fast-track approval	Yes	No
1	Will the study involve discussion/collection/processing of **regular** personal data, or will you collect and (temporarily) store video or voice recordings for the purpose of conducting interviews? *Additional explanation: For example, name, address, phone number, email address, IP address, gender, age, video or interview recordings? If you are not sure whether your data contains personal data, please contact the Data Stewards Team (rdmsupport@tue.nl).*		no
1A	If yes: Please describe which regular personal data you will collect in this study?		
2	Will the study involve discussion/collection/processing of **special category** personal data or other **sensitive data**? *Additional explanation: Examples of special category personal data are race, religion, health information, political views, genetic or biometric data for the unique identification of a person, sexual preference, etc. Health information concerns personal data of the physical or mental health of persons, including the provision of health care. Examples of other sensitive data is information such as communication data, financial records or credit scores, camera surveillance data, location/GPS data, internet-of-things data, employee monitoring, observing or influencing behaviour, criminal records, data of vulnerable persons (children, people with disabilities, refugees), BSN number etc. Please be aware that the use of special category personal data in research requires extra security measurements in order to safeguard the privacy of data subjects and to comply with the GDPR. Processing of this special category data is prohibited, except for specific purposes and under certain circumstances. If you need to process special category data, please consult the data stewards at rdmsupport@tue.nl.*		no
2A	If yes: Please describe which special-category personal data and/or sensitive data you will collect in this study?		

If you answered yes to either question 1 or 2, please answer the questions below. If you answered no to both questions, you can skip this part and continue onto part 7. Also, if an answer to any of the following questions is 'yes', please contact a Data Steward at rdmsupport@tue.nl

		Yes	No
3	Will your project involve the processing of personal data on a **large scale**? *Additional explanation: In general, any processing that involves more than 10.000 data subjects should be considered "large scale". However, if the data of approximately 1000 persons (or more) are involved, the data processing may still be considered large scale. In that case, besides the number of persons involved in the study, one should also assess (i) the amount of data collected from these persons taking into account the type/risk level of the personal data, (ii) the duration of the data processing, (iii) the geographic scope or extent of the processing. For example, if you would collect and process data across several European countries with 10+ socio-economic data items of 1200 individual persons for several years in a row, that is likely "large-scale processing". Other examples of a large-scale processing activity are:* • *Monitoring driving behavior of road users on Dutch highways* • *Collecting data of Covid patients* • *A hospital that processes patient data as part of its usual operations*		

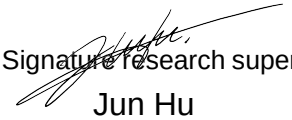
	• *A transport company that processes travel information of people who travel by public transport in a certain city. For example, by tracking them through travel maps.*		
4	Does this processing activity involve the use of new or innovative technologies? *Examples of a new technology: combining fingerprints and facial recognition for physical access control, the use of bodycams in public spaces, the use of new technical methods in conducting research such as AI. This question also refers to new technologies that have not been deployed by TU/e so far.*		
5	Does your study involve systematic (c.q. automated) monitoring of persons? *Additional explanation: Consider data processing activities that have the purpose of observing, monitoring or controlling individuals, for example in circumstances where the individuals are not aware by whom their personal data is collected and how it is used. Examples of such activities are using camera systems to monitor driving behavior on highways, monitoring email inactivity or employee phone use, certain applications of machine learning and artificial intelligence.*		
6	Does the study involve collaborations (with third parties) in which data are shared or exchanged in order to link or combine data? *Additional explanation: This may often apply in a collaboration between the university and a commercial party, contract research, etc. It is important to assess this for all data in the entire project, not just your own data.* *An important consideration in this situation is whether the person whose data is involved could have expected that data from these different databases or sources of information were to be combined. For example, it is less likely for data subjects to expect that databases from different parties will be combined and the results are used for different purposes than one could reasonably expect; this may apply for example in a collaboration between the university and a commercial party.*		
7	Will the study include data processing activities that prevent data subjects from exercising their rights or using a service or contract? *Additional explanation: Examples include processing operations carried out in public places that people cannot avoid (train station, airport, shopping mall, public university premises, etc.) or processing operations whose purpose is to allow or not allow data subjects to use a service or enter into a contract (examples: by refusing to pay a benefit, not being able to apply for a loan, etc.).*		
8	Will the study process personal data to score, rank or profile persons? *Additional explanation: Examples: monitoring (highway) roads to give road users a "score" based on their detected driving behavior, a bank assessing its customers based on their creditworthiness, or an organization building behavioral and marketing profiles based on use of their website or navigating their website.*		
9	Does your data processing include activities that involves composing "**blacklists**" – and, in particular, in relation to sensitive or special category data, such as communication data, financial records or credit scores, genetic data, biometric data, health data, camera surveillance data, location/GPS data, internet-of-things data, employee monitoring, observing or influencing behaviour, etc. *Additional explanation: This situation will not be a common occurrence in research, but you may indirectly be involved in this. In general, this typically concerns processing operations involving personal data relating to criminal convictions and offences, data relating to unlawful acts, data concerning unlawful or annoying behaviour or data concerning bad payment behaviour by companies or individuals are processed and shared with third parties (blacklists or warning lists, as used, for example, by insurers, hospitality companies shopping companies, telecom providers as well as blacklists relating to unlawful behavior of employees, for example in the healthcare sector or by employment agencies, etc.).*		
10	Will personal data be transferred or shared outside the EU/EEA? EU data protection rules apply to the European Economic Area (EEA), which includes all EU countries and non-EU countries Iceland, Liechtenstein and Norway. *Additional explanation: The GDPR has drafted additional requirements for transfers data outside of the EU/EEA. Typically, additional safeguards must be implemented to protect the personal data of residents in the European Union. For example, if you collaborate with an American, Indian or Chinese university or other third party outside the EU/EEA, you must first check whether this is allowed and under which conditions this is allowed. Another typical example is storage of data on American providers of cloud (storage) services. Please contact the data stewards first to discuss this.*		
11	Will any raw or anonymized personal data or any other sensitive data or research results from the project possibly be transferred to a high-risk country*? ***High risk countries**: China, Russia, Iran, Turkey, and North Korea.* *If personal data or other potentially sensitive data is exchanged with one of these countries, or if part of the data processing takes place in one of these countries: **an advice from the Data Protection Officer, the kennisveiligheidsteam (Knowledge Security team), and the CISO (Chief Information Security Officer) is ALWAYS required.***		

Ethical Review Form

Part 7a: Processing of research data		
1	Is consent your legal basis for processing the personal data in your study? *Additional explanation: What is a legal basis? One of main principles in the GDPR is to ensure that personal data is processed lawfully, fairly, and transparently. To comply with this principle, the processing of personal data also requires that you have a valid legal basis for the personal data processing activity.* *In research projects, the legal basis is often but not always consent. However, it is possible that it is not clear or not possible to establish whether to use consent as a legal basis.* *Some examples where consent may not be applicable as legal basis are covert research, data collection in public spaces, secondary data analysis of existing data, data that are transferred to you by a third party, consent is not possible or would require disproportionate effort, etc. In that case, please indicate which legal basis you think that applies or (preferably) contact a data steward first.*	☒ Yes and it will be obtained via an informed consent form An informed consent template* is attached to this application. ☐ No, I will use another legal basis to process the data. Namely, …….. * You can download a suitable template **here**.
2	Where will the data come from?	☐ Data obtained from another party (secondary data use) ☒ New data collected only by my research team ☐ New data collected together with collaborators
3	Which of the following tools will you use to process personal data?	**Surveys** ☐ Qualtrics ☐ Limesurvey ☐ MS Forms ☐ Other, namely …….. **Interview/workshop recordings** ☐ Voice/video recorder ☐ Phone in a flight mode ☐ MS Teams ☐ Other, namely …… **Transcription** ☐ Manual transcription ☐ Microsoft Office software (e.g. Word, Teams) ☐ Other, namely …… **Statistical analysis** ☐ SPSS ☐ R ☐ Other, namely …… **Other tools**, specifically……
4	Where will the data and in particular the personal data be stored during and after completion of the study? If you have already uploaded your Data Management Plan, you can refer to your Data Management Plan.	☒ Onedrive ☐ Research Drive ☐ Network Drive

	Additional explanation: University supported-storage facilities are SURF Research Drive, Ceph, departmental drives (this includes BE Project Drive), and the TU/e instance of Microsoft OneDrive. For most personal data, the use of SURF Research Drive or departmental drives (including BE Project Drive) is required.	☐ Research Manager ☒ Other, namely in a physical notebook
Part 7b: Safety and security measures		
1	Will you pseudonymize/anonymize the data? *Additional explanation:* *Anonymization: remove all direct identifiers (name, address, telephone number etc.) but also indirect identifiers (age, place of birth, occupation, salary) that, linked with other information, can lead to a person's identification. Anonymization to the point that a data subject is no longer identifiable means that the anonymized data is not considered to be personal data anymore.* *Pseudonymization: replacing the unique identifier of a data subject with an artificial pseudonym. This means that identification is still possible with the identification key. The identification key needs to be stored securely and separately from the pseudonymized data. If the data subject can be identified by combining data with additional information, the data is also called pseudonymous.*	☐ Yes ☒ No If yes, describe how:
2	Is access to (personal) data restricted? (Select all that apply)	☐ No ☐ Yes, via access control ☒ Yes, via password protection ☒ Yes, access only given to TU/e research team ☐ Yes, access only given to research team, including non-TU/e collaborators ☐ Other, specify…….
3	Who will have access to the data during and after completion of the project? (Select all that apply)	☒ Main researcher ☒ TU/e supervisor(s) ☐ External supervisors ☐ TU/e research team ☐ Other, specify…….
4	Will you store data for future research?	☒ No ☐ Yes, in a public data repository ☐ Yes, in a public data repository under restricted access ☐ Yes, in a TU/e-recommended storage (SURF Research Drive, Network Drive)
5	Will you share data outside the TU/e?	☒ No ☐ Yes, in a fully anonymized form ☐ Yes, raw or pseudonymized data* *If you selected this box, make sure that a suitable data agreement is put in place. You can contact the Data Stewards for support in preparing such an agreement
6	How long will data be stored after the end of the project?	1 months

Ethical Review Form

Part 8: Closures and Signatures		
1	Enclosures (tick if applicable and attach to this form):	☒ Informed consent form ☐ Informed consent form for other agencies when the research is conducted at a location (such as a school) ☐ Text used for ads (to find participants) ☐ Text used for debriefings ☐ Approval other research ethics committee ☐ The survey the participants need to complete, or a description of other measurements ☐ Data Protection Impact Assessment checked by the privacy officer ☐ Data Management Plan checked by a data steward
2	Signature(s)	Signature(s) of applicant(s)  Date:22/3/2024  Signature research supervisor Jun Hu Date:22/3/2024

Yunyin Lou / y.lou@tue.nl

Jun Hu / J.Hu@tue.nl

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April 2, 2024

Reference
ERB2024ID71

Ethical Review Board TU/e

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Ethical review research proposal

Dear Yunyin,

It is a pleasure to inform you that the Ethical Review Board (ERB) has discussed and preliminary approve your application.

Furthermore, the Board wants to draw your attention to the terms and conditions in the appendix.

Success with your research!

Sincerely,

Dr. D. Lakens
Chair Ethical Review Board TU/e

Enclosures
1

The ERB retains the right to revise its decision regarding the implementation and the WMO[1]/WMH[2] status of any research study in response to changing regulations, research activities, or other unforeseen circumstances that are relevant to reviewing any such study. The ERB shall notify the principal researcher of its revised decision and of the reasons for having revised its decision.

[1]WMO: Law on Medical Scientific Research involving Human Beings (in Dutch: Wet medisch-wetenschappelijk onderzoek met mensen)

[2]WMH: Medical Device Directive (in Dutch: Wet op de medische hulpmiddelen)

APPENDIX 1

Terms and conditions

Amendments
When considerable amendments are made to the design of the study or educational activity, or when the time period between ERB approval and start of the study is longer than one year, please consult the ERB.

Privacy and research data management
The ERB would like to point out that collecting, handling and storing personal information is subject to the General Data Protection Regulation. Please visit TU/e intranet for the latest information and regulations on www.tue.nl/rdm