DESIGNING FOR HEALTHY SELF-REFLECTION ON COGNITIVE DATA IN THE CONTEXT OF BURNOUT

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PREFACE

As the end of my two-year master journey at TUDelft is approaching, I hope to use this thesis project to integrate, showcase and reflect on all the skills I gained. These past 2 years have reshaped me as a designer. I enjoyed the challenge and new perspectives I have the honor to encounter thanks to all the teachers, friends and projects. The

Here I would like to express my gratitude towards everyone who generously shared their wisdom to make this project come true.

First, I would like to express my sincere gratitude to my supervisors, Christina and Evan, for their invaluable guidance, support, and positive spirit throughout this journey. Your expertise, insightful feedback, and unwavering belief in my abilities have been instrumental in shaping this thesis. I thank you deeply for encouraging and inspiring me along the way. I wouldn't be able to finish this project without your support.

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To my readers, I hope you enjoy this project.

Sincerely,
Lingge

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EXECUTIVE SUMMARY

Introduction: Individuals with burnout often experience cognitive challenges in general performance or the excessive effort to perform certain tasks. With the increasing work pace over the years, on average, over 10% of workers in Europe and over 17% in non-European countries had experienced burnout up until 2018 (Schaufeli, 2018). Personal solutions like websites and guided meditation applications have emerged to help alleviate burnout symptoms. Governments have passed legislation to prevent burnout from occurring.

The advancing cognitive personal informatics (CPI) technology has made it possible to monitor psychophysiological data and quantify human cognition and cognitive activities. The quantified human cognition-related data could be of great value to people who wish to be more aware of their condition or needs and refer to this information in reflective activities to become a better version of themselves.

Methodology: Three main research questions were generated to inquire about the role of cognitive data in burnout solutions. This project follows the principles of participatory design and the double diamond framework with minor adaptations to answer the research questions. Background research was conducted to gather theoretical and practical information on topics related to burnout solutions, measures of cognitive data, and state-of-the-art CPI technology. Semi-structured interviews with people with burnout experience were conducted as a user study. Creative sessions with target users were conducted to guide the design direction.

Results: The background research clarified the basic burnout profile as well as the cognitive burnout correlates that can be measured by CPI systems. This part of the research elaborated on 7 key correlates that can later be applied in the design phase. The participatory design research activities revealed different perspectives from potential users on burnout that complemented the background research. The participatory design activities also proposed key features that shaped the initial concept.

Conclusion: A design guideline was proposed to help users make good use of CPI technology and self-reflection to search for burnout solutions independently based on the research findings. Some of the key stages in the guideline were conceptualized into wireframes. The guideline suggests users should have full control and support over the entire burnout recovery process, with resources for community support when needed.

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Chapter 1

INTRODUCTION

1.1 Project brief

Burnout is an emerging mental problem among people who deal with high level of stress on a daily basis. Individuals with burnout often experience cognitive challenges in general performance or the excessive effort to perform certain tasks, especially those with a clinical diagnosis (Maslach, 2006)(Oosterholt et al., 2014). With increasing work pace through the years, on average over 10% of the workers in Europe and over 17% in non-European countries had burnout experience up until 2018 (Schaufeli, 2018). Personal solutions like websites and guided meditation applications have been emerging to help alleviating burnout symptoms. Governments passed legislations to prevent burnout from happening (1). Yet the problem is still at the center of people's attention.

The advancing technology has made it possible to monitor psychophysiological data and quantify human cognition and cognitive activities. Some physiological variables are proven to be effective indicators to determine burnout manifestation, for example, heart rate variability (HRV), mean arterial blood pressure (MAP), cortisol level (Traunmüller et al., 2019). These variables can be collected by chest straps, touch-type wristbands, brain-sensing headbands. The quantified human cognition-related data could be of great value to people who wish to be more aware of their condition or needs and refer to this information in reflective activities to become a better version of themselves. Common brain data that can be collected by cognitive personal informatics (CPI) systems are for example brain waves, blood saturation etc. (Krigolson et al., 2021)

Self-regulation is an accessible and effective method to deal with psychological situations. It can be described as an iterative process of making adjustments to adapt to personal and environmental changes (Zimmerman, 2000). Reflection is a key step in the self-reflection process, for which evidence to support or oppose people's current course of response is needed. For users with self-reported burnout symptoms, CPI systems could provide them with a meaningful set of data to refer to in self-regulation/ reflection activities. For users who are prone to burnout, CPI systems could potentially prevent burnout by giving insights to facilitate meaningful self-reflection activities, therefore aid the recovery of burnout.

Burnout studies are beginning to explore the possibility of cognitive data in measuring its influence on human cognition, especially cognitive performance (Luijtelaar et al., 2010). But when it comes to the practice of burnout intervention, the mainstream direction still relies on the research subjects to subjectively assess their burnout situation (Murali et al., 2023) (West et al., 2018). The approach to aid burnout interventions from a sensor-based angle is relatively uncharted territory.

We envision that CPI technology can improve the precision of burnout intervention and lower the threshold for accessing professional help. Hence, this project aims to explore and experiment with ways for cognitive data to aid reflection on an individual's cognitive states, with a specific focus on self-report burnout users.

(1) https://europeanstudiesreview.com/2022/04/25/a-look-at-european-legislation-designed-to-prevent-burnout/

1.2 Research questions

The main research goal of this project is to investigate for a suitable design approach to maximize CPI systems' advantages in burnout intervention. All research and design activities are guided by the main goal and segmented research questions (RQs). The RQs are as following:

RQ1. What constitutes a comprehensive understanding of burnout?
1.1 How does burnout influence people's life at different development stage?
1.2 What are the common approaches to intervene burnout?
1.3 How is burnout measured?
1.4 What is the relationship between burnout and human cognitive correlates?

RQ2. What do people need to effectively intervene burnout episodes?
2.1 What is the general experience of people dealing with burnout?
2.2 What are the key qualities should an effective burnout intervention have?

RQ3. How to give CPI technology meaning in designing burnout solution?

RQ1 is mainly explored in Chapter 2. By answering RQ1, theoretical information related to the project is gathered. The purpose of gathering such information is to understand the state-of-art of relevant topics, ground the following user studies and clarify the design space.

RQ2 is mainly explored in Chapter 4. By answering RQ2, a comprehensive set of user need is defined. The purpose of answering RQ3 is to define the design area and clarify the key qualities to guide the design.

RQ3 is mainly explored in Chapter 5. By answering RQ3, a design approach of how to incorporate a tailored CPI system into burnout solution is outlined. The answer to RQ3 is the ultimate outcome of this design research project.

Chapter 2
BACKGROUND

This chapter focuses on investigating background knowledge of the relevant topics. The literature and desk top reserach section provides a general understanding of burnout and its relationship with key research subjects in cognitive science. The competitor research explores the strong points and weak points of a self-help burnout application on the market.

2.1 Literature and desk top research

Literature research in this section delves into the scientific theoretical knowledge of burnout. Desk top research focuses on understanding existing burnout and CPI products on the market.

All sub-RQs of RQ1 is answered in section 2.1. RQ1.1 and RQ 1.3 is answered in section 2.1.1. RQ1.2 is answered in section 2.1.3. RQ1.4 is answered in section 2.1.2 and 2.2.

2.1.1 Burnout basics

To better answer RQ1, the phenomenon of burnout must be clarified. Burnout first came to be an individual concept in psychology back in the 1970s by an American psychologist Herbert J. Freudenberger. He, as a person who experienced burnout himself, defined burnout as “to fail, wear out, or become exhausted by making excessive demands on energy, strength, or resources” (Freudenberger, 1974). Later studies suggest burnout as a subcategory of or a reaction to chronic stress (Maslach, 2003) (Pines and Keinan, 2005). It is worth noting that burnout has never been recognized as a type of “disease” and there has not been any well-established treatment for it (Maslach and Leiter, 2021).

2.1.1.2 Three dimensions of burnout

One of the most practiced models of burnout contains three dimensions: exhaustion, cynicism, and inefficacy (Maslach, 2006). Exhaustion dimension refers to the feeling of overwhelming mental and sometimes physical exhaustion as the result of overly draining a person’s resource of energy. When emotional exhaustion overloads the person, the cynicism dimension could start to manifest as a protective mechanism. The person feels disconnected from the work and loses the drive to bring high-quality work. The inefficacy dimension refers to people’s evaluation that they can no longer maintain the quantity and quality of work as a further development of burnout. People tend to doubt their career choice and conceive self-loathing. Notably, there is no strict chronological order for the three dimensions to occur. Although cynicism is more likely to appear when exhaustion is accumulated. Similarly, inefficacy is more likely to come after cynicism.

Burnout was an exclusive phenomenon in professional context that may spread its influence on other non-professional contexts at first (Maslach, 2003). Later it became applicable to other contexts like family relationships (Iacovides et al., 2003). People might only experience burnout in one aspect of life while feel perfectly fine in another.

2.1.1.3 Measuring burnout

Burnout as a phenomenon with no unified definition also does not have a universally recognized measurement. Although some objective psychophysiological data are proved to have some correlation with burnout, all validated burnout measurements found are Patient-Report Outcome Measures (PROMs) (Shoman et al., 2021) (McCormack et al., 2018). The most widely applied measurement is Maslach Burnout Inventory (MBI), which is a questionnaire first created in the 1982. It consists of 22 items that assess the following perspectives of burnout: Emotion Exhaustion, Depersonalization, Personal Accomplishment, Cynicism and Professional Efficacy (Maslach et al., 2018). In the past years, MBI was developed into multiple variations to suit different groups and context better, for example MBI-HSS (Maslach Burnout Inventory-Human Service Scale). Researchers later adapted MBI for usage in different countries, for example the Dutch adaptation of MBI Utrecht Burnout Scale (UBOs) consisting of 16 items (Schaufeli & van Dierendonck, 2000).

Although MBI and its variations for different professions is the golden standard to measure burnout by some authors (Williamson et al., 2018), some others argued its limitations (Traunmüller et al., 2019) (Iacovides et al., 2003) (Shoman et al., 2021). A study compared the five most used burnout scales, MBI, Pines’ Burnout Measure (BM), Psychologist Burnout Inventory (PBI), OLdenburg Burnout Inventory (OLBI), Copenhagen Burnout Inventory (CBI) for their psychometric properties (2) (Shoman et al., 2021). Each measure has its own specific use purpose and targets different group (Table 1). By comparing the psychometric properties of each measure, the conclusion was CBI and OLBI are the only two that were considered to be valid burnout measure as the studies that used them ended up with high content validity and more assessed psychometric properties. Yet there is no sufficient evidence to tell which of the measures are collectively recognized to be the best for many considerations. For example, adapting the measure to another language could result in slight biased working (Shoman et al., 2021), or demographic difference could lead to inconsistent result of burnout diagnosis (Iacovides et al., 2003).

Table 1 Purpose and target groups of common burnout measurements

BURNOUT MEASRUE	PURPOSE	TARGET GROUP
Maslach Burnout Inventory (4th edition)	Exploring new strategies of coping in workplace (Maslach & Leiter, 2021).	All paying occupations (Kristensen et al., 2005)
Pines’ Burnout Measure	Assessing exhaustion in three dimensions and defining burnout with a cutoff score (Malach-Pines, 2005).	General population (Shoman et al., 2021)
Psychologist Burnout Inventory	Assessing level of burnout.	Psychologists (Ackerley et al., 1988)
OLdenburg Burnout Inventory	Assessing exhaustion and disengagement level from work.	All paying occupations (more friendly to physical workers) (Demorouti et al., 2001)
Copenhagen Burnout Inventory	Assessing personal, work-related, and client-related burnout.	General population (Kristensen et al., 2005)

Due to the nature of burnout as a mental health experience or phenomenon, it is not ethical to only use PROMs as tools to diagnose burnout (Maslach & Leiter, 2021). Instead, such measuring methods give practitioners lenses to understand core challenge imposed by burnout on each patient.

(2) Psychometric properties are in rough terms reliability, validity and norming. These properties should be carefully evaluated to determine a good test in psychology research.

2.1.2 Cognitive Personal Informatics and burnout

Cognitive Personal Informatics (CPI) systems refer to tools to collect brain data such as electroencephalogram (EEG) (Dudley & Jones, 2018) which can provide many insights about human cognition and emotion state. Common human cognition concepts can be measured by most of the existing mainstream products. For example, the Emotiv earbuds can assess the user's cognitive performance, stress level, or cognitive workload based on several electrodes on the scalp (3). The Muse headset provides its users immediate feedback of their brain state in audio to help them become more informed in meditation sessions (4). Despite EEG remains the mainstream technology to collect human brain data, near-infrared spectroscopy (NIRS) is becoming another effective way to know more about human cognition (Welch & Pasternak, 2017). For example, the Cortivision PHOTON headset mainly uses NIRS to measure hemodynamic responses of the brain (5).

The burnout scales widely practiced clinically heavily rely on the patient's subjective assessment. The integrity and objectivity of memory and subjective judgement could potentially hinder the reliability of burnout self-reflection that is going to be designed later in Chapter 5. While involving quantitative cognitive data is a promising approach to solve this problem. Cognitive data that can be picked up by these devices can already provide so much information about people's cognitive state and mental well-being. These devices could also have the potential to provide burnout-related insights.

This section investigates what subjects to look at to fill the gap between cognitive CPI technology and burnout solution. This section provides the building blocks to answer RQ3 later in Chapter 5.

2.1.2.1 Cognitive burnout correlates

To investigate what role can well-explored concepts and information in human cognition studies play in burnout solution, it is necessary to find out the relation between those concepts and burnout (Table 2).

Four stress-related antecedents of burnout are identified in a study: mental fatigue, monotony, satiation and stress sensation (Demerouti et al., 2002). Mental fatigue as an immediate reaction to stressors is likely to have impact on the emotional exhaustion aspect of burnout. Monotony refers to decreased level of work activation that can be reversed when work task is changed. Satiation refers to agitated state when facing repetitive work. Both monotony and satiation are prone to have bigger impact on disengagement aspect of burnout. Stress sensation refers to how an individual subjectively perceive the level of stress. How people mentally react to stressors is dependent on how the actual stress is perceived. Stress sensation can influence both emotional exhaustion and disengagement aspect of burnout. The causal relation between stress level and emotional exhaustion is positive (McManus et al., 2002).

From the advice on burnout self-check on official government websites, other cognitive correlates of burnout are identified (6) (7) . Mental workload, emotional stressors and cognitive function impairment are the most mentioned aspects.

(3) https://www.emotiv.com/mn8-eeg-headset-with-contour-app/
(4) https://choosemuse.com/products/muse-2
(5) https://www.cortivision.com/products/photon/
(6)https://omh.ny.gov/omhweb/disaster_resources/pandemic_influenza/doctors_nurses/common_stress_reactions.html#:~:text=Increased%20heart%20rate%20and%20respirations,by%20weight%20loss%20or%20gain
(7) https://www.verywellmind.com/stress-and-burnout-symptoms-and-causes-3144516

Table 2 Table 2 Cognitive burnout correlates (Grossi et al., 2015) (Nayernia and Babayan, 2019) (Akca and Küçükoğlu, 2020) (Bianchi et al., 2020) (Zapf et al., 2001) (Demerouti et al., 2002)

	COGNITIVE CORRELATES	RELATED BURNOUT ASPECTS
Temporal antecedents stages of burnout	Mental fatigue	Emotional exhaustion
	Monotony	Disengagement
	Mental satiation	Disengagement
	Stress sensation	Emotional exhaustion + Disengagement
	Mental workload	Direct and Indirect statistical relation
	Evmotion	Emotional labor as stressor impacts emotional exhaustion and depersonalisation dimension
	Cognitive performance	Memory: Burnout patients tend to have memory bias to negative information, like depression (Foreign) language proficiency: Negative relation with emotional exhaustion and depersonalisation dimensions, positive with personal accomplishment dimension Visual and auditory attention span: worse performance in non-clinical burnout group. Improved attention performance only suggests partial recovery of burnout

* The study that investigated "stress sensation" used OLBI to evaluate burnout profile. OLBI proposes a two-factor burnout structure (disengagement and exhaustion) which is different from Maslach's three-dimension theory.

Mental workload is not solely determined by the amount of requirement imposed on an individual, but rather by how significant the gap between the required skills for the required tasks and the actual skills an individual holds is perceived (Hart, 2006). Research shows mental workload and burnout are statistically relevant to each other (Abareshi et al., 2022) (Akca & Küçükoğlu, 2020). Mental workload does not only have a direct positive relation with burnout, but also indirect relation. For example, high mental workload can result in low job performance, and consequently leads to the occurrence of burnout (Akca and Küçükoğlu, 2020).

Emotional labor refers to the organizationally required emotional expression that is does not match with the personal feeling of the individual (Zapf et al., 2001). Experiencing excessive emotional burden could indicate there is conflict between the individual and the organization's value, which was mentioned as one of the major causes of occupational burnout (Maslach, 2006).

Memory, language proficiency, visual and audio attention span are some of the major cognitive performance aspects that burnout can have influence on. The cognitive performance impairments can be treated as indicator of burnout occurrence as well as burnout recovery (Grossi et al., 2015) (Nayernia and Babayan, 2019) (Bianchi et al., 2020). But such impairments cannot be direct evidence of burnout for other psychological conditions like depression and anxiety could have similar impact on cognitive performance (Luijtelaar et al., 2010).

2.1.2.2 Measuring burnout correlates

How should correlates mentioned in Section 2.1.2.1 be measured by either objective or subjective methods is further investigated in this section.

Mental fatigue

Mental fatigue can be assessed by self-report scales, such as the fatigue assessment scale (FAS) (Michielsen et al., 2003). One recent study established a framework that allows mental fatigue detection by constructing correlations between participants' FAS results and physiological data (Ramírez-Moreno et al., 2021). The identified variables that correlate with mental fatigue are EEG power ratios between frequencies, P300 waveforms, body temperature, low frequency electrocardiogram (ECG). More specifically, the correlations between these variables and mental fatigue are shown in Table 3. The physiological data collected in this study did not show statistical correlation with mental fatigue but was noticeably by visual check.

Table 3 Correlations between physiological variables and mental fatigue(Ramírez-Moreno et al., 2021)

VARIABLE	CORRELATIONS WITH MENTAL FATIGUE
EEG power low frequency/high frequency ratio	Negative
P300 latency	Positive
P300 amplitude	Negative
Body temperature	Negative (non-statistically)
Low frequency ECG	Positive (non-statistically)

Monotony

Mackworth Clock Test is a famous protocol to measure the level of monotony or drowsiness. A study about monitoring driver's monotony level by implementing physiological and psychological measurement in the Mackworth Clock Test (Steele et al., 2004). EEG, galvanic skin response, electrocardiogram and head movement acceleration are the investigated variables. Every time when the second hand of the clock skipped a second is a target. How the data collected after the target occurs is different from before is key of investigation. Take EEG for an example, change in alpha wave amplitude is compared right before and after each target occurs. From analyzing the alpha waves, the research discovered as time pass, the level of vigilance drops.

Mental satiation

Mental satiation is relatively an uncharted territory in physiological data measuring studies. Yet people still have some level of control over mental satiation in work. By definition mental satiatoin, in other words being "fed up" with the tasks, occurs when people face repetitive tasks continuously. But repetitive tasks do not necessarily lead to satiation. One study suggests if people acknowledge the value of the repeating tasks, they can avoid satiation by autonomously taking volitional control (Mojzisch & Schulz-Hardt, 2007).

Stress sensation

Many types of physiological and psychological data can tell so muhearch about stress sensation level. Heart rate variability (HRV) refers to the changes of interval between heart beats from which information about physical and psychological events can be derived (Shaffer & Ginsberg, 2017). A study evaluated the accuracy of using HRV as an indicator for stress detection (McDuff et al., 2014). They identified significantly rise in low frequency components as well as the low frequency/high frequency ratio when the participants are under stress. The accuracy is up to 80%. EEG is also widely applied in stress detection research. One study set up a three-level stress inducement experience and successfully distinguished the 2 of the 3 levels of stress from relaxed state (Al-shargie et al., 2016). Other variables like breathing rate, skin temperature, blood pressure also correlate with stress (McDuff et al., 2014)(Yoon et al., 2016)(Munakata, 2018). The mentioned variables and their relationship with stress are shown in Table 4.

Table 4 Correlations between physiological variables and stress (Al-shargie et al., 2016)(McDuff et al., 2014) (Yoon et al., 2016)(Munakata, 2018)

VARIABLE	CORRELATIONS WITH MENTAL FATIGUE
HRV low frequency components	Increase when stress is induced
HRV low frequency/high frequency ratio	Increase when stress is induced
EEG alpha wave power	Lower than relaxed state when stress is induced
EEG beta wave power	Higher than relaxed state when stressed is induced
Peripheral skin temperature (8)	Negative relationship with chronic stress
Out-of-office blood pressure (9)	Increased most significantly on Mondays

Mental workload

Cardiovascular and EEG are the most widely practiced methods to measure mental workload among other physiological methods such as eye movement, respiration and skin conductance (Tao et al., 2019). The main cardiovascular variables mentioned are heart rate (HR) and HRV (Table 5). Due to the limited

(8) Peripheral skin temperature is often measured at wrist. It is usually lower than core body temperature.
(9) Out-of-office blood pressure is self-measured for whole day long.

comparison studies cross variables and test scenarios, there has not been enough evidence to determine which variable has the best performance in mental workload measurement. One study attempts to compare EEG, physiological data and eye measures in measuring mental workload (Hogervorst et al., 2014). Their results suggest EEG to be the most accurate method among the rest. EEG in combination with eye movements or physiological variables increased the measuring accuracy slightly.

Table 5 Correlations between physiological variables and mental workload(Hogervorst et al., 2014)(Tao et al., 2019)

VARIABLE	CORRELATIONS WITH MENTAL FATIGUE
HR	Positive
HRV low frequency/high frequency ratio	Positive
EEG alpha wave power	Negative
EEG theta wave power	Positive

Emotion labor

Emotion labor can be measured by a self-administrated questionnaire in which 3 levels of emotion acting is assessed subjectively (Hu et al., 2023). Unlike other correlates which can be measured by acute bodily or mental reaction, emotion labor is assessed for a period of time as a whole.

Cognitive performance

Negative memory bias can be measured implicitly by Self-Referent Encoding Task in which participants are asked to examine 12 positive and 12 negative words in terms of how well each word represents them. The participants are later asked to list as many words as they can recall (Derry & Kuiper, 1981) (Duyser et al., 2020). Among the assessed mental disorders, negative memory bias can only indicate depression severity.

Foreign language proficiency is usually assessed by examinations such as TOFEL and IELTS. One study successfully established a model that predicts Japanese native speakers' English listening proficiency by comparing EEG signals and traditional foreign language examination outcomes (Ihara et al., 2021). Another study synchronized the EEG data measure in two groups of Austrian students who speak English as a second language with different proficiency level. The lower level group showed higher involvement of right hemisphere in gamma wave range (Reiterer et al., 2009).

Visual attention span can be measured by "character-recognition" experiment. The experiment flashes similar characters to the participants who have to report the characters which already appeared before (Yeari et al., 2017). Attention in general can be detected by EEG technology (Shestyuk et al., 2019). But no EEG application has been found particularly in visual or audio attention span studies.

2.1.3 Concurrent solutions of burnout

Burnout is related with stress closely, yet it is not an immediate reaction to but an accumulated outcome of repeated stress-triggering events (Demerouti et al., 2002). Not only can burnout be a consequence of long-term stress, but also a result of work-related meaninglessness and underappreciation (Maslach, 2006). It is important to know higher stress level does not equal to higher risk of experiencing burnout symptoms.

Studies found out burnout can be approached from both individual and organizational angle. For healthcare employees specifically, exercises that help develop personal abilities to deal with stress and people-related work are found helpful to battle against burnout (West et al., 2018). Hospitals might have resilience rooms for nurses to temporarily recover from intense stress from work (Murali et al., 2023). For a broader population, mindfulness is one of the most popular solutions to mitigate burnout (Goodman & Schorling, 2012) (Kinnunen et al., 2019). Although the effectiveness difference between individuals is wide, significant amount of mindfulness-based intervention cases against burnout turned out to be effective (Kinnunen et al., 2019). Web-based solutions are also emerging in recent years. With help of smart phones and tablets, people can receive immediate notification on what action to take in a personalized way. However, whether having immediate feedback on burnout state is beneficial is still debatable (Murali et al., 2023). Implementing organizational solutions such as reducing working hours is more difficult than individual solutions, as well as proving its validity (West et al., 2018).

According to the studies, effective ways to tackle burnout situation should have the following important traits: 1) approach strategy should be setting positive and motivating goals instead of getting rid of the negative symptoms of burnout (Maslach, 2006), 2) approach strategy should help people establish a healthy valuing system of one's work, 3) approach strategy should facilitate collective acknowledgement and support for burnout (Arman et al., 2011).

2.2 Competitor Research

Aside from traditional therapies, there are digital products on the market that target specifically for dealing with burnout. Researching on what competitors provides to its target users can reveal many interesting strong and weak points to consider in the design phase. Competitors might have different standpoints from this project that provides opportunities for differentiation from speculative point of view.

Competitor products that have potential insights to benefit this design project should have similar form and main features. More specifically speaking, suitable competitors should focus on long-term personal use and empower the users to reflect. The key research point to focus on is the competitor's usability and user experience.

Digiburn is a mobile application that focus on burnout self-help (10). Digiburn is positioned as a supportive role in burnout recover journey. It provides its users with a fixed 12-week program for tracking burnout states and low-level therapeutic exercises. Digiburn claims the goal of for users to use their product is to become a better version of themselves.

2.2.1 Major features and use flow

The main body of Digiburn is the 12-week program that consisting of 3 types of activities: 1) course and quizzes; 2) practical exercises; 3) burnout state self-tracking (Figure 1).

The courses provided in the program themed in body, mind and growth in this fixed order. Usually, a class starts with presenting some facts. Next to the facts Digiburn provides real life stories to put better users in the context (Figure 2). On the next day, users need to complete a small quiz to continue to the next class. This type of activities requires users to spend some time reading and processing the information.

Following closely after the courses and quizzes, users need to finish the homework, in most cases practical exercises, to continue to the next class. The practical exercises are further break down to sub-tasks. For example, in the body chapter, the sub-tasks are "go for a walk", "take the stairs" and "active break" etc. Another practical exercise separated from the course content is pushed to the user depending on the current time (see "Daily practical exercises" tag in Figure 1).

Burnout self-tracking assess two aspects at different frequencies. The emotion status can be entered on daily basis (see the "Burnout state self-entry" tag in Figure 1). Users can describe the exact mood and add remarks about what puts them into good or bad mood by using the pre-packed keywords. At the end of each month, users can update the burnout assessment result they received before starting the program by using the Burnout Assessment Tool (11). The assessment result takes the form of a qualitative scale from low risk to high risk.

The use flow of Digiburn is visualized in Figure 3. The classes share the same structure of reading, completing quiz, and do practical exercises to reinforce the learning outcome. This loop of activities will go on until all classes are finished. After completing the 12-week program, shortcuts to the sub-tasks in each class are organized altogether for quick access.

(10) https://digiburn.health/
(11) https://burnoutassessmenttool.be/handleiding_vragenlijst_eng/

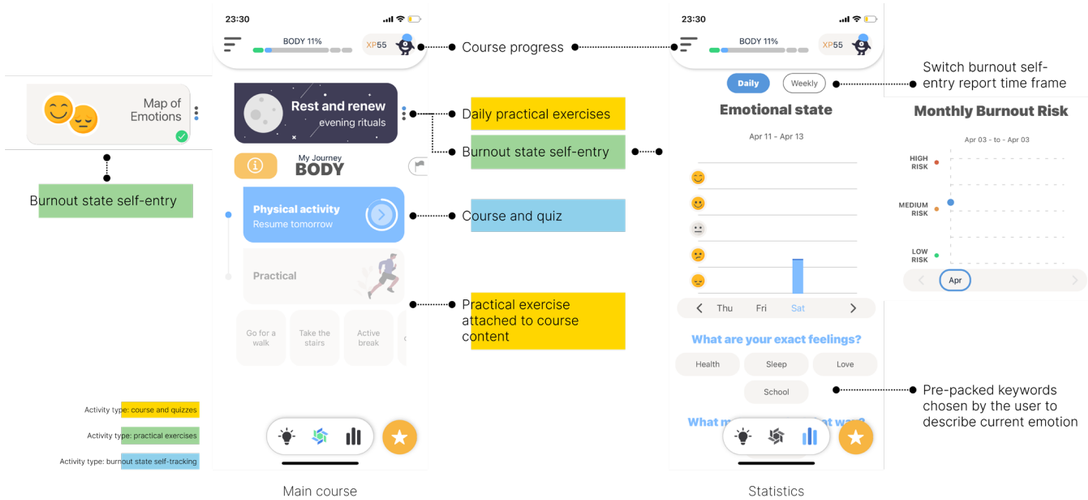


Figure 1 Digiburn program structure

2.2.2 Strengths and weaknesses

Strengths

#1 Structured guidance
The 12-week program schedule is fixed. User don't have the freedom to skip classes or immediately do the quiz after the reading the presented facts. In this way best learning outcome is ensured. Progress of both the program and personal growth is visualized (Figure 1). The personal growth visualization especially indicates if the user is making progress or having setbacks.

#2 Practicality
Digiburn provides hands-on techniques to care, train and reflect on body, mind and growth. For each theme, there are various of techniques to choose according to different personal circumstances. Applying these techniques put the theoretical facts of burnout into real life context, and further translate the knowledge into actions.

#3 Reaching the core of burnout
Bodily care and mental training exercises help in alleviating the symptoms and build resilience to stress load. This type of low-level support does not reach the core nature of burnout. Therefore, they could only be temporarily effective. Not only does the program include some self-reflection sessions to form healthier reasoning strategy (e.g. chapter "limiting beliefs"), guidance on understanding the nature of current burnout episode is mentioned too. When doing daily emotion entry, users can identify the source of their mood and add elaborate remarks to it (Figure 4). It is helpful for users in building an understanding of how the they react to positive and negative emotion triggers.

#4 Involving the other perspectives
Digiburn incorporates real life examples in the class flows. Users get to know how to effectively apply the theory in real life self-care activities. In this way, users get inspired and gain more confidence in making their first try.

Weaknesses

#1 Insufficient reward
The level of the user's motivation is the major influence to complete the 12-month program. Notifications are the only feature to encourage usage, which is usually less satisfying.

#2 Lonely journey
As elaborated in section 4.1.3, people find it beneficial to engage with other people when they face burnout symptoms. Digiburn does not support social activities. Within the application, users cannot communicate with other users. Outside the application, no share feature is provided to the users to share their progress through social media. Digiburn's program is a lonely journey that users only keep the accomplishment to themselves.

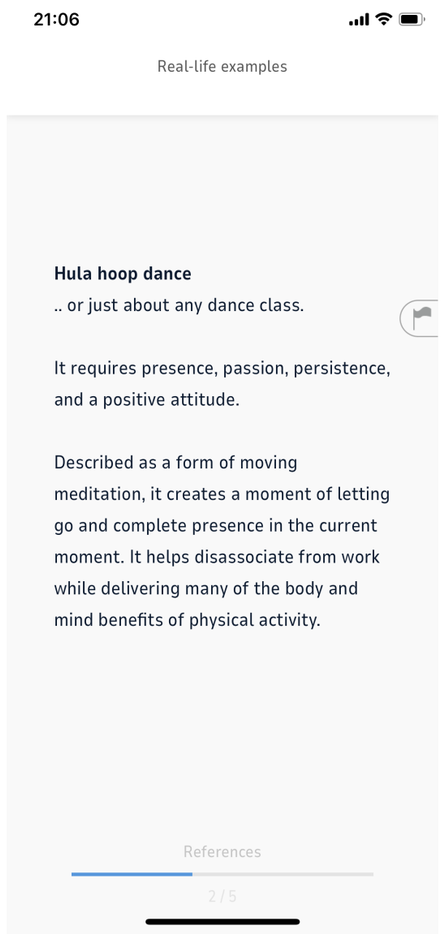


Figure 2 One page of the "Body" course

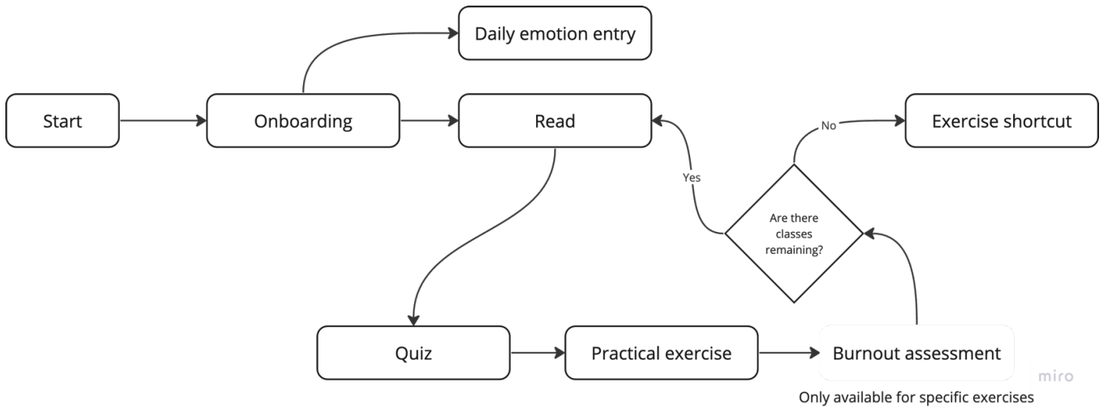
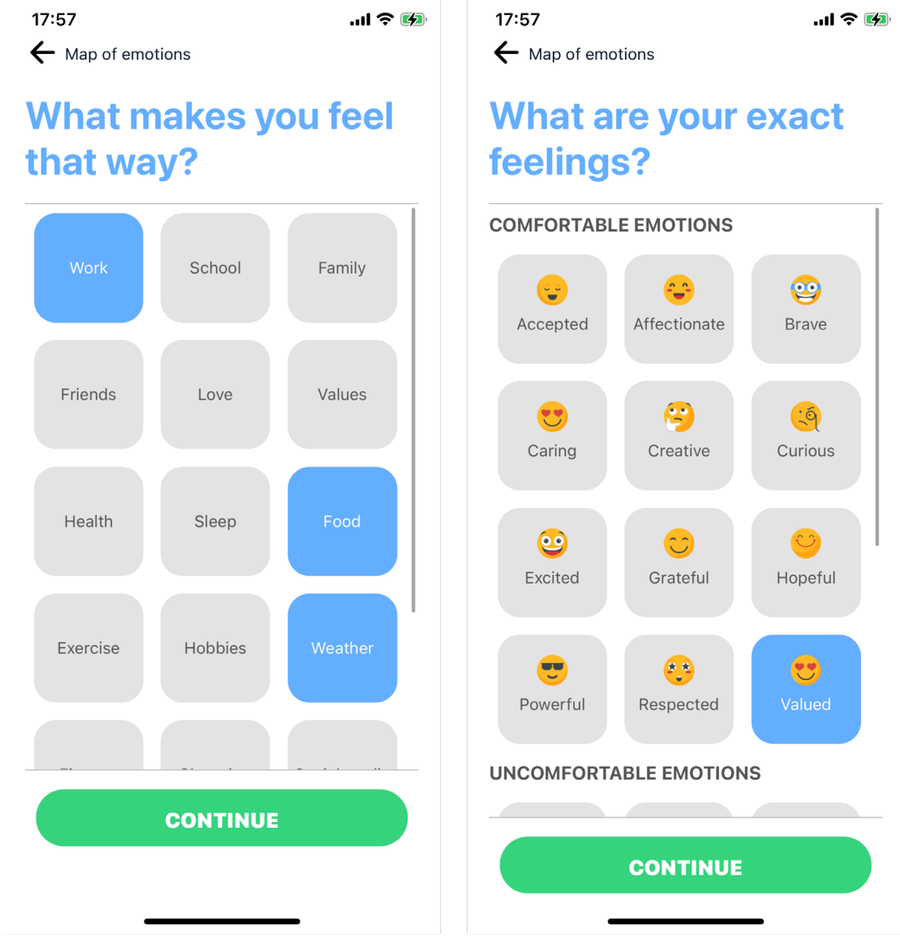


Figure 3 Digiburn use flow



Pre-packed causes

Pre-packed moods

Figure 4 Daily emotion entry

Chapter 3
METHODOLOGY

This chapter focuses on explaining the structure of the project and corresponding methodology to execute. The design methodology is derived from the double diamond model.

This project follows the rules of the Double Diamond model from a participatory design approach (The Double Diamond - Design Council, n.d.). The original Double Diamond model divided design process into problem diamond and solution diamond. The problem diamond helps people to understand the issue to be solved by design and further define the exact design challenges. The solution diamond enables multiple ideas to be discussed and selected to develop and evaluate a final design outcome.

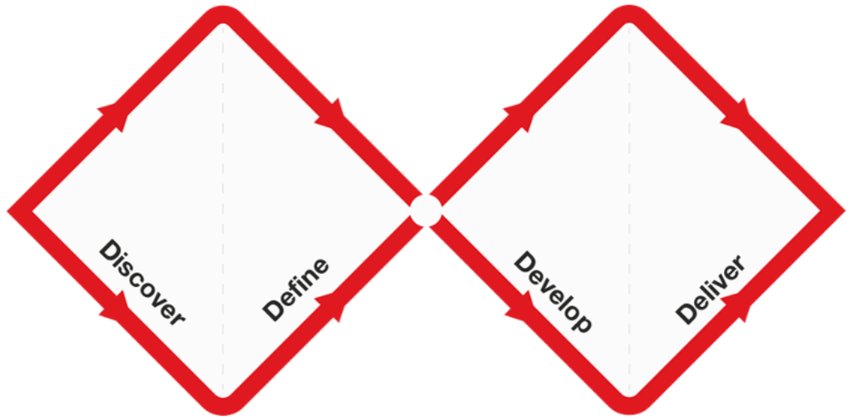


Figure 5 Standard double diamond (The Double Diamond - Design Council, n.d.)

A tailored Double Diamond model is developed for this project based on the original version (Figure 6). With the research gap between burnout intervention and cognitive data specified, the research diamond consist of 3 research approaches. Relevant theoretical facts of burnout and cognitive science are investigated through literature research. Expert insights of burnout are gathered through user research. Usability and user experience of existing CPI products is evaluated by exploring the technology. The first half of the design diamond is diverging design possibilities by conducting a creative session with experts. With the insights, the second half of the diamond is refining the creative session outcome into a final design as well as the following evaluation of it.

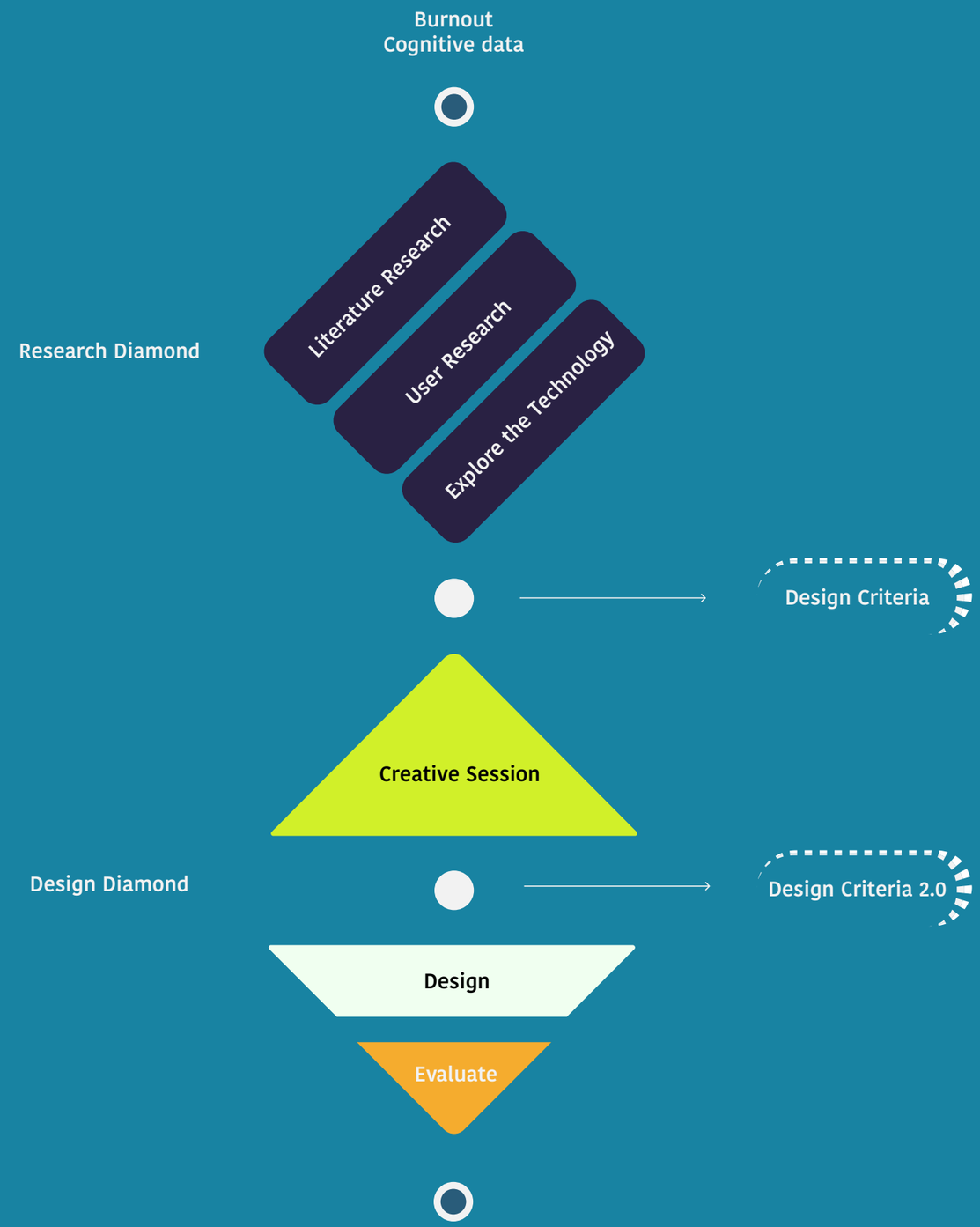


Figure 6 Design methodology

Chapter 4
EXPLORATION

This chapter focuses on exploring the truth stories of people who dealt with burnout before. The first exploration activity is in the form of semi-structured interviews with recruited participants. Insights provided from the interviews consist of the participants' lived experience, coping mechanisms and self-reflection of burnout. The results provided basis for subsequent participatory design activities.

RQ 2.1 is answered in section 4.1. Section 4.2 provides part of the answers to RQ 2.2.

4.1 Lived experience of burnout

4.1.1 Participants

Demographics

Six participants were recruited through social media. All recruited participants are in their 20s and highly educated (Table 6). The experienced symptoms are in line with the human cognition correlates identified in literature research, in which “Feeling unmotivated”, “Fatigue”, “Sleeping problem”, “Helplessness”, “Compromised work performance” are the most identified symptoms (Figure 7). The symptoms are often experienced simultaneously according to the questionnaire. Participants experienced four symptoms in the lowest number of cases and nine in the highest. See Appendix B for the questionnaire result.

Table 6 Semi-structured interview participant profile

	AGE	CURRENT OCCUPATION	HIGHEST EDUCATION	Gender
P01	24	Unemployed	Master	Female
P02	24	Student	Bachelor	Male
P03	28	Student	Master	Female
P04	25	PhD researcher	Master	Female
P05	26	Working	Master	Female
P06	23	Student	Bachelor	Male

4.1.2 Procedure

To put literature research result into practical perspective, a link between it to people’s true stories of burnout needs to be established. A study conducted qualitative interviews in a spontaneous manner with people who received clinical care for burnout to gain philosophical understanding of it (Arman et al., 2011). The interview topics they covered are for example, life events as narratives to back up the articulation of burnout causes, the actual feeling of burnout and self-reflection on burnout recovery experience.

The mentioned topics are relevant to this project too for it reveals aspects to focus on in design research activities in later stages. Therefore, by conducting interviews with people who experienced burnout before, I wish to understand their lived experience and coping mechanisms, as well as the reflection on the whole experience. The interviews are prepared in semi-structured way for it gives both the interviewees and me structure and space to diverge the conversation.

Before starting the interview, the purpose of this research project was presented before reviewing the informed consent forms. The interviewees were informed that their personal information will not be included, and they were free to terminate the interview any time they would like. The interviewees were asked to specify if they gave permission or not to audio record the interview. See Appendix A for the informed consent form and interview outline.

At the very beginning of the interview sessions, they will be asked to fill in a questionnaire for basic demographic information and experienced burnout symptoms. The multichoice options of burnout symptoms in the questionnaire referred to Chapter 2’s result and a couple of governmental mental health webpage for burnout early self-check (12) (13) (14). The purpose of this questionnaire is to have deeper conversations according to the participant’s situation. The interviews were recorded and transcribed for analysis purpose.

4.1.3 Result

In general, the duration of the participants’ experienced burnout ranged from a few weeks to more than three months. The main source of stress for the participants is work/study issues. Two among six participants received professional help in identifying and treating burnout, while the rest only relied on themselves. The 2 participants both have been doing psychological therapy for other issues regularly at the time they identified burnout. Figure 7 indicates the experienced symptoms from the questionnaire.

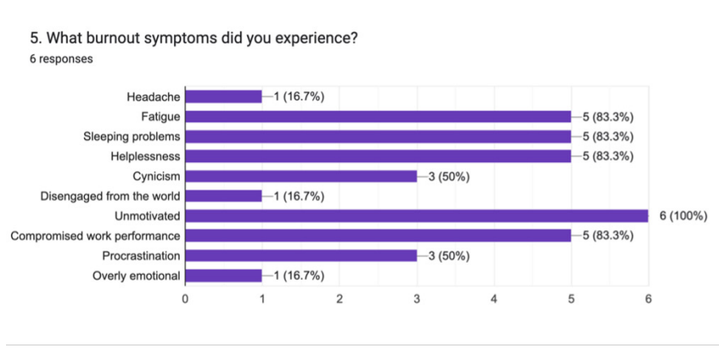


Figure 7 Experienced symptoms from questionnaire

The interview transcripts were processed by simplified thematic analysis. Normally, standard thematic analysis should involve iterative process of evolving the codes as the research team understands the qualitative data better (Cooper et al., 2022). For this study, the codes originated from the three main investigation themes (lived experience, coping mechanisms, and the reflection on the whole experience) of the interview script. All information related to the themes are noted down. Meanwhile, other pieces

(12) https://www.darlingdowns.health.qld.gov.au/about-us/our-stories/feature-articles/signs-you-might-be-experiencing-a-burnout-and-how-to-regain-balance-in-your-life
(13) https://mentalhealth-uk.org/burnout/
(14) https://burnout-test.nl/klachten-symptomen-bij-stress/vragen/?msclkid=6329476cd9351085c11022a6f396b1df&utm_source=bing&utm_medium=cpc&utm_campaign=EM%20Burnout-test%20(Burn%20out)&utm_term=symptomen%20burn%20out&utm_content=Burnout%20-%20Symptomen

of information discovered that did not belong to the themes are gathered and later clustered into new themes. From the clusters, five take-aways were summarized:

Take-away #1: Early signaling of burnout is not easy for most interviewees, even if they claim to be sensitive to change of their mental state.

In the interviews, all participants faced the question "Do you consider yourself sensitive to any change of your mental state?". 5 of them replied yes to it (P01, P02, P04, P05, P06), while only two of them (P03, P06) realized they were going into burnout state very quickly. The participants pointed out several reasons why they failed to identify early burnout signals.

1. Lack of basic understanding of burnout.

   "I wasn't aware of it, didn't recognize the symptoms ... It wasn't that serious." (P02)

   "Actually, I didn't specifically set out to confirm that I was burnt out ... And I did look up some symptoms of burnout online, and it seemed to match." (P04)

   "I didn't realize it was an incorrect environment because I hadn't had much work experience or practical experience, so I thought it was normal, but it's not ... At that time, I wasn't aware that I was in a state of burnout. It wasn't until I saw your message looking for participants." (P05)

2. Too overwhelmed to self-evaluate.

   "I might just think I'm tired, or just in a bad state for a while, but perhaps, I lost sense of my own body ... I don't know what state I'm really in, I can't judge anymore, and this leads to an intense level where I suddenly realize what's going on." (P01)

The participants who succussed in early signaling burnout symptoms pointed out it was because they experienced burnout multiple times. They already understood their body and mind well enough to identify unique early signs. When burnout strikes again, they can take action quickly.

Take-away #2: The nature of the source of stress highly influences the interviewees' coping mechanism.

When deep diving into the coping mechanisms taken by the participants, they all referred back to the event that caused their burnout situation. For example, P02 mentioned that the best strategy for him is to make plans for the large amount of work that led him to burnout. But P05 mentioned that she couldn't do anything but to run away from the workplace because she had no power to change the situation.

"It can only help me plan what to do, but not complete them." (P02)
"I just left. As soon as I walked away from the company, it was fine." (P05)

For the participants who experienced multiple burnout episodes, their coping mechanisms evolved. For example, when P04 experienced burnout for the first time, she didn't know what to do but powering it through until she couldn't keep going anymore. But the second time she was on the verge of burnout, she chose to reach out for help at once.

"(The first time) I felt like I was carrying it all by myself without telling anyone ... (the second time) my first reaction was to discuss it with my supervisor during our meeting." (P04)

In general, the coping mechanisms taken by the participants can be placed into three categories:

1. Fight. Participants proactively take actions to fight against burnout.

   "'Traffic Light'. It's about categorizing your personal state into red, yellow, and green lights. What is your state in green? What can you do in green? What about when in yellow, experiencing mild stress? How do you identify you're in yellow, and what should you do then? Maybe take a break, go for a 5-minute walk during lunch. It's about classifying your stress levels and being constantly aware of which level you're at. There are corresponding strategies for each level, so when I want to freeze or run, I can directly refer to this chart and act without overthinking." (P01)

   "Get a notebook." "It helps me know what I still have to do since it's basically just a planner. It can only help me plan what to do, but not complete them." (P02)

   "... like dividing a week very clearly, for example, dedicating one day entirely to meetings, then two days for reading, and the last day focused entirely on writing, making clear what to do each day." (P04)

2. Run. Participants escape from the situation that caused burnout.

   "I didn't tell anyone about the burnout or my feelings, which made the recovery process very long" (P04)

   "I just left." (P05)

3. Endure. Participants tolerate the burnout situation to their limit or until the situation is over.

Coping mechanisms also depend on people's personality and value. For example, P01 described herself as very strict towards her own shortcomings. She did not feel comfortable seeking help regarding burnout from people in professional settings. Most of the time work related problems are the main stressors to worsen her burnout. But people from work have the best chance in providing practical support. Other participants for example P03 and P04 were more open to adapting workload according to their own status. The process of struggling to endure burnout's impact was relatively shorter. P02 and P05 relied on their social circle differently from the other participants in terms that they did not seek constructive support from others, but rather distraction to pull them out of the stressful swirl of over-thinking. More fundamentally speaking, how people react to challenges highly influence what type of stressors influence them the most, thus influence their coping mechanisms further.

Take-away #3: Burnout is not always a problem with a solution. It's more like a situation that can be better or worse.

It is worth noting according to the participants that burnout is not something that can be "solved". It is more like a negative side of life that can be better or worse on different days. There is no magic cure for burnout in a blink of an eye. The closest response to a magic cure is getting rid of the source of stress, yet it's not always possible. Burnout's impact has an "inertia" on the mind according to P01. The longer she tolerates her burnout symptoms without taking any actions, the longer it takes for her to recover even if the stress is removed.

"But you can hope that once you finish your thesis, things will get better, I didn't get better when my thesis was done ... and I fell into post-depression after graduation." (P01)

Only two out of the six participants completely got rid of burnout since they escaped from the stressful situation. With the efforts to recover from burnout, the rest of the participants still face burnout's impact on their daily life. The mentioned coping strategies and their results is listed in Table 7.

Table 7 Coping strategies and results.

	COPING STRATEGIES	PARTICIPANT NUMBER	RESULT
Fight	Traffic light checklist	P01	It helped
	Planning/break down the task	P02; P04	It helped
	Seek help from others	P03; P04; P06	It helped
	Lower the standard	P02	It helped
	Meditation/mindfulness	P02; P03; P04	No difference
Endure	Power it through	P01	Backfired
	Force oneself to work	P02; P03	Backfired
Flee	Self-isolate	P03	It solved everything
	Quit job	P04; P05	It solved everything

Take-away #4: Individual difference of burnout first signs is large. There is no universal set of indicators for burnout early signaling.

Participants were asked to recall on the first signs they experience in the early stage of burnout. Both physical and cognitive signs varied very much according to the nature of the source of stress.

P01 experienced insomnia, headaches and nausea in early stages of burnout. She considered her first signs partly as consequences of her anxiety disorder. And the symptoms were not clear to her from the very beginning. They manifested suddenly when they crossed the threshold.

"It reaches a point where I can't ignore it anymore, like when I start having headaches and nightmares every night for a month, or when my sleep is so disturbed that I wake up every night. That's when I realize it might be burnout or anxiety." (P01)

P02 experienced fatigue, procrastination, unmotivated in the early stage of burnout. He couldn't focus on the work at hand.

"I feel like I just don't have the motivation. And when I actually start doing something, sometimes I don't even know what to do, like I can't concentrate, for example, writing a paper requires a mind flow, but I just don't feel it." (P02)

P03 often gets overly emotional and feels tension in her muscles. She stated that some of the earliest symptoms of the recent burnout episode were the same as the last one.

“I also had like the very overemotional, stressing about like very tiny things and getting too hyped up and tension in my shoulders and … I think a bit of the same symptoms, but I noticed it earlier because I experienced it already, so I could signal it a little bit earlier.” (P03)

P04’s first signs were feeling agitated and emotion roller coaster. She couldn’t keep her work performance up to her usual level.

“I felt completely restless, I couldn’t focus on anything, it was very painful. Sitting in front of the computer, looking at literature, I felt very troubled and annoyed, and I didn’t want to look at it at all … I’ve been crying at home every day … There’s a kind of inexplicable anger, wondering why I suddenly burnt out.” (P04)

P05 stated the first symptom she noticed from a retrospective point of view was she couldn’t stop thinking about work even outside office hour. Other signs like headaches and feeling helpless were also mentioned.

“I often had severe headaches at work … I felt my work state was very poor. Design work usually relies on passion and enthusiasm, but when you try to execute someone else’s ideas, it can be very demotivating.” (P05)

P06 first realized abnormality of his mental state when doing sports. He also experienced a clear drop of work performance in the early stage.

“My first reaction is to go swimming because it usually can regulate my mood. So I went the other night but that was the first time I felt swimming didn’t help at all to make me feel better.” (P06)

Take-away #5: Engaging with external environment is important for people to deal with burnout.

When asked for a single advice for other people to prevent burnout from happening, the participants brought up a common advice to actively engage with the external environment. There are three merits of reaching out to others according to the participants:

1. Coping methodology

   P01 now is able to keep good track of her mental state with the help she received from her therapist. Her therapist not only taught her the methods to monitor and reflect on her mental health, but also provided her a different angle to view burnout as a phenomenon instead of a problem.

   “I was given some guidelines to take action. I just need to exercise, to give myself space and time to practice and grow.” (P01)

   P05 and P06 mentioned they received practical advice from fellow students or colleagues that helped them get out of the tunnel vision. Their condition improved when they changed their approach to the problems that caused their burnout.

   “I remember they would give more practical advice on how to communicate better with the leader.” (P05)

   “We would discuss about my project practically.” (P06)

2. Emotional support

   P03, P04 mentioned the emotional support from people around them was greatly beneficial to their recovery. When they faced the impact of burnout alone, they tended to hold negative opinions of themselves.

   “Like normally you have like … a day off or something and they think like ohh I have the day off and I can do all these things and for me at that time it was like ohh I have the day off so I’m useless … So I beat myself up about it and then I became even more stressed because I was like I cannot even do this right.” (P03)

   When the people around them show empathy and tolerance, the participants felt easier to accept their situation and adjust to a more positive attitude.

   “I don’t recall people being like overly supportive, but I also don’t recall people being like weird about it … sometimes it’s nice to hear everything good your friend saying, like, oh, it’s OK.” (P03)

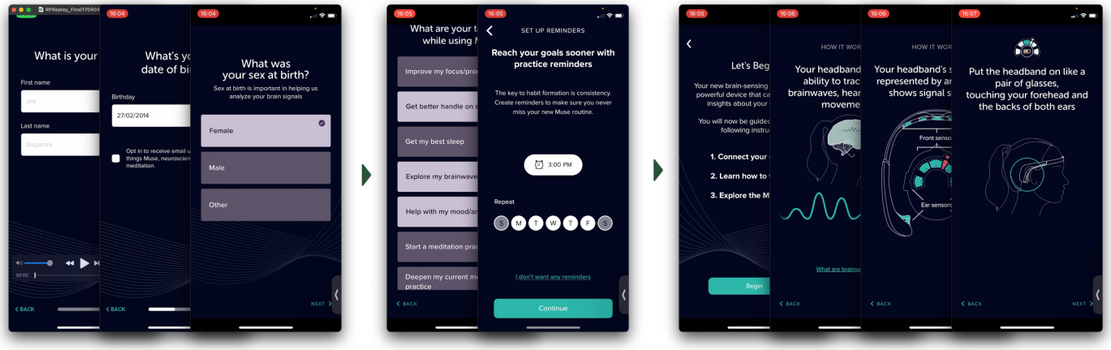
   “And my boyfriend was just beside me … He doesn’t need to do anything; I just needed someone there to listen to me while I was breaking down, that’s okay.” (P04)

3. External monitoring

   P02 mentioned working in group setting benefited his recovery journey because the group members monitored each other’s working state. Once he reached his anticipated work performance, mental symptoms of burnout were alleviated.

   “It feels like someone is always watching me, and I can’t … Like a school teacher always keeping an eye on your progress.” (P02)

Figure 8 During the test



User information (name, birthday, gender...) Personalised usage habits Pairing the headset

Figure 9 MUSE 2 setup use flow

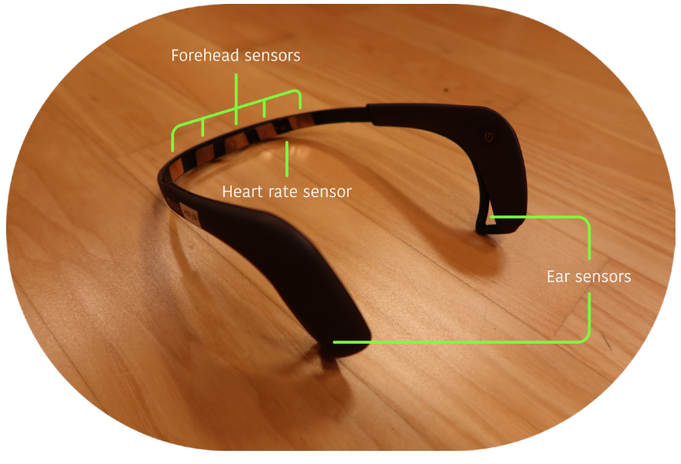


Figure 10 Sensor layout of MUSE 2 headset

4.2 Exploring the technology

There are existing smart CPI products that collects cognitive data and provide the users with interpretations. These products often come together with mobile applications to visualize the information, each with unique use scenarios. As commercial CPI products have not yet been applied in burnout intervention accessible for personal use, evaluating the existing products' approach towards simpler mental exercise and monitoring tasks can setup a set of criteria for design phase later.

In this section, 2 CPI wearables are explored and analyzed for their usability and user experience. The exploration follows the framework of cognitive walkthrough in the following steps (Lewis & Wharton, 1997, p. 30):

Preparation:

1. Specify user group characteristics.
2. Specify target function of the device for testing.

Execution

Analysis:

1. Identify the pain points and sweet points of the whole interaction process.
2. Create positive or negative stories for each point of interaction.
3. Summarize key takeaways to form design criteria.

4.2.1 Devices

In this section, 2 CPI wearables are explored and analyzed for their usability and user experience. The exploration follows the framework of cognitive walkthrough in the following steps (Lewis & Wharton, 1997, p. 30):

MUSE 2

MUSE 2 is a headset that consists of 1 heart rate senser and 7 EEG sensors on the forehead and behind the ears (Figure 10). Users can follow meditation exercises embedded in the mobile application. Although MUSE 2 does not make raw EEG data available to its users, user's cognitive activity state is shared in real-time through the smart phone's audio feedback. Additional features in the mobile application allow users to log their meditation progress daily and setup personalized meditation training goal. Other MUSE models now are applied as a reliable data collector in brain assessment studies (Abujelala et al., 2016) (Krigolson et al., 2021).

4.2.2 Result

Testing was done in library to mimic typical use scenario where people take longer breaks during working hour to practice meditation. Library is an ideal place to eliminate interruption and noise from people to reach the optimal performance of the devices (Figure 8).

User group

MUSE 2 headset's target user group can be described as people who are starting a meditation habit or wishing to boost their meditation progress. The user's motivation to start involving cognitive assessment technology can be: 1) they feel the need to be more aware of their cognitive state in each exercise; 2) they need coaching in improving cognitive performance in longer term; 3) they have faith in the reliability and accuracy of CPI technologies.

Tasks for testing

Task #1: Set up MUSE 2 headset.
Task #2: Follow a 5-minute meditation beginner exercise.
Task #3: Review the performance after completing the exercise.

Analysis

Task #1:
The process to initialize the sensor and its paired mobile application is relatively long (Figure 9). Basic anatomy of the device is introduced to users aside from the regular steps like creating user profile. The step to pair up the device is integrated in the initializing flow. The whole process took round 4 minutes 30 seconds. Only then will it be possible for users to see the main page to choose meditation programs.

The user flow to setup the device is information heavy. To users who just start to CPI technology for the first time, it is hard to understand and remember every bit of information in one go. Luckily all information is accessible in the setting page. The most time-consuming step in the whole flow is confirming all sensors are sending out steady signal where some sensors need multiple attempts to be successfully connected.

Task #2:
MUSE App provides all kinds of exercises for different training purposes, e.g. mind, body, heart. The biofeedback on the headphones reacts to EEG signal from the headset in different sound themes. For example, in a guided meditation program for the mind, the volume of rainfall sound indicates how active the user's brain state is while chirping of bird indicate the user has sustained focus for 5 seconds. The sound feedback points out to the user the exact moment when they need to regain their concentration, unfortunately with a slight delay.

Bodily movements are a great interference to the biofeedback. For example, slightly opening the eyes can cause great rise in detected brain activity. Users have to stay absolutely still to ensure accurate biofeedback.

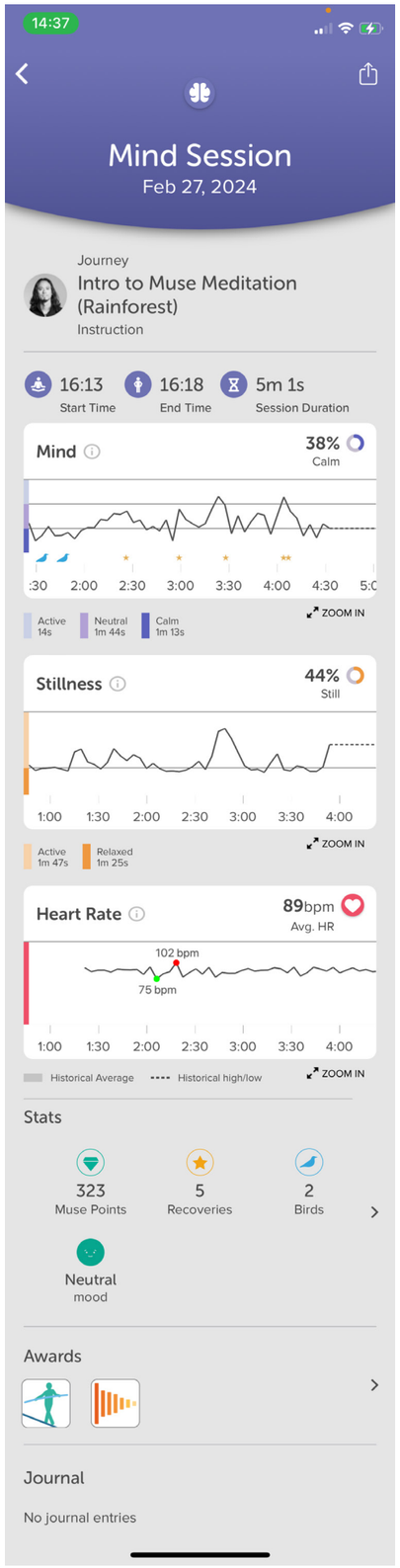


Figure 11 Summary of one meditation exercise

Task #3:
Each practice history is stored in user's personal page (Figure 11). All the data collected during the practice is visualized with concise annotation on the side. Although users can see their progress by comparing the numbers of each practice, the visualized graph does not give too much information about why a sudden change of brain state happened at a specific moment. The reflection of how to improve meditation effectiveness is for the user themselves to figure out.

Summary:

In general, the use scenario of MUSE 2 is simple and specific. Its usability and user experience fits the requirements of users who are very dedicated to meditation in the long run. Its approach to providing audio biofeedback greatly reduces the interference of wearable CPI devices with meditation.

4.3 Design criteria

As all research activities are finished, potential design directions are emerging from the insights. Design criteria is generated to frame the design directions and guide the ideation activity from this point forward. Design criteria address the challenge from the following angles:

1 (The design should) **allow users to early identify the burnout progress.**

From literature research -> Intervention timing is key. (The design should) allow users to early identify the burnout progress.

2 (The design should) **teach users how to figure out a suitable coping mechanism to burnout.**

From literature research & semi-structured interviews take-away #3, #4 -> Role in user's recover journey. Forming mechanism of burnout is complex and highly dependent on individual circumstances and qualities (Iacovides et al., 2003). Therefore, a universal coping strategy for burnout is unlikely to exist.

3 (The design should) **be in an easily accessible form to users to get accustomed to use it on regular basis.**

From semi-structured interviews take-away #3 & technology exploration -> Accessibility on regular basis. Burnout's impact cannot be removed by a one-time intervention. Considering the best timing to intervene burnout development is in the early stage, the development process should be more effectively controlled if it is checked-in regularly.

4 (The design should) **flatten the learning curve for first-time users who have no experience in CPI products.**

From technology exploration -> Learning curve of novel technology.

5 (The design should) **contain community features that facilitate collective insights, awareness, and support.**

From the semi-structured interviews take-away #5 -> Social qualities in use scenarios.

The work in Chapter 2 suggests that although there has not been a clear set of indicators that explicitly correspond to comprehensive burnout diagnosis, cognitive data is useful in providing a new perspective to assist burnout self-evaluation. The design challenge to guide the following participatory design activity is:

"How to make use of CPI systems to support people in signaling burnout early symptoms on regular basis?".

4.4 Target user group

From the literature research and exploration with people who experienced burnout, the target user group is set as people who are under high level of stress. **A persona is created to demonstrate the key characteristics of the target group.**

The persona was generated based on the common characteristic of the interview participants. All participants are young students or employees who hold high expectation of their hard work. Two of the six of them experience non-work-related stressors in life. The “financial pressure” was chosen to represent this type of stressors in the persona. As take-away #2 and #3 suggest, the participants all struggled in finding out the right way to deal with stressful events in life in long term. The “challenges” section reflects this insight.

Persona

- **Name:** Alex
- **Age:** 24
- **Occupation:** Student/Part-time programmer
- **Background:**

  Alex is a computer science student in the Netherlands who is about to start his graduation project. He is very determined to kick off his career as a software developer. So he started working as a part-time programmer at a tech start-up a few months ago.

  With the increasing stress from his study and job, maintaining a good work-life balance is becoming more and more challenging. Alex is starting to experience some change when he tries to work. Such as fatigue, difficulty in concentrating, feeling inadequate.

- **Personality traits:**

  Hardworking
  Ambitious
  Perfectionist
  Independent

- **Stressors:**

  Workload
  Performance pressure
  Financial pressure

- **Challenge:**

  Alex is facing a great deal of challenge in multiple dimensions.
  1. Learning to set realistic work and learning goal and expectation to sustain work performance.
  2. Figuring out effective techniques to self-care
  3. Establishing a robust support system to reinforce stress resilience.

Chapter 5

PARTICIPATRORY DESIGN

Chapter 5 explains the process and results of the design diamond. The chapter first starts with ideating design directions by facilitating a creative group session. The results then determine the final design criteria. Design directions converge according to all previous design research activities. The final design concludes the chapter.

Section 5.1 provides the remaining answer to RQ 2.1. Answers to RQ3 ends up being the final design.

5.1 Creative Session

To make the best of the research and exploration outcomes, the first step to kick off the participatory design phase is involving the actual users in the ideation process.

Design facilitation gives opportunities for novel ideas to merge by dialogues and visualizing in the context of participatory design process. By involving stakeholders or people who are interested in the topic together in a creative session, different perspectives collide and create something novel (Mosely et al., 2021).

Therefore, a creative group session with the target users was facilitated. The session was set up according to principles and techniques of integrated creative problem solving. The principle of a comprehensive creative session contains 3 stages: Problem finding, Idea finding and solution finding (Heijne & van der Meer, 2019). Each stage consists of the process of diverging, reverging and converging. Due to the nature of this project topic, the problem finding stage was replaced by the research outcome so far. Only the idea finding stage was done (Figure 12).

Before starting the creative activities, the moderator must brief the participating group of the session goal and relevant information to the topic. In the diverging stage, the group keeps an open mind and try their best to produce as many ideas as possible without overly thinking about practicality. In other words, participants should not exclude 'stupid' ideas in this stage. In the reverging stage, all ideas generated in the diverging stage are sorted and reviewed. When an idea is considered to be controversial or unclear in the group, it is given a second chance to be reconsidered in the reverging stage. Finally in the converging stage, the group choose the most suitable ideas from the pile and further work them into a more elaborated concept, which is the end output of the session.

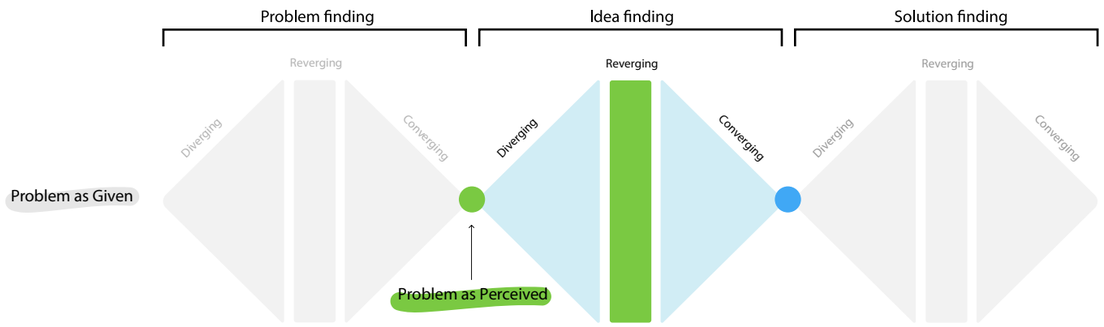


Figure 12 Framework of creative facilitation

5.1.1 Session goal

The main goal of the creative session is: **"How to make use of CPI systems to support people in signaling burnout early symptoms on regular basis?"**.

The session goal sets the boundary of creative exploration within the scope of CPI and burnout to make sure the exploration outcomes can be used as beginning points for subsequent design conceptualization stages. It is not specified in the session goal that the participants should explore in the early stage of burnout. Participants are thus not too fixated on a narrow field to utilize their creativity.

5.1.2 Procedure

Step 1: Recruiting

Four to five people is the most suitable number for a creative session to ensure balance between the participants in the group. Each participant will have enough time to produce enough insights within roughly 1 hour. To make sure the group has enough knowledge to fully enquire into the topic, the following groups of participants are targeted:

People who are currently facing challenging work or life situation.
This group represents the target users of this design project.

People who experienced burnout before.
This group can provide burnout related insights that should be taken into account.

People who have basic knowledge or experience of using CPIs.
This group can provide insights from their working experience CPIs to produce practical ideas technology wise.

The all 3 groups of target participants may not be reachable. The final group members should at least cover two of the three target groups for diversity. Demographic information of the participants is gathered by a questionnaire.

Step 2: Sensitizing

Sensitizing tasks are useful especially when involving users in design process for complex and abstract design topics. By sensitizing, designers can gently educate the users with necessary knowledge and lead them to a creative mindset for the subsequent participatory design activities (Alvarado et al., 2020). These exercises should take place a few days prior the official participatory design activities to prepare the participants.

Sensitizing tasks will be sent to the participants via text messages once a day for 2 days (See Appendix C).

Sensitizing day 1: Burnout
The basic information of burnout and its impact on life is one necessary field to understand prior the creative session. The participants will receive a link to a quiz of burnout basics. The right answers will be shared with them later.

Sensitizing day 2: CPIs
Participants need to understand what CPIs can do for people's daily life before envisioning its possibility in burnout solutions. The participants will receive a link to a video reviewing existing wearable CPIs on the market.

Figure 13 Session setting

Step 3: Executing the session

The creative session is divided into 4 parts: briefing, diverging, reverging, and converging.

- Briefing and ice breaking (10 minutes)

Before starting to generate ideas, the participants need to get to know with each other as well as the session topic. The moderator will first give a short presentation on the project. The participants will play a ice-breaking game to introduce themselves.

- Diverging (20 minutes)

Diverging stage is standing two steps. The first step is called purging which the purpose is to quickly clear the most obvious ideas out of the participant's mind to make room for more novel ideas in later stages (Heijne & van der Meer, 2019). The technique used for this stage is called "Flower association" In which participants write associating keywords next to the existing keywords without thinking too much.

The technique called "Creative Excursion" is used to generate novel ideas for the problem statement beyond the obvious by making mental or physical excursions (Heijne & van der Meer, 2019). The method used for carrying out the excursion is called "Criminal Rounds", where participants were asked to first think of illegal ideas and later translating them into appropriate ideas.

- Reverging (15 minutes)

The technique used for reversing is called spontaneous clustering in which participants put all the generated ideas into different clusters without discussing the clusters beforehand (Heijne & van der Meer, 2019). This technique is suitable for ideas more than 50. It can bring order to the mixed ideas so the group can have a clearer overview and decide which cluster to go forward with. Based on the result of the reverting stage of the group can decide if the converging outcome is sufficient to continue.

- Converging (20 minutes)

The technique used for a converging is called UALo (Unique, Advantages, Limitation and overcoming limitations) (Heijne & van der Meer, 2019). By discussing the topics that are already included in the name of the technique, the pros and cons of the selected ideas are clarified from an objective perspective. The affirmative judgement and remaining questions brought up by the participants well provide insights for determining design criteria and evaluation criteria in the subsequent stages. The UALo analysis template is included in Appendix D.

5.1.3 Result

Participants

The participants were recruited through my personal student network in TU Delft (Figure 13 & 14). Four participants joined the creative session on campus (Table 8). The group consists of people who are experiencing a lot of stress and people who dealt with burnout before, therefore two of the three categories of target participants. All participants are young adults in their 20s who have design education background.

Table 8 Creative session participant profile

	AGE	CURRENT OCCUPATION	HIGHEST EDUCATION	PARTICIPANT CATEGORY
C01	24	Food delivery	Bachelor	No experience
C02	26	Student	Bachelor	My work is getting overwhelming lately; I experienced burnout before
C03	24	Design student	Master	No experience
C04	23	Student	Bachelor	I experienced burnout before

Key design directions from Diverging phase

Diverging activities revealed many potential directions to answer to the problem statement. Participants discussed the underlying reasonings for the “criminal” ideas they generated before doing the forced fitting step. Potential directions emerged in this process:

#1 “Find ways to be heard.”
Participants believe one big reason why people are experiencing burnout in workplace is because of stigmatization and lack of channels to seek recognition or sympathy. It is necessary to eliminate obstacles for people to take action.

#2 “Get rid of the inner/outer stressors.”
Getting rid of stressors was interpreted in 2 directions. The first direction proposed by participants is actively remove oneself from the stressors. The second direction is to take action to improve the stressful aspect of the workplace.

#3 “Tune mental state.”
Tuning mental state also split into 2 directions. One direction is to energize one’s spirit to make up for the lacking work capacity to deliver sufficient work quality. Another direction is opposite to the first one. It is to calm one’s spirit to reach an inner peace, so the sense of stress is lowered.

#4 “Get community support.”
The essence of getting community support is to create a collectively recognized value that help people find meaning in their work again. Or it can also be creating strong bonds within a small community to provide company and mutual recognition.

#5 “Break old rules. Establish new rules.”
Direction #5 can be seen as a proactive variation of direction #2. Instead of running away from the source of work-related discomfort. Another approach to take is breaking the existing value judgement system in organizational level and individual level.

#6 “Distribute the workload.”
Since excessive workload is one of the main reasons that cause burnout, the participants proposed having a non-human helper to take some workload off the shoulder off the person who is burnout out.

#7 “Rely on collective intelligence.”
Participants mentioned aspects like learning from each other on tricks to maintain a good mindset, or better coping strategies. They also mentioned creating room for people to feed their cognitive data to AI that helps people in getting accurate assessment of their minds.

Figure 14 During the session

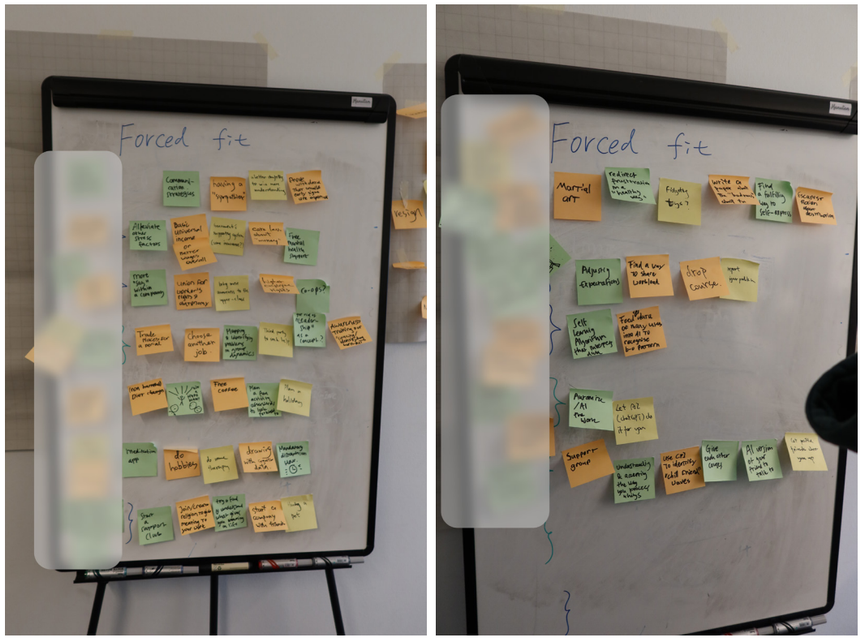


Figure 15 Diverging outcome

A search for your purpose

Do hobbies

Care less about "money"

Choose another job

Plan a holiday

Find a fulfilling way to self-express

Have a pet

Try find and understand what give you meaning in lfie

Plan a fun activity afterwards to look forward to

Join/create religion to give meaning to your wrok

A bandaid sulution

(Short-term fix that doesn't solve the underlying problem)

Adjust expectations

Free coffee

Mandatory distraction hour

(non harmful) diet change

Imagine a better world

(taking control)

Let AZ (chatgpt) do it for you

Find a way to share workload

Start a company with friends

On better wages overall

more "say" within the company

Automize/AI the work

Getting negative energy out

Fidget toys

Write a paper about the badness about tu

escapist fiction about destruction

drawing with cognitive data

martial art

redirect frustration in a healthy way

The world is messed up

(changing the system)

Basic universal income

Government's supporting system (same insurance)

Get rid of "leadership" as a concept

Co-ops?

Higher employee right

Alleviate other stress

Union for worker's right and autonomy

Quantified interpretations

Use CPI to identify "chill friend" waves

prove with data that small & early signs are improtant

self learning algorithm that interprets data

mapping & identifying problems in group dynamics

feed CPI data of many users into AI to recognise b-o pattern

No boundaries human (-ish) support

Meditation App

Report your problem

Third party to seek help

do some therapy

communication strategies

give each other courses

having a "sympathier"

Free mental health support

Support group

Other

Trade place for a denial

Drop course

awareness training for causing/identifying burnout

bring more awareness to the upper-class

Hire a hype man

let positive friends cheer you up

Start a support club

A better story telling to win more understanding

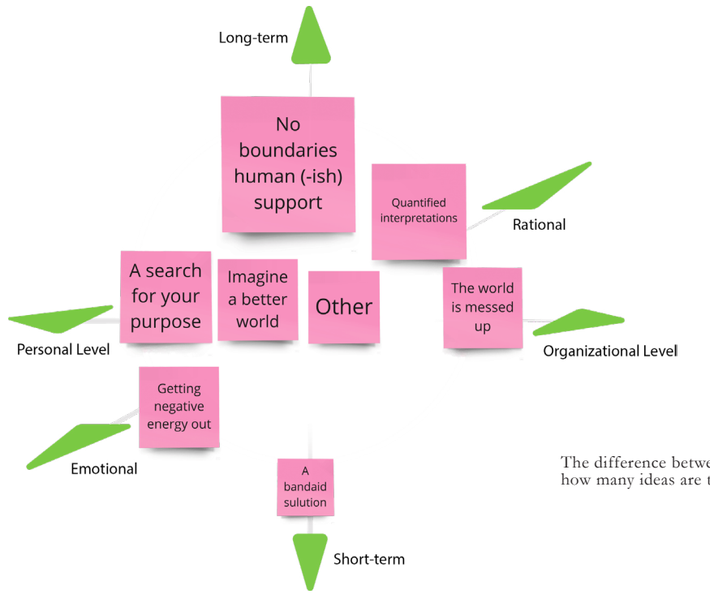
understand and accepting the way you process things

AI version of your friend to talk to

*White circles mark the ideas that were voted by the partcipants.

Idea clusters in reverging

By spontaneously clustering the “legalized” idea, partcipants grouped solutions ideas that can be compared on different dimentions in the reverging step (Figure 16). Each cluster was presented by a representative of the group to clarify the meaning of each cluster to everyone present.



The difference between post-it sizes suggests how many ideas are there in 1 cluster.

Figure 16 Visualization of idea clusters

No boundaries human-ish support

This category collects the ideas that go beyond the limit of human helpers when supporting employee’s stress management but keep the humane characteristics.

Imagine a better world

This category focuses on changing the stressful situation from gaining more personal control.

A search for your purpose

This category collects ideas that allow an individual to figure out ways to maintain a sustainable balance between stress level and mental resource.

A bandaid solution

This category is similar to the “getting the negative energy out” group, the ideas don’t solve the essential problems. But they provide a temporary solution to prompt burnout symptoms.

The world is messed up

This category represents ideas that care for employee’s well-being from an organizational point of view. These ideas are normally difficult to implement by an individual.

Getting negative energy out

Ideas in this category don’t necessarily solve the underlying problems that cause burnout. It rather focus on temporarily narrow the peak stress sensation.

Quantified interpretations

Instdead of a set of direct solutions, the ideas belong to this category aim to add a quantifed perspective to burnout self-assessing process. This is also the category where CPI technology is actively taken into account.

Other

The remaining ideas that couldn’t be put into any of the above categories formed this group.

Final outcome group 1

UNIQUENESS:

1. Trained on personal data to emulate your friend. → A specific friend!
2. Uses CPI data to identify specifid mood / need.

AI version of your friend to talk to

ADVANTAGES:

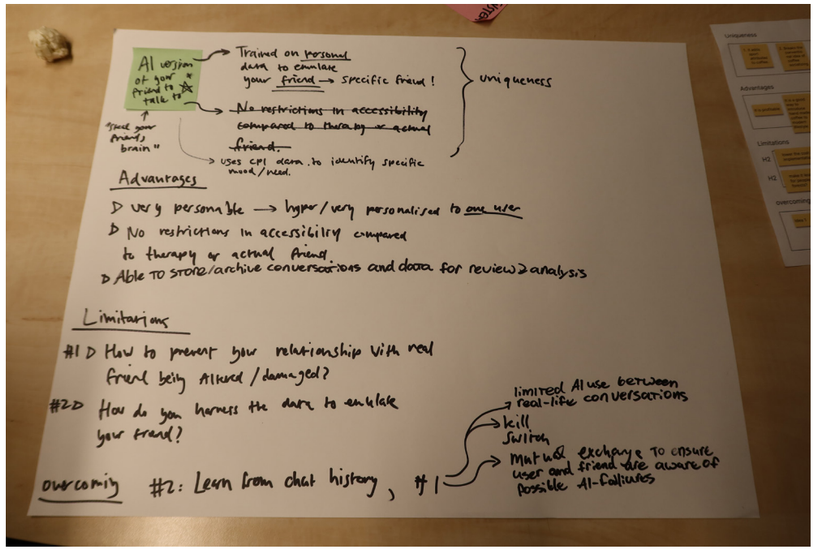
1. Very personable → hyper / very personalized to one user.
2. No restriction in accessibility compared to therapy or actual friend.
3. Able to store / archieve conversations and data for review & analysis.

LIMITATIONS:

#1 How to prevent your relationship with real friend being awkward / damaged?
#2 How to harness the data to emulate your friend?

ovcoming LIMINTATIONS:

#1.1 Limited AI use between real-life conversations
#1.2 Kill switch
#1.3 Mutual exchange to ensure user and friend are aware of possible AI-falirues.
#2.1 Learn from chat history



Final outcome group 2

UNIQUENESS:

1. It has access to personal data
2. It can think in a more rational way than human beings

having a "sympathier"

feed CPI data of many users into AI to recognise b-o pattern

Use CPI to identify "chill friend" waves

ADVANTAGES:

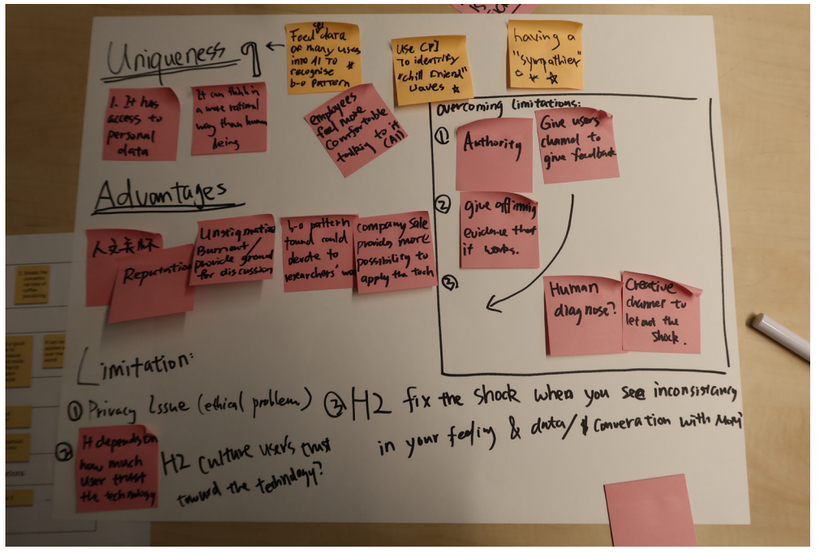
1. Employees feel more comfortable talking to it (AI)
2. It gives humanistic care. Helps to build up company's reputation.
3. Unstigmatize burnout / provide ground for discussion
4. Burnout pattern could devote to research
5. Company scale provides mroe posibility to apply the tech

LIMITATIONS:

#1 How to prevent ethical issue?
#2 How to cultivate user's trust towards the technology?
#3 How to fix the shock when you see inconsistancy in your feelings & data?

ovcoming LIMINTATIONS:

#1.1 Stronger authority
#1.2 Provide channel to give feedback
#2.1 Give affirming evidence that it works
#3.1 Involve human diagnosis?
#3.2 Provide channel to let out the shock



Both groups finalized the selected idea by combining other ideas or completing the underlying rationale. The “AI friend” in the idea chosen by group 1 refers to a virtual character that doesn’t necessarily provide the user with professional burnout-related suggestions. It is more like a friend who understands the user well and is available 24/7:

“He received support from our friends, or we try to learn from our friends that that is the main message.” (C02)

Group 2 integrated 3 ideas together. The participant explained “sympathier” in group 2 as “a company mom” (C01) who can accept all doubts and struggles of an employee like a mother in company setting. The “sympathier” processes professional knowledge and each employee’s cognitive data to provide meaningful suggestions. Unlike the one-on-one relationship between the user and a unique AI friend, the “sympathier” provides both individual and group support.

5.1.4 Conclusion

There are some consensual characteristics discovered from the creative session participants’ takes on the implementing CPI technology in burnout intervention. First, the participants believed the intervention should have humanistic characteristics such as trustworthiness, care, and empathy. They visioned the interaction between people and to be human-like, whether it involves real human or not. Second, the participants agreed that using CPI technology as a tool to directly diagnose burnout is not ideal. They agreed cognitive data should only be used as a reference in the user’s self-assessing process. Third, the favored ideas proposed in the creative session involved learning efforts, whether it is from other people, insights from cognitive data or the user’s self-reflection. Forth, some of the favored ideas had community attributes. The participants preferred approaches that put the users into a group setting where they can improve and recover counting on each other.

5.2 Design criteria refinement

The research activities so far have set up a general course and vision of the final design.

The initial design criteria define an overall frame for the design. The creative session provided more insights from the user's point of view to refine the criteria list. The final outcomes from the UALo analysis raised some concerns of the selected ideas that should be carefully addressed in the final design. These concerns and reflections are translated to new design criteria as supplement to design vision. Participants touched upon practical issues that include the implementation of the technology (demonstrated by no. 6 and 7), importance to build strong trust towards the reliability of the design (demonstrated by no. 11) and unexpected scenarios that needs to be well thought of beforehand. The participsants' vision on the design being adaptive to different user needs inspired some other design criteria (demonstrated by no. 5 and 10).

The refined design criteria are divided into 5 levels: 1) Interaction level; 2) Personal growth level; 3) Technology level; 4) Community level; 5) Service ecosystem level.

The green cards hold the original design criteria generated from literature research and user research. The blue cards hold the additional criteria generated from the creative session.

INTERACTION LEVEL

1 (The design should) allow users to early identify the burnout progress.

2 (The design should) teach users how to figure out a suitable coping mechanism to burnout.

3 (The design should) be in an easily accessible form to users to get accustomed to use it on regular basis.

PERSONAL GROWTH

4 (The design should) flatten the learning curve for first-time users who have no experience in CPI products.

5 (The design should) provide programmes for users to choose for the best fit.

TECHNOLOGY LEVEL

6 (The design should) involve CPI technology as a supportive role.

7 (The design should) make quantified data easy to understand.

COMMUNITY LEVEL

8 (The design should) contain community features that facilitate collective insights, awareness, and support.

9 (The design should) facilitate collective intellegence.

SERVICE ECOSYSTEM

10 (The design should) provide service for users with different experience level of burnout.

11 (The design should) be trustworthy.

12 (The design should) have a human touch.

13 (The design should) allow users to help it be iterated.

5.3 Final design

The final design is developed according to design criteria 2.0. In section 5.3, the final design is explained from holistic picture to details. The strategy to integrate the concept can be split into the following steps:

Setting the interaction vision
Confirming concept framework
Confirming user journey map
Gathering building blocks to fill different sections of the design
Conceptualizing

5.3.1 Interaction vision

final design, from which the interaction vision is inspired by. The purpose of creating an interaction vision in the design phase is to focus on the desired interactions only instead of jumping to the potential functions of the concept. It is also useful in communicating the essence of the concept. An interaction vision is a commonly understandable analogical situation completely different from the design context that represents the same qualities as the design should have (Pasman et al., 2011).

The integration vision for the following design process is **“The interaction should be like going through airport security check.”** (Figure 17)

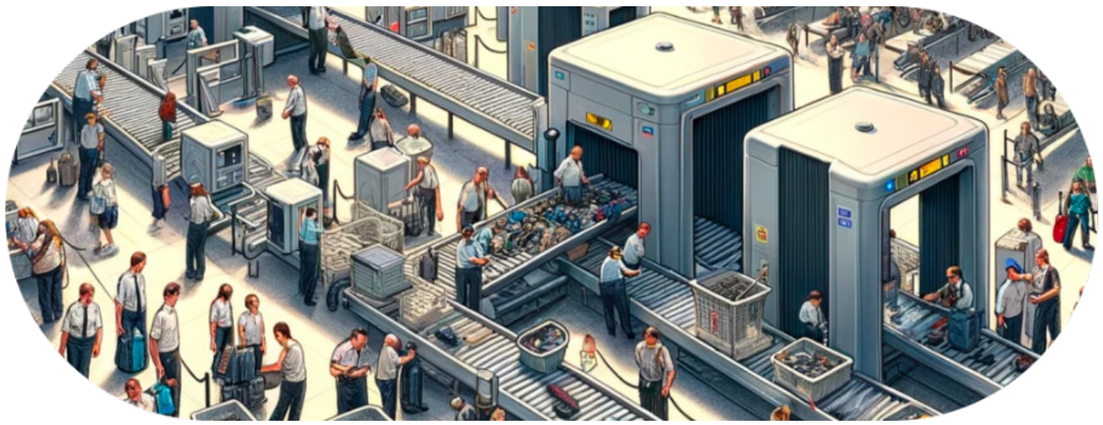


Figure 17 Interaction vision (generated by ChatGPT)

An interaction vision is only complete when the desired qualities of the interaction are specified. The qualities of the interaction vision are:

Reliable.
The standardized procedure and predictability of the scanning machines and protocols.

Anchoring.
Security checks makes travel by air unique from all other transportation methods. Some of the passenger’s memories are anchored to the security checks.

Human touch.
The airport staff is always there when the belt shows error.

Flexible.
When passengers carry liquid or wear boots, the security check procedure adapts to it.

The interaction vision highlights the core qualities as principle to follow in the design process. In the context of technology assisted self-logging tasks, reliability translates into be stable that users can rely on it for all time without doubting its accuracy. "Reliability” is key aspect brought up multiple times during the creative session. Participants actively discussed about necessary components that maintain a reliable usage. “Anchoring” in this context corresponds to design criterion no. 3. More specifically, anchoring translates to having an anchor in the user’s living environment that nudges them to keep monitoring regularly for best performance. “Human touch” is a key feature included by both groups in the creative session final step. It can also be an adaption of “community features”, one of the original design criteria. “Flexible” can be interpreted in 2 dimensions. One dimension is the adaptability to support burnout coping mechanisms based on the specific nature of the underlying problem. The other dimension is the adaptability of the user's personalized usage settings.

5.3.2 User journey mapping

From the research activities, universal challenges in burnout recovery are clarified. The journey map demonstrates a user's desired full process from the emergence of burnout symptoms to being able to figure out an appropriate coping strategy in early stage of burnout with design intervention.

The journey map contains six stages in which users learn and practice self-assessing and reflection on burnout to become an expert for themselves in managing burnout.

The emergence of burnout symptoms marks the first moment where any burnout intervention starts to play a role. In this stage, there is no guarantee that an individual is capable of realizing the first symptoms. According to previous research, many people only realize them after they have progressed.

The degree of burnout current development and the nature of the stressors constitute the situation of burnout's overall influence. The assessment of such situation is based on both physical/cognitive data and self-evaluation on mental health. With the assessment, people understand the severity of current burnout development, acknowledge the core problems that need to be solved.

Forming the coping strategy is the first step to kick off the journey to get rid of burnout's impact. People with different personalities and practical considerations would prefer different coping style. The severity of their current burnout development also highly influences the appropriate coping strategy.

When people are coping the stress and burnout symptoms, it is necessary to keep tracking the progress to adapt the coping strategy. CPI technology provides quantitative insights in this process for people to refer to. According to previous user research, endeavors to cope with burnout work best if they are practiced on regular basis. The regular checking of cognitive performance and mental state helps people to be more aware and therefore benefits the recovery. In this stage, people gradually learn how to make use of cognitive data in adjusting their coping strategy. Stage 3 and 4 could be iterative..

When people consider their current coping strategy to be stable, they only need cognitive data as burnout assessment basis. If any change is identified, people already have the right building blocks to build new coping strategy.

Full recovery often is achieved when the source of stress no longer exists. No matter it is removed or just disappeared. After completing the previous stages, people understand how their body and mind react to stress better. Most importantly, they know better what situation brings higher burnout risk for them. At this point they don't have to keep close look at burnout risks.

5.3.3 Design Scope

The full recovery process is not linear. The user's iterative endeavor to fine tuning burnout coping strategy can also extend beyond stage 3 and 4 to stage 2. In order to ensure insightful burnout recovery journey, the design should provide users structure to manage the reflective progress (Figure 17). Stage 2 is when users complete the actual burnout check-in, while stage 3 and 4 are when users reflect on the check-in results and see if they need to make any adaptions to their current coping strategy. This back and forth among the 3 stages produce scattered insights that possibly get override over time. Hence a fixed reflection interval is necessary to keep track of the recovery progress.

Considering the previous research outcomes, what challenges people the most when dealing with burnout is stage 2 and 3 in the desired user journey. Two out of six participants of the semi-structured interviews were able to identify early burnout symptoms. From their explanations, leaving their burnout

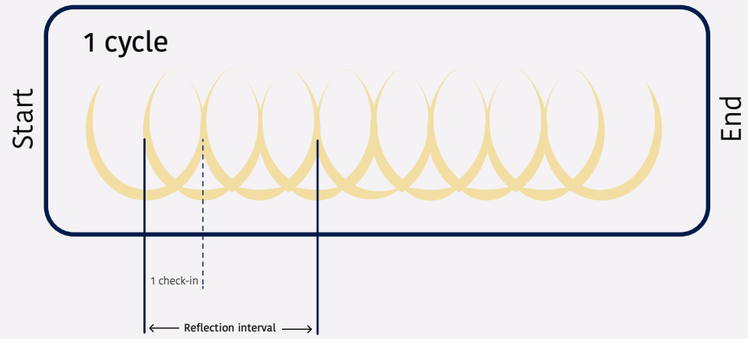


Figure 17 Spiral recovery process visualization

symptoms to develop untreated led to more negative impact on their work performance and mental health. On the bright side, cognitive correlates that have direct or indirect relation to burnout can be picked up in quantitative form by CPI technology. Such data have the potential to provide useful insights for early signaling burnout. Therefore, the design will focus on stage 2 and 3.

To better picture the design form, a zoomed-in user journey map is made for stage 2 and 3 (Figure 18).

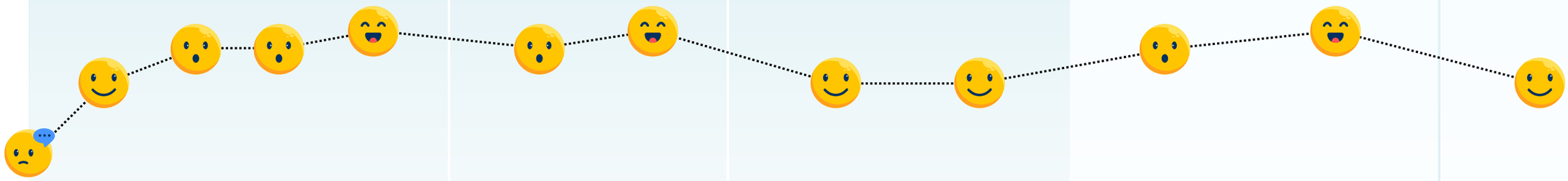
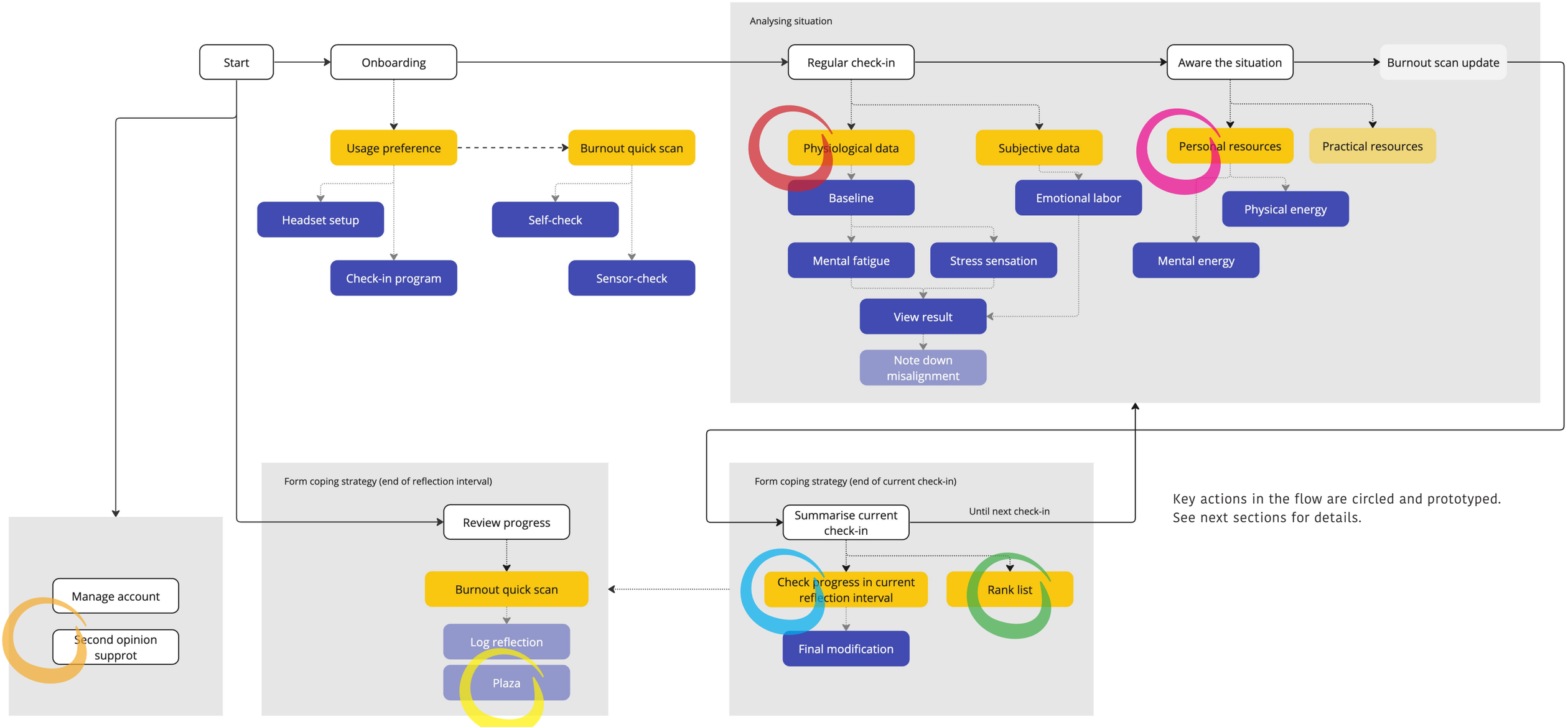
Stages	2 ANALYSE SITUATION						3 FORM COPING STRATEGY			
Actions	Input physiological data				Input subjective data		Aware the situation		What happens now?		Nudge changes
	Prep sensors	Log baselines	Collect data	Visualise data	Self-assessment	Receive result	Clarify the nature of stress	Clarify resources	Comprehensive assessment	Prioritise problems	Notify improvements and drawbacks
Description	Sensors need to be calibrated every time before usage.	Users have to log their baseline data for the cognitive and physiological data to be analysed.	Data types for collection: mental fatigue and stress sensation.	Before moving forward to next stage, the quantitative data is presented to users in visualisation.	Emotion labor and burnout are assessed by subjective scales.	The result is presented to the users in the form of a "diagnosis": it emphasise the aspects that need extra attention.	The nature of stress determines what is appropriate strategy to alleviate it. Common burnout causes can be referred back to.	Practice resources (e.g. organisational help and paid leave) and personal resources (e.g. the level of physical and mental well-being) are crucial to form burnout strategy.	Summarising all the assessment in stage 2, users now have an overview of the aspects that need extra care.	Every time the user log their burnout check-in, the problematic aspects are counted. They can see what is the top-ranking problem they need to work on.	Compare the latest check-in outcome with the last one. Users are reminded to reflect on their current coping strategy.
Desired Emotions											
Remarks	The start of stage 2 marks that the users already aware of the importance of burnout's impact on their work life. They kick off stage 2 feeling slightly nervous about what the check-in outcome might be. Along the process of logging in biometric data, they feel ensured and exciting.				Subjective assessment requires more effort to complete than putting on sensors. But users still keep the motivation to continue.		The start of stage 2 marks that the users already aware of the importance of burnout's impact on their work life. They kick off stage 2 feeling slightly nervous about what the check-in outcome might be. Along the process of logging in biometric data, they should feel ensured and excited.		Users have many insights from the assessment from stage 2. They should feel calm and confident to reflect on the insights.		The nudges for the users to change their coping strategy should be firm but supportive. Users should feel optimistic .

Figure 18 Zoomed in user journey map

5.3.4 Interaction flow chart

The flow chart shows the interaction flow of the application part of the design. The white, yellow, and blue marks first level, second level, and third level activities. Some of the most essential activities are prototyped in wireframes. The green post-it's indicate the location of those wireframe pages in the flow.



Key actions in the flow are circled and prototyped.
See next sections for details.

5.3.5 Input physiological data

Choosing burnout correlates

From section 2.1, research studies found ways to measure all mentioned burnout correlates in one way or another. Although the cognitive and physiological correlates do not have direct indication toward burnout, they can be referred to when a person is actively assessing their burnout situation. The measurement methodologies for the correlates can be put in two categories (Figure 19). The first category consists of methods that can be completed quickly with no experiments needed in laboratory settings. Mental fatigue, monotony, stress sensation, mental workload, emotion labor and foreign language proficiency belong to this category. The second category consists of methods that require (inducive) tests to assess performance. Mental satiation, negative memory bias and visual attention span belong to this category. Mental satiation can be induced by doing repetitive task under two circumstances: either the experimenter gives strict instructions or the participants have complete freedom in arranging the task with no interference (Mojzisch & Schulz-Hardt, 2007). But explicit measuring technique is not clarified in literature. The Self-Referent Encoding task that measures negative memory bias mainly assesses how many words participants can recall after the encoding tasks (Derry & Kuiper, 1981). The “character-recognition” experiment that measures visual attention span requires the participants to report the characters they were flashed before (Yeari et al., 2017).

Category 1 clearly fits the third item in design criteria 2.0, but not all of correlates in this category are eligible to be included in the design. Foreign language proficiency indeed can be predicted by EEG measurement. But the studies did not address the how the combination of the mother tongue and assessed second language is going to influence the prediction result (Ihara et al., 2021) (Reiterer et al., 2009). Besides, the detection target is the overall proficiency instead of a constant monitor of its changes. The Mackworth Clock Test takes 1 hour to complete, and it measures monotony by inducing it. Although it is a reliable method for testing monotony, it is likely to add excessive demand to the users to conduct on a regular basis. Therefore, the burnout correlates that are suitable for a self-reflection system are mental fatigue, stress sensation, mental workload, and emotion labor.

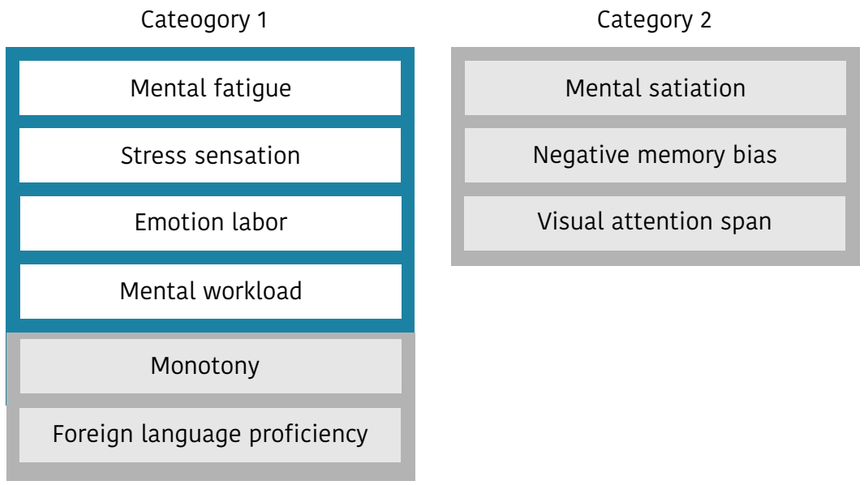


Figure 19 Two categories of burnout

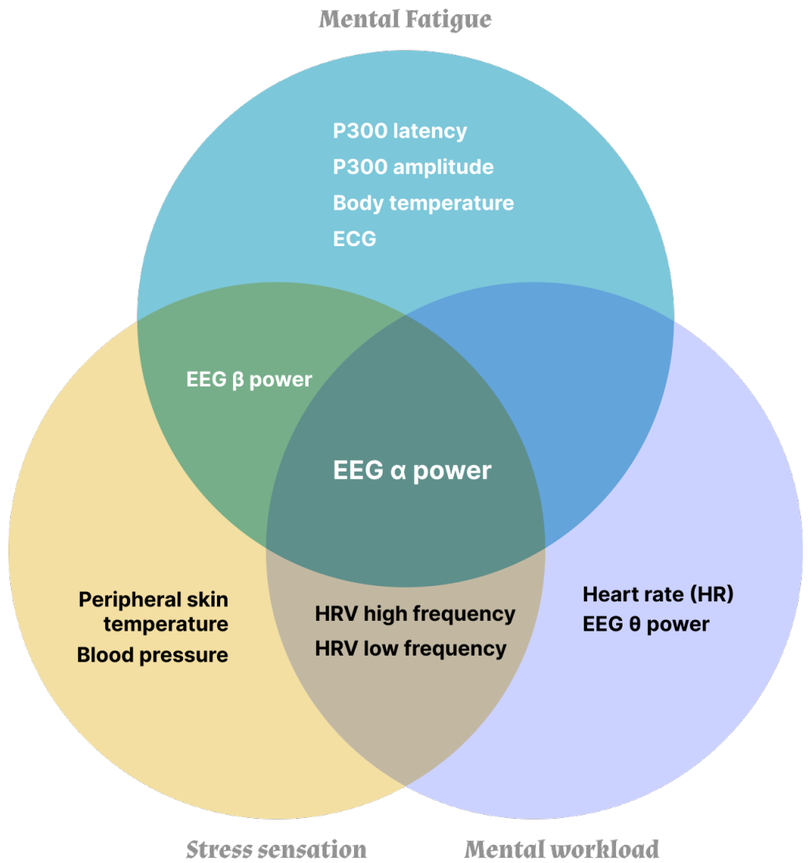


Figure 20 Relevant physiological variables

Data collection scheme

Mental fatigue and stress sensation are the correlates that can be assessed by physiological data (Table 3). EEG Alpha power is the only variable that is relevant to mental workload, mental fatigue and stress sensation assessment (see section 2.1.2.2). Other variables like HRV or blood pressure are unique to one of the three or shared by only two of them (Figure 20). It is worth noting that EEG theta power in stress sensation box is put there as a representation of low EEG frequencies since theta power is well studied along with alpha power (Tao et al., 2019).

Practical constraints need to be considered when making the data collection scheme. P300 component is by definition the potential occurs after actively receiving a stimuli that usually happens with a 300 milliseconds delay (Picton, 1992). To measure it requires inducing tasks such as the odd ball experiment. Body temperature refers to core body temperature that can be measured most accurately from skin on the forehead (Hymczak et al., 2021). But peripheral skin temperature is usually measured on wrists (Yoon et al., 2016). Out-of-office blood pressure needs to be measured by wearing an inflatable cuff on the arm. To minimize the effort needed to use the design on a regular basis, peripheral skin temperature, bloody pressure and P300 components are not ideal to be included in the final data collection scheme (Figure 21). HRV analysis is usually conducted on ECG signals, so HRV is included in the collection scheme to maintain a unified variable level.

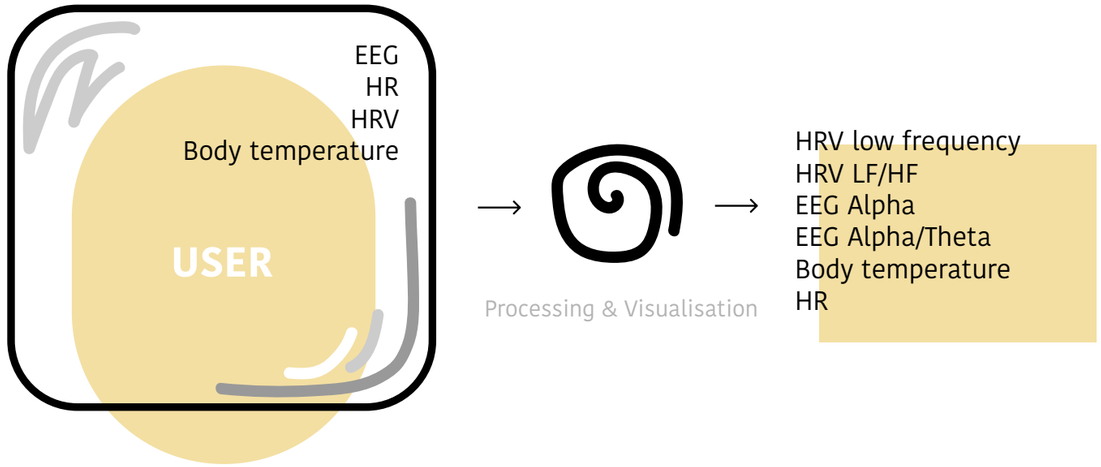


Figure 21 Data collection scheme

In line with the usual approach to assess EEG data, users need to record their EEG baseline with eyes closed as preparation. The official measurement should be recorded for a fixed epoch. Data processing in backstage should divide the epoch into short intervals to calculate the average power for each interval (Luijtelaar et al., 2010).

Users should be given comprehensive step-by-step guidance to properly wear the headset and calibrate. In the data collecting process, all measured correlates and their relevant variables are visualized in three parallel columns that gives users a straightforward structure of the variables (Figure 22).

Figure 22a **Baseline page**

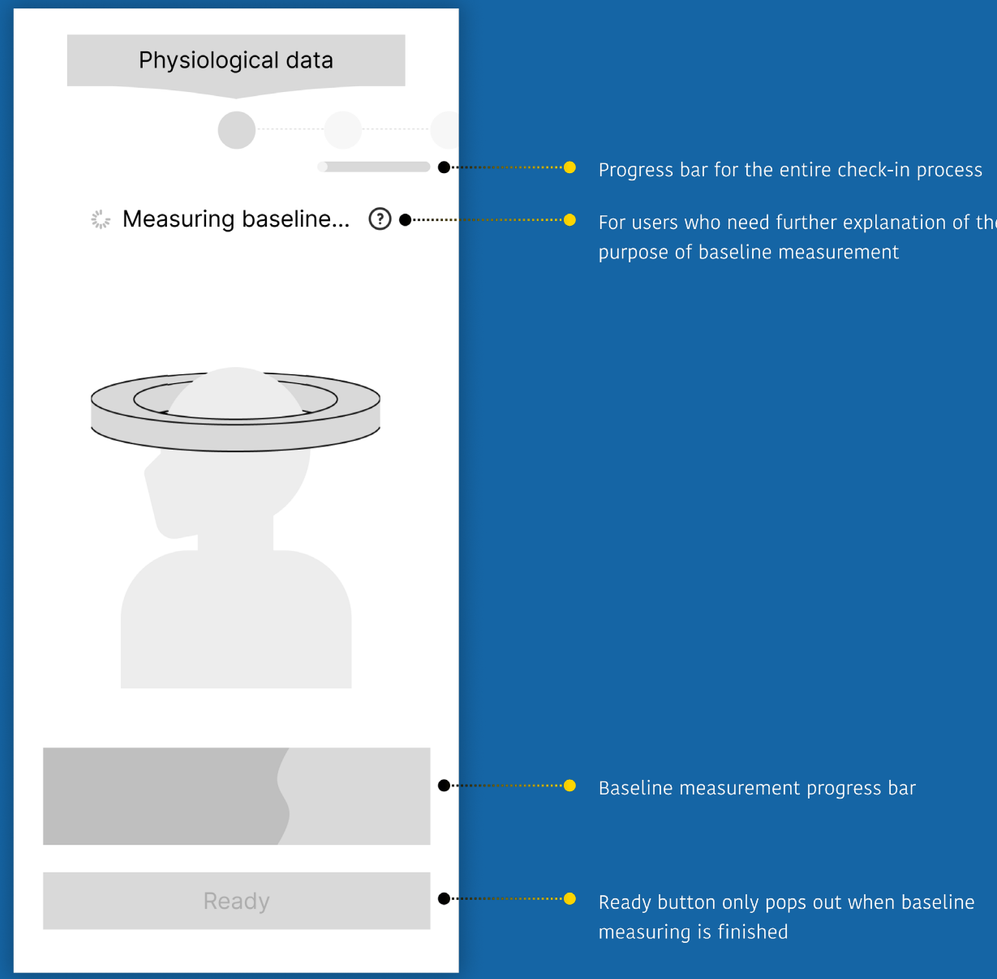
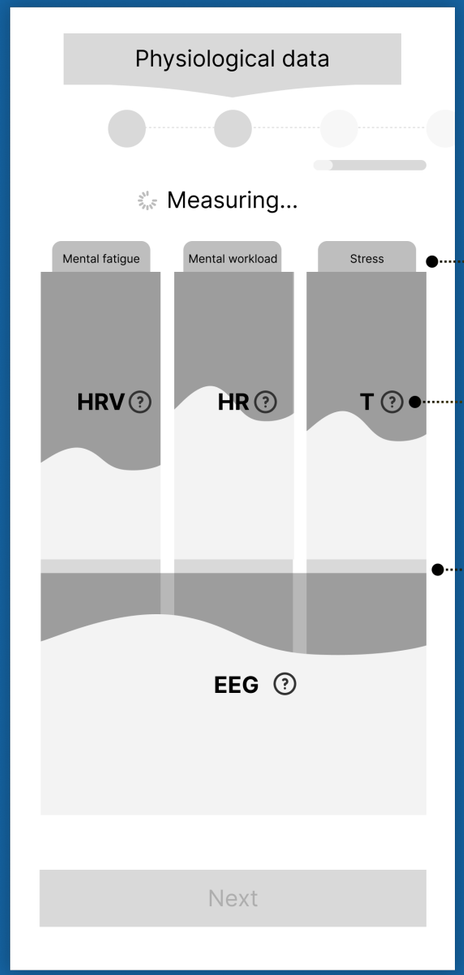


Figure 22b **Sensor collecting physiological data page**



5.3.6 Input subjective data

Subjective assessment features reinforce the design's reliability by actively involving the user's truth feelings. When physiological data gives a conclusion that is not in line with how the user feels, subjective data can inspire the user to reflect with no bias. Notably, subjective assessment tools can be applied to analyze performance over time. Physiological data reflects momentary cognitive status which is not as suitable as subjective data in this case.

Burnout quick scan

Involving a subjective perspective can be an alternative or complementary step in the user flow for the nature of its data acquisition method. Burnout quick scan is the main subjective data that indicates the user's burnout check-in progress. According to section 2.1.2, the suitable burnout measures for the target user group are Pine's Burnout Measure and Copenhagen burnout inventory. To finally decide on which measurement to apply, it is necessary to consider the measures in conjunction with the interaction vision qualities. "Reliable" quality can be translated to being able to ensure meaningful result for various burnout situations. The Copenhagen burnout inventory measures specifically in the context of professional life, while Pine's Burnout Measure takes the three dimensions of burnout as the standpoint which does not distinguish professional or private life burnout situations (Shirom, 2003). Pine's burnout inventory provides a clear cutoff to determine if a participant is in low-burnout state or high-burnout state (Malach-Pines, 2005), while the Copenhagen Burnout Inventory is not applied in the same way. Pine's burnout inventory cannot independently separate burnout from other similar psychological conditions like anxiety and depression (Shirom, 2003).

Therefore, by comparing the level of in-depth insights that can be derived from the self-measuring scales and the target group's main burnout-related stressors coming from work-related situations, the Copenhagen Burnout Inventory better fits the design. The Copenhagen Burnout Inventory is shown in Appendix E.

Burnout quick scan is a mandatory step that is required at multiple stages. The first time when users need to do burnout quick scan is when they set up the account and check-in program. This outcome is compared with later quick scans required after completing each reflection interval to determine the recovery progress so users can reflect on their performance. The three contexts included in Copenhagen Burnout Inventory should be examined separately, which allows users to choose the interested context freely.

Emotional labor

Emotional labor as an additional factor to assess similar to mental fatigue and stress sensation, is usually measured by self-assessment scales (Hu et al., 2023). Emotional labor is assessed in 3 levels: surface acting, deep acting and genuine acting. In surface acting level, people hide their true emotions and fake emotional expression to fit the desired emotion expressions from work. In deep acting level, people pay cognitive efforts to adapt their emotions to desired emotions from work. In genuine acting level, people true emotions and expressions naturally are in line with what is appropriate to in work situations. Several items are included in the measurement scale for each of the levels (Appendix F). Emotional labor strategies are not only a burnout correlate, but also a strong predicter to burnout (Ghanizadeh & Royaei, 2015). If obtaining burnout indications from sensor-collected physiological data is a

passive way of checking in, self-assessing emotional labor level is a proactive approach.

It is worth noting that burnout self-assessed severity is not an assessed correlate that belong with others like mental fatigue, stress sensation and emotional labor. Burnout quick scan should be used in stage-by-stage check-ins for it gives overall conclusions of burnout instead of immediate indications.

5.3.7 Understanding the situation

At this stage users have the most preliminary information regarding internal burnout aspects that need to attend to. To simplify the terms, this information can be referred to as **“attention-grabbers”**. With the external situation clarified, users can move forward to form a coping strategy.

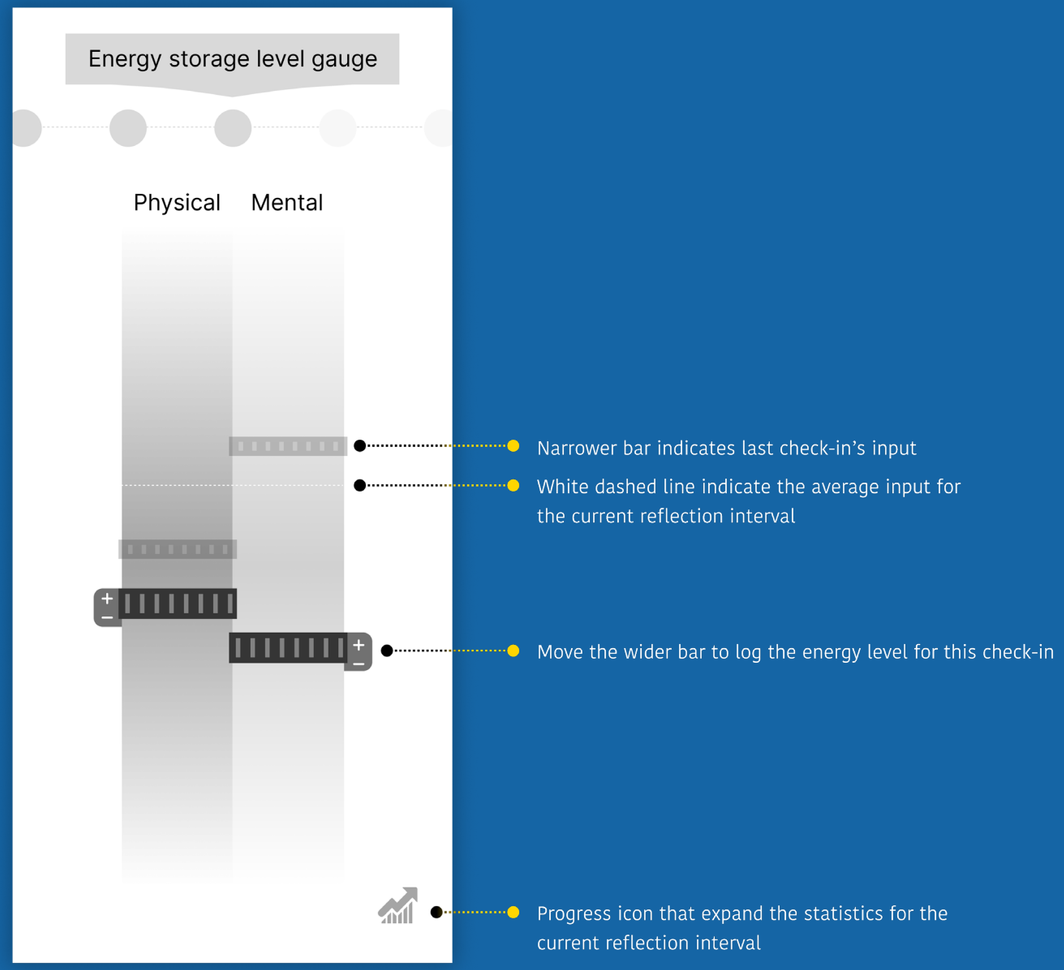
The external situation consists of two parts: source of stress and practical resources. According to the user research, sources of stress for the target group are usually study or work related. The mentioned nature of them can be the high intensity of workload, social relationship struggles or value conflict. Practical resources refer to the concrete support for burnout recovery that users have access to in their life situation. More specifically paid leave, chance to reallocate workload, student mental health service department all fall in the range of practical resources. The level of physical and mental resource is people’s “battery level” that fuel the actions to intervene burnout recovery journey. These resources are assessed and logged solely by user’s subjective feeling throughout the day. The “battery level” logging method is inspired by the “Mood battery” designed by Clair Atherton (15) in which the stressors and de-stressors that occurred during the day are noted down in the shape of a battery in red and green (Figure 23). The focus of noting down physical and mental resource level is not quantifying it but to note down the change. Instead, focusing on the how the user’s resource change between each check-ins provide is more insightful for managing burnout development (Figure 24).

Figure 23 Example of Mood battery card

(15) https://www.youngminds.org.uk/professional/resources/mood-battery/

Figure 24

Physical and mental resource logging page



5.3.8 What happens now?

Actions in stage 2 accumulate data to sculpture the quantified personal burnout-related state that users should practice frequently. Stage 3 is a milestone to translate the gathered information into a workable plan of action.

All the fragmented insights gathered from stage 2 come together at the beginning of stage 3. Given the complexity of information structure, it is not necessary to provide a full report of what stage 2 entails. Instead, the point of providing an insight cluster for stage 2 is for users to grasp the paramount factors in very short time. The severity of each burnout correlate is summarized for the latest reflection interval (depending on how often the user does their check-in) according to the following formula:

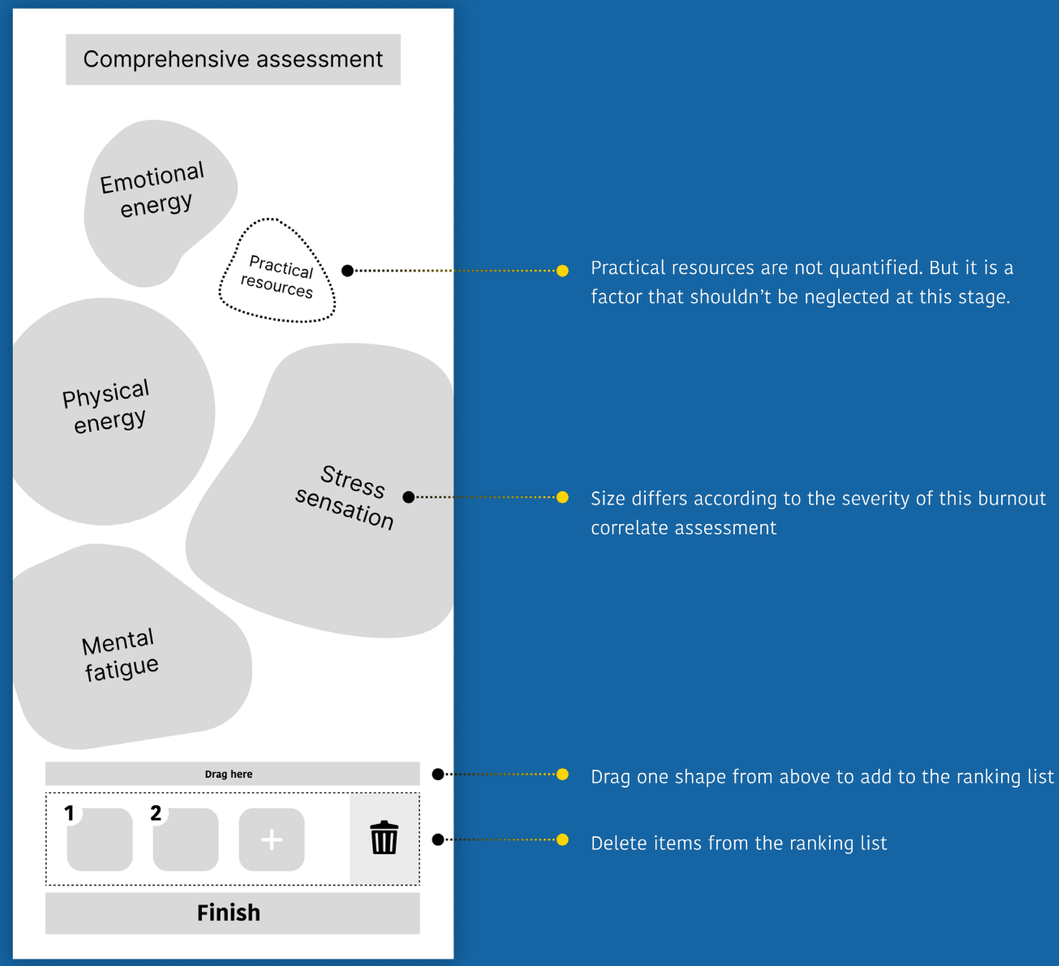
$$S_C = \sum_{k=1}^{n} (x_C - x_0) \cdot n$$

Sc refers to the overall severity of the burnout correlate. n is the number of check-ins for one reflection interval. Xc is the measured value of the burnout correlate. X0 is the reference value registered for the burnout correlate. The assessed burnout correlates are then visualized in terms of unique shapes in different sizes according to the severity level (Figure 25).

The last step before adapting personal burnout coping strategy is to prioritize the existing problems. Relying solely on the calculation results is imposing the technology's intelligence on users with not enough autonomy to support their control over burnout recovery. Therefore, the prioritizing responsibility is left to the user.

After the users finished ranking their problems, users should receive confirmation of completion consisting of the important information of current check-in, such as date, brief summary of the selected burnout correlates. At this point, all mandatory steps for one check-in are finished.

Figure 25 **Comprehensive assessment page**



5.3.9 Nudge changes

A crucial component of the design's contribution to its users is to nudge the reflection on the recovery journey regularly. When the users employ the design in a long run, their reflection is always something to refer back to, whether it is for self-encouragement or adapting changes.

The "nudge changes" step is essentially a further deep dive into the comprehensive assessment of all burnout correlates (Figure 26). Comprehensive assessment outcome suggests which burnout correlates raise attention for extra care according to data analysis. Nudging users to keep using the technology should facilitate positive feedback in the long run, which is in line with what is recommended by research (Maslach, 2006). After each reflection interval is finished, users need to complete the burnout quick scan again as an official documentation for progress.

Reflection box is for noting down the elaborated remarks on recent life events and feelings. It is an optional step to avoid imposing too much effort on the user. It is also left to the user to decide what to note down in the text box.

At this point a check-in session is fully completed. The users should be able to review all session results from the very beginning, as well as weekly/monthly/quarterly progress. It is key for the users to understand that the design is not reflecting or fine-tuning burnout coping strategy for them, instead it only supports them in keeping long-term monitoring to early signaling burnout occurrence.

5.3.10 Community support

Burnout is often not an easy situation to overcome solely by individual effort. From literatures, organizational support is essential to remove the fundamental stressors that cause large group of people to experience burnout, although such support is still difficult to implement (West et al., 2018). Some participants from the semi-structured interviews suggested that personal solutions like meditation exercises only alleviate the symptoms temporarily (P04 and P05). Therefore, building a channel to move forward from personal support to organizational support is meaningful.

The main goal of including community support to the design is to break the wall between individual users so that the burnout-related struggles and achievements have the channel to be shared. By sharing the insights, users get rid of the obstacles and shame of proactively seeking support and alternative recovery approaches from others. The design in this sense should create a safe ground for users to share.

Shared insights are included as a sub-function in community support page (Figure 27). Users can go to the "plaza" to check out other user's insights as well as make their own reflection public. All activities in one reflection interval are visualized as a map in which each check-in is marked. Post by others who have similar progress as the user, for example users who are doing the first reflection interval, is visible in the plaza.

Under the hamburger menu in the top left corner (Figure 28), users can change general settings and check out relevant information to seek human professionals in burnout for help (phrased as "second opinion support" in the flow chart). According to what the creative session suggests, providing human support as redundance in case the technology produced incomprehensible results is a preferred way to enhance reliability.

Figure 26 **Nudge changes page**

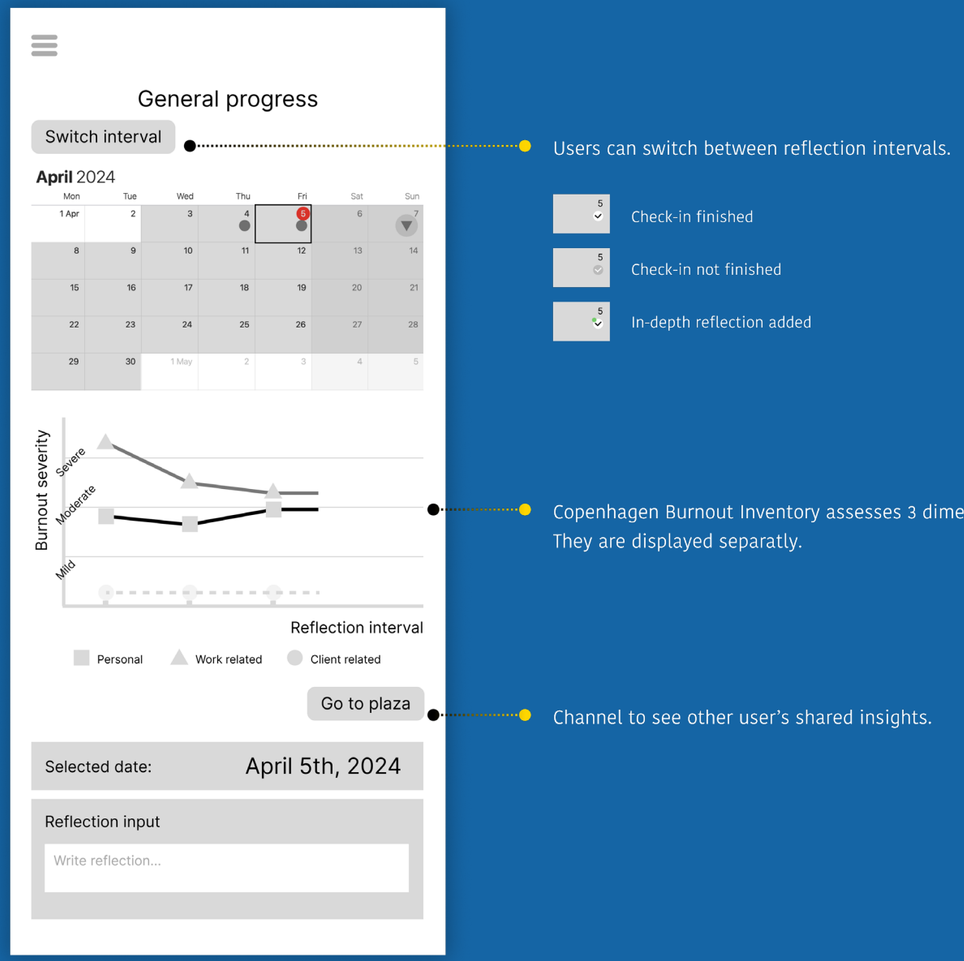
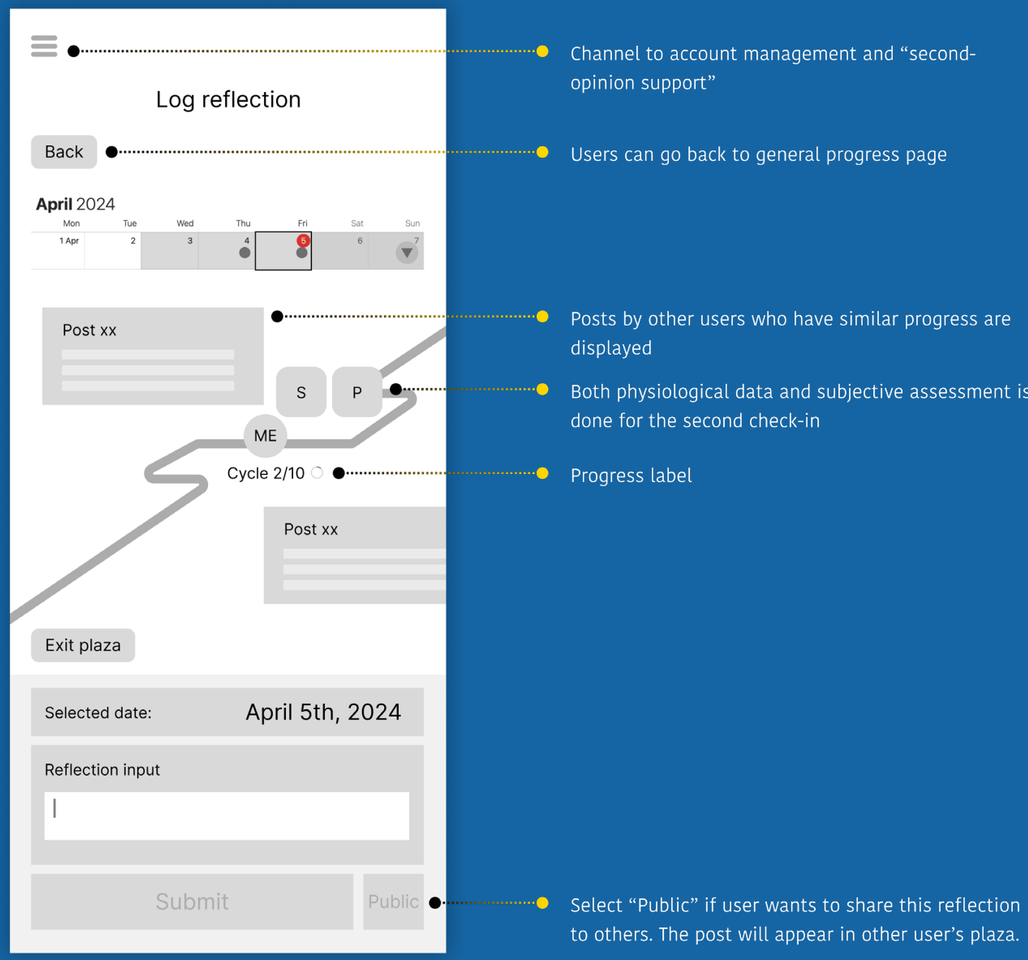


Figure 27 **Log reflection page**



Channel to account management and “second-opinion support”

Users can go back to general progress page

Posts by other users who have similar progress are displayed

Both physiological data and subjective assessment is done for the second check-in

Progress label

Select “Public” if user wants to share this reflection to others. The post will appear in other user’s plaza.

Figure 28 **Log reflection page (hamburger menu)**

Chapter 6

DISCUSSION AND CONCLUSION

6.1 Design research outcome

This study took the research gap between cognitive science practice and burnout as the starting point. The target user group of this study is people who are facing a high chance of burning out. And the timing of design intervention to take place is prior or in the early stages of burnout. To overcome the difficulty of finding and screening for the real target users, this study adapted the existing participatory design research methodologies to apply the knowledge from people who hold some of the valuable insights for the study. The design outcome takes a unique approach that is not shared with other competitors to our knowledge.

This section reflects on the quality and logical connection between the design research outcomes. The discussion is elaborated in the following dimensions: RQ, participatory activities, interaction qualities and evaluation approaches.

6.1.1 Are the research questions answered?

This section aims to provide comprehensive discussion on how well the RQs are designed and answered based on the findings.

RQ1: What constitutes a comprehensive understanding of burnout?

RQ1 is mainly answered by literature research. In academia, burnout is the exhaustion of physical and cognitive resources as the result of the combination of long-term stress, work-related meaninglessness and underappreciation (Maslach, 2006). Burnout influence people's life from three dimensions: exhaustion, cynicism, and inefficacy. Based on the original works, researchers developed various methods for measuring, quantifying burnout profile from different angles. Although only subjective assessment is applied in scientific research of burnout. Physiatrists, organizations and product designers all strive to provide solutions to burnout. Aside from traditional therapy, it is difficult for other non-professional support systems to reach essence of why burnout occurs.

The explorations in Chapter 4 provided answers to RQ1 from a different angle. The real-life stories put some of the cognitive consequences (e.g., mental fatigue) of burnout into context and provided opposite opinions regarding current mainstream burnout solutions (e.g., P02's dislike against meditation applications).

The findings of existing burnout studies revealed the subjectivity of burnout diagnosis and intervention. But researchers' effort in studying the relationships between burnout and cognitive topics paid off. Cognitive correlates associated with burnout build up the bridge to designing data-oriented burnout interventions. Hence, evidence supports that design proposition has potential.

RQ2. What do people need to effectively intervene burnout episodes?

RQ2 is mainly answered by participatory activities in Chapter 4 and Chapter 5, including both semi-structured interviews and the creative session. The semi-structured interview outcome revealed some common struggles and tricks of recovery, therefore setting a rough scope for design work to unfold. For example, individual differences and the nature of stressors highly determine burnout recovery. One key message was specified from the interviews: Imposing a universal coping strategy to broad population who suffer from burnout is not ideal.

The interviewees are the true experts on burnout. Their insights were key to keep the creative session participants on the right track to generate ideas. Due to practical constraints, there was insufficient time and resources for the creative session participants to specialize enough in the topic to ensure viable ideas. But the session succeeded in drawing a design vision and specifying key features and concerns. Both participatory activities produced insights that were referred to in setting up the design criteria.

RQ3. How to give CPI technology meaning in designing burnout solution?

RQ3 is mainly answered in 2 steps. The first step is understanding existing technology by testing, as elaborated in Chapter 2. In conclusion, existing commercial products that monitor human cognition are helpful in amplifying how cognitive states are reflected through people's senses, without interfering too much. This outcome articulated how hardware can enhance and hinder the effectiveness of the technology.

The second step is to conceptualize the knowledge about burnout theory, real-life burnout insights and CPI technology. Chapter 5 depicted the whole vision and zoomed in on the most important stages. This study applied CPI technology in a supportive role to point out the mild cognitive discomfort that might be difficult to notice early. On top of this, channels are given to users to log reflections and check on progress easily. They are also connected to the others if personal self-help routines do not suffice. In this way, users can take actions to prevent burnout from progressing.

6.1.2 Design guideline and considerations

The methodology of this study employs the participatory design principle. Design research activities are constructed based on case-specific interpretations of this principle. This section aims to discuss how the design outcomes render the findings of participatory design activities.

Interaction quality #1: Reliable

Reliability concerns raised in the creative session are mainly about the technology, since commercial products that employ cognitive data yet do not have a large user community to guarantee robust trustworthiness. Participants discussed how to define reliability for this specific use scenario. They agreed that the essential focus of design intervention is not improving the accuracy of the sensors, but providing follow-up solutions that respond to possible issues in the interaction flow.

This understanding of reliability is translated into the design by introducing channels to get human service when users encounter incomprehensible abnormal results during the check-in process (Figure 28). Human expert's role in dealing with abnormal results is not focused on trouble shooting malfunctions of hardware or incorrect usage, but more on providing extra guidance on how to understand the results and act upon it. In the future, it will be necessary to think carefully about what form the human service should take. Target users' preference and use scenario of the product should be considered for this matter.

Interaction quality #2: Anchoring

Creating an anchor point in user's daily routine to remind user in keeping up their regular check-in is key to effective reflection. From what the competitor research suggests, pushing notifications on the phone does not suffice as an anchor point to nudge regular usage. It ultimately could lead to users falling behind in the program.

Therefore, an anchoring effect is not particularly achieved by the application design. As mentioned previously, an anchoring effect could potentially be achieved by implementing the regular check-ins in the user's living routine. There are a few factors that determine what form an anchor point should take. The first one is where the users do the check-ins. If the location is at home, the product can be placed in the user's daily line of movement as an ornament. If the location is in public (e.g. at the office or on the road), the anchor point could be something small users can put in their bags. Secondly, whether the design is utilized by private users or business users for company benefits. For private users, they could team up with "burnout partners" who use the same product in burnout recovery on social media to supervise each other on keeping up the regular check-ins. For business users, a billboard in the office could easily function as an anchor point.

If to search for more general solutions, the general progress feature has the potential to create anchoring effect (Figure 27). The calendar view that displays all check-in days can be integrated with other calendar tools in the user's daily flow.

Interaction quality #3: Human touch

Human touch is a broad term in the user experience context. In this study, both semi-structured interviews and the creative session, participants came to the conclusion that human touch is an essential building block of an effective coping strategy to recover from burnout. They discussed what personable support should be employed for burnout and the solutions inevitably arrived in the same area. They believed the biggest values of human touch are companionship and they bring different perspectives together on one shared problem.

The human touch quality is translated into community support feature (see section 5.3.10). Metaphorically speaking, user's check-in progress is visualized as a journey where they occasionally meet other travelers (users) at every milestone. Seeing other users create a sense of companionship. Users exchanging reflections brings different perspectives to collide.

Interaction quality #4: Flexible

One of the key takeaways from the semi-structured interviews is the uniqueness of burnout. Not only unique between individuals, but also between episodes for the same individual. Therefore, a universal solution does not exist for burnout problems.

The balance between fixed structure and flexibility is key for a long-term self-growth process to succeed. Take Digiburn as an example, it maximized the level of structure to ensure meaningful learning outcome. But enhancing too much structure is not ideal for this study. Introducing self-monitoring and self-reflection to burnout recovery essentially supports people to fine-tune burnout coping strategy according to the nature of it, hence flexibility is more important.

Flexibility is reflected in the very beginning of the whole use flow to freely set up the reflection interval and check-in frequency. Flexibility is also reflected in each check-in session. Users have the freedom to choose to whether to do subjective assessment or not.

Three dimensions from creative session

During the creative session, the scope of the idea clusters generated by the participants can be analyzed from 3 perspectives. Each perspective can be visualized as a scale (Figure XX). It is clear from the visualization that the most generated viable ideas are on the end of "personal level", "long-term" and "rational". In other words, the participants saw more possibilities in burnout solutions that: 1) provide personal level support; 2) be alongside the users for longer time; 3) give objective information. These findings are reflected in the design.

6.2 Limitations

Participants

The participants for both the semi-structured interviews and the creative session are recruited from the researcher's personal connections. This inevitably leads to lack of demographic divergence. Only 10 participants who have similar age and education background in total participated in this study. The choice for the final target user group is highly influenced by this limitation. Therefore, the design only considered the most representative problems of this small group of users.

Design evaluation

The design is not evaluated scientifically by real users. One of the most important subjects to evaluate is the long-term usability. Points like how easy the current system is to keep regular usage, or how effective the nudged self-reflection is to support burnout recovery should be essential focus of the evaluation. To make sure plausible conclusion can be drawn from the evaluation, it is key to carefully decide on the set of participant inclusion and categorization criteria. Aside from standard considerations like demographic diversity, key subjects to consider when making the criteria can be:

1) The level of burnout development. It is important to distinguish between the difference of burnout high-risk group, early-stage burnout group and others to evaluate the effectiveness of burnout prevention.
2) The constitution of the participant's burnout episode. It can be probed by using burnout self-assessment tools.
3) Nature of stress. From Chapter 4, the nature of stress that fundamentally caused burnout to occur also determines the suitable coping strategies to it. The performance of the self-reflection framework proposed by this study might be influenced by the user's coping strategy.
4) Personal preference. There are some personality traits that make people more susceptible to burnout (Deligkaris et al., 2014). Personality traits developed as a result of the influence of different cultures and their value systems determine the coping strategies to stress.

Components that remain open

The final design only demonstrated part of the user journey outline. The remaining stages are left out due to the limitation of the project scope. The same reason applies to only taking out some of the design criteria to focus on. For example, design criterion 4 is more applicable in hardware-related design work.

6.3 Conclusion

This project delved into the gap between CPI technology and personal burnout solutions, targeting young individuals at risk of burnout and intervening prior to or in the early stages of the condition. The project adapted the double diamond methodology to approach the research challenge incorporating both literature and participatory design.

By enquiring the fundamentals of burnout from literature and participatory research approach, it was clear that the target user group's burnout situation is subjected to multiple personal or environmental factors. By exploring CPI products on the market, it was clear that this technology can largely benefit burnout self-help solutions by quantifying the early symptoms.

The research outcome suggested key criteria to approach burnout from a supportive angle rather than imposing solutions to fit every user's circumstances. By co-creating with potential users, some design directions emerged. The participants envisioned the design to provide personal burnout-related data and a safe ground to explore appropriate burnout solutions.

In the end, a design guideline was proposed to help users make good use of CPI technology and self-reflection to search for burnout solutions independently.

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IDE Master Graduation Project

Project team, procedural checks and Personal Project Brief

In this document the agreements made between student and supervisory team about the student's IDE Master Graduation Project are set out. This document may also include involvement of an external client, however does not cover any legal matters student and client (might) agree upon. Next to that, this document facilitates the required procedural checks:

- Student defines the team, what the student is going to do/deliver and how that will come about
- Chair of the supervisory team signs, to formally approve the project's setup / Project brief
- SSC E&SA (Shared Service Centre, Education & Student Affairs) report on the student's registration and study progress
- IDE's Board of Examiners confirms the proposed supervisory team on their eligibility, and whether the student is allowed to start the Graduation Project

STUDENT DATA & MASTER PROGRAMME

Complete all fields and indicate which master(s) you are in

Family name	Wu	6917	
Initials			
Given name	Lingge		
Student number	5528984		

IDE master(s) IPD ☐ Dfl ☑ SPD ☐

2nd non-IDE master

Individual programme *(date of approval)*

Medisign ☐

HPM ☐

SUPERVISORY TEAM

Fill in he required information of supervisory team members. If applicable, company mentor is added as 2nd mentor

Chair	Christina Schneegass	dept./section	HCD, HICD
mentor	Evangelos Niforatos	dept./section	SDE, KInD
2nd mentor			
client:			
city:		country:	
optional comments			

! Ensure a heterogeneous team. In case you wish to include team members from the same section, explain why.

! Chair should request the IDE Board of Examiners for approval when a non-IDE mentor is proposed. Include CV and motivation letter.

! 2nd mentor only applies when a client is involved.

APPROVAL OF CHAIR on PROJECT PROPOSAL / PROJECT BRIEF -> to be filled in **by the Chair** of the supervisory team

Sign for approval (Chair)

Christina Schneegass — Digitally signed by Christina Schneegass Date: 2023.12.01 18:41:49 +01'00'

Name Christina Schneegass Date 1 Dec 2023 Signature

CHECK ON STUDY PROGRESS

To be filled in **by SSC E&SA** (Shared Service Centre, Education & Student Affairs), after approval of the project brief by the chair. The study progress will be checked for a 2nd time just before the green light meeting.

Master electives no. of EC accumulated in total _____ EC

Of which, taking conditional requirements into account, can be part of the exam programme _____ EC

★	**YES**	all 1st year master courses passed
	NO	missing 1st year courses

Comments:

Sign for approval (SSC E&SA)

Kristin Veldman — Digitally signed by Kristin Veldman Date: 2023.12.08 17:00:02 +01'00'

Name K. Veldman Date 8 Dec 2023 Signature

APPROVAL OF BOARD OF EXAMINERS IDE on SUPERVISORY TEAM -> to be checked and filled in by IDE's Board of Examiners

Does the composition of the Supervisory Team comply with regulations?

YES	★	Supervisory Team approved
NO		Supervisory Team not approved

Comments:

Based on study progress, students is ...

★	**ALLOWED** to start the graduation project
	NOT allowed to start the graduation project

Comments:

Sign for approval (BoEx)

Monique von Morgen — Digitally signed by Monique von Morgen Date: 2023.12.12 10:25:37 +01'00'

Name Monique von Morgen Date 12 Dec 2023 Signature

Personal Project Brief – IDE Master Graduation Project

Name student Lingge Wu **Student number** 5,528,984

PROJECT TITLE, INTRODUCTION, PROBLEM DEFINITION and ASSIGNMENT

Complete all fields, keep information clear, specific and concise

Project title Designing for healthy self-reflection on cognitive data in the context of burnout

Please state the title of your graduation project (above). Keep the title compact and simple. Do not use abbreviations. The remainder of this document allows you to define and clarify your graduation project.

Introduction

Describe the context of your project here; What is the domain in which your project takes place? Who are the main stakeholders and what interests are at stake? Describe the opportunities (and limitations) in this domain to better serve the stakeholder interests. (max 250 words)

The ever-developing technology has made it possible to monitor psychophysiological data and quantify human cognition and cognitive activities. Some physiological variables are proven to be effective indicators to determine burnout manifestation, for example, heart rate variability (HRV), mean arterial blood pressure (MAP), cortisol level (Traunmüller et al., 2019). These variables can be collected by chest straps, touch-type wristbands, brain-sensing headbands (Mundayadan, 2016) (Traunmüller et al., 2019). Now researchers continue to explore affordable ways to detect more complex cognitive states or activities (Goumopoulos and Potha, 2023), yet these endeavors have not resulted in mainstream consumer products. The quantified human cognition-related data could be of great value to people who wish to be more aware of their condition or needs, and refer to this information in reflective activities to become a better version of themselves.

This project aims to explore and experiment with ways for quantified cognitive data to aid reflection on an individual's cognitive states, with a specific focus on self-report burnout users. Individuals with burnout often experience cognitive challenges in general performance or the excessive effort to perform certain tasks, especially those with a clinical diagnosis (Oosterholt et al., 2014). The commonly accepted attitude of burnout intervention is to 'positively boost engagement' instead of 'passively getting rid of it'. For users with self-reported burnout symptoms, such smart products that can monitor people's cognitive state could provide them with a meaningful set of data to refer to in self-regulation/reflection activities. For users who are susceptible to burnout, such smart products could potentially prevent them from experiencing severe symptoms. By facilitating effective reflection, such a smart product could ideally be beneficial for its users to improve their understanding and control of their cognitive state.

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introduction (continued): space for images

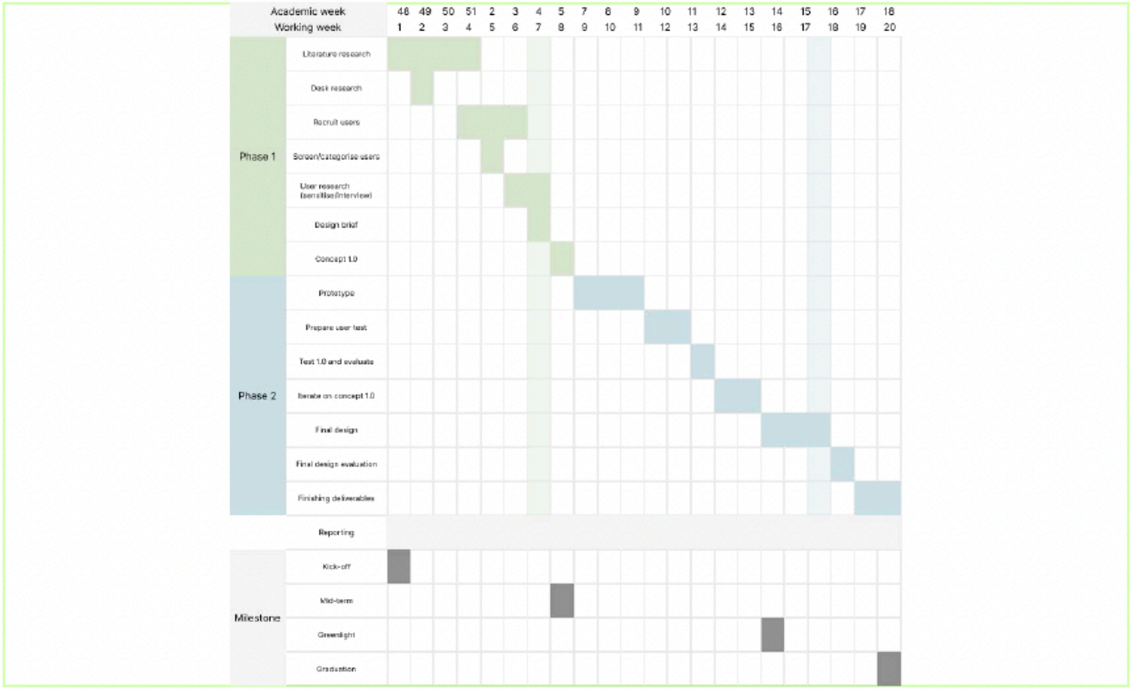


image / figure 1 Project timeline

image / figure 2

Personal Project Brief – IDE Master Graduation Project

Problem Definition

What problem do you want to solve in the context described in the introduction, and within the available time frame of 100 working days? (= Master Graduation Project of 30 EC). What opportunities do you see to create added value for the described stakeholders? Substantiate your choice.
(max 200 words)

The ultimate problem I want to solve is, 'How to make use of quantified cognition data in creating a healthy reflective experience for people against burnout?'. Further, I would break it down into the following sub-problems:

1. What are the most essential difficulties people face when they try to self-regulate?
2. What kind of quantified cognition data can be indicators to determine the type/severity of burnout?
3. What kind of self-regulate activities might people with different burnout symptoms find useful?
4. How to translate quantified cognition data into meaningful insights that can help people with burnout symptoms in self-regulation activities?

People with only burnout symptoms might not seek clinical help immediately. A self-regulation solution supported by reliable and meaningful cognitive data could potentially be beneficial for them. For people who are susceptible to burnout, a self-regulation solution could be useful in monitoring their cognitive state and taking early actions to prevent burnout.

Assignment

This is the most important part of the project brief because it will give a clear direction of what you are heading for. Formulate an assignment to yourself regarding what you expect to deliver as result at the end of your project. (1 sentence) As you graduate as an industrial design engineer, your assignment will start with a verb (Design/Investigate/Validate/Create), and you may use the green text format:

Create a self-regulation guide and prototypes that use quantified cognitive data to enable people to conduct meaningful self-regulation sessions against workplace burnout.

Then explain your project approach to carrying out your graduation project and what research and design methods you plan to use to generate your design solution (max 150 words)

In general, I would take the participatory design approach. The main structure of the project would be as follows (see Figure 1):

1. Kick off the project by doing literature research to understand the current state of cognitive activity monitoring technology; the existing effective self-regulation strategies for burnout.
2. Research existing smart products that collect and quantify cognitive data to understand the key differences between them and the vision of how those products are going to evolve in the future.
3. Recruit a group of user research participants who report burnout symptoms. The recruited participants will be screened by validated self-assessment tools (e.g., Utrecht Burnout Scale(Oosterholt et al., 2014)).
4. Conduct pre-prototyping user research with screened participants. This research phase mainly focuses on finding out their current self-regulation strategies and attitudes towards the aforementioned smart products.
5. Facilitate creative sessions with the research participants to generate/iterate ideas of self-regulation methods together.
6. Create a high fidelity prototype for the whole self-regulation process..

Project planning and key moments

*To make visible how you plan to spend your time, you must make a planning for the full project. You are advised to use a Gantt chart format to show the different phases of your project, deliverables you have in mind, meetings and in-between deadlines. Keep in mind that all activities should fit within the given run time of 100 working days. Your planning should include a **kick-off meeting**, **mid-term evaluation meeting**, **green light meeting** and **graduation ceremony**. Please indicate periods of part-time activities and/or periods of not spending time on your graduation project, if any (for instance because of holidays or parallel course activities).*

Make sure to attach the full plan to this project brief.
The four key moment dates must be filled in below

Kick off meeting	27 Nov 2023
Mid-term evaluation	29 Jan 2024
Green light meeting	2 Apr 2024
Graduation ceremony	3 May 2024

In exceptional cases (part of) the Graduation Project may need to be scheduled part-time. Indicate here if such applies to your project

Part of project scheduled part-time	
For how many project weeks	
Number of project days per week	

Comments:

Motivation and personal ambitions

Explain why you wish to start this project, what competencies you want to prove or develop (e.g. competencies acquired in your MSc programme, electives, extra-curricular activities or other).

Optionally, describe whether you have some personal learning ambitions which you explicitly want to address in this project, on top of the learning objectives of the Graduation Project itself. You might think of e.g. acquiring in depth knowledge on a specific subject, broadening your competencies or experimenting with a specific tool or methodology. Personal learning ambitions are limited to a maximum number of five.
(200 words max)

My Bachelor's thesis was closely related to the brain and human cognition. I find this graduation direction a good opportunity to deepen my knowledge in this field. I wish to take this project's opportunity to develop my understanding of AI and data, as well as to envision their relationship with human beings in the future. I would also like to practice my skills in doing participatory user research and design iteration.

The notion of burnout is not new in academia, but it is relatively new to the masses. Researchers have discovered several indicators of different types and levels of burnout. I find it meaningful if I can transform this type of insight to be directly useful to people experiencing burnout risks.

At the end of this project, I would like to see myself as a independent designer who is capable of conducting design research with empathy and care. More specifically, I would like to practice my co-design and visualization skills developed in previous courses, such as EI and UXAD. In connection to my aspiration to start my career in the game industry, I wish to take this project to explore how to incorporate fun actiivities using the technology and iterative design approach I learned in the course ITD.

APPENDIX

A: Interview script and consent form

About first-hand experience

1 How do you typically realize that you are experiencing burnout?
1.1 What the first signs?
1.2 Can you give some background information on what was going on in life that might have caused burnout to occur?
1.3 Did you tried to do anything to stop burnout from getting more serious?
2 Did you seek help from professionals?
2.1 Did you get clinically diagnosed?
2.2 If not, why did you choose not to seek external help?
3 After you realized that you might had burnout, how did it influence your life? Work, study, physical health etc.
3.1 How did the people around you reacted to it?
3.2 How was your own attitude towards it?

About coping mechanisms

1 How was the recovery journey?
1.1 Do you think you are fully recovered from burnout now? If not, what are the aspects that are still under burnout's influence?
1.2 Would you consider your recovery journey a linear/iterative/spiral process?
1.3 Do you think you are well supported in your recovery journey? What kind of support you received?
2 What were your efforts to get better?
2.1 Which of them are effective/didn't make any difference/backfired? (Support system, physical activities, change of daily routine)
2.2 If you sought help from professionals, was it helpful? If not, what made you not to choose this option?
2.3 How did you figure out what you should do to get better? By gathering information from internet or books? Or just following your heart?
2.4 Have you considered relying on any kind of technology to support your recovery?

About reflecting on the whole experience

1 Now looking back, how would you have prevented burnout from happening?
1.1 If you can give one advise to prevent burnout, what would it be?
2 What type/shape of support do you think is proper for people experiencing burnout?
2.1 What kind of support did you wish you had?
3 If burnout strikes you again, would you do any differently this time?
3.1 Do you have a "alert system" against burnout?

Introduction to interview on lived experience of burnout

Dear participants,

You are invited to join the interview on lived experience of burnout as part of a design research done by student Lingge Wu. This research is conducted as part of the graduation thesis of 'Designing for healthy self-reflection on cognitive data in the context of burnout' for MSc study of Design for Interaction at the faculty of Industrial Design Engineering, TUDelft.

The essential objective of this interview is to gather lived experience and insights of participants who experienced burnout before. Your insights are important for the research to identify the pain points and design opportunities in the process of burnout recovery from a user-centered perspective. The interview will take approximately from 45 minutes to 1 hour. The topics being covered in the interview are:

1. Your overall experience of burnout
2. Your coping mechanisms against burnout
3. Your reflection on the recovery process

As with any online activity the risk of a breach is always possible. To the best of our ability your answers in this study will remain confidential. We will minimize any risks by strictly following the European General Data Protection Regulation (GDPR) legislation. All identifiable personal information of the participants is anonymised. The gathered data will only be safely stored in the student's local drive.

In the next page, you will find a consent form. Please review it carefully. It contains detailed information about the procedures, your rights as a participant, and our commitment to confidentiality and data protection.

Thank you so much for considering joining the research. We are looking forward to your participation.

Sincerely,

Lingge Wu

Please ensure to read the attached consent form thoroughly before agreeing to participate in the interview.

Informed consent participant

I participate in this research voluntarily.
I acknowledge that I received sufficient information and explanation about the research and that all my questions have been answered satisfactorily.
I was given sufficient time to consent my participation.
I can ask questions for further clarification at any moment during the research.

I am aware that this research consists of the following activities:

1. Questionnaire
2. Interview

I am aware that data will be collected during the research, such as notes, screen and/or audio recordings.
I give permission for collecting this data and for making photos and/or audio during the research. Data will be processed and analysed anonymously (without your name or other identifiable information) and is protected by GDPR. The data will only be accessible to the researcher and their TU Delft supervisors. The screen and/or audio recordings will be used to support analysis of the collected data.

I give permission for **using screen and/or audio recordings** of my participation for transcription purposes only.
I give permission for using my anonymized quotes in research publications.

I give permission to store the data for a maximum of 5 years after completion of this research and using it for educational and research purposes.
I acknowledge that no financial compensation will be provided for my participation in this research.
With my signature I acknowledge that I have read the provided information about the research and understand the nature of my participation.
I understand that I am free to withdraw and stop participation in the research at any given time.
I understand that I am not obliged to answer questions which I prefer not to answer and I can indicate this to the research team.
I will receive a copy of this consent form upon request.

Signatures

Name of participant	Signature	Date (dd/mm/yyyy)

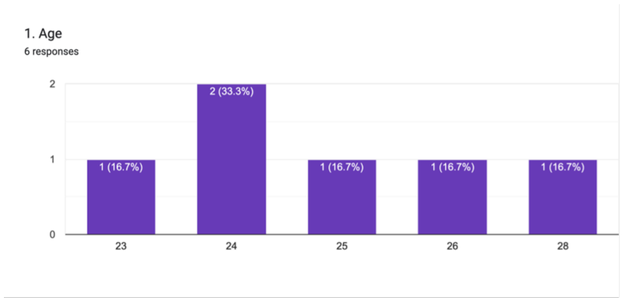
I, as researcher, have accurately read out the information sheet to the potential participant and, to the best of my ability, ensured that the participant understands to what they are freely consenting.

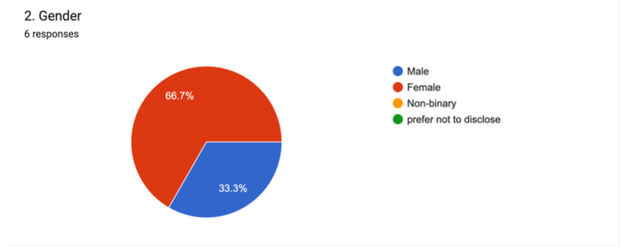
Lingge Wu

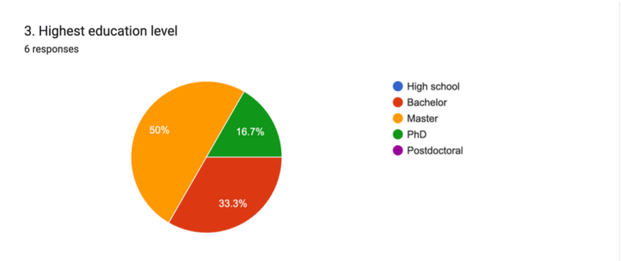
Researcher name	Signature	Date (dd/mm/yyyy)

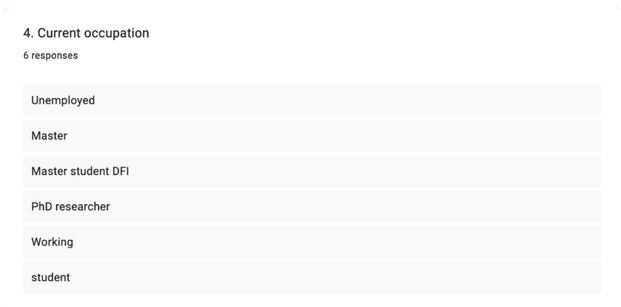
Study contact details for further information: [Lingge Wu,

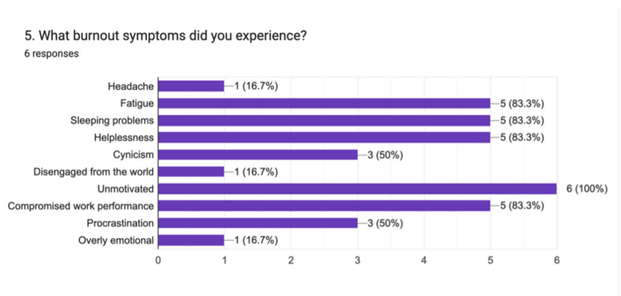
B: Interview quesionnaire result











C: Sensitizing tasks

Day 1:

https://forms.gle/3AdN6B48xKB4mcT26

#1 What is burnout?

Burnout is a phenomenon rising in recent years that usually links with work situations.

"To fail, wear out, or become exhausted by making excessive demands on energy, strength, or resources" is the definition brought by the founding researchers of burnout.

You can understand burnout as a model consists of the following **3 dimensions**:

1. **Exhaustion**, refers to the overwhelming emotional and physical exhaustion because of high work demand.
2. **Cynicism**, refers to the stage where people start to disengage from the job and lose drive to produce high-level work.
3. **Inefficacy**, refers to people's evaluation that they don't have the ability to maintain high level work quality and quantity.

Burnout sometimes comes along with other psychological conditions such as depression or anxiety disorder.

There can be physical symptoms such as headaches, sleep loss and nausea.

Day 2:

https://www.youtube.com/watch?v=fLtSL_z_pEE

#2 What causes burnout?

All the listed options are independent causes of burnout. A common misunderstanding is that burnout is purely a consequence of intense stress. In fact, many people dealing with intense workload don't necessarily suffer from burnout because they find their job meaningful.

Instead, burnout manifests when **elements that form a healthy coping mechanism of stress are missing.** A healthy coping mechanism can have the following qualities:

1. capable of sufficiently validating a person's production;
2. capable of sustaining confidence and control over the work;
3. capable of sustaining value of the work
   ...

These elements are not universal but dependant on each person's personality, the nature of the stressful event, external support resources etc.

Everyone has their own way to cope stressful situations. How do you cope with your daily workload? Do you think it is healthy?

D: UALo template

Uniqueness

1. It adds sport attributes to coffee.

2. Breaks the conventio nal idea of coffee socializing

Set up coffee points in forest for young customers all over the world to gather for hand made coffee.

Advantages

It is profitable

It is a good way to introduce hand made coffee to modern lifestyle

It can be applied all over the world

Limitations

H2 lower the cost of implementation?

H2 make it less dangerous for people to go into forests?

overcoming Limitations

Idea 1

Idea 2

...

E: Copenhagen Burnout Inventory (16)

Part one: Personal burnout
Definition: Personal burnout is a state of prolonged physical and psychological exhaustion.
Questions:
1. How often do you feel tired?
2. How often are you physically exhausted?
3. How often are you emotionally exhausted?
4. How often do you think: ”I can’t take it anymore”?
5. How often do you feel worn out?
6. How often do you feel weak and susceptible to illness?
Response categories: Always, Often, Sometimes, Seldom, Never/almost never.
Scoring: Always: 100. Often: 75. Sometimes: 50. Seldom: 25. Never/almost never: 0.
Total score on the scale is the average of the scores on the items.
If less than three questions have been answered, the respondent is classified as non-responder.

Part two: Work-related burnout
Definition: Work-related burnout is a state of prolonged physical and psychological exhaustion, which is perceived as related to the person’s work.
Questions:
1. Is your work emotionally exhausting?
2. Do you feel burnt out because of your work?
3. Does your work frustrate you?
4. Do you feel worn out at the end of the working day?
5. Are you exhausted in the morning at the thought of another day at work?
6. Do you feel that every working hour is tiring for you?
7. Do you have enough energy for family and friends during leisure time?
Response categories:
Three first questions: To a very high degree, To a high degree, Somewhat, To a low degree, To a very low degree.
Last four questions: Always, Often, Sometimes, Seldom, Never/almost never. Reversed score for last question.
Scoring as for the first scale. If less than four questions have been answered, the respondent is classified as non-responder.

Part three: Client-related burnout
Definition: Client-related burnout is a state of prolonged physical and psychological exhaustion, which is perceived as related to the person’s work with clients*.
*Clients, patients, social service recipients, elderly citizens, or inmates.
Questions:
1. Do you find it hard to work with clients?
2. Do you find it frustrating to work with clients?
3. Does it drain your energy to work with clients?
4. Do you feel that you give more than you get back when you work with clients?
5. Are you tired of working with clients?
6. Do you sometimes wonder how long you will be able to continue working with clients?
Response categories:
The four first questions: To a very high degree, To a high degree, Somewhat, To a low degree, To a very low degree.
The two last questions: Always, Often, Sometimes, Seldom, Never/almost never.
Scoring as for the first two scales. If less than three questions have been answered, the respondent is classified as non-responder.

(16) https://nfa.dk/da/Vaerktoejer/Sporgeskemaer/Sporgeskema-til-maaling-af-udbraendthed/Copenhagen-Burnout-Inventory-CBI

F: Emotional labor assessment scale (Hu et al., 2023)

Construct	Dimensions
Emotional labor	
Surface acting	
	Surface acting
	1. I often pretend to have the emotions I need to show for customers
	2. I often fake to customers that I am in a good mood
	3. I can create a look of concern for the client when in reality I am not
	4. I often put on an act in order to deal with customers
	5. Even if I am in a bad mood, I can leave a good impression with the customers
Deep acting	
	Deep acting
	1. I can manage my emotions to help me understand the customers' perspectives
	2. I try to feel the positive emotions I must show to the customers
	3. I can separate my feelings enough to deal with tough customers
Genuine acting	
	Genuine acting
	1. I feel it is difficult not to express my real emotions at work
	2. I feel embarrassed for the difference between real emotions and expressed emotions