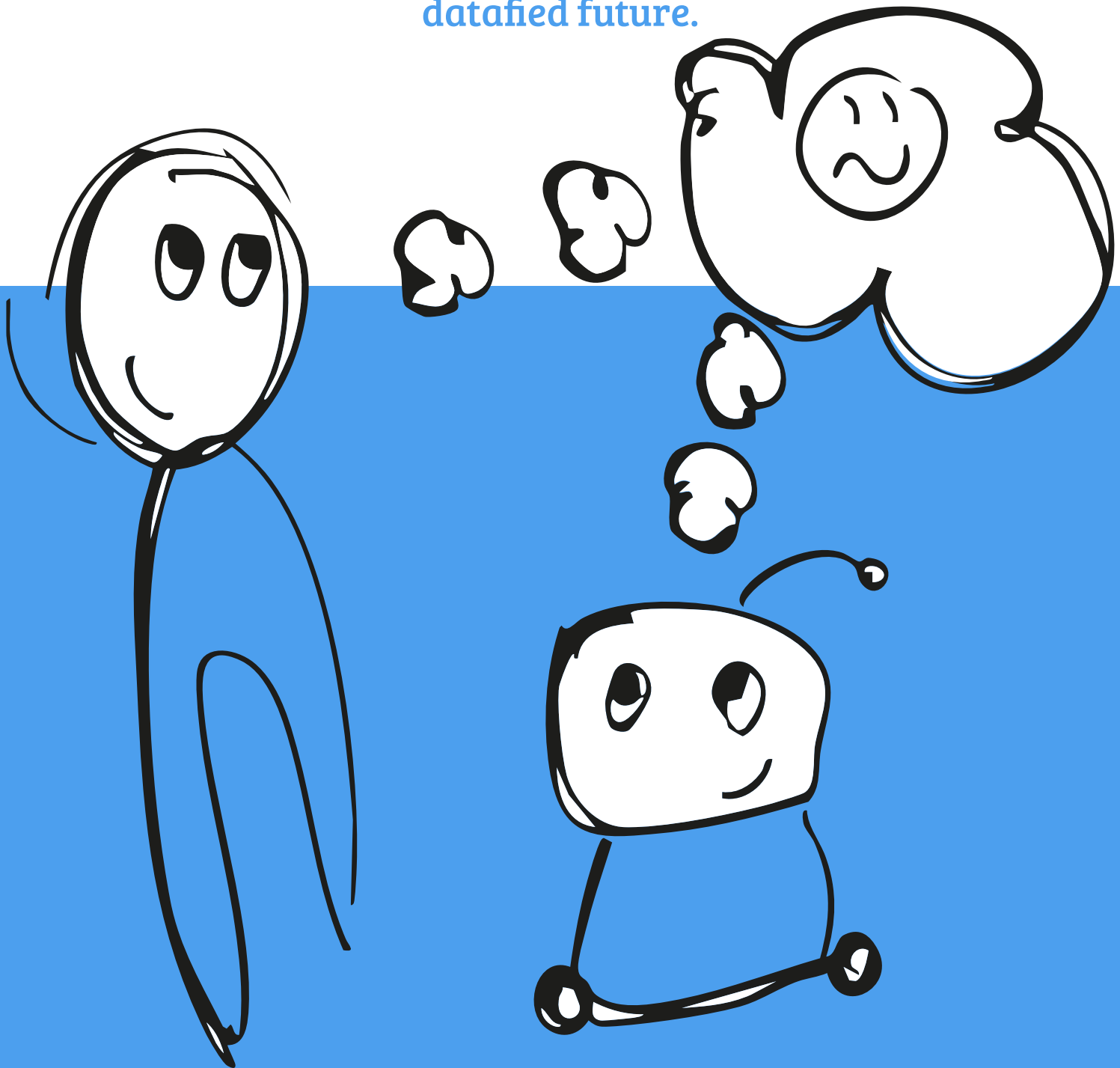


Between Data and the Self

Preserving lived experience in a
datafied future.



Preserving lived experience in a datafied future.

A Speculative Design Research Project Exploring the Future of Digital Twins in Psychiatric Care, Using PTSD as a Case Study.

MSc Thesis Design for Interaction

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Summary

*This thesis explores how **digital twin technology** might introduce a **trade-off between datafication and lived, intuitive experience** in psychiatric healthcare for people with **Post-Traumatic Stress Disorder (PTSD)**. A digital twin refers to a **virtual simulation** of a person's behaviour and emotional states constructed through continuous data collection. Such systems promise more personalised care and autonomy, yet they also raise ethical and epistemical concerns.*

For people with PTSD, the ability to trust their own bodily signals is often disrupted. A digital twin could create a sense of enhanced self-understanding, yet at the same time **risk undermining one's relationship with lived experience**.

Using speculative design research, this project examined how people with PTSD interpret and emotionally respond to potential technological futures. Through a combination of contextual immersion, expert interviews, **and iterative** prototyping, a final speculative design was developed that materialised **the tension between analytical feedback and subjective reflection**.

This tension was expressed through an **interactive experience that alternated between different modes of feedback**, ranging from quantitative data to narrative and interpretive forms.

The prototype was then tested with people with PTSD to **ensure that their lived experiences were meaningfully translated**.

Their engagement revealed personal values related to how different forms of feedback shaped their sense of understanding and agency.

The findings show that the trade-off between datafication and lived experience is **not an opposition of forces, but a productive tension** that can be intentionally designed. When **analytical insights are intertwined with guided personal reflection**, digital twins can complement psychiatric care by creating conditions that support self-understanding, emotional safety, and interpretive agency. The study further revealed that **the framing of feedback** from the digital twin to the user strongly shapes **whether the technology feels supportive or intrusive**, and how trust in data is formed.

Finally, the study offers **recommendations for designers** of future digital twin technologies, emphasising the need **to balance predictive accuracy** with **reflective engagement** that is sensitive to the richness of lived experience. In doing so, it positions speculative design as a method for anticipating the experiential and relational futures of psychiatric technologies before they are built.

Dedication to People with PTSD

Over the past few months, I've met many people who did not choose the life they are living now. It makes me angry that life can unfold in ways that are completely beyond our control, yet some people are the ones who have to live with and repair the consequences for years. I am deeply inspired by the way these individuals continue to strive for recovery, and by the vulnerability it takes to keep trying.

This semester, I've learned a lot about the psychiatric care system, and how easily people can get stuck in it when getting better is not as straightforward as hoped. That truly sucks.

I'm grateful to have met you all, to have learned from your perspectives, and to carry those lessons with me into whatever comes next. This thesis is dedicated to your voices. Your perspectives deserve to be heard.



Acknowledgements

Is data making our society better, or is it depriving us of the ability to truly progress?

What started as an exploration of technological possibilities in data and digital twins evolved into an epistemic and philosophical journey. The tension explored in this thesis resonated deeply with me, as I highly value intuition yet remain fascinated by innovation. Combining these two perspectives proved challenging but profoundly meaningful.

This project has also been a personal journey. Since I quit rowing to return to my studies, I have often struggled to find motivation. I rediscovered it through this project. Although I was initially anxious to begin, I gradually developed a rhythm that worked for me. I am proud of this process and deeply grateful to all the people who supported me along the way.

A big thank you to:

My **parents, family, and friends**: thank you for your endless love and presence. I thought that by now I had enough life experience to avoid emotional breakdowns, but they came anyway. Thank you for picking me up every single time and reminding me that it is okay to fall apart for a bit before moving forward again. To my **rowing team**, thank you for keeping me healthy, sane, and happy this summer.

A special thanks to **Julius** for always finding the most creative ways to cheer me up, and for making sure that after 28 years I finally learned how not to study through the night and how

to have a proper morning routine, in which I prepare my lunch and cycle to school. It sounds simple, but it truly isn't!

A special thanks to **Annabel** for all the coffee moments in which we always end up having philosophical discussions about our futures. Also thanks for the notebook you gave me made from the loveliest type of paper for writing down all of my messy (non-thesis!) thoughts.

I am very grateful for my supervisors. **Nazli**, for trusting me to find my own way and for giving me the freedom to do so. **Karin**, for your sharp feedback, for helping my free creative brain stay within academic boundaries, and for always being available when it mattered most. Thank you **Peter** from **GGZ Noord-Holland-Noord** for connecting me with experts, and for your contagious enthusiasm at every presentation I gave.

Thanks to everyone working in the **StudioLabs** for welcoming me and supporting me by providing interesting insights and motivation. Especially **Aadjan** for providing me a desk.

I want to thank all the **people** I interviewed. You provided valuable insights and gave me direction when I felt lost in the beginning.

Most importantly, I want to thank **all participants with lived experience of PTSD** who trusted me with their stories and allowed themselves to be vulnerable. Your openness gave this project its depth and meaning. I am deeply grateful to have met you, and I hope that we can continue learning from one another beyond this project.

Glossary

Agent: an artefact capable of sensing the user and its surroundings, communicating with it and evolving.

Boundary object: an artefact that remains flexible enough for different stakeholders to interpret and use in distinct ways, yet robust enough to maintain a shared identity.

Digital Twin: refers to a virtual simulation of a person's behavioural and emotional state that is constructed through continuous bidirectional data collection.

Digital Phenotyping: continuous collection of data from personal digital devices to quantify behavioural characteristics in real-world contexts. Such devices may include smartwatches, smartphones, or computers, providing data such as typing speed, social media activity, and online search behaviour.

Datafication: The transformation of aspects of everyday life into quantifiable data, often through digital monitoring and measurement technologies.

PTSD (Post-Traumatic Stress Disorder): A mental health condition that can develop after exposure to traumatic events involving actual or threatened death, serious injury, or sexual violence, and is characterised by symptoms such as intrusive memories, avoidance, negative alterations in mood or cognition, and changes in reactivity.

Digital Biomarker: measurable signals that can support diagnostic interpretation obtained through digital phenotyping.

Data Phantom: a metaphor describing how traces of the past continue to inform algorithmic judgment in the present. Data from the past might 'haunt' you in the present.

Data Shadow: a metaphor describing the trace of personal data collected through digital interactions, which can shape decisions about individuals without their direct awareness.

Speculative artefact: a designed object or scenario intended to provoke reflection, discussion, or critique, rather than to solve a problem; used in speculative design research.

Mediation: in a psychiatric healthcare organisation, this means the way roles between care seekers and therapists could be shaped by a digital twin.

Personal values: refer to what an individual finds meaningful, desirable, or important in their own life and experiences, reflecting their priorities and sense of well-being. Rather than assuming these values beforehand, the study explores how they emerge from participants' reflections and interactions with the speculative artefacts.

Lived experience: refers to the embodied and experiential ways in which people make sense of their emotions and bodily signals, in contrast to data-driven interpretation.

Speculative Design Approach: a design methodology that explores and questions possible futures by creating provocative artefacts or scenarios, aiming to spark critical reflection rather than provide immediate solutions.

Trauma-Informed Design Principles: a framework co-designed through a network of trauma survivors, structured around four lenses: research, design, policy, and organisational. It consists of seven core principles that guide ethical engagement with trauma survivors. It translates lived experience into concrete practices that promote safety, agency, and emotional well-being.

Overbruggingszorg: interim care provided to individuals awaiting formal treatment, aiming to reduce symptom worsening and prevent negative outcomes during long waiting periods.

Wizard-of-Oz: a form of research where you use make-believe in order to pretend that a technology is working in order to test an interaction with a non-existent, future technology.

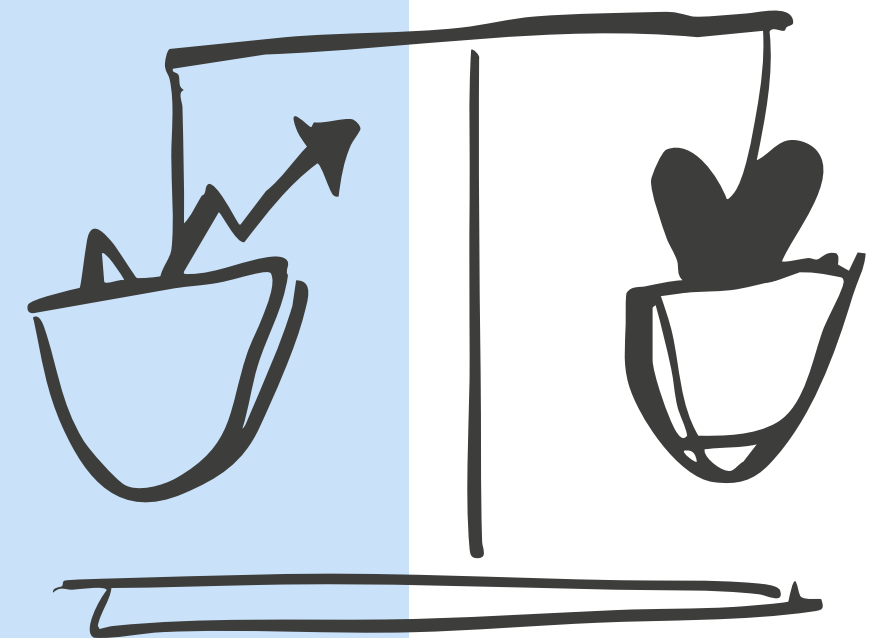
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1.

Introduction & Methodology



1.1 Introduction

*Imagine sprinting to catch the bus: your heart starts racing, your blood pressure rises. You know it is simply your body responding to stress. But what if you could no longer rely on that sense of trust in your own body? For many people with **Post-Traumatic Stress Disorder (PTSD)**, this uncertainty is a daily reality. Bodily signals that are meant to guide and protect can become confusing, or even threatening, blurring the line between ordinary stress and trauma-related reactions. For people with PTSD, their own body can become an unpredictable reminder of fear; a system they can no longer trust.*

This tension raises a broader question: how can we understand and regulate our internal states when our body no longer feels trustworthy? Could technology assist in interpreting emotional and physiological signals?

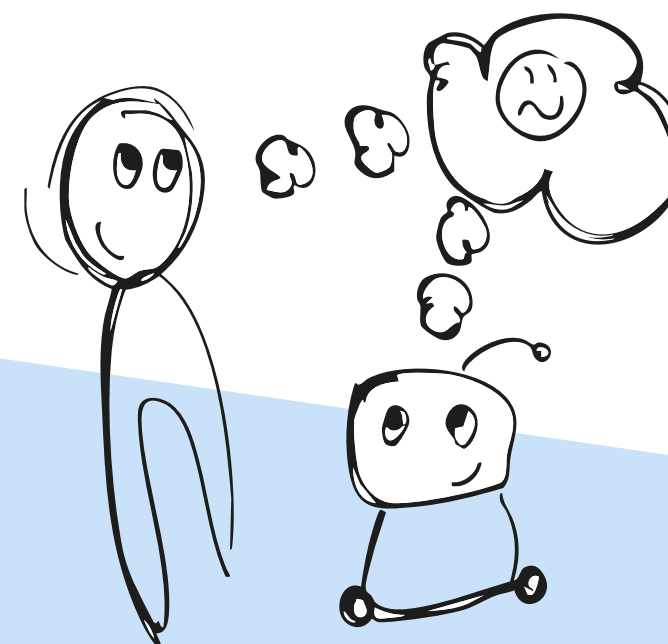
Recent developments in **psychiatric healthcare** suggest that this might soon be possible. A **digital twin** is a virtual simulation of a person's behaviour, constructed through continuous data collection. Within psychiatric contexts, such systems could monitor changes over time, predict relapses, and provide feedback to support therapy (Spitzer et al., 2023). Digital twins therefore hold the promise of more personalised and patient-centred care.

Yet, scholars warn that **digital twins risk reducing complex emotional and contextual realities to simplified data representations, overlooking their personal meaning** (Sharon, 2016; Ruckenstein & Schüll, 2017). For individuals already struggling to trust their own bodily signals, such an external “mirror” introduces a paradox: it can give an impression of self-enhanced understanding by revealing hidden patterns, yet in doing so, it may also create a sense of alienation from one's own intuition.

Beyond this conceptual tension, there are also practical and ethical risks. **Reliance on data-driven insights may disrupt the intuitive coping mechanisms of people with PTSD.** It could undermine self-trust, increase anxiety, and foster over-reliance on algorithmic interpretations of mental states (Ruckenstein & Schüll, 2017). Scholars further argue that reducing experiences to shallow data patterns can discourage deeper personal reflection (Sharon, 2016). Serious concerns also remain regarding patient privacy and data ownership, including the risks of data breaches or misuse of sensitive information (Thieme et al., 2020).

I am personally drawn to this dilemma, as it **resonates with my own experience**. As a former elite athlete, I spent years training with data: tracking heart rate, sleep, diet, and lactate levels in the pursuit of peak performance. Although this quantification helped me succeed, it also distanced me from my own sense of intuition. I learned what my data told me, but forgot to feel when I was overtrained. **This personal experience parallels the challenge in psychiatric healthcare today:** how might we use data to support, rather than override, human intuition?

This tension is even more relevant for **people with lived experience of PTSD**. PTSD can develop after exposure to traumatic events involving actual or threatened death, serious injury, or sexual violence, and is characterised by symptoms such as intrusive memories, avoidance, negative alterations in mood or cognition, and changes in reactivity (American Psychiatric Association [APA], 2022). While clinical treatments, such as exposure therapy, cognitive restructuring (changing unhelpful thought patterns), or medication, can be effective, they are not always available, affordable, or sufficient (Fonzo, Federchenko, & Lara, 2020; National Institute of Mental Health, 2023). A **digital twin could potentially support self-management by signalling triggers or early signs of relapse**. However, for people with PTSD, such feedback requires careful consideration in its design, as data-driven interpretation directly touches on the fragile balance between bodily awareness and technological mediation.



Design can make a critical contribution in exploring this dilemma. **Speculative design**, in particular, enables us to critically explore “what-if” scenarios, imagine futures before they are implemented, and to question their desirability and ethical implications (Savransky, Wilkie & Rosengarten, 2017). Through this approach, I aim to explore how **speculative design research** can **provoke reflection** on the ways digital twin technologies might introduce a **trade-off** between datafication and **subjective lived experience** within psychiatric healthcare. **Using PTSD as a case study**, the project explores how the underlying **personal values** and perspectives of people with PTSD can **inform recommendations for designers** on how to anticipate and critically engage with the futures of this emerging technology.

*In this thesis, a **personal value** refers to what an individual finds meaningful, desirable, or important in their own life and experiences, reflecting their priorities and sense of well-being (Desmet & Roeser, 2015). Rather than assuming these values beforehand, the study explores how they emerge from participants' reflections and interactions with the speculative artefacts.*

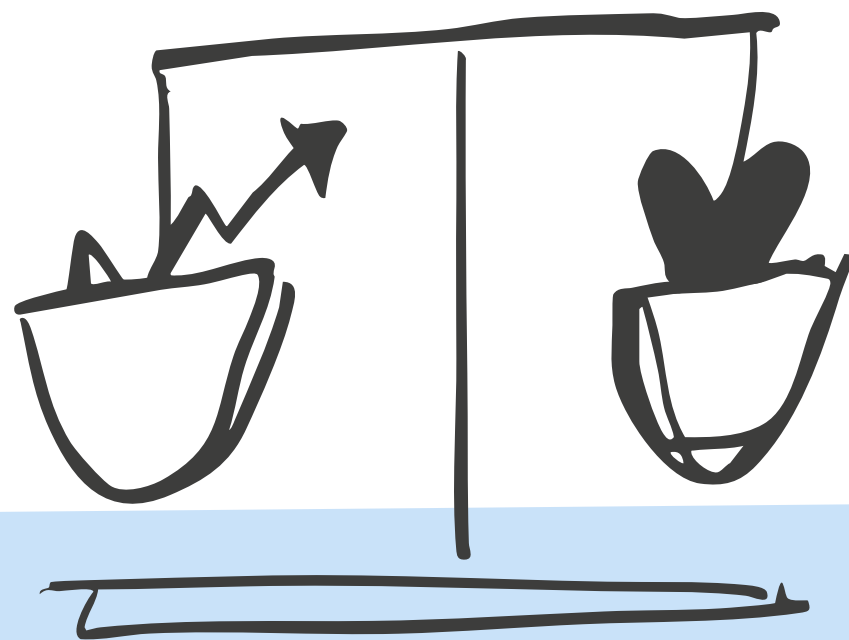
*Subjective **lived experience** refers to the embodied and experiential ways in which people make sense of their emotions and bodily signals, in contrast to data-driven interpretation (Oudin et al., 2023; Coghlan & D'Alfonso, 2021). The term subjective is included deliberately to highlight the personal and situated nature of lived experience, which stands in tension with the objectivity implied by datafication. In the remainder of this thesis, it will simply be referred to as lived experience.*

Research Question

In what ways might digital twin technology introduce a trade-off between datafication and intuitive, lived experience in psychiatric healthcare for people with PTSD?

Sub-Questions

1. How can speculative design elicit and communicate the personal **values and concerns of people with PTSD** to inform future design of digital twin technologies?
2. How might **different ways of representing and framing feedback**, from data-driven metrics to intuitive and narrative forms, shape how people interpret and **relate to their lived experience**?
3. How might engaging with such feedback **influence a person's sense of agency and self-understanding** in managing their mental health?



Tone & Structure

To address these questions, this thesis applied a **speculative design methodology** that combined contextual grounding with participatory elements. In the grounding phase, insights from literature, expert interviews, and early exploratory sessions informed the development of **speculative artefacts** that materialised tensions between datafication and lived experience. These artefacts were first iterated and tested with design students to explore **how they could provoke reflection** on future psychiatric technologies. The final prototype was then **evaluated with individuals with lived experience of PTSD** to examine how they interpreted and emotionally responded to the envisioned interaction. Their reflections provided insight into how the artefact's tone, pacing, and emotional resonance were perceived, helping to evaluate whether it represented lived experience authentically. Insights from both stages informed the final analysis and design recommendations, which aim to **stimulate critical reflection** among designers and researchers on the implications of digital twins in psychiatric healthcare.

The following chapters outline how this process unfolded, from the initial grounding and speculative explorations to the evaluation of the final prototype. Together, these stages build toward insights that inform both the design outcomes and the broader discussion on datafication, lived experience, and the future of psychiatric healthcare.

Throughout the thesis, **short author reflections are interwoven with the main analysis** to make the design process transparent. This stylistic choice not only situates the researcher within the inquiry but also mirrors the very theme of the study, balancing reflection and analysis in both content and form. This deliberate decision also does greater justice to the nature of speculative design, which cannot be fully captured within conventional analytical frameworks.

1.2 Methodology & Scope

*This chapter outlines the methodological approach and scope of the study. It explains how **speculative and participatory methods** were combined to investigate digital twin technologies within psychiatric healthcare. The chapter also defines the **target groups**, describes the **process of grounding, ideation, and testing**, and clarifies how these stages contributed to the development of the final speculative prototype.*

Target Group

This project was developed with **two perspectives in mind**: that of designers who shape emerging technologies and that of individuals with lived experience of psychiatric conditions who are most affected by them. The speculative artefacts were designed to encourage reflection among designers on how data-driven technologies might influence human experience and self-understanding in psychiatric contexts.

To ensure that the speculation was grounded in lived experience rather than assumption, the case study focused on people with **Post-Traumatic Stress Disorder** (PTSD). PTSD was chosen because it represents a condition in which bodily awareness and trust are deeply challenged, making it a meaningful context for exploring how data-driven feedback technologies might interact with lived experience (Landry et al., 2010).

While the broader discussion concerns the use of digital twins in psychiatric healthcare, this study focuses on PTSD as a **specific and illustrative case**. The intention was not to make generalisable claims about all mental

health contexts, but to explore how speculative design can engage with lived experience to surface values and tensions relevant to such technologies.

The final speculative prototype was tested with **two participants** with lived experience of PTSD. Their reflections provided nuanced insights into how data-driven feedback might be interpreted and felt within a trauma-related context. These insights, in turn, inform a set of design recommendations aimed at helping future designers critically engage with the ethical and experiential implications of digital twin technologies.

The following section outlines the methodological approach used to develop and evaluate these speculative artefacts, detailing the stages of grounding, ideation, and testing that structured the design process.

Procedure

This study employed a **speculative design approach** complemented by participatory methods. Speculative design was used to explore possible futures of digital twin technologies in psychiatric healthcare, while participatory activities provided contextual insight into the lived experience of PTSD.

To build this contextual grounding, I conducted interviews with **individuals with lived experience of PTSD** and with **mental healthcare professionals**, including psychologists, psychotherapists, and psychiatric nurses. I also engaged in voluntary activities with people experiencing psychiatric vulnerabilities, including weekly support for a young woman with complex PTSD. These experiences helped develop contextual sensitivity and empathy, complementing insights from interviews and literature.

Participant recruitment took place through the network of the client organisation, **GGZ Noord-Holland-Noord (GGZ-NHN)**, and through my own professional connections within the mental healthcare field.

Although the research process was inspired by the framework of Bendor and Lupetti (2024), it was not applied as a fixed sequence of steps. As is common in speculative design, **the methodology functioned as a guiding structure rather than a prescriptive model**. Each stage was adapted to the specific context and aims of the study, allowing room for intuition, iteration, and emergence throughout the process. This flexible approach aligns with the broader view in speculative design literature that each project requires its own situated and context-sensitive process rather than a standardised method (Mitrović et al., 2021).

Process overview

1. **Grounding** the context through **ten expert interviews**, conversations with people with lived experience, and literature review.
2. Identifying and reframing key **tensions** emerging from these materials.
3. **Ideating and positioning the design** around these tensions.
4. Creating low-fidelity **speculative artefacts** to test and refine the tensions with **eight design students**.
5. Developing and evaluating the final **speculative prototype** together with **two individuals with lived experience of PTSD**.



During the **grounding** phase, ten participants were interviewed, including managers in psychiatric health-care, individuals with lived experience of PTSD, psychiatric nurses, psychotherapists, and psychologists. Complementary insights were gained through two visits to a voluntary community organisation for people with psychiatric vulnerabilities and through weekly volunteering with a young woman with complex PTSD (see *Ethnographic lens*).

Tensions were primarily derived from literature and interview insights, which were iteratively reframed and combined. This process led to the early development of **speculative artefacts**: low-fidelity prototypes created to test whether identified tensions were indeed provocative (Bendor & Lupetti, 2024). Testing these artefacts with **eight design students** helped assess their relevance and depth, refining the conceptual direction of the work. The iterations culminated in a set of clustered tensions that informed the written speculative scenarios and, eventually, the final high-fidelity prototype.

The final prototype was then tested with **two individuals with lived experience of PTSD** to ensure that the design resonated with their perspectives. Insights from these sessions informed design recommendations intended to help future designers critically engage with the experiential and ethical implications of digital twin technologies.

Context

The project was conducted in collaboration with **GGZ Noord-Holland-Noord**, a regional psychiatric healthcare institution in the Netherlands. The Dutch psychiatric healthcare system currently faces increasing waiting lists for specialist care (Nederlandse Zorgautoriteit, 2024), see Figure 1.1. These extended waiting times affect both patients and professionals, placing **additional pressure** on psychiatric nurses and general practitioners, who are increasingly required to manage mental-health issues beyond their formal training (Nederlandse Zorgautoriteit, 2024). In 2023, individuals suffering from trauma faced an average wait time of **13 weeks** before initial intake, followed by an **additional**

21 weeks before receiving treatment (Nederlandse Zorgautoriteit, 2024). Such delays are associated with poorer treatment outcomes, lower patient adherence, and worsening of symptoms, which in turn affects the cycle of long waiting lists.

In response, national healthcare discussions have increasingly emphasised the need for **overbruggingszorg** (bridging care): interim support for individuals awaiting treatment to mitigate the negative effects of these delays (Nederlandse Zorgautoriteit, 2024). A digital twin could play a role in providing **overbruggingszorg** for individuals awaiting treatment.

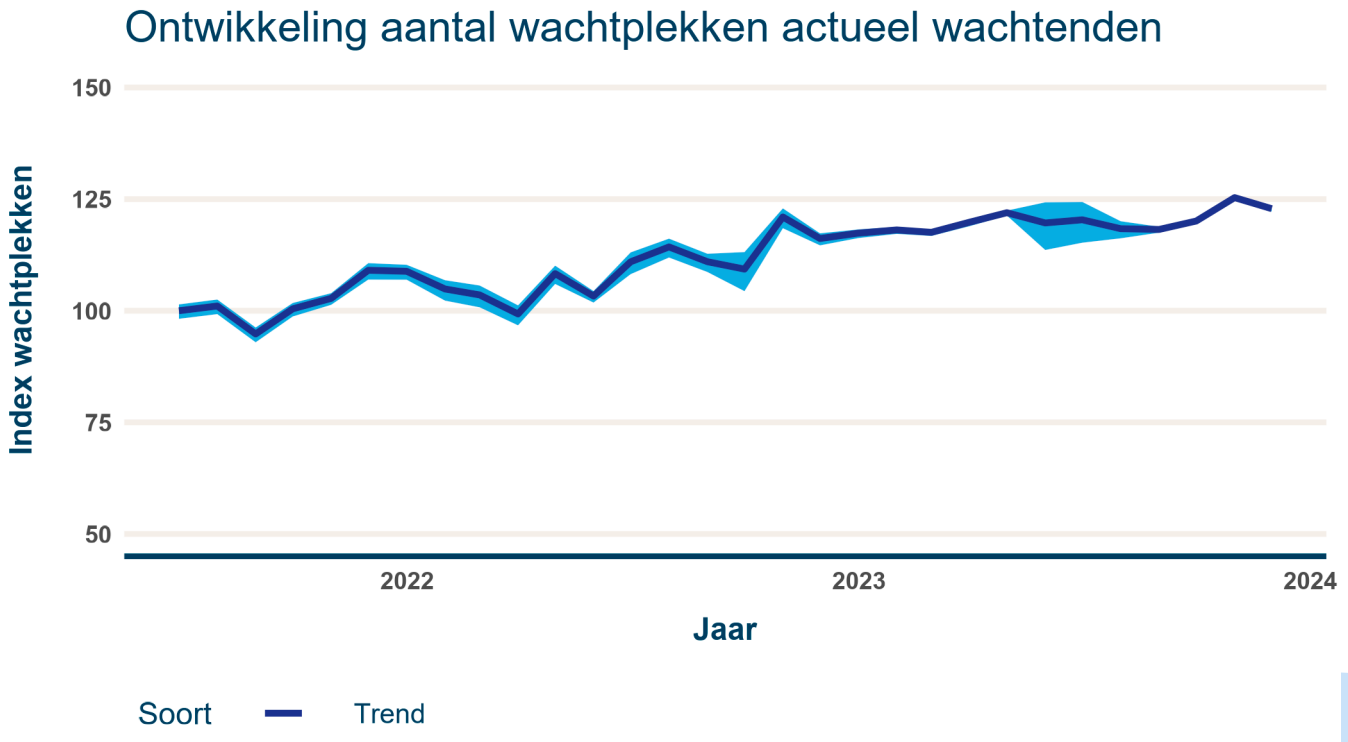


Figure 1.1 The increasing growth index of waiting lists (Nederlandse Zorgautoriteit, 2024)

Scope

The scope of this project focuses on the interaction **between patient and digital twin**, acknowledging but leaving aside the roles of healthcare professionals and broader structures.

A simplified overview of the key stakeholders and the potential position of the digital twin within this care landscape can be seen in figure 1.2.

GGZ works through a **triage system**. When a person experiences mental problems, he or she first visits the General Practitioner, and through there receive an official indication to receive specialised help from therapists, psychologists or psychiatrists. POH-GGZ is in between, helping either when someone is awaiting care or when problems can be solved in a non-specialist way (Nederlandse Zorgautoriteit, 2024).

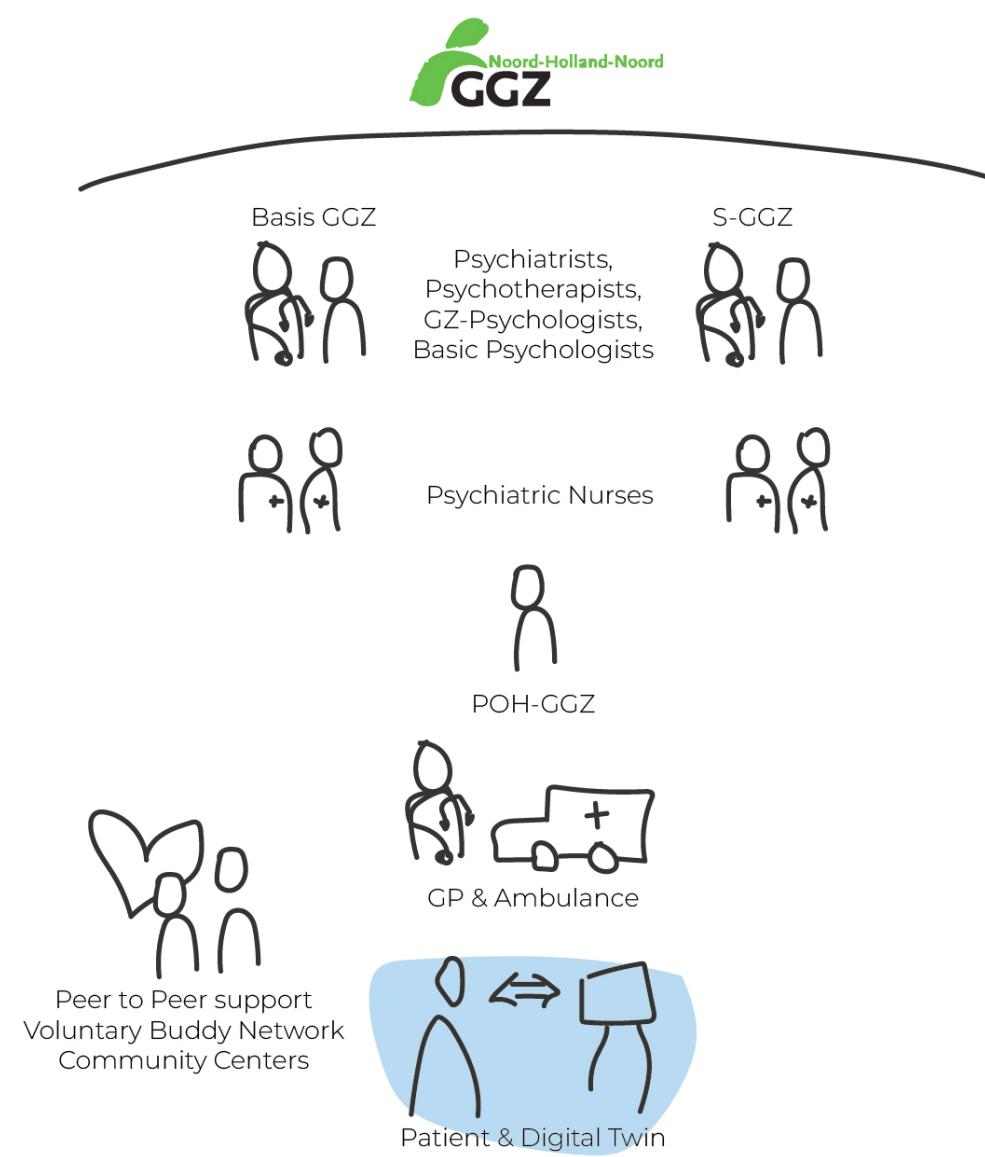
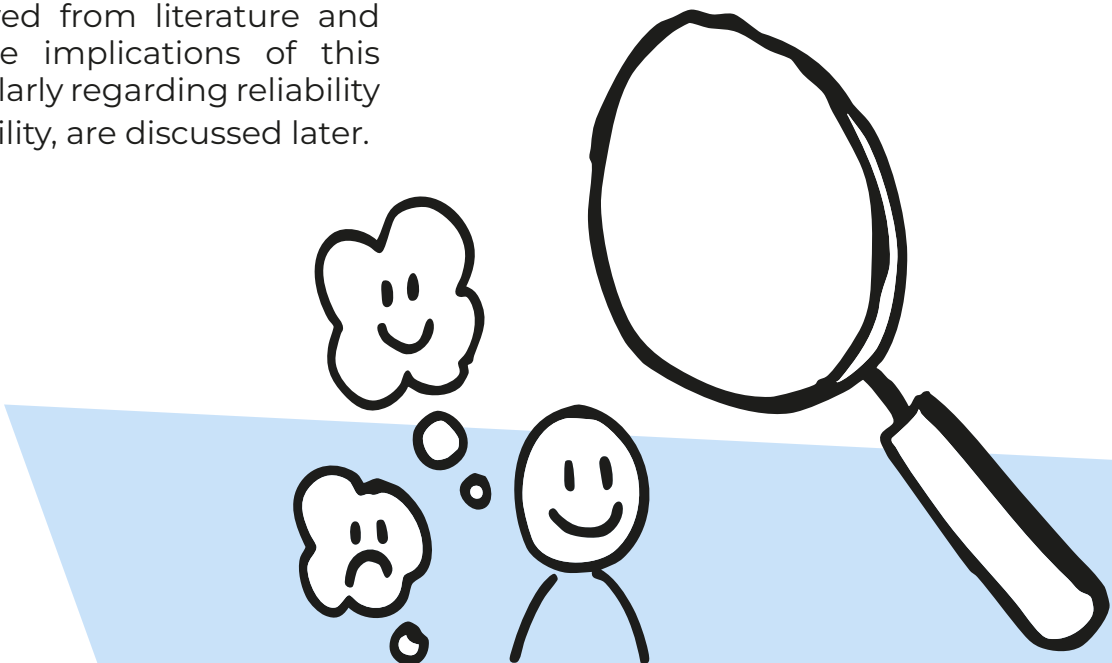


Figure 1.2 Simplified visual of the Dutch psychiatric healthcare system, showing how the digital twin relates to the patient and to existing forms of clinical and community care.

Ethnographic lens

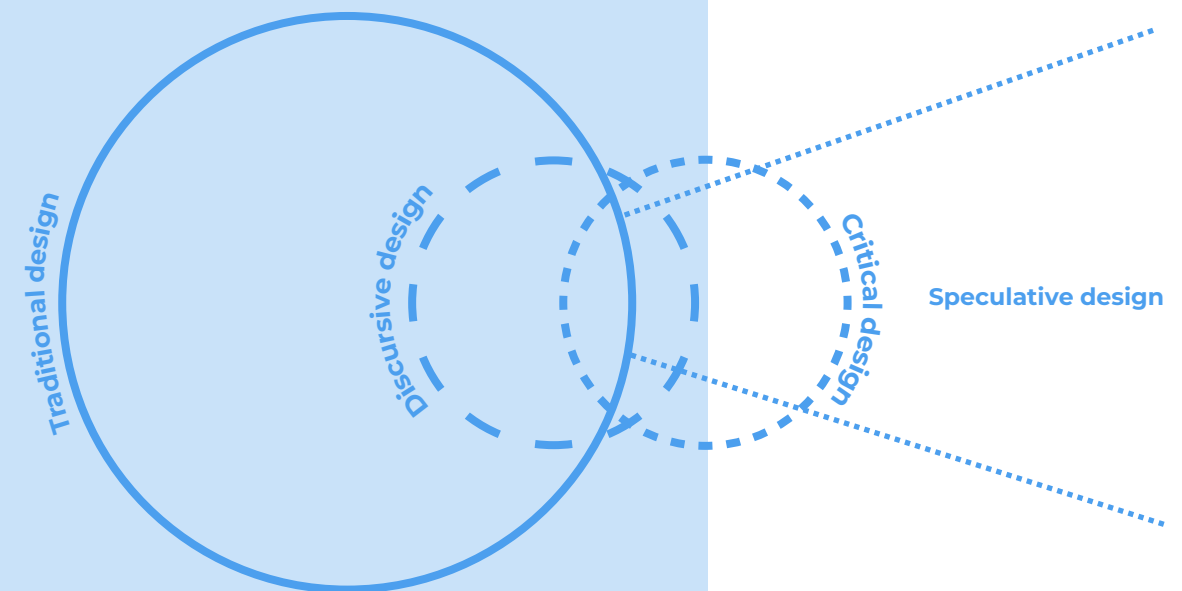
To incorporate the perspectives of people with lived experience of PTSD, this research adopted an **ethnographic lens**. Weekly volunteering with a young woman with complex PTSD created a form of **contextual embedding**, offering experiential insight that complemented rather than quantified understanding. This approach was inspired by Claisse et al. (2025), who, through a three-year collaboration with the Recovery College Collective, advocate for keeping data in context and argue that quantitative methods can diminish the richness of people’s lives. Following their reasoning, this project used participant observation through voluntary work to challenge purely clinical perspectives and foreground the everyday realities of living with trauma.

While such long-term community engagement was beyond the scope of this study, it served as a **valuable methodological reference point**. Consequently, insights from this engagement were treated as complementary to those derived from literature and interviews. The implications of this choice, particularly regarding reliability and transferability, are discussed later.



2.

Grounding the speculation



Chapter 2 - Grounding

To create an engaging and meaningful speculation, it is crucial to strike a balance between **strangeness** and **familiarity**. Before exploring imaginative possibilities, speculative design must be **anchored in real-world conditions** that make the work recognisable and relevant. Grounding provides the contextual foundation from which speculation can meaningfully evolve (Bendor, 2023).

“Both futurists and designers recognise that the work of the imagination must be situated and grounded in real-world conditions” - Bendor, 2024

The grounding of this speculation consisted of an extensive literature review of key concepts that underpin the project. The focus was first mainly on forming the **approach**, reviewing literature on **speculative design and trauma-informed design**. After this, the focus shifted to more informational topics forming the **content** of this speculation, including **Post-Traumatic Stress Disorder (PTSD), digital twins, digital phenotyping**, and recent research on **human-technology relations**. Together, these topics provide the necessary background for understanding how digital technologies might shape the future of psychiatric healthcare.

To enrich this foundation, **interviews** and **observations** were conducted, as described in the section about the ethnographic lens. Through direct engagement with people with lived experience of PTSD and relevant professionals, in-depth insights emerged, particularly concerning the everyday dynamics of PTSD and the role of coping mechanisms and service dogs.

Grounding this speculation also involved exploring the designer’s positionality within this subject through reflections on personal experiences with data collection and mental health. This positionality informed how tensions were interpreted and how the speculative exploration was shaped.

The combined findings from the literature review and contextual research were synthesised into a series of **tensions**. These tensions form the foundation of the speculative work that follows.

2.1 About Speculative Design

Speculative design does not follow a single or prescriptive method. Rather than focusing on critique alone, it uses speculation as a way of thinking through possible futures and their social, ethical, and experiential implications (Dunne & Raby, 2013). This is illustrated in figure 2.1. While approaches differ, speculative design consistently aims to provoke reflection on what kinds of futures are being imagined, for whom, and under what assumptions.

Dunne and Raby describe the speculative designer to be “somewhere between literature and cinema,” crafting just enough cues for audiences to imagine a broader world with its

politics, ideologies, and everyday life. Design becomes a narrative medium that invites reflection on the present through the lens of imagined futures. As they note, speculative design aims to “unsettle the present rather than predict the future.”

“Design shows people what is possible, but it is up to them to judge whether that future is desirable and to what extent their actions and attitude contribute to that future” - Bendor, 2024

Speculative design achieves this through the creation of **tensions**: deliberate dilemmas that expose ambiguities and competing values surrounding emerging technologies. These tensions often arise from thought experiments that extend certain assumptions or developments to their extremes (Mitrović et al., 2021).

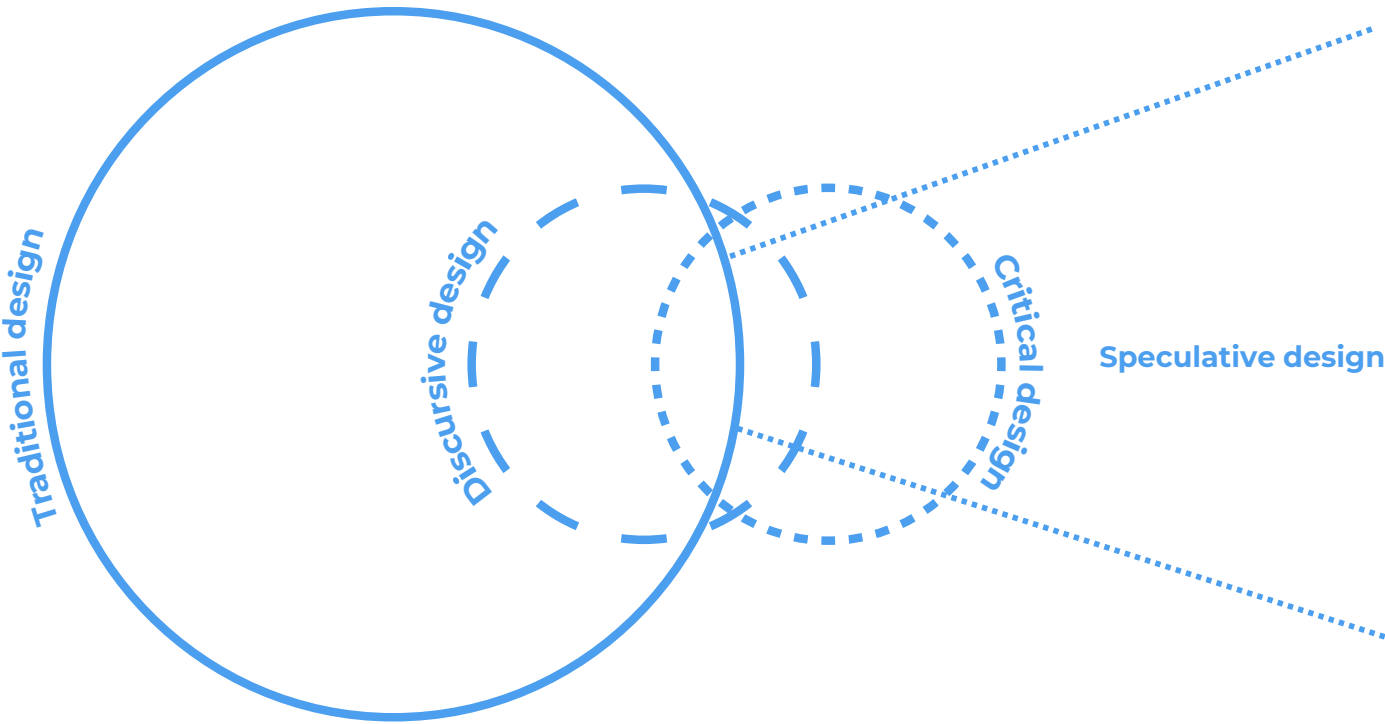


Figure 2.1 Visualisation of what speculative design is compared to design methods

A tension differs from both a **risk and a dichotomy**: risks demand mitigation, while tensions call for reflection; dichotomies simplify, while tensions acknowledge coexistence and interdependence.

For instance, in healthcare a person may value the efficiency of digital tools yet still seek the empathy of human interaction. This is an ambiguity that is not a problem to be solved but a condition to be explored.

“Unsettle the present rather than predict the future.” – Dunne & Raby (2013)

A well-formulated tension captures such interdependence and forms the basis for **worldview narratives**: speculative scenarios that translate abstract concerns into tangible, situated experiences. The aim of these narratives is not prediction or resolution, but to foster reflection on present design practices and their broader implications (Mitrović, 2016; Bendor & Lupetti, 2024). As Auger (2013) notes, compelling speculative designs balance **familiarity** and **strangeness**, provoking both intellectual and emotional engagement.

Bendor and Lupetti (2024) further distinguish between **pragmatic speculation**, which anticipates probable futures, and **imaginative speculation**, which challenges assumptions through provocative and unfamiliar scenarios (Figure 2.2). Effective speculative design leans toward the imaginative, encouraging audiences to confront values that conventional foresight might overlook.

Such speculations must nonetheless be grounded in a well-defined context.

Grounding involves developing a foundation of knowledge from literature, expert insights, and contextual observations that shape the plausibility and ethical orientation of the work (Bendor & Lupetti, 2024). From this foundation, designers articulate a stance and test the identified tensions through low-fidelity **speculative artefacts**: prototypes designed to provoke reflection on specific aspects of the envisioned future. Iterative testing refines both the scenarios and the underlying tensions before reaching a final outcome.

This process allows designers to question and reflect on technological developments before they become normalised in practice, encouraging alternative perspectives on their societal and experiential implications (Lawson et al., 2015).

In the context of this Master’s thesis, speculative design offered a means to explore how digital twin technologies might influence experiences of care and self-understanding in psychiatric contexts. Speculative design has also been critiqued for its potential elitism, as designers often determine which futures are explored and how they are represented (Farias et al., 2022). In response, this project aims to treat speculation not as detached critique but as a situated, dialogical practice attentive to the contexts and experiences it engages.

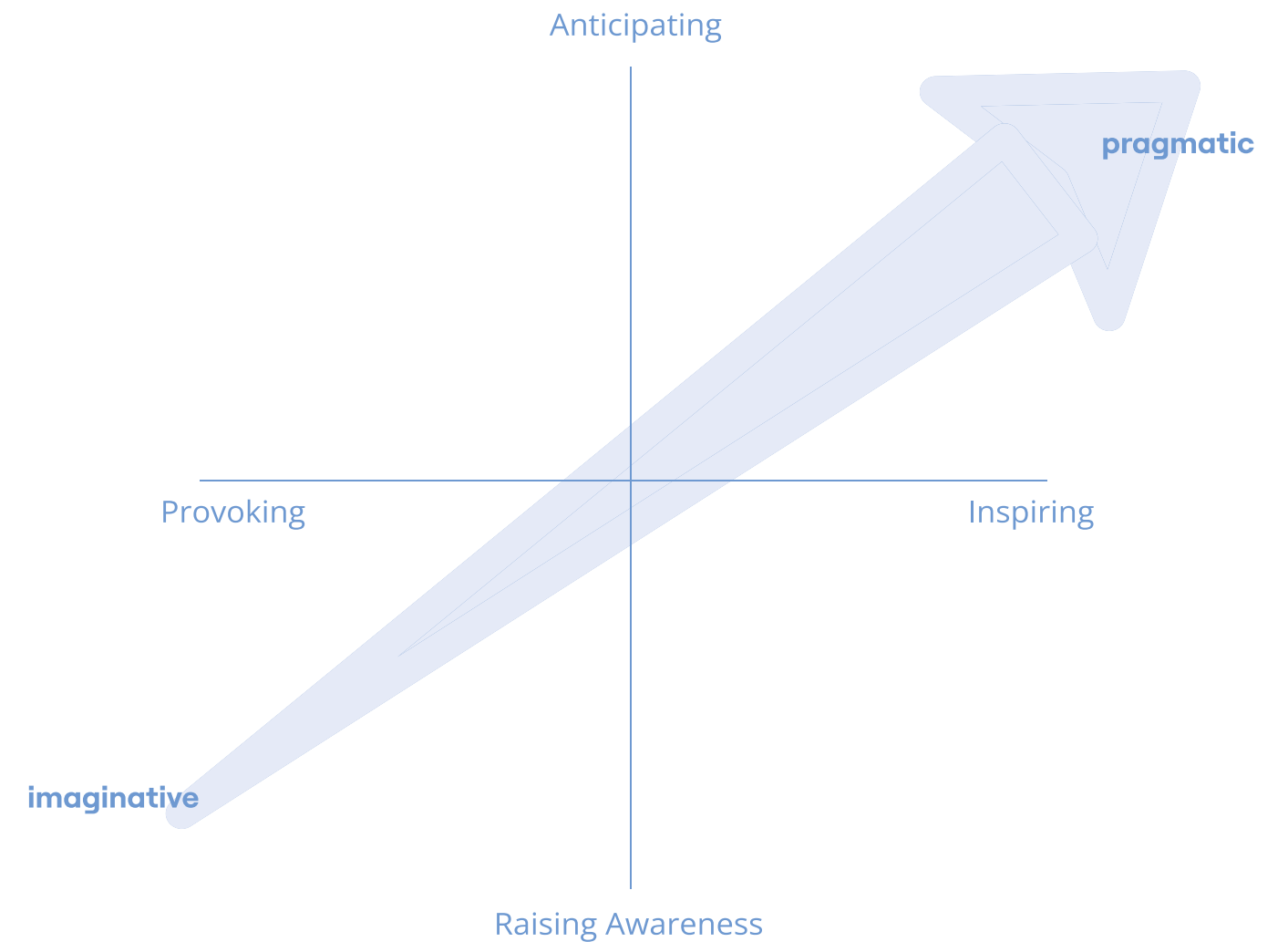


Figure 2.2 This grid can serve as an inspiration in finding tensions that are really imaginative (based on figure by Bendor & Lupetti, 2024)

2.2 Inspiring Examples

A number of speculative works have explored related tensions between care, technology, and human experience. These projects formed concrete examples that served as how to speculative design research. The examples illustrate how speculative design can make ethical and emotional questions tangible.

Superflux – Uninvited Guests



Figure 2.3 Elderly man is being monitored by his children on whether he is eating healthy by a smart fork (Superflux, 2015)

In *Uninvited Guests*, Superflux (2015) presents a near-future scenario in which an elderly man lives surrounded by health-monitoring devices gifted by his children (figure 2.3). The film juxtaposes the reassuring promise of technological care with the emotional discomfort of constant surveillance. It exposes a subtle tension between **autonomy** and **control**: between being cared for and being watched. This ambivalence closely aligns with the focus of this thesis, which similarly examines this.

Lucy McRae – Compression Carpet

Lucy McRae's *Compression Carpet* (n.d.) envisions a post-apocalyptic world in which physical intimacy has been lost, and human touch must be re-learned through an improvised mechanical device (figure 2.4). The project demonstrates how speculative design can translate abstract fears such as isolation and dehumanisations by technology into tangible, embodied experiences. By inviting tactile and emotional engagement, McRae's work serves as an important inspiration for this thesis, as it similarly investigates the tension between human interaction and data-driven interpretation.



Figure 2.4 Compression carpet embodying abstract fears like dehumanisation and isolation (Lucy McRae, n.d.)



Figure 2.5 Snapshot out Black Mirror episode where instead of blocking people online, people blocked each other in real life, becoming no more than just a ghost to each other (Brooker & Tibbetts, 2014)

Black Mirror – White Christmas

The Black Mirror episode White Christmas (Brooker & Tibbetts, 2014) extends the idea of digital consciousness into a dystopian narrative where digital replicas of human minds are used as obedient assistants. The story raises fundamental ethical questions about autonomy, identity, and consent in human-machine relationships. While its tone is intentionally extreme, it resonates with ongoing debates about digital twins, which also blur boundaries between self, simulation, and control. Although the speculative approach in this thesis adopts a more hopeful stance, *White Christmas* demonstrates how narrative speculation can powerfully elicit these tensions before these technologies become reality (Figure 2.5).

2.3 Trauma-Informed Design

Building on the ethnographic lens described earlier, this research also adopted a **trauma-informed perspective** to ensure that participation remained emotionally safe and empowering for all involved.

This project followed the trauma-informed design framework developed by **the Chayn Network** (Hussain et al., 2022). It is structured around four **lenses**: research, design, policy, and organisation, and seven core principles that guide ethical engagement

with trauma survivors (see **Figure 1.5**). Developed through a decade of collaboration with survivors, the framework translates lived experience into concrete practices that promote safety, agency, and emotional wellbeing.

Since this thesis primarily concerns speculative research, the **research lens** was most directly applied, though insights from the design and organisational lenses also informed the overall approach. The application of these principles is reflected in the ethical checklist and informed consent form, which were aligned with the Chayn guidelines (see **Appendix A**).

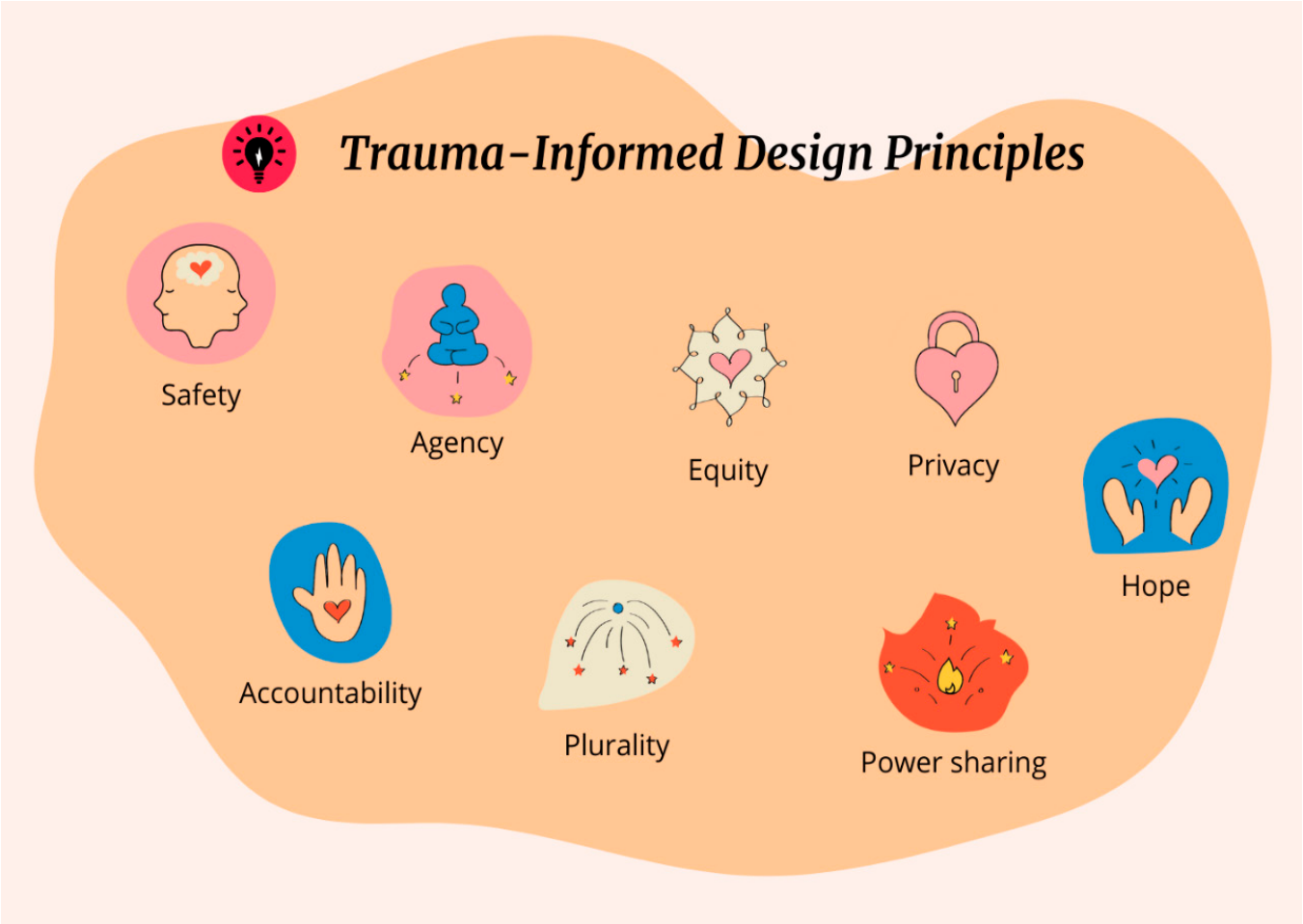


Figure 2.6 The co-designed Trauma-Informed Design Principles by Chayn Network (Hussain et al., 2022)

Implementation in thesis

During interviews and prototype testing, participants were briefed about their **right to pause** or withdraw at any moment. Conversations were flexible and participant-led, allowing individuals to move beyond the main topic or express discomfort when needed. The researcher took care to prevent oversharing of distressing experiences and used transparent language to foster trust.

Recruitment took place through **voluntary networks** and personal connections rather than institutional databases, in order to increase accessibility for marginalised groups and maintain trust. Consent forms were written in accessible language, clearly outlining the intentions and emotional tone of the sessions. Ethical practices such as participant validation and the use of pseudonyms were also guided by this same ethos of care.

The principle of **hope** played a particularly important role in this project. Hope, as defined by Chayn, extends beyond optimism: it is about fostering empathy, calm, and recognition. Hopeful design avoids retraumatising or sensational imagery and instead creates an atmosphere of warmth and trust. Within this project, hope guided both the tone and structure of the speculative prototype, aiming to help participants feel seen and respected rather than pathologised.

Hope also functions as an **ethical counterpoint** to the often dystopian tendencies within speculative design. Rather than imagining futures defined by control or fear, the aim was to create speculative artefacts that evoke **recognition** and possibility. For participants, this meant being able to see aspects of

their own lived experiences reflected in the design in a way that felt genuine and human. In this sense, feeling seen does not imply agreement with the design, but recognition, that their perspectives and vulnerabilities were meaningfully acknowledged within it. Within psychiatric contexts, **lived experience** is closely tied to autonomy and emotional safety. Emphasising this connection framed the ethical orientation of the study: the speculative prototype was designed not to measure or correct behaviour, but to provide a safe space for reflection and recognition. Supporting participants' lived experience thus became a guiding aim throughout the process, ensuring that engagement fostered agency rather than dependence.

In later chapters, this will be elaborated upon regarding how these principles were integrated into the prototype design and testing process to support participants' lived experiences, agency, and emotional safety.

"It is not what we do, but the way how we do it." - Chayn Network, 2022

2.4 Post-Traumatic Stress Disorder (PTSD)

*There has been a growing awareness of the impact of **psychotrauma** in both personal and societal contexts resulting from accidents, assaults, natural disasters, or war (Hengeveld et al., 2016). Although the condition now known as **Post-Traumatic Stress Disorder (PTSD)** existed long before its clinical definition, its formal recognition as a diagnosis can be traced to war experiences and train accidents of the nineteenth century (Hengeveld et al., 2016). The prevalence of PTSD is considerable, ranging from 10–20 % among women and 6–8 % among men (Burbach et al., 2023). The following section examines how these diagnostic criteria are interpreted within psychiatric practice and how they inform the design focus of this thesis.*

To construct a thorough understanding suitable for this speculative design research, **three perspectives are combined: psychiatry, psychology, and design literature**. Because definitions vary across cultural and disciplinary boundaries, this thesis draws on a Dutch psychiatric textbook (Hengeveld et al., 2016) to maintain alignment with the clinical context of GGZ-NHN.

Definition

The textbook written by Hengeveld et al. (2016) bases its definition of PTSD on the *Diagnostic and Statistical Manual of Mental Disorders* (DSM-5), the standard manual used by mental health-care professionals and widely cited in psychiatric literature.

According to the **DSM-5**, PTSD can be clinically diagnosed when two conditions are met:

1. **exposure to threatening death, serious injury or sexual violence, and**
2. **the presence of a collection of specific symptom clusters.**

These symptoms include intrusion (e.g. distressing memories or recurring

dreams), avoidance of triggers, negative alterations in cognition or mood (e.g. memory loss, or negative beliefs) and changes in reactivity (e.g. irritability or angry outbursts) (American Psychiatric Association [APA], 2022). These symptoms can initially be classified as acute stress disorder, but if they persist longer than a month, the diagnosis shifts to PTSD (Hengeveld et al., 2016).

Acknowledgement of suffering

Trauma experience is different for everyone. While most people will encounter a major trauma at some point during their lifetime, most cases are often considered part of the normal human experience (Hengeveld et al., 2026). Whereas **psychotrauma** was once defined exclusively as an extraordinary and overwhelming event, its definition has now extended to a broader spectrum of experiences that provoke helplessness or loss of control. These range from large-scale catastrophes, explosions, and acts of brutal violence, to individual events like traffic accidents, sexual assaults, or robbery (Hengeveld et al., 2016).

There is an ongoing debate over the specific definition of psychotrauma,

as some scholars fear that the term is becoming **too inclusive**. The concern is that by applying the concept of trauma too broadly, covering experiences ranging from life-threatening events to more common forms of distress, the term risks losing its **diagnostic precision** (Burback et al., 2023). However, the broadening and redefinition of psychotrauma also highlight the societal importance of **acknowledging pain and suffering, shaped by historical events** that caused collective trauma, such as the Vietnam War, the Holocaust, and the recognition of sexual assault as a source of lasting psychological harm (Burback et al., 2023; Hengeveld et al., 2016). In the past, the existence of such suffering was often denied. Its recognition now not only validates those affected but also strengthens societal responsibility for preventing and acknowledging trauma.

Individual trauma response

Every adult can respond differently to trauma, and most individuals exposed to psychotrauma do not even develop PTSD (Olff, 2005). The development of PTSD is linked to an interaction between the cognitive appraisal of trauma, coping styles, and biological responses, which together influence the vulnerability to the disorder (Hengeveld et al., 2016). **Cognitive appraisal** is the subjective interpretation of the trauma, starting the development of psychobiological traumatic response. Appraisal processes vary per person, which means that the same trauma can be distressing for some individuals but not for others (Olff, 2005). Coping responses also differ. Think of the famous fight, flight or freeze response. This is personal for every individual and may depend on underlying neural circuits in the brain (Olff, 2005). This altogether makes the severity of every PTSD diagnosis and the required therapy unique. Figure 2.7 shows a simplified visualisation.

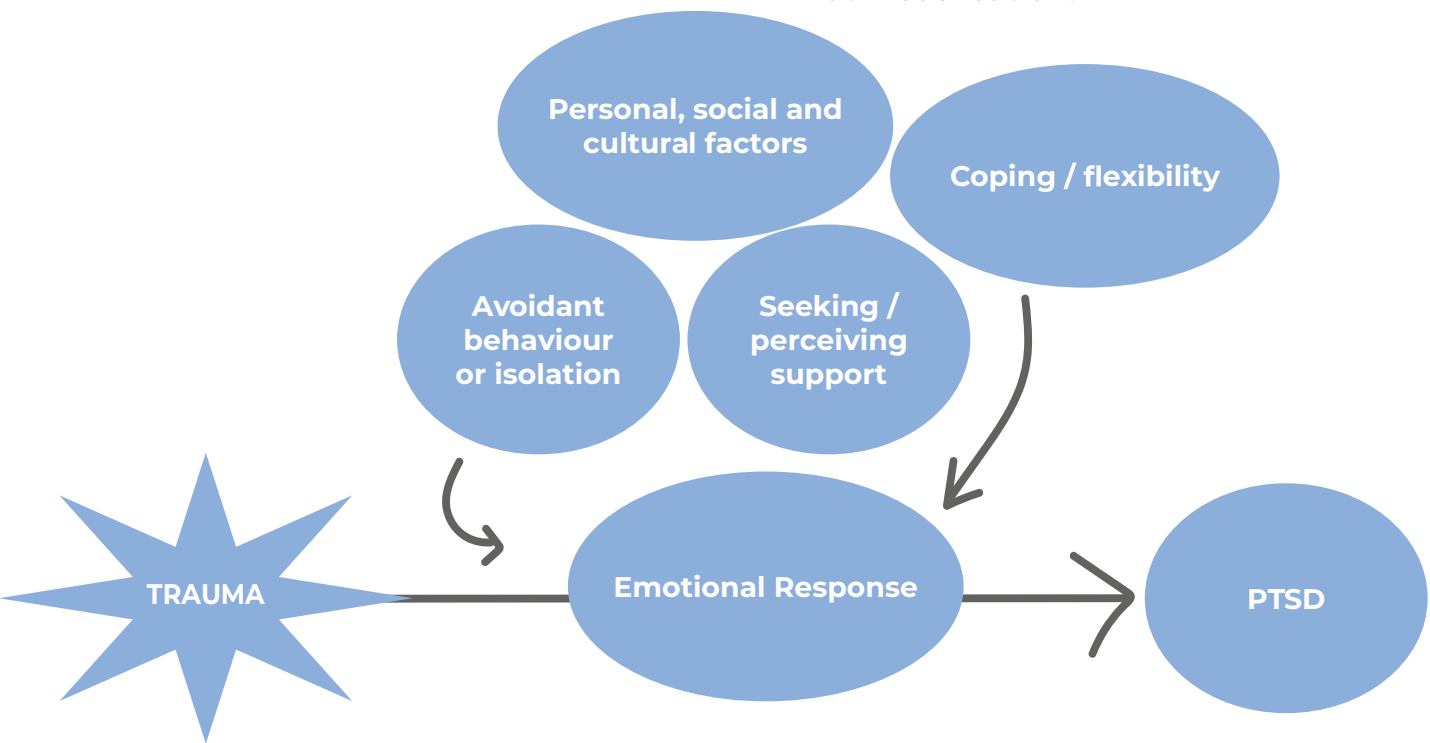


Figure 2.7 Trauma appraisal: to different contextual factors, presence of support, or differences in personality, the perceivance of trauma can differ (Olff, 2005)

Subtypes

Based on the nature of the trauma, various subtypes of PTSD can be distinguished, each associated with different symptoms and corresponding treatment approaches. These subtypes often occur alongside additional mental or physical conditions, which further complicates diagnosis and treatment (Burback et al., 2023). For reasons of privacy, the nature of the trauma and the specific subtype of PTSD will not be asked of participants in this study. Therefore, within the scope of this research, it is not necessary to discuss all possible subtypes in detail.

Beyond the standard diagnosis of PTSD, **two subtypes** are clinically recognised. Both are typically associated with long-term trauma exposure, often beginning in childhood, and involve complex patterns of chronic trauma-related dissociation in addition to the core PTSD criteria (Burback et al., 2023).

The first subtype is the **dissociative subtype of PTSD**, which can include symptoms such as depersonalisation, derealisation, or temporary episodes of memory loss (Burback et al., 2023). These experiences involve a sense of detachment from one's body, emotions, or surroundings, which can interfere with emotional processing and treatment (Hengeveld et al., 2016).

The second subtype, **Complex PTSD** (CPTSD), includes persistent emotional dysregulation. This may, for instance, lead to self-destructive behaviour or very deep feelings of shame and guilt (Burback et al., 2023).

Since both subtypes are difficult to diagnose, the process of finding an

effective treatment can take considerable time (Hengeveld et al., 2016). In this context, future simulation technologies could support individuals with these subtypes in exploring and evaluating therapeutic approaches, helping them identify suitable treatments at an earlier stage.

Treatment possibilities

A wide range of treatments for PTSD exists, varying from clinical to alternative approaches. The effectiveness of treatment for an individual depends on multiple factors that are not always known in advance. Clinical treatments are divided into *First-Line* and *Second-Line* treatments (APA, 2025). The **first-line**, or most evidence-based, treatment choice is Cognitive Behavioral therapy (CBT), which focuses on the interaction between thoughts, feelings, and behaviours. It tries to change patterns in order to make functioning in daily life less difficult.

If CBT proves ineffective, **second-line treatment options** may be considered. These are generally supported by less extensive evidence but can be effective alternatives. These include Eye Movement Desensitisation and Reprocessing (EMDR), other variants of cognitive therapy, or medication (APA, 2025). Although guidelines differ slightly across countries or disciplines, most recommended therapies are variations of CBT, which include elements of exposure and cognitive restructuring (Hengeveld, 2016).

In addition, a variety of **alternative treatment options** are available. Although not evidence-based, and therefore not regarded as clinical, they can be beneficial for people. Examples of alternative treatments are body- and

movement-oriented interventions and other types of exposure therapy (APA, 2025).

Additionally, experienced experts sometimes provide healing practices offering **experimental therapy** forms like cacao rituals, dance, or meditation workshops (Hofman, 2025). While these therapies are not evidence-based either, they are acknowledged to provide emotional support and a sense of connection for certain individuals (APA, 2025).

Design opportunities and m-Health

Within psychiatric research, the potential benefits of m-Health have increasingly gained attention (Olff, 2015). Landry et al. (2010) systematically deconstructed the development and coping mechanisms of PTSD, identifying **multiple opportunities for technological intervention across different stages**. They propose that technology could complement therapy by **extending support beyond the clinical context**: offering assistance at the moment of a trigger, potentially reducing re-exposure, and thereby enhancing therapeutic effectiveness. Although their work is now somewhat dated, it still provides a comprehensive overview of design opportunities that continues to inform later research.

More recent **design interventions have been specifically developed for people with PTSD**. In reviewing contemporary design research on health technologies aimed at this group, such as virtual-reality sound systems (Yamauchi et al., 2025), gamified mental-health applications (Doron et al., 2025), and virtual-reality exposure tools for firefighters (Wang et al., 2024), **the definition of PTSD is often reduced to**

a brief reference to DSM-IV criteria.

These studies are typically presented from a technology-push perspective, where the technology is developed **before a clear need from potential users has been identified**, making adoption and effective use more challenging (Shaw et al., 2018).

This limited user grounding is also reflected in how these technologies are evaluated. Wang et al. (2024), for instance, examine a highly specific user group (firefighters) without a control group; Doron et al. (2025) rely on self-selected users without a formal PTSD diagnosis; and Yamauchi et al. (2025) do not test with people with PTSD at all. While such approaches may advance technological innovation, they illustrate a **broader tendency in design research to under-elicited lived experience and user values**. This thesis seeks to critically address this issue through an ethnographically informed design lens, foregrounding lived experience without presuming to resolve this tendency.

By testing the speculative prototype developed in this thesis with people who have lived experience of PTSD offers an **opportunity to directly incorporate their perspectives and values into the design process**. The aim is to **bridge two domains** that are often treated separately: the technology-push tendencies in design research and the psychological realities of trauma and recovery.

2.5 Digital Twins

Digital Twins were first introduced by NASA in the 1960s and were further developed within the field of computer science. Digital twins consists of a **physical entity** and a virtual **counterpart**, connected through a **bidirectional flow**, that enables continuous exchange of information between the two (Abilkaiyrkyzy, et al., 2024). Figure 2.8 shows a simplified overview of the definition.

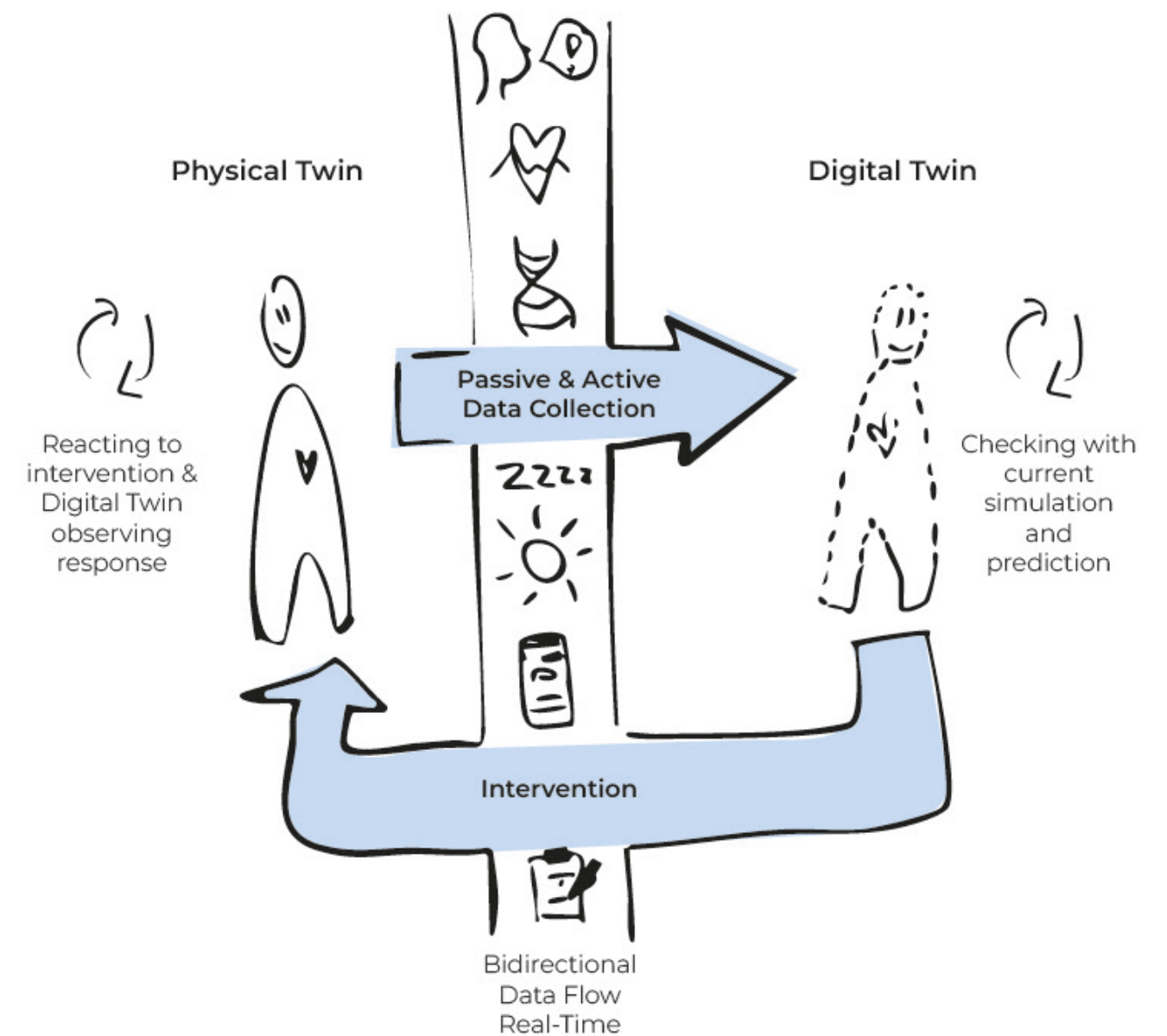


Figure 2.8 Visualisation of a Digital Twin: consists of real and virtual entity, twin collects data through digital phenotyping and exchanges it back to real person who reacts on data. This continues in an ongoing feedback loop.

In psychiatric healthcare, a digital twin represents a **virtual model** of a care seeker. It is not merely a replication of observable behaviour but a **simulation** that models the individual's **emotional states, cognitive processes and behavioural dynamics**. To achieve this, a **continuous, real-time connection** between the individual and their twin is required. Data collected from the care seeker are used to **update and refine the ongoing simulation**, allowing it to predict changes in mental health. These predictions are then **presented back to the individual**, whose responses in turn inform the model, creating an **iterative feedback loop** between simulation, prediction, and lived experience (Barresi et al., 2023).

Digital phenotyping

The data gathered by a digital twin may include biological indicators and observable behavioural patterns, but it can also extend **beyond conventional clinical** data collection by incorporating information generated through the use of digital technologies. This extension of traditional measurement is referred to as **digital phenotyping**, which involves the continuous collection of data from personal digital devices to quantify observable characteristics in real-world contexts. Such devices may include smartwatches, smartphones, or computers, which can provide data such as typing speed, social media activity, and online search behaviour (Jain et al., 2015).

For instance, frequently posting about having a bad day might indicate an underlying shift in mood or wellbeing. Digital phenotyping therefore opens new possibilities for detect-

ing symptoms and translating them into behavioural patterns that can be quantified in real time, **extending the possibilities of symptom detection in psychiatric healthcare** (Oudin et al., 2023; Birk & Samuel, 2020).

“Digital phenotyping is the moment-by-moment quantification of the individual-level human phenotype in situ using data from personal digital devices” - Oudin et al. (2023)

Digital phenotyping data can be collected in different ways: **actively** and **passively (figure 2.9)**.

- **Passive data collection** refers to information gathered automatically through sensors in digital devices such as smartphones or smartwatches. Examples include GPS location, accelerometer readings, microphone input or heart rate data.
- **Active data collection**, in contrast, requires engagement from the user, such as filling in self-reports or surveys, responding to digital prompts, or posting about wellbeing on social media.

Combining both modes of data collection can improve the accuracy and contextual interpretation of behavioural patterns (Oudin et al., 2023).

The data obtained through these combined sources can then be used as **digital biomarkers**: measurable signals that can support diagnostic interpretation. However, there is no clear consensus on what exactly falls under this term (Bogdanova et al., 2025). Examples include heart rate variability, time spent in daylight, number of calls made, typing speed, proximity to other devices, or tone of voice (Bogdanova et al., 2025; Oudin et al., 2023).

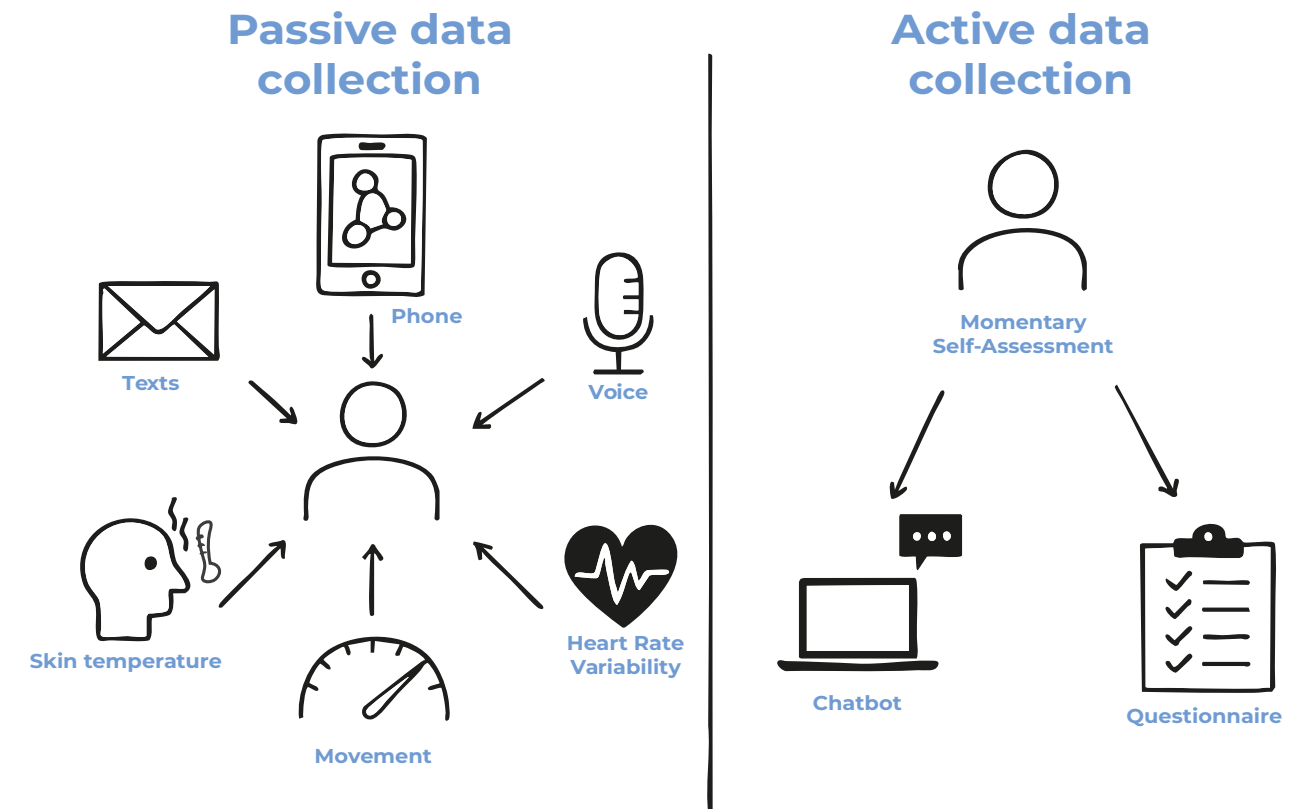


Figure 2.9 Digital Phenotyping collects data passively through the use of smart sensors, but combines it with active data collection which requires active user engagement.

For people with **PTSD**, this could involve using data such as heart rate variability, cortisol levels, voice characteristics, or changes in smartphone usage patterns to identify signs of stress or potential trauma-related triggers.

“Some researchers have hypothesized that heart rate variability is influenced by the progression of the patient’s depression and could be a new biomarker of treatment response” - Oudin et al., 2023

The purpose of a Digital Twin

By combining **digital phenotyping** with **artificial intelligence (AI)**, a digital twin can translate the **collected set of digital biomarkers** into individualised predictions and simulations. According to Spitzer et al. (2023), digital twins

can serve several purposes:

1. **Monitoring:** tracking the mental state of individuals, informing them of changes, detecting deterioration, signaling the need for preventive intervention, and predicting the impact of future stressors.
2. **Diagnosing:** identifying mental health disorders by observing their development over time.
3. **Prognostics:** forecasting the course of a disorder by simulating patient outcomes using real-world data and predictive models.
4. **Guidance:** providing personalized treatment recommendations based on available options and patient data.

Testing interventions in a virtual setting can prevent lengthy trial-and-error processes for both care seekers and therapists. This approach may help individuals better recognise their mental health needs and gain deeper insight into their condition. Some researchers suggest it could also improve treatment adherence and enhance the overall efficiency of clinical services (Abilkaiyrkyzy et al., 2024).

The promise of a digital twin

A digital twin holds promising potential for patients with PTSD. It could shift agency back to the individual, allowing patients greater involvement in understanding and managing their own mental health. Furthermore, it may enable more personalised treatment approaches, moving away from **disorder-centred care towards a more holistic, person-centred model** (Oudin et al., 2023). In this way, it could foster greater autonomy, help individuals live more independently from psychiatric services, much like how a service dog supports day-to-day functioning outside of clinical settings.

Since digital phenotyping involves both passive and active, real-time data collection, it allows treatment to become more specific and contextually attuned. By capturing real-world experiences in situ, it can provide patients and caregivers with insights into potential triggers, symptom fluctuations, or prognoses.

Concerns about digital twins and phenotyping

While technology is innovating fast in this field, the effectiveness has not been fully proven yet (Oudin, 2023). Nonetheless, **commercial digital twin applications are already being marketed** in mental healthcare settings. For example, Ontark Health (2024) claims to personalise mental-health interventions to each patient's needs through digital-twin technology. However, such emerging applications raise several **ethical and epistemological** concerns, underscoring the need for speculative design research to critically reflect on their future implications.

Epistemic concerns

These concerns are on the level of interaction between twin and user; the way both entities shape each other and the way this can lead to a distorted self-perception. They are from a more philosophical angle compared to the more practical ethical concerns.

Interaction

There are growing concerns about the interactive relationship between the digital twin and its user. The continuous presentation of algorithmic feedback may begin to influence an individual's behaviour, subsequently altering the very data that are collected. This phenomenon is described by Milne et al. (2022) as a loop of reflexive recomposition. Over time, this process may **distort how individuals perceive themselves** (Green & Svendsen, 2021; Barresi et al., 2023) leading them to question the accuracy of their own feelings or interpretations (Thieme & Belgrave, 2020).

Comprehensibility

Users often have limited understanding of which data are gathered and how these are processed. This lack of transparency can lead to mistrust or misinterpretation, undermining users' sense of control over the process. When the mechanisms behind interpretation remain obscure, the system may produce errors or biased outcomes without anyone noticing. This concern is referred to as the **black-box effect** (Oudin et al., 2023).

Objectivity

A further epistemic tension concerns the **question of objectivity**. Predictions always depend on how data are interpreted and how the resulting insights are perceived. For example, using GPS data to measure physical distance from others might be treated as an objective indicator of social connectedness. However, loneliness does not necessarily result from literal distance to others but is often a deeply subjective and context-dependent experience (Birk & Samuel, 2020). This raises the question of **whether a digital twin can meaningfully translate such lived experiences into data-driven insights**.

Birk & Samuel (2020) warn about the risk of **reification of mental disorders**: the risk of reducing complex and dynamic realities to stable, purely biological **things**. Yet, most psychiatric disorders are highly contextual, and different for every individual. For instance, being depressed can mean something very different for someone living on the streets compared to someone struggling at work. Simplifying these conditions into fixed biological conclusions or behavioural markers, there could be

downplay of environmental, cultural, or social dimensions (Birk & Samuel, 2020). As Bemme et al. (2020) argue, **rich lived experience can become fragmented into isolated data points**, losing the nuance that gives it meaning.

Bias is further embedded in the way most algorithms are trained. Since most available data come from privileged populations, there is a risk that digital twins **reproduce existing inequalities by misrepresenting or excluding certain demographic groups** (Birk & Samuel, 2020; Green & Svendsen, 2021). This lack of representativeness can lead to distorted outcomes or **conclusions that fail to reflect the lived experience of users** who belong to groups on which the data have not been trained.

Data shadow and Data phantom

A more philosophical perspective questions what it means to coexist with a virtual version of oneself. Milne et al. (2022) explore this concern through the metaphor of the **data shadow**. Whereas the loop of reflexive recomposition describes ongoing behavioural feedback between user and system, the **data shadow** highlights the **existential implications of prediction**. By generating simulated predictions based on collected data, a digital twin does not only mirror experience but also starts to anticipate and shape it. Such prognoses can influence how individuals perceive themselves and their future possibilities. Living **"in the shadow"** of a prognosis may create a sense of inevitability and loss of control over one's future wellbeing, particularly when the predicted outcome is undesirable (Milne et al., 2022).

Another philosophical metaphor is the **data phantom**, introduced by Green and Svendsen (2021), capturing the persistence of digital traces. While the **data shadow** is about how predictive simulations can shape an individual's imagined future, the **data phantom** reveals how traces of the past continue to inform algorithmic judgment in the present. Data are never simply erased. People may change, yet algorithms retain their histories. A past diagnosis or behavioural pattern can continue to influence new assessments, thereby **haunting the present**. Because algorithms struggle to “unlearn” prior information, a digital twin may fail to reflect an individual's current state, even without their awareness.

“Data phantoms can take shape of frozen mirror images that no longer provide an adequate picture of the individual” - Green & Svendsen, 2021

Ethical concerns

As the predictive power of digital twins grows, so does their influence on the individuals who use them. Ethical reflection is therefore essential, not only regarding the interactive effects between the twin and its user but also in relation to how such systems are implemented within psychiatric healthcare. The following subsections describe the key ethical risks that are mentioned in literature.

Autonomy and psychological safety

Continuous feedback can shape how individuals perceive themselves and their emotional state. It may unintentionally steer behaviour or result in anxiety when predictions present negative outcomes (Coghlan & D'Alfonso, 2021). The way feedback is framed therefore

requires careful ethical consideration. Autonomy may also be compromised if a digital twin is designed to nudge or manipulate user behaviour (Oudin et al., 2023). Systems that provide feedback must avoid controlling behaviour, particularly in contexts involving psychiatric vulnerability.

Prediction errors

Errors in prediction can have severe consequences in psychiatric healthcare. False outcomes or inaccurate risk assessments may lead to inappropriate interventions or even forced hospitalisation (Thieme & Belgrave, 2020). Ethical design should therefore prioritise the contextual validation of algorithmic results through human review before clinical decisions are made.

Inequalities

Bias and inequality extend beyond issues of data representation. Access to digital-twin technology itself may increase societal disparities (Birk & Samuel, 2020; Oudin et al., 2023). While such tools could enhance accessibility to care for individuals awaiting therapy, they may also function as self-improvement devices for those already receiving treatment, increasing existing gaps in access (Birk & Samuel, 2020; Oudin et al., 2023; Barresi et al., 2023). Moreover, “normality” become ethically loaded: are these systems designed to restore functioning, or to optimise behaviour (Barresi et al., 2022)?

Transparency

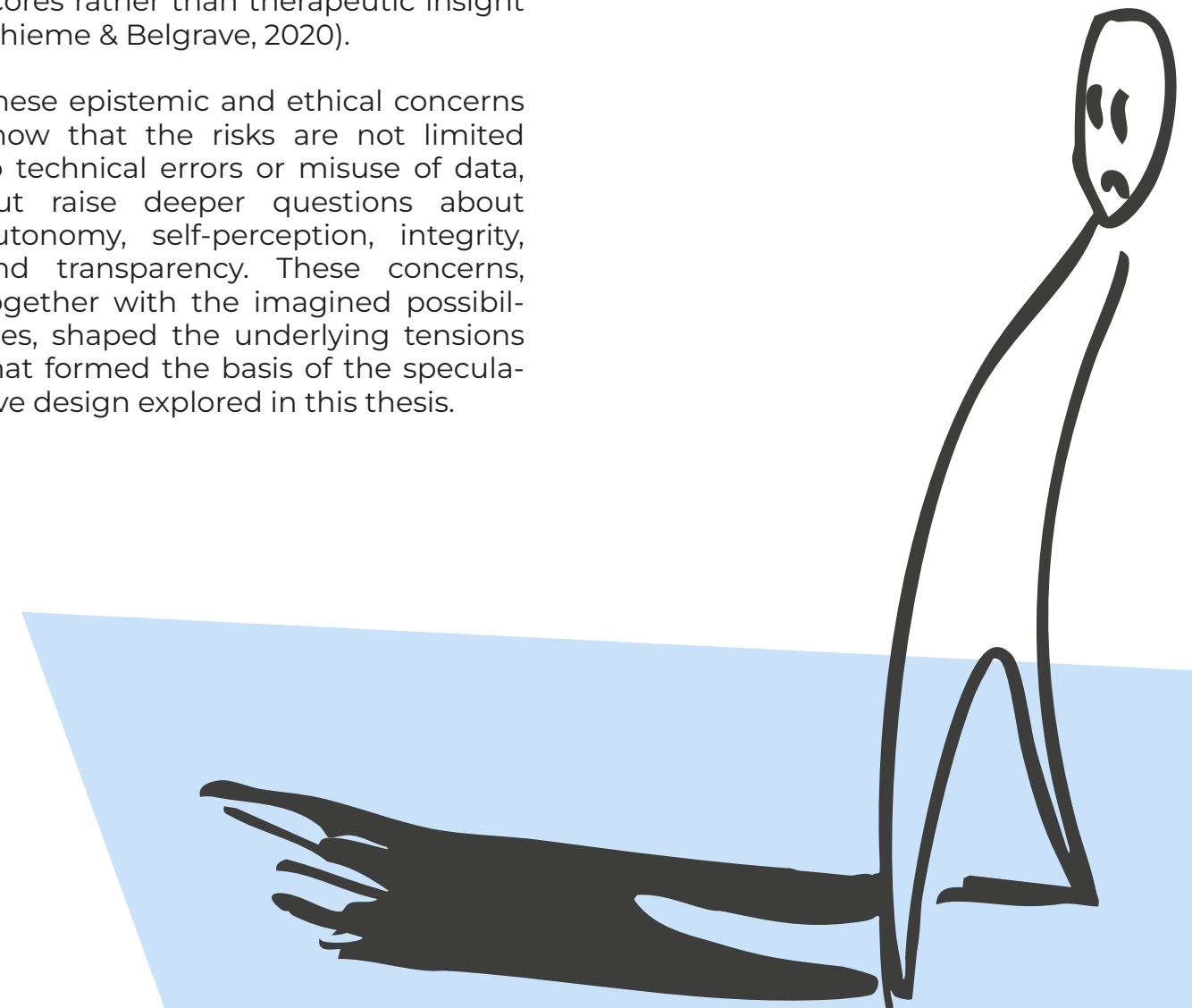
Transparency regarding the training of the model is important to reduce the black-box effect. Equally important is the transparency about data ownership. Sharing or selling sensitive mental-health data to external authorities such as insurance companies could

directly affect a person's access to services (Oudin et al., 2023; Thieme & Belgrave, 2020). In psychiatric healthcare, confidentiality is a core ethical principle. Any secondary use of data without explicit consent constitutes a serious breach of trust.

Professional Integrity

Finally, the introduction of a digital twin should not undermine the expertise of mental health professionals. Over-reliance on machine-learning recommendations could negatively influence clinical judgement, particularly among trainees who may adapt their practice to align with algorithmic scores rather than therapeutic insight (Thieme & Belgrave, 2020).

These epistemic and ethical concerns show that the risks are not limited to technical errors or misuse of data, but raise deeper questions about autonomy, self-perception, integrity, and transparency. These concerns, together with the imagined possibilities, shaped the underlying tensions that formed the basis of the speculative design explored in this thesis.



2.6 Human-technology mediation

Building on the concerns raised in the previous section, it is essential to consider how **human-technology relationships** shape experiences of agency, transparency, and lived experience in the design of digital twins. The research in this chapter explores how such relationships can foster **meaningful collaboration between humans and digital twins**, and is therefore essential for grounding the speculation and resulting design recommendations.

On a broader level than psychiatric healthcare, previous research has examined how collaboration between humans and technology can become meaningful. Cila (2022) has developed several design considerations that support this collaboration between human and smart products or robots. She argues that technology should not be seen as a passive object but as an **active agent**: an artefact capable of sensing the user and its surroundings, communicating with it and evolving. Central to these guidelines is the fact that the **thingness** of robots and the **humanness** of humans should be respected when delegating tasks. Both should perform what they are inherently better at, rather than attempting to replace one another.

Cila also emphasizes **flexible autonomy**, allowing users to dynamically adjust the level of control a digital agent can intervene with. She also proposes **intelligibility**, meaning that transparency should enable users to **comprehend** how data is interpreted

and how the agent's intentions are formed. Contributing to this, communication between agent and human should not rely only on verbal forms, but should also involve gestures or expressions. Finally, she highlights the role of **proactivity**: systems that can detect when a user needs support and initiate action. Proactivity is directly relevant to the speculative nature of this thesis.

Building on this, but focusing more closely on mental health technology, Bogdanova et al. (2025) argue that digital phenotyping should move beyond diagnostic and data-driven functions toward more thoughtful and engaging ways of collecting and presenting information. Inspired by their discussion on **felt informatics**, this thesis explores how feedback from digital twins might be experienced somatically and reflectively rather than purely cognitively. Bogdanova et al. emphasise that people who use digital tools to track their wellbeing should not be seen as **passive data receivers**; but that everyone has their own **unique style of meaning-making depending on their personal values and lived experiences**. Instead of translating behaviour into metrics or diagnostic labels, they propose a **felt and embodied** form of interaction, in which data becomes a medium for care and reflection. Mental health, they argue, cannot be understood purely through biometric systems, it is something that is **felt** in the body and that it can also be affected by data.

This perspective acknowledges that both patients and clinicians are often ambivalent about using data points without contextual detail. Bogdanova

et al. therefore call for designers to take into account not only how technologies shape values and behaviour, but also how perception and interpretation of data are influenced by your **felt and lived** experience. This thesis builds on that call by imagining a future in which personal values and lived experience become central to the design of digital twin interaction in psychiatric healthcare.

At a more organisational level, Frennert et al. (2022) demonstrate how the material aspects of technology are dynamic and evolve within context, affecting care and care work through the **mediating roles of technology**. Humans act upon and respond to technology, which results in technology **mediating** how humans perceive what is health and what is sickness. Frennert et al. argue that humans and technologies are inseparable, continuously co-defined through human practices and the material characteristics of technology. In a psychiatric healthcare organisation, this would mean that **the roles between care seekers and therapists could be mediated by a digital twin**. Such **mediation** is inseparable from materiality: data visualisations can both enable and constrain clinical practice. It may also reinforce dependency or power asymmetries, which is an especially important consideration in psychiatric contexts, where interpretive safety is critical.

Elaborating on this mediating role of the digital twin, Terlouw et al. (2022) conceptualise technological innovation as a **boundary object**: an artefact that remains flexible enough for different stakeholders to interpret and use

in distinct ways, yet robust enough to maintain a shared identity. Boundary objects can help not in striving for consensus but in identifying and addressing underlying needs and differences in interpretation across disciplines. In the context of this thesis, **if a digital twin would act as a boundary object, it could play an interesting role in shaping the relational dynamics between therapist and care seeker by mediating shared understanding and different expectations**.

Together, these perspectives position technology as an artefact whose material form, interaction principles, and aesthetic choices can preserve lived experience while engaging with processes of datafication. This understanding provides an important grounding for defining the envisioned relationship between the digital twin, its user, and the broader system of psychiatric care.

2.7 Expert Interviews

To complement the literature review with contextual insights, **semi-structured interviews were conducted.** The sample included ten participants, ranging from experts by experience to professionals working within psychiatric healthcare. Their roles included psychiatric nurses, psychotherapists, psychologists, and innovation specialists.

An overview of the participant distribution is presented in **Figure 2.10**. In some cases, professional backgrounds overlapped; however, for reasons of privacy and clarity, these intersections are not shown in the figure.

Psychiatric nurses	n = 3
Therapists	n = 2
Experts-by-Experience	n = 3
Other	n = 2

Figure 2.10 overview of different backgrounds of the professionals.

Interviewees were asked about their perspectives on the potential future use of digital twins and digital phenotyping. In combination with the insights gathered from the literature, these differences were translated in the form of tensions, which can be found in the next chapter.

Key interview insights

After conducting the interviews, key insights were gathered. Quotes by participants are included to support these perspectives.

Systemic pressure

Healthcare professionals expressed their concern about the overwhelming demand in psychiatry. Reasons for this could be the inefficiency in triage system, insufficient resources, shortage in trained staff, and the pressures of our rapidly changing society.

“Now people call the nurse for every small incident.” - Z3

“There are too many inexperienced people providing low quality care.” - Z1

“Post-covid society and social media lead to a rise in mental problems.” - E3

Professionals expressed a positive attitude toward the potential role of a digital twin, particularly if it could support triage or assist patients on waiting lists. However, there was less consensus regarding its implementation. Interestingly, when asked to adopt the perspective of a patient, many professionals transformed to a more ambivalent or critical stance.

“It could prevent a patient from receiving unneeded treatment.” - E2

“Shouldn’t we just use technology if it can help us further?” - Z6

“I have a positive stance towards technology, however I am not sure whether I would want to use it myself.” - Z1

These findings suggest that professionals are overworked and acknowledge the systemic potential of digital innovations. Yet this trust proves fragile, even disappearing once they are invited to adopt the patient’s perspective.

Desire for autonomy and privacy Concerns

Participants valued the idea of a digital twin as a supportive tool that could help predict and prevent relapses, similar to how service dogs currently assist in the early detection of distress. They envisioned it as a means to help them reflect on emotions through technological guidance. However, it was emphasized that privacy and data protection had to be guaranteed.

Positive expectations about supporting autonomy included:

“I could predict and prevent a relapse, like a service dog does now.”- E3

“The hardest problem is recognizing your own emotions. A digital twin could help with that.” - Z5 & Z3

Others, however, feared that such a system could undermine rather than strengthen autonomy:

“It can stop me, but should not steer me.”- E1

“Patients are often not capable enough to make their own choices.” - Z2

“Providing my data should not affect my health insurance.”- E3

These responses reveal a fundamental tension: participants desired guidance and emotional insight from technology, yet resisted the idea of being steered or monitored by it. Underlying this ambivalence was a shared concern for autonomy, agency, and the ethical handling of personal data.

Ability of AI to interpret psychiatric Conditions

Opinions on the ability of artificial intelligence (AI) to interpret psychiatric symptoms varied widely. While some professionals saw potential in the technology’s future use, all interviewees expressed serious concerns about how a digital twin might translate lived experience into data and whether it could meaningfully predict a person’s mental health prognosis.

Perceived potential included:

“AI could help in finding out what a patient really needs” - Z4

However, most comments reflected caution:

“AI cannot yet interpret feelings in a sensitive way.”

“What if AI starts misdiagnosing?”- Z6

“What if AI averages all the nuanced differences down to a general conclusion?”- Z1

These responses indicate that while participants recognised AI’s potential to support clinical reasoning or experimentation, they doubted its ability to grasp the emotional, relational, and contextual nuances that define psychiatric care.

Human Connection and intuition

Many interviewees emphasised that the success of therapy and the healing process depends strongly on the personal relationship between people and the physical presence of support. The embodied presence, subjective interpretation, and the intuition of both care seekers and providers were described as essential human qualities that a digital twin could not replicate:

“Taking out the human element would be a sign of emotional poverty.” - Z5

“Subjectivity in every treatment is very important.” - Z4

“Part of therapy is building a relation with your therapist to learn more about attachment.” - Z5 & Z4

“Trauma healing requires treatment with human connection.” - Z6

Experience experts also expressed the importance of maintaining connection with one’s own body and their learned skills to recognise signals. They did not believe a digital twin could ever understand this connection:

“A robot cannot feel where the tension in your body is coming from” - E4

“There is more need for coaching in learning to feel your own body in the GGZ” - E4

Together, these reflections reveal that participants viewed human connection and embodied awareness as fundamental to recovery. While technology might support reflection or insight, it was seen as incapable of replacing these human and embodied aspects of therapy.

Animal connection

A recurring theme across interviews was the perceived value of assistance dogs in supporting emotional regulation and early recognition of distress. Like the human aspects, the unique role of animals highlights the significance of attunement, interpretation, and non-verbal regulation, capacities that participants felt could not be replicated by artificial systems.

“Something in me changes, and my dog just knows it. I don’t even know what kind of signals. But it helps me recognise relapses” - E4

“How could a robot ever learn to notice what my dog notices?” - E4

“Skin contact can be very regulating” - E4 & Z5

“Animals can react strongly to changes in energy.” - Z5

Even though they acknowledged the shortcomings of a digital twin in replacing a service dog, participants did imagine ways in which the **dog could serve as a metaphor** in designing the digital twin:

“A digital twin could act as a service dog, in a way that it makes you feel safe in a non-verbal way.” - Z3

These reflections suggest that the way a dog intuitively reads its owner and responds to bodily cues represents an important aspect of support for people with PTSD, and should therefore be taken into account when designing for them.

Observations

To further ground the interview insights and deepen contextual understanding of psychiatry, observational fieldwork was conducted. This involved two days of volunteering at a psychiatric institution followed by weekly engagement as a buddy to a woman diagnosed with a severe psychiatric condition resulting from trauma. Given the vulnerability of the people that were involved, no quotes will be provided to support these insights.

The observations highlighted the importance of not diminishing the human factor in providing care, since people with PTSD already feel lonely. While there appeared to be an openness towards the use of a digital twin, it kept becoming clear that **a patient’s agency** is *very important*, not imposing control. A digital twin could help by acting as emergency button or as an instrument for early detection of appropriate treatment and diagnosis.

Personas

To provide an overview of the differing perspectives that emerged from the interviews and observations, a

set of **personas** was developed. Since the **professional background of the interviewees strongly influenced their views**, the personas were used to illustrate how these backgrounds shaped their reactions. This approach **supported sense-making during analysis** and helped to abstract the findings into thematic tensions. In a later stage, the personas also informed the design process, **ensuring that the speculative artefacts remained grounded in the personal values** expressed by experience experts and professionals.

One persona is included in this thesis, the rest can be found in **Appendix B**.



Figure 2.11 One persona included to reflect on the influences of someone's background on their stance. Rest of the personas can be found in Appendix B.

2.8 Comparing the interviews insights with literature

The interviews provided contextual and personal insights in how professionals and experience experts perceive the potential and limitation of digital twin technologies in psychiatric care. While the literature already grounded most of these promises and concerns regarding digital twins, digital phenotyping and human-technology interactions, the interviews provided contextual depth in how these theoretical discussions are expressed in practice. Together they form the tensions that formed the basis of the speculative artefacts.

Systemic pressure

The exhaustion, work overload and emotional strain of our current psychiatric system expressed by the participants reflects the literature about the waiting times (Nederlandse Zorgautoriteit, 2024). It seems as if the interest of care professionals stems mostly from a sense or pragmatic hope for relief rather than real enthusiasm towards the technology, since their trust diminished as soon as they imagined themselves as patients.

Autonomy

Participants also discussed autonomy, but their interpretation diverged subtly from how it is framed in design literature. While Cila (2022) and Bogdanova et al. (2025) emphasise autonomy as interpretive agency, transparency, and the ability to regulate one's interaction with technology, participants described it in more practical terms. For

them, autonomy referred to becoming less dependent on psychiatric care by learning from their emotions and gaining confidence to manage daily life independently.

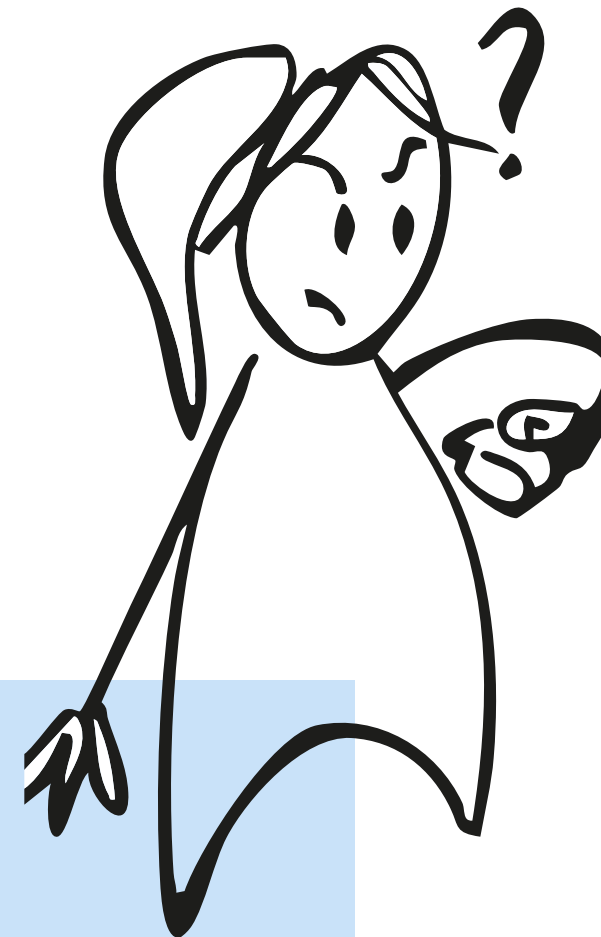
Trust in interpreted predictions

Participants doubted whether a digital twin could ever meaningfully translate lived experience into data or predict mental health trajectories without oversimplifying them. These reflections echoed the **epistemic concerns** raised by Birk and Samuel (2020), Oudin et al. (2023), and Green and Svendsen (2021) about reification and the black-box effect. Participants grounded these worries in everyday realities such as misdiagnosis and the potential loss of clinical intuition. However, because the concept of a digital twin was highly abstract, it was difficult for participants to fully imagine its implications, which limited the epistemic depth of their responses.

Human and non-verbal aspects

The metaphor of the service dog, introduced by participants themselves, captured the kind of empathetic, non-verbal responsiveness they felt was missing from current digital tools. This metaphor extends existing theoretical perspectives such as Bogdanova et al.'s (2025) notion of **felt informatics** by illustrating how digital systems might evoke a sense of safety and attunement without replicating human contact. However, unlike the literature, **the conversations took a more spiritual turn**, as participants emphasised the **importance of the connection between body and mind**; not only within themselves, but also in the non-verbal bodily signals and perceived energy flows between care seeker and therapist or assistant dog.

Together, these findings demonstrate how abstract ethical and epistemic discussions can be grounded through the rich contextual insights gained from the interviews and observations. Although the literature review is presented first for structural clarity, the interviews were carried out in parallel and continuously informed the theoretical exploration. Beyond serving as written grounding, this **process also facilitated the researcher's contextual immersion**, ultimately contributing to a more situated and contextually attuned speculative prototype.



Author's positionality

My experience as a former member of the Dutch national rowing team has shaped my interpretation. Within this environment, data were continuously gathered, from heart-rate variability, lactate levels to psychological assessments and rowing speed.

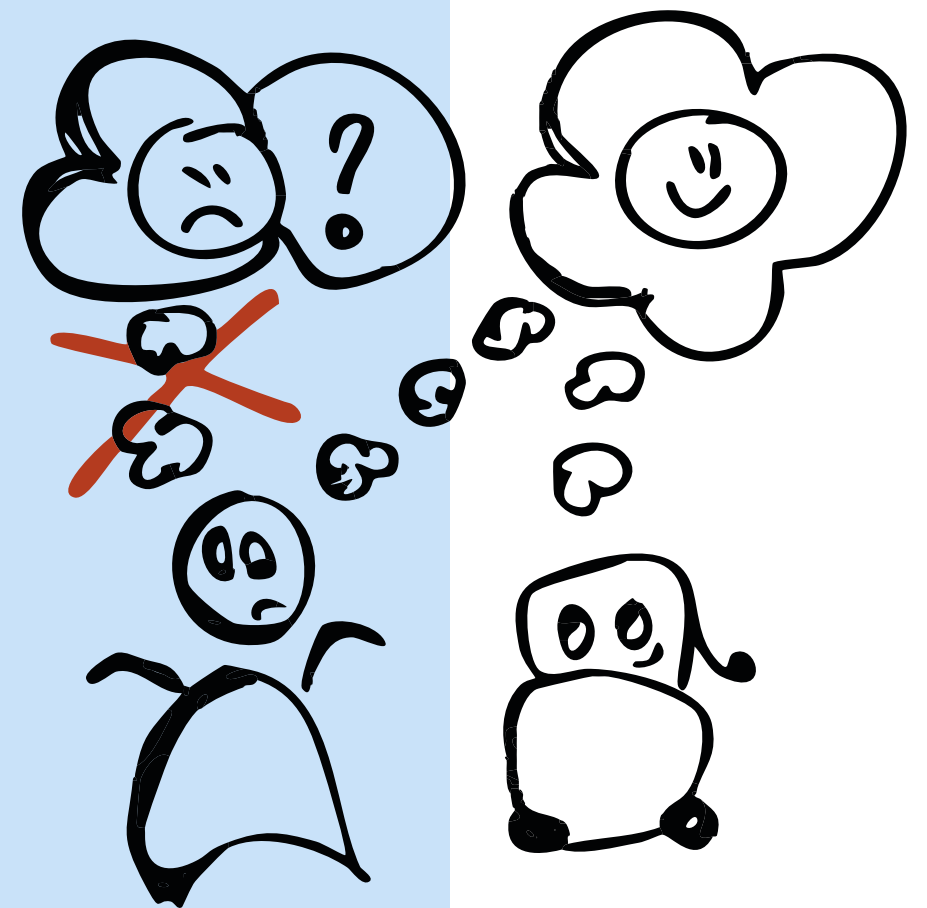
I had always been an intuitive rower, recognising when to rest and when to accelerate. A new coach introduced the extensive collection of data, making me feel constantly monitored and increasingly detached from my own intuition. Team members also started to rely more heavily on their smart-watch, with more focus on power than technique during training. Eventually, I was excluded from the team, with the coach claiming to make objective choices based on data. I believed, however, that there is always a subjective lens when making such decisions; a realisation that deeply shaped my view on algorithmic perceived objectivity.

These experiences resonate strongly with concerns raised by Green and Svendsen (2021) & Oudin et al. (2023), who question how data can be considered objective when it shapes those who use it. While the team went on to win Olympic gold the following summer, this raised a question that continues to inform my design philosophy: **is success meaningful if it comes at the cost of reducing human experience to data points?**

This background has led me to approach digital health technologies critically, yet constructively. I aim to explore how data can be used in ways that acknowledge the richness of lived experience, rather than diminish it.

3.

Tensions & Speculative Artefacts



3.1 Tensions emerging from the literature

Through an iterative process of articulation and reflection, the tensions were developed from the grounding in literature, interviews, and personal experience. These tensions informed the creation of low-fidelity speculative artefacts, which were used to probe and evaluate different aspects of the envisioned future. Insights from these evaluations fed back into the process, refining the tensions and ultimately guiding the direction of the final speculative prototype.

Epistemic overlapping tension:

The parts vs. the whole

This first overlapping tension reflects on systemic discussions about what it means to perceive someone as a whole. Can a simulation that combined data points ever capture richer information than the individual parts situated in their lived context, or is the opposite true?

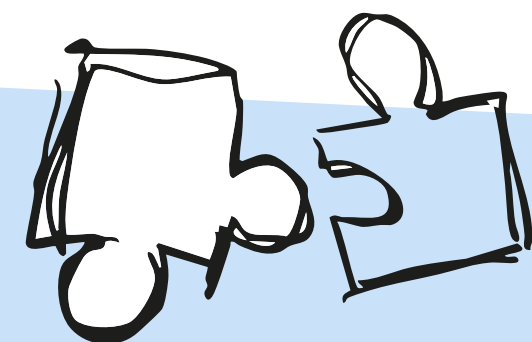
The parts

A digital twin can be seen as a virtual representation of a physical person, capable of simulating, predicting, and experimenting with different scenarios without real-life consequences. Referring to Aristotle's saying that **"the whole is greater than the sum of its parts,"** one might assume that a simulated model of a person's internal state could contain more information about someone's mental health. By combining multiple data streams through artificial intelligence, correlations can be uncovered that may otherwise remain unnoticed (Spitzer et al., 2023). The sum of all these parts could therefore seem to offer a more complete understanding of an individual.

The whole

However, scholars in digital psychiatry warn that this logic risks oversimplifying what it means to be human. Bemme, Brenman, and Semel (2020) describe how digital phenotyping reconfigures the relationship between parts and wholes: rather than interpreting a person in context, it breaks lived experience into behavioural fragments such as speech, movement, and typing speed, which are later recombined into an assembled version of the person. In this process, what appears to be a complete picture is, in fact, an illusion of wholeness. As Latour et al. (2012) provocatively argue, **"the whole is always smaller than its parts."**

The richness of lived experience lies in context, relationships, and situational nuance. When attempts are made to simulate this complexity, the **risk is that human experience becomes reduced to fragmented data points.** Future design should aim to preserve this experiential richness, while maintaining context and meaning, even as it integrates these fragments into a broader data picture.



Core research tension:

Datafication vs. intuitive care

Whereas datafication promises precision and predictive power, intuitive care values presence, attunement, and emotional resonance. The challenge for future design is to explore how digital systems such as digital twins might combine analytical insight with more intuitive and felt modes of understanding.

Datafication

Digital twins have the potential to provide people with PTSD with detailed insights into their mental state, enhancing self-understanding and agency. Such systems could help identify personal triggers that indicate emotional dysregulation. By systematically collecting and analysing behavioural and contextual data, **individuals might gain insights into patterns that would otherwise remain unnoticed** (Spitzer et al., 2023).

However, this data-driven approach also carries risks. **Over-reliance on algorithmic feedback can undermine self-trust, increase anxiety, and foster dependence on external validation** (Ruckenstein & Schüll, 2017). Furthermore, reducing complex emotions to quantifiable data points may discourage the kind of deeper, reflective sense-making that is essential in trauma recovery (Sharon, 2017).



Figure 3.1 Assistance dog (Hulphond Nederland, 2025)

Intuitive care

In contrast, intuitive forms of care rely on embodied presence and empathy, rather than quantified data. Participants described how therapists depend on intuitive connection: reading body language, tone, or subtle shifts in expression (interview Z5; Bonini, 2022). **Physical presence was seen as essential for building trust** and helping clients relearn attachment and safety. This aligns with the fundamental **human need for touch and relatedness** (Desmet & Fokkinga, 2020).

Similarly, **assistance dogs demonstrate an intuitive sensitivity** to emotional and physiological changes in their owners. They detect small changes in body movements and react instantly, often before the person consciously recognises distress (interviews Z5, E2, E4). Their intuitive sensitivity is a non-verbal, embodied type of feedback that supports emotional safety, which is something current technologies cannot replicate. However, such embodied support is not universally accessible. The limited access to assistance dogs and long waiting lists highlight an urgent need for alternative forms of emotional support and presence for individuals awaiting therapy.

Relationship to self:

Trust vs. Autonomy

While previous tensions focused on epistemic aspects, this one examines the relational and ethical dimension of technological mediation. Digital twins promise to enhance autonomy by giving individuals more insight and control over their mental health data, yet they simultaneously require trust in the **'black-box'** of algorithmic processes.

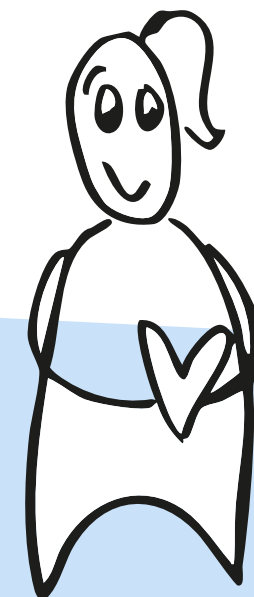
Trust

In a world without data, care relationships depend primarily on interpersonal trust. One would have to believe that the other would work in the client's best interest (Thieme & Belgrave, 2020). Such trust allows for subjectivity, intuition, and personal interpretation within therapeutic processes (Oudin et al., 2023). However, as digital systems become more embedded in care, clients are increasingly expected to place their trust in algorithmic processes **they cannot fully oversee or understand**. This results in a shift in trust changing from human relationships to trust in technological systems.

Autonomy

In contrast, tracking one's own health data through a digital twin can offer a sense of self-control and empowerment (Sharon, 2016). Patients may feel more autonomous in managing their symptoms or recognising patterns in their wellbeing. **Yet this autonomy can become paradoxical: as reliance on data increases, individuals may become dependent on algorithmic interpretations to validate their experiences**. While it first might seem to increase autonomy, it might come at the expense of lived experience and intuitive self-knowledge.

This tension illustrates the balance between trusting a system and being guided by it. For design, this implies that digital twins should not simply aim to maximise either trust or autonomy but to mediate between the two; by enhancing self-understanding without eroding the relational trust.



Normative vs. pluralistic care

Digital twins are located at the intersection of two opposing logics of care. On one side lies normative care, which seeks to support psychiatric healthcare systems through standardised procedures and shared definitions of what counts as “normal.” On the other side lies a pluralistic approach, which recognises that recovery is deeply personal and that experiences of well-being cannot be universally prescribed.



Normative

Within psychiatric practice, normative frameworks define diagnostic and therapeutic standards that ensure consistency across the healthcare system (APA, 2025). Such frameworks help maintain safety, comparability, and efficiency in treatment. A digital twin could strengthen this by continuously comparing a user’s behaviour against generalised norms, identifying deviations, and recommending statistically proven interventions.

However, these same norms are **prescriptive**: they are shaped by those in positions of institutional power who decide what is considered “healthy” or “abnormal.” Because digital twins are typically trained on data from privileged populations, they risk misinterpreting what falls outside these norms as deviant or incorrect, potentially marginalising unique recovery trajectories (Birk & Samuel, 2020).

Pluralistic

In contrast, a pluralistic approach acknowledges that recovery, especially for conditions such as PTSD, is deeply personal and contextual. Rather than comparing users to population averages, a digital twin could act as a **co-explorer** (Birk & Samuel, 2020), respecting the users’ personal values and individual meaning-making processes. Yet pluralism also carries its own vulnerabilities: when care becomes too individualised, shared understanding can decrease, and place too much responsibility on the individual to manage their own condition (Sharon, 2016).

This tension is about finding balance between systemic standardisation and individuality. For design, it raises the question of how digital twins might preserve the reliability of standardised practice while still allowing space for unique, personalised paths to recovery.

Prediction vs. Ignorance

Digital twins embody the promise of prediction and prevention in psychiatry: the ability to detect changes in mental health and simulate possible outcomes of interventions. Yet this same predictive power must be weighed against the emotional burden of anticipating future distress.

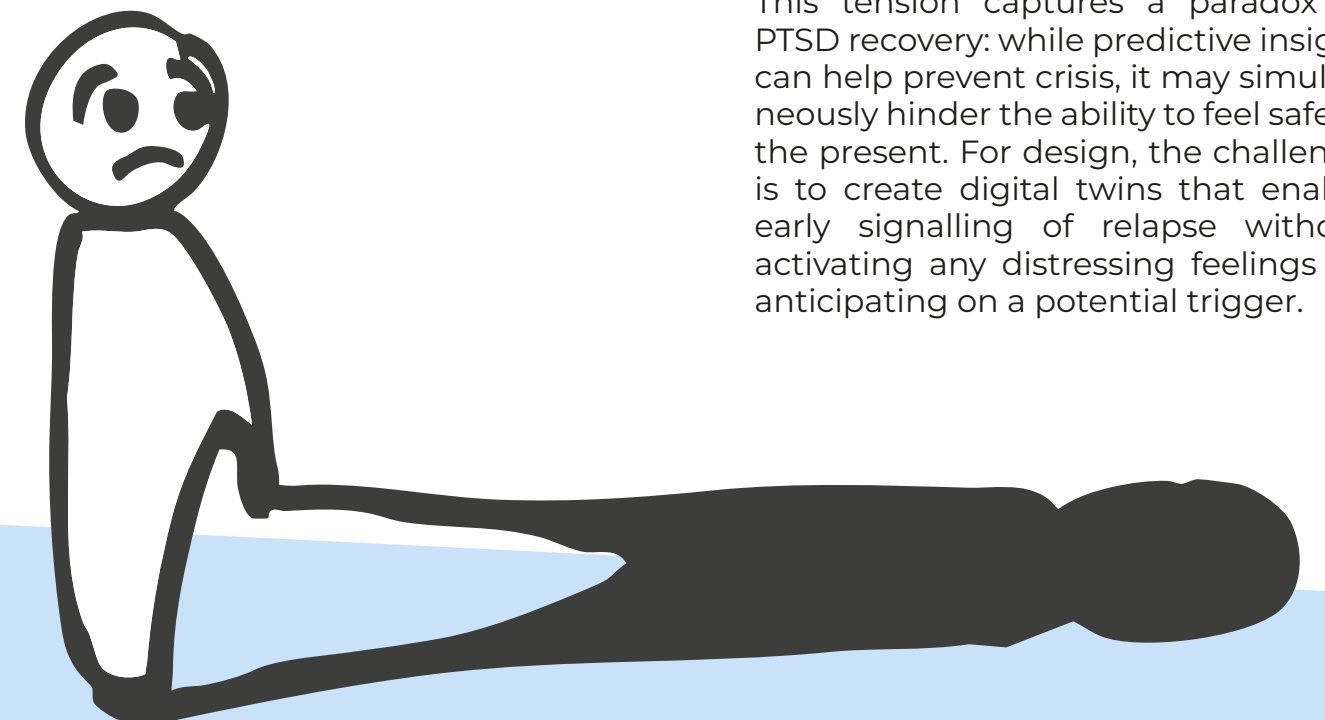
Prediction

For people with PTSD, early detection of emotional distress could help prevent relapses and support recovery. Through digital phenotyping, subtle changes in voice, sleep, or movement patterns could be analysed to identify early signs of relapse and suggest recommended interventions (Oudin et al., 2023). Predictive monitoring might therefore help individuals better understand how their trauma responses emerge, how potential triggers are related, and when additional support may be needed.

Ignorance

At the same time, continuous prediction may come at a psychological cost. Knowing too much, especially when predictions suggest possible relapse, can reinforce anxiety rather than reduce it. As Milne et al. (2022) describe, such prediction can create “**a life lived in the shadow of prognosis.**” For many trauma survivors, emotional safety lies in not monitoring everything: in allowing themselves to feel, to rest, and to be present without anticipating crisis (Hussain et al., 2022). Mindfulness and somatic therapies rely precisely on this state of embodied acceptance rather than constant prediction (APA, 2025).

This tension captures a paradox in PTSD recovery: while predictive insight can help prevent crisis, it may simultaneously hinder the ability to feel safe in the present. For design, the challenge is to create digital twins that enable early signalling of relapse without activating any distressing feelings by anticipating on a potential trigger.



Intertwined vs. Separate

This tension addresses the psychological relationship between individuals and their digital twins. As these simulations become increasingly personalised, they raise questions about identity and self-perception. Should the digital twin be regarded as an extension of the self, or as a distinct companion separate from its user?

Intertwined

The more accurately the digital twin mirrors its user, the more personalised and effective its feedback can become. In this sense, the twin functions as a “**window on the self**” (Coghlan & D’Alfonso, 2021). Yet this closeness also introduces a risk: when past data continues to inform how a person is seen or treated, it may begin to shape identity in unintended ways, creating what Green and Svendsen (2021) call a **data phantom**.

Separate

Maintaining a degree of separation between self and simulation is essential for preserving clear boundaries between the individual and the digital twin. The twin should support understanding, not replace it. When its representations become **too closely intertwined with self-perception**, individuals may begin to lose connection with their **sense of identity** (Milne et al., 2022). This entanglement can **distort perception of self** (Spitzer et al., 2023), and in extreme cases, lead to **alienation from one’s own embodied experience** (Oudin et al., 2023).

This tension highlights the need to design digital twins that enable data insight that resembles their personal situation without losing the connection with their inner self. Rather than mirroring users too closely, these systems should evoke understanding, while staying distant enough to preserve the integrity of lived experience.



3.2 Ideation the low-fidelity artefacts

This section outlines ideation based on the identified tensions. Through iterative redefining and reclustering, axes were formed to show interrelations and potential overlaps. These grids guided ideation by revealing promising quadrant combinations. The final grid is shown in Figure 3.2, with additional quadrant-based ideations in Appendix C. The ideation grid thus served as a conceptual map linking tensions to speculative opportunities, forming the basis for five low-fidelity artefacts.

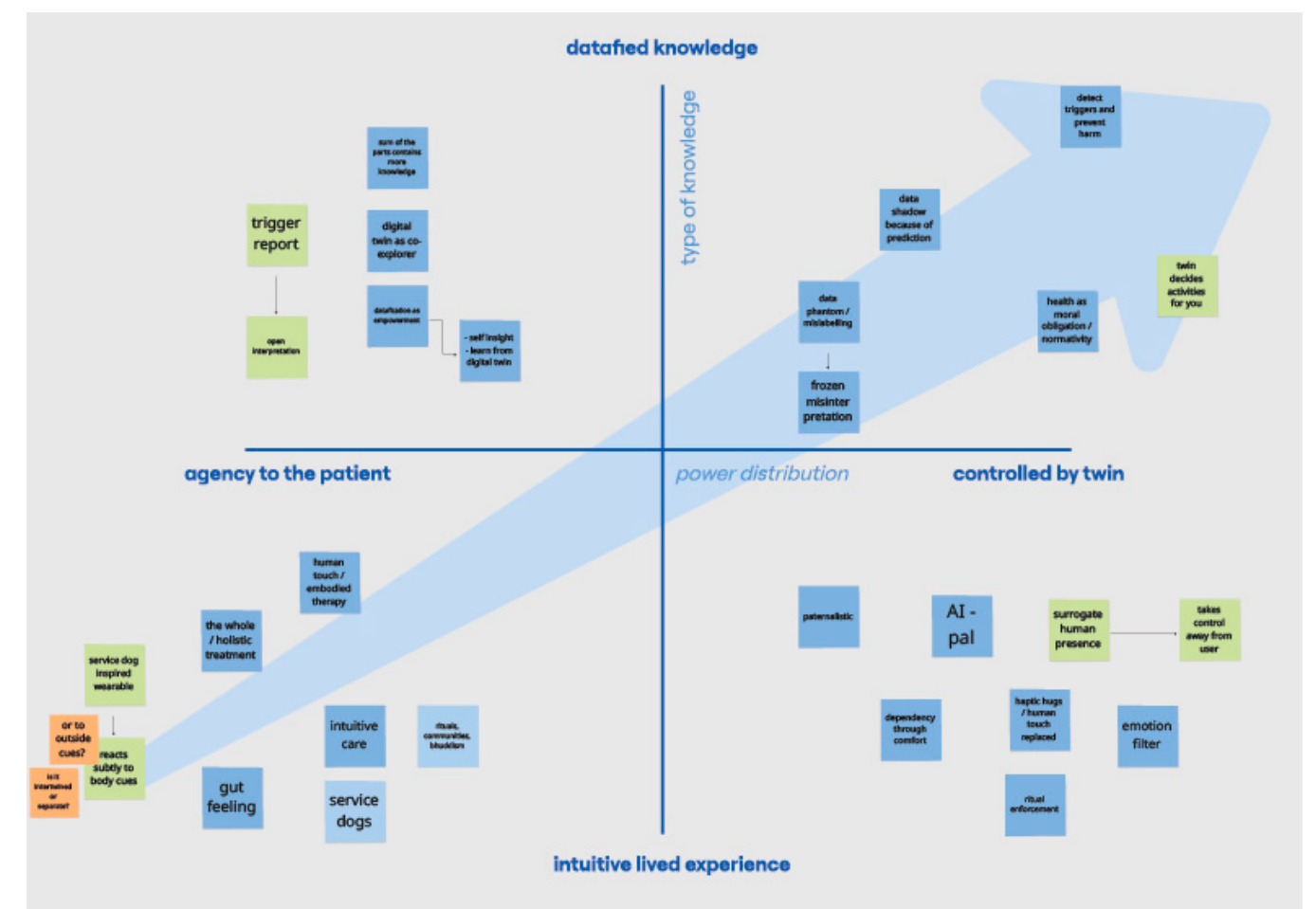


Figure 3.2 Exploration grid for ideation phase

Low-fidelity speculative artefacts were then created to probe people’s reactions to selected tensions. Insights from testing and evaluation informed the narrative and design direction of the final speculative prototype.

3.3 Testing the Speculative Artefacts

Purpose and Overview

This chapter presents the testing of five speculative, low-fidelity artefacts developed to explore how people might respond to the idea of a digital twin through real interaction. The aim was not to evaluate usability or technical feasibility, but to examine how speculative interactions could provoke reflection on the future role of digital twins in mental health. Insights from these tests informed the design of the final speculative prototype, which was later tested with people with PTSD.

Method

After abstracting and ideating, five speculative artefacts were developed. To explore whether these artefacts effectively conveyed the tensions, low-fidelity prototypes were tested with design students. The tests aimed to provoke reflection through embodied interaction, using techniques such as **Wizard-of-Oz (make-believe) storytelling and roleplay** to create a convincing speculative scenario (Bendor & Lupetti, 2024). This resulted in interesting insights, either confirming the tensions that were reflected in the artefacts or highlighting new unforeseen perspectives.

Choice of participants

Eight Master's students of Industrial Design Engineering were recruited as participants because they represent the primary target group for whom reflection is intended. Their critical design literacy made them suitable for early-stage exploration. In line with trauma-informed design

principles (Hussain et al., 2022), individuals with lived experience of PTSD were not yet involved, since the artefacts relied heavily on Wizard-of-Oz make-believe and could provoke unpredictable emotional reactions. The Chayn Network's principles on safe design for trauma survivors supported this choice.

Procedure

Each session lasted approximately 60–75 minutes and consisted of four stages:

Introduction

Minimal information was provided to reduce bias. Participants were told they were in the year 2030, asked to wear a smartwatch (pretending to collect physiological data) and to hand in their phone, which was presented as being “connected” to the prototype.

Interaction

Participants engaged with the speculative artefacts, not yet knowing about the Wizard-of-Oz setup of the test. Roleplay was used to situate the participants in the speculative scenario.

Think-aloud protocol

Participants were asked to think out loud, while the researcher asked specific questions during the process. The goal of these questions was to validate specific reactions from participants that were triggered during the test.

In-depth interview

After testing, an in-depth semi-structured interview followed, in order to gain deeper reflections from participants. Audio recordings of the conversations were made during all sessions. An ethical checklist guided the process (appendix A).

Results per speculative artefact

The following section elaborates on each artefact and the resulting insights. A short description of each artefact will be given, highlighting the parts of the tensions they reflect. This will be followed by the results, supported with quotes. The quotes will be presented in the right column, next to the claim they are supporting.

Artefact 1: The Buzzing Watch - intertwined vs. datafication

Aim and scenario

In this scenario, the participant wore a watch that buzzed whenever it supposedly detected heightened stress or anxiety levels (Figure 3.3). Using the Wizard-of-Oz technique, the participant was led to believe that the watch was measuring real-time physiological responses. In reality, the device was remotely controlled by the researcher. The watch started buzzing whenever the participant mentioned topics that were pre-identified as emotionally charged or potentially triggering, leading her to believe the device could recognise specific words and respond accordingly.

This artefact was designed to examine the tension between the intertwining of lived experience and datafication in mental health, focusing on how it feels when bodily data are translated into automated feedback. After the interaction, participants discussed their experiences and reflected on the emotional and ethical implications of such intimate data interpretation. The Buzzing Watch prompted progressive layers of reflection among participants, beginning from concrete concerns about privacy and data use, and gradually moving toward more personal, bodily, and emotional interpretations of feedback.



Figure 3.3 “Predictive” secretly controlled by researcher, worn by participant.

Key participant reactions

Privacy concerns

This first speculative artefact primarily evoked discussions about privacy. All participants expressed a need for reassurance regarding the safety of their data. One participant additionally noted that collecting personal data might also involve collecting data from others without their consent, such as people the user interacts with through messages or voice recordings.

These reactions indicate that participants see data privacy not only as a personal concern but also as a relational one. The discussion highlighted how data collection in digital twin systems extends beyond the individual, raising ethical questions about consent, transparency, and relational boundaries.

Haptic feedback

The haptic feedback was distracting to all participants. They mentioned the buzzing signals of the watch to be contributing to a higher feeling of anxiety.

These reactions reveal that bodily feedback meant to signal stress can itself become a stressor when perceived as intrusive. This illustrates how easily such feedback can shift from supportive to intrusive, depending on how it is experienced.

Support vs unwanted confirmation

There were mixed reactions to how the watch interpreted participants' data and intervened in their actions. Some participants responded positively, mentioning feelings of support and protection.

These responses suggest that participants appreciated the potential of data-driven interventions when they

"I need the assurance that my data is safe"
- Q1

"It is also important to consider the other person you are involving in this. Recording voice also involves the other person in the conversation." - Q2

"The watch itself now kind of triggered me" - Q3

"The vibration of the watch made me feel even more agitated" - Q4

"It actually triggered a stress reaction" - Q5

"It might help me recognise my triggers in daily life" - Q4 & Q3

"I really liked it, because it nudges you to distance yourself from the conversation"
- Q1

"I feel supported by it" - Q5

were experienced as gentle guidance rather than control. The interaction prompted reflections on *trust and care* in data interpretation, touching on the tension between technological support and personal autonomy.

However, others were more reluctant to accept that the watch could interpret their data accurately enough to act protectively.

These contrasting responses reveal a tension between the desire for technological guidance and the need for personal autonomy. While some participants valued the potential of digital interventions to provide emotional support, others questioned the legitimacy and transparency of algorithmic interpretation. This highlights an underlying uncertainty about whether such systems can *truly* understand lived experience, or merely mirror what users already know.

Interpretation

The Buzzing Watch revealed how participants' reflections evolved from external concerns about data use toward more personal experiences of bodily intrusion and emotional meaning. Initially, discussions centered on privacy and consent, highlighting the relational nature of data collection and the need for transparency. As the conversation progressed, attention shifted to the felt experience of bodily feedback, showing how signals meant to represent care and awareness could instead evoke anxiety or agitation. These insights expose the fragility of trust in data-driven interpretations of emotion and the delicate balance between feeling supported and feeling monitored.

"An assistance dog is more clear in this, and the watch is not transparent in the data it is recording" - Q2

"I am not sure it could conclude the right things based on so many variables." - Q2

"Why would I need an external device telling me the things I already know?" - Q6 & Q7

Mini reflection

The Buzzing Watch effectively set the scene but did not provoke deep reflection. The discussions that followed were mostly superficial, centering on the haptic feedback itself or familiar ethical topics such as privacy and data ownership.

*Lessons learned from this test were that **believability** in the scenario is crucial for engagement, yet the form of **haptic feedback** used here became too dominant and distracted participants from the intended reflection. Although the artefact succeeded in sparking conversations about **datafication**, it did not invite participants to reflect on the deeper notion of **being intertwined** with a digital twin as part of one's identity.*

Future iterations should therefore aim to balance sensory engagement with narrative framing, allowing participants to move beyond surface-level responses toward more experiential and value-oriented reflection.

The Trigger Glasses - intertwined vs. datafication

Aim and scenario

In this scenario, the participant wore a pair of glasses that were presented as future Augmented Reality (AR) glasses, connected to both the watch and phone. The system was said to predict and detect triggers in real life. When a potential trigger appeared, the glasses would automatically remove it from the participant's view, while the accompanying noise-cancelling feature filtered out any associated sounds. Through an AI-based visual filter, the view remained undistorted so that the participant would not notice that anything had been removed.



Figure 3.4 Participant wearing the Trigger Glasses involving roleplay to simulate the technology.

The interaction combined elements of role play and the Wizard-of-Oz technique (Figure 3.4). During testing, the participant was led to believe that someone had entered the room with a barking dog, which was detected by the system as “triggering but safe.” The participant was told that the AR glasses had filtered out the dog and its sound, preventing her from perceiving the trigger. This artefact was designed to explore the tension between **being intertwined** and **datafication**, questioning what it means when technology starts to mediate perception and decide what aspects of reality are visible or not. It aimed to provoke reflection on how emotional safety might be achieved at the cost of personal agency and the integrity of lived experience.

The Trigger Glasses prompted more in-depth reflection than the Buzzing Watch, shifting the focus from data interpretation to the perception itself. Participants discussed how technological mediation could reshape their sense of reality, safety, and control, revealing both fascination and discomfort with the idea of algorithmically curated experience.

Key participant reactions

Agency vs. protection

Because this scenario deliberately pushed the boundary of agency further, participants were more outspoken about the unease it provoked. By deciding what users should be protected from, without their explicit consent, the system made participants feel infantilised and deprived of control.

The responses suggest that when technology acts on behalf of the user, it can inadvertently diminish the sense of self-determination. The artefact illustrates how easily an intervention framed as protective can slip into paternalistic control, revealing a persistent tension between **protection and autonomy**.

Sense of reality

Another issue mentioned by participants was a **lost sense of reality**. By augmenting their vision, participants felt that an essential sensory field used for navigation and orientation was being taken over. When comparing it to noise-cancelling headphones while cycling, participants noted an important difference: the glasses selectively decided what to remove, whereas headphones filter *all* sound in a neutral way.

Some participants suggested that the experience might feel different in a controlled or therapeutic environment. In such a context, the technology could be used as a *form of training*, without overriding one's sensory perception in everyday situations:

“I want more control over it.” - Q1

“It feels strange that my visual input, which is a very important sensory input, to be overruled by a program” - Q3

“The glasses are choosing for me what to filter out, i don't like this agency to be taken over by the glasses.” - Q7

“The power to really remove things is funky. My vision is like 99% of the time true, so having this overruled by some product feels weird.” - Q3

“It is nice to feel isolated, but you feel more vulnerable.” - Q5

“Altering my vision feels like another level of editing the real life.” - Q6

“Create a room where you can work on your triggers, in a safe environment where you still have the agency to choose to work on a trigger in a safe environment.” - Q6

These reflections reveal that participants strongly resisted technological interference once it began to alter their *direct perception of reality*. The scenario exposed a critical threshold between *supportive augmentation* and *distortion of lived experience*, underscoring how fragile the boundary is between *feeling guided* and *feeling manipulated*.

Interpretation

The Trigger Glasses revealed how technological mediation of perception can redefine the boundary between trust and control. Participants' reactions showed that even subtle alterations of sensory input can provoke strong existential unease, raising broader questions about how mental-health technologies might balance safety, authenticity, and user autonomy.

Mini reflection

*The Trigger Filtering Glasses were intentionally designed to be more extreme, which indeed resulted in deeper reflections than the Buzzing Watch. During the testing process, it became evident that **narrative framing** played a crucial role in conveying the intent of the low-fidelity prototype. When this framing was incomplete, participants found the concept less credible, limiting the depth of reflection.*

*The analogy participants drew with **noise-cancelling headphones** proved particularly valuable, as it enabled them to articulate why filtering visual input felt more intrusive than filtering sound. This comparison prompted more philosophical discussions about **personal boundaries and the point at which agency becomes overridden**.*

*However, the artefact's explicit emphasis on the **agency-protection** tension led to relatively homogeneous reactions. The scenario left limited room for divergent interpretations, suggesting that future iterations should incorporate greater ambiguity or contextual variation to provoke a broader spectrum of reflection.*

Data Diary - separate vs. nudging

Aim and scenario

Participants were asked to imagine walking through the centre of Rotterdam while wearing a smartwatch. In the evening, they reflected on their day by writing in a journal while reviewing their data. The diary enabled them to record their own thoughts but also featured an automated function that generated diary entries based on the collected data. Participants could edit or delete these entries, after which the diary would propose possible actions such as contacting a therapist, practising yoga, or taking a breath. It also provided an overall score, the meaning of which remained deliberately ambiguous (figure 3.5)

This artefact was designed to explore the tension between **being separate and being nudged**, questioning what occurs when personal reflection becomes guided or even steered by algorithmic suggestions. It aimed to provoke reflection on whether such systems truly support self-understanding or gradually replace it through data-driven advice.

The Data Diary invited a different kind of engagement than the previous artefacts. **While the earlier scenarios prompted primarily ethical and emotional discussions, this one encouraged participants to reflect more deeply on self-knowledge, authenticity, and trust.** It opened up conversations about how algorithmic suggestions might shape personal meaning-making and emotional interpretation.

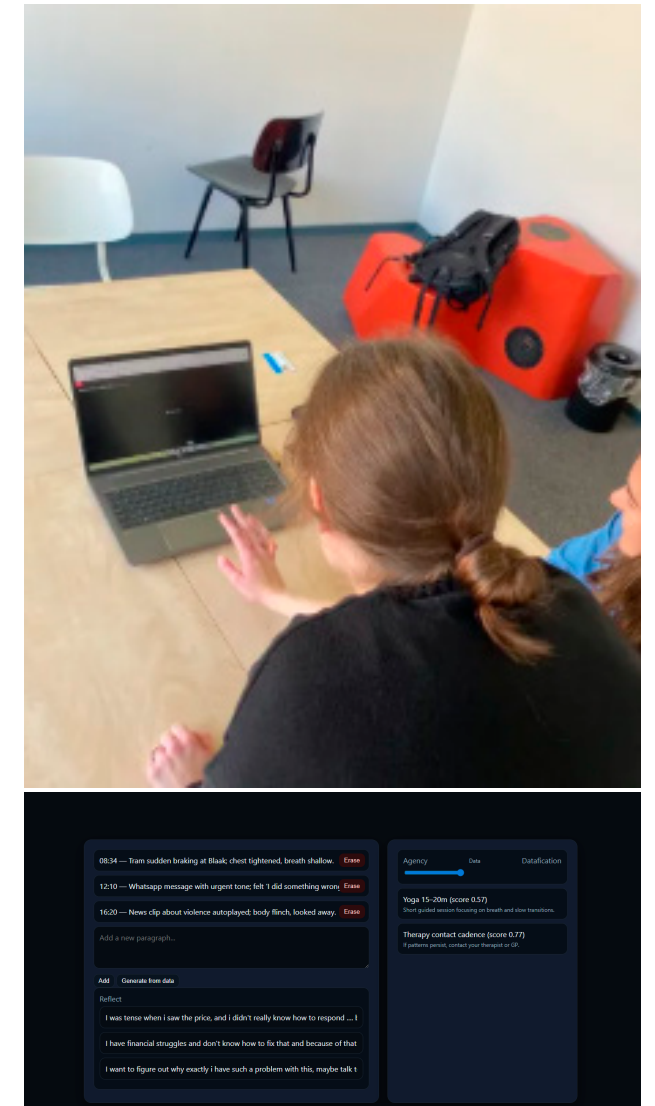


Figure 3.5 Above is a picture taken of participants interacting with the data diary. The lower picture is a screenshot of the prompts that were generated by the diary for the user to reflect on.

Key participant reactions

Difference in acceptance towards data interpretation

Participants responded differently to the diary, ranging from recognising certain potential benefits to expressing strong aversion. Interestingly, there was unanimous agreement regarding the distinction between the digital twin's interpretation of *physiological* data and its interpretation of *emotional* sentiment. While the former was generally accepted, the latter was consistently rejected. This distinction raises questions about its origin: it may stem from a difference in perceived reliability, or from a broader cultural familiarity with the quantification of bodily states compared to emotional ones.

These reactions highlight a crucial boundary in the perceived *legitimacy* of data interpretation. Participants were willing to delegate interpretation when it concerned bodily signals but resisted when the system attempted to translate emotions into data. The diary therefore revealed an underlying tension between **quantifiable understanding** and **personal experience**, pointing to a broader discomfort with the datafication of emotional life.

Lived experience

Beyond the discussion on data interpretation, participants also reflected on how the diary influenced their connection to their own feelings. Concerns extended beyond agency to include how the diary might affect participants' connection to their own emotions. Participants differed in how they valued their lived experience: some feared losing touch with their emotions or beginning to doubt

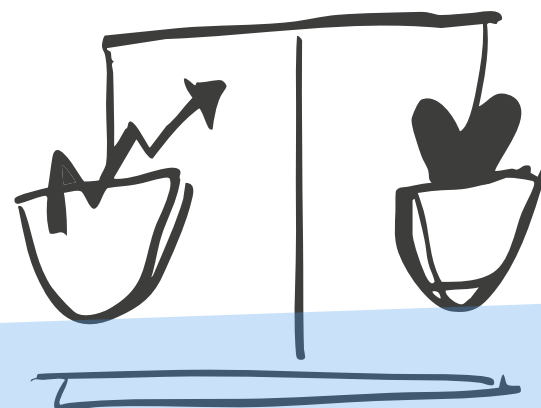
"I would appreciate to look back and get insights of why I feel anxious"- Q3

"I like the concrete suggestions however."- Q5

"That is too much interpretation. How would it know how I feel?"- Q4

"My best friends or family would also not have guessed right how I would feel so why would this watch guess it right"- Q1

"It is collecting and documenting all the worse parts of my day. How is that gonna help me?!"- Q6



their own interpretations, while others welcomed the support of algorithmic structure and external perspective.

These reflections reveal a tension between *outsourcing reflection to data* and *maintaining an authentic sense of self-awareness*. While some participants valued the objectivity and convenience of automated insights, others feared becoming detached from their own emotional understanding. The artefact exposed how technological reflection can both support and undermine personal meaning-making, raising questions about what happens when lived experience becomes mediated through data.

Transparency about being a computer

Participants also reacted differently to the human-like tone of the diary entries generated by the digital twin. Some expressed that they missed a human aspect in the communication, while others felt that the system's attempt to appear human, without being transparent about its artificial nature, was disconcerting.

These reactions indicate that emotional credibility does not necessarily increase through human-like communication. Instead, authenticity appeared to depend on **clear acknowledgment of the system's non-human nature**. The artefact showed how subtle cues of humanness could shift from comforting to uncanny, suggesting that trust in AI design may rely more on transparency than on imitation.

"It is telling me I am stressed, so I must be stressed"- Q1

"I like the fact that it offers me concrete suggestions based on the objective things it has seen during the day."- Q1

"After a whole day I might not remember everything, but looking back at it I would think 'oh that might be the reason I am feeling anxious today"- Q3

"Now I don't have to spend time reflecting on my whole day and specific events"- Q8
 "I feel like the action of journalling has a very good effect on me. If i just read it, it might not be as effective."- Q7

"I am missing empathy here"- Q8

"Would like it to be more human."- Q5

"I feel like it is trying to be my therapist or my friend by trying to be more human. I don't know how i feel about that."- Q1

Interpretation

Overall, the Data Diary invited a more introspective and value-oriented engagement than the previous artefacts. It revealed how algorithmic feedback can both enable and erode emotional self-understanding, depending on whether users experience it as guidance or interference. The artefact thus highlighted the fine balance between self-reflection and automation in data-driven support systems.

Mini Reflection

The Data Diary was where the exploration started to become genuinely interesting. In contrast to the earlier artefacts, participants' responses moved beyond surface-level reactions and began to engage with more personal, reflective, and value-oriented themes. Their reflections touched on several tensions described in the literature while also introducing new perspectives that expanded the conceptual scope of the study. The storytelling and narrative framing of the diary proved convincing and created the right mindset for participants to reflect on the digital twin and its role in shaping self-understanding.

This test underscored the importance of *storytelling* and *narrative plausibility* in speculative design. When the framing feels coherent and credible, participants are able to suspend disbelief and explore a scenario as if it were real. However, the diary's deliberately dystopian tone likely influenced the direction of reflection, prompting predominantly critical and cautionary responses. It raises the question of how participants might respond to a design that communicates care or optimism instead. A future iteration could therefore experiment with a more **hopeful** framing to examine whether it would still evoke latent, critical reflection, or whether a more positive sentiment might surface different forms of emotional engagement and self-recognition.

Stress scenario interface - datafication vs. agency

Aim and scenario

Participants were asked to continue wearing the smartwatch while interacting with a dashboard interface that visualised their real-time stress levels and heart rate. They were led to believe that the system continuously measured and interpreted their data through digital phenotyping. The display presented a progressing scenario ranging from *moderately stressed* to *anxious* to *panicked*. When participants scrolled down, additional information appeared explaining the reasoning behind the diagnosis and the underlying measurements. Using a Wizard-of-Oz setup, participants were convinced that these data interpretations were genuine (figure 3.6).

This artefact was designed to explore the tension between **datafication and agency**, questioning what happens when algorithmic systems begin to define emotional states more authoritatively than the individual experiencing them. It aimed to provoke reflection on how digital feedback can shift self-perception, potentially leading users to doubt, validate, or redefine their own feelings. The Stress Scenario Interface prompted strong and often contradictory reactions. While some participants appreciated its apparent precision, others experienced discomfort or disbelief when the system's feedback conflicted with their own sense of

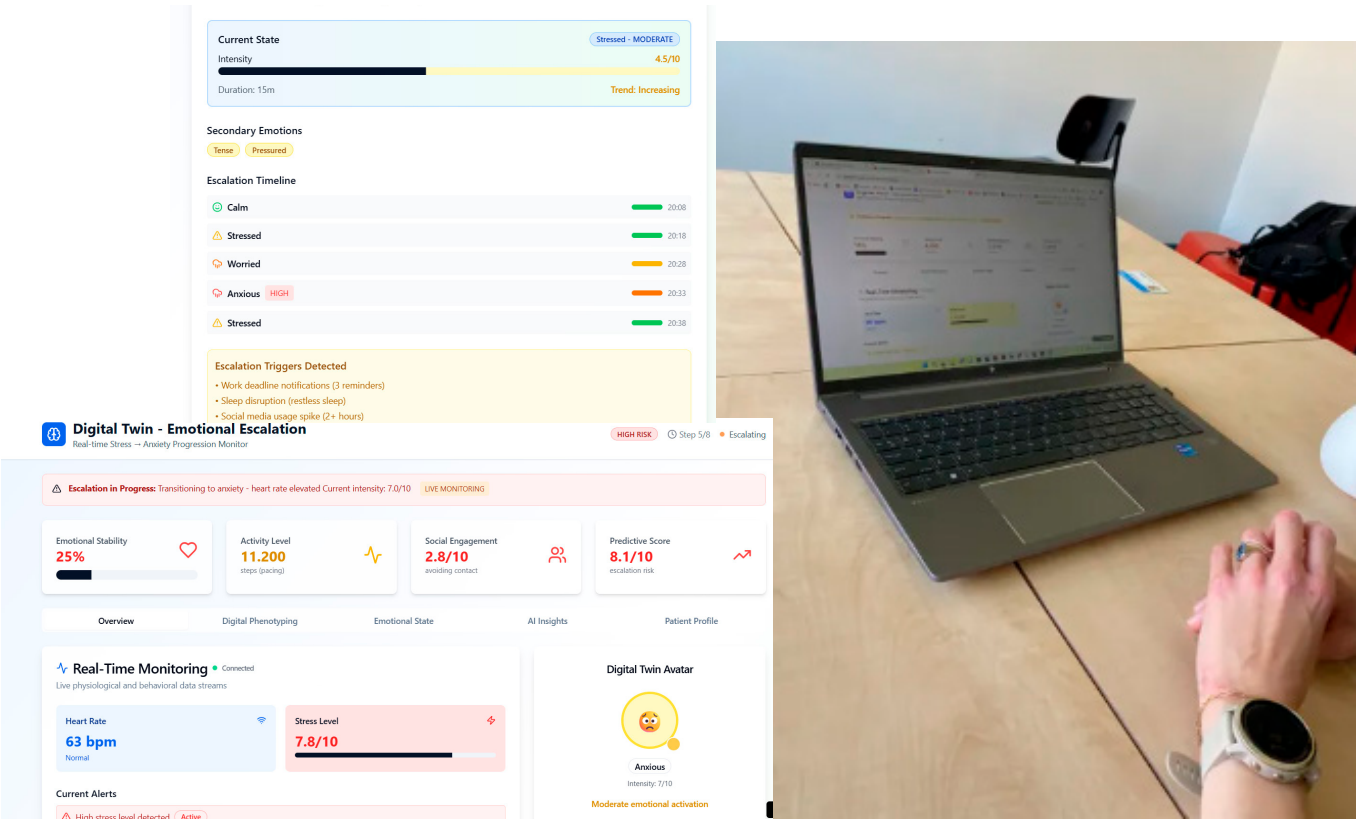


Figure 3.6 On the left are screenshots from the stress scenario display, highlighting some of the possibilities of digital phenotyping. On the right includes a picture of a participant interacting with it.

emotion.

Key participant reactions

Doubt about own feelings

The dashboard proved highly convincing and made several participants question their own feelings. The discrepancy between their subjective state and the dashboard's diagnosis led to distress and confusion.

Other participants, however, explicitly rejected the dashboard's authority and trusted their own experience more strongly. Their quotes on the right illustrate this.

These reactions illustrate the powerful **epistemic authority** of data representations in shaping self-perception. When digital feedback contradicts lived experience, it can provoke doubt rather than insight. The artefact thus revealed a tension between **trusting one's intuitive emotional awareness** and **accepting the persuasive objectivity of quantified feedback**.

Reflection through insight

Participants expressed mixed opinions about the dashboard's potential to enhance emotional insight. Several found it helpful for articulating or understanding their feelings, while others primarily used it as a means of validation rather than reflection. Examples of positive reactions on reflecting through data are stated on the right.

Others, however, perceived the interface as overwhelming, overly negative, or emotionally reinforcing rather than clarifying. Similar to the Data Diary, participants were more accepting of the system's physiological interpretations than its emotional ones.

"I feel stressed because I don't feel stressed and it says I'm stressed right now." - Q3

"But is this how I feel or how i should feel me? Am i stressed of am i not aware of my stress?" - Q6

"Basing my emotional state on this data does not sit right with me." - Q1

"I feel like it is accurate but not relatable." -Q8

"Maybe the diary is the sweet spot of reflection and insight."- Q3

"I find interpreting my feelings easier with this display than personally searching for the why behind my feelings." - Q1

"It is either confirming what I already thought; or it is making it worse." - Q8

"Seeing this data does not help me"- Q4

"I feel like there is always interpretation when I look at the data. So i would not immediately believe it."- Q5

"It feels like someone is watching me." - Q6

These responses show that **reflection through digital insight is far from straightforward**. While some participants appreciated the structured feedback, others experienced it as intrusive or destabilising. The artefact demonstrated that gaining self-understanding through data can both deepen and distort reflection, revealing an uneasy balance between **clarity, control, and emotional safety**.

Interpretation

Together, these reflections reveal how the Stress Scenario Interface made visible the psychological effects of datafication on emotional agency. The artefact demonstrated how quickly quantified feedback was taken more seriously than the own feelings of the user, leading to distress, even though the participants stated to be generally not very trusting in data.

Data quickly have a highly perceived authority and can lead to self-doubt when it misaligns. Although people appreciate this way of reflecting through insight, a future digital twin should balance this by sensitively handling the emotional reactions the data

feedback can cause.

Mini reflection

The anxiety scenario proved highly convincing. Several participants began to doubt their own feelings when confronted with the dashboard's feedback. Interestingly, they did not notice that the heart rate displayed on the smartwatch was inconsistent with the values shown on the dashboard. Participants accepted the data as genuine and adjusted their interpretation of their own state accordingly. This strong belief in the credibility of data visualisations is an important insight for the final prototype, particularly when involving participants with lived experience of PTSD. Reactions to this artefact were more emotionally charged than anticipated, with some participants gradually becoming anxious when their subjective feelings did not align with the system's diagnosis. For this reason, the make-believe element should be omitted in future testing with vulnerable user groups to avoid inducing distress.

The interface itself contained too many visual and functional elements, which diverted attention from the intended reflection. Participants tended to focus on details of the interface design rather than on the broader technological implications. Future iterations should therefore adopt a simpler and more abstract representation, encouraging reflection on the principle of algorithmic interpretation rather than its interface execution.

Tarot Card Role Play - surveilling vs. own lived experience

Aim and scenario

In this scenario, participants wore the smartwatch while engaging in a **role-play interaction** in which the researcher acted as their *digital twin*. The twin was described as a mirror of the participant, processing both physiological data from the watch and insights from their lived experience. During the interaction, the twin simulated a data-based assessment and then offered a set of “personalised” tarot cards from which participants could select three and provide their own interpretation. After listening to the participant’s interpretation, the twin offered a pill supposedly based on the narrative that emerged, which participants could choose either to take or to return (figure 3.7).

This artefact was designed to explore the tension between **surveillance and lived experience**, questioning what happens when one’s identity and emotions become mediated through both data and symbolic interpretation. It aimed to provoke reflection on how individuals negotiate agency and self-understanding when their inner life is mirrored, and potentially appropriated, by a computational twin.

The Tarot Card Role Play prompted diverse and emotionally rich reflections. Participants discussed both the empowering potential of interpretive ambiguity and the discomfort of being mirrored or simplified by a system claiming to “know” them.



Figure 3.7 These are pictures of the Tarot Card role play involving choosing cards to reflect on and receiving a (vitamin D) pill.

Key participant reactions

Interpretation through visual guidance

Participants expressed positive opinions about the way the cards helped them reflect on their day. The open-ended nature and visual abstraction of the cards encouraged deep personal engagement and self-interpretation. Participants stated that “the relevance might even lie more in the moment of reflecting than the data prediction itself.”- Q1.

These reactions suggest that open-ended, visually guided reflection fosters a stronger sense of agency and personal meaning-making than direct data interpretation. By leaving space for multiple interpretations, the artefact allowed participants to project their own emotions and experiences, turning abstract prompts into personalised insights. The use of visual guidance thus demonstrated how **ambiguity can serve as a productive design strategy** for supporting self-reflection.

Simplification

Participants reacted strongly to the moment when the digital twin failed to respond to their narrative and simply prescribed a pill. Many perceived this as the system crossing a boundary, reducing their complex experiences to a single, simplistic output.

These reactions on the right highlight **participants’ resistance** to one-directional, solution-driven interventions that disregard emotional complexity. The artefact exposed how technological **simplification can undermine agency and self-knowledge**, illustrating the risk of reducing lived experience to actionable data.

“I like that i got the chance to give my own interpretation of the cards.”- Q1

“I think the relevance lies more in the moment of reflection with the cards.”- Q3

“AI prompting me to reflect is not a bad thing though”-Q6

“I like the way I used tarot cards to reflect and the way i journaled in the diary.”- Q7

“I am able to address my struggles in a structured way with a very abstract prompt.”- Q8

“I also would want to be able to say no to it. It should really be the last step; when I am already considering taking one.”- Q1

“I feel sceptical. I said some very layered things, but the pill really oversimplified this. There was no link with my story.”- Q3

“It feels weird that someone else is telling me what to do, while i personally just felt fine.”- Q5

“The hard work of knowing what i need in the moment and learning what i need is now being taken over by AI” - Q6

Loss of identity

One participant voiced a deeper existential concern about the concept of the digital twin itself, describing it as a threat to personal identity:

“Why is someone copying me? It feels like I am being cloned!” - Q1

This reaction captures a profound unease about representation of self through data and the potential loss of identity. The notion of being digitally mirrored evoked questions about where the boundary lies between the self and its simulation, exposing the **ontological** tension inherent in the idea of a digital twin.

Interpretation

These reflections show that the Tarot Card Role Play successfully encouraged personal interpretation and emotional exploration. By combining ambiguity with playfulness, the artefact created a safe distance for reflection while still allowing participants to engage deeply with their own experiences. It demonstrated how symbolic, imaginative interaction can evoke empathy and insight without relying on data or algorithmic interpretation. It made the way people value the richness of their own stories clearly visible.

Mini reflection

From a design perspective, the Tarot Card Role Play generated some of the most conceptually interesting insights in this study. As this was the final test, participants were already attuned to thinking about digital twin technology in a more speculative and future-oriented way. The open-ended format encouraged creative interpretation: participants read meaning into the cards in ways that were more diverse and unexpected than anticipated. Although the cards were deliberately selected for their seemingly negative tone, this did not influence participants' readings. This outcome highlights the **reflective potential of artefacts designed for multi-interpretability**, demonstrating how symbolic and ambiguous materials can evoke personal meaning rather than impose it.

For future iterations, the design could move beyond the static transition from interpretation to prescription. The abrupt shift to a single “solution”, symbolised by the pill, interrupted the reflective flow and led to unanimous rejection. A more interactive narrative, in which the twin responds to the participant's story or allows multiple possible endings, could foster deeper engagement and a richer dialogue between system and user. Such an approach would preserve ambiguity while strengthening the sense of agency that underpins meaningful reflection.

Conclusion of Low-Fidelity testing

Across all five speculative artefacts, participants' reflections evolved from surface-level ethical concerns towards deeper experiential and existential questions about self-knowledge, trust, and agency. Early prototypes, such as the Buzzing Watch, mainly prompted discussions about privacy, consent, and the relational nature of data exchange. As the scenarios invited deeper engagement and reflection on emotional meaning, participants began to question how feedback that claims to support emotional regulation might instead unsettle bodily trust, distort perception, or challenge autonomy.

The later artefacts, particularly the Data Diary, Stress Scenario Interface and Tarot Card Role Play, revealed how algorithmic feedback can both clarify and confuse emotional understanding. Participants oscillated between viewing data as a source of guidance and as an intrusion into their lived experience. Ambiguity and interpretive openness, rather than precision or realism, proved most effective in provoking meaningful reflection.

Together, these insights demonstrate that speculative artefacts can make tangible the psychological and ethical consequences of datafication within mental-health contexts. They show how easily systems designed for care can slip into control, and how self-knowledge becomes a negotiated balance between data interpretation and lived experience. These findings informed the direction of the final speculative prototype, which builds on this understanding to explore how digital twins might foster reflection without undermining autonomy.

Author's reflection on Speculative aspects of the Testing Process

As was stated in the conclusion, the speculative artefacts provoked increasingly meaningful forms of reflection. Compared to the interviews in Phase 1, participants' reactions were more varied and revealing, suggesting that the interactive and embodied format encouraged deeper engagement. Since the technology of digital twins can be hard to grasp; a interactive prototype can help in immediately setting the scene, inviting participants to really engage with the tensions.

The process also revealed **that speculative prototypes only function as provoking tools** when their storytelling and **framing were convincing**. When participants focused on technical plausibility rather than experiential meaning, reflection remained superficial. Later artefacts, such as the Data Diary and Tarot Card Role Play, demonstrated that narrative plausibility matters more than technological realism.

Participant interpretation itself became a design material. The most valuable insights often arose from how participants reinterpreted the scenario, projected their own emotions, or subverted its intended meaning. Designing for such open-ended interpretation, rather than delivering a fixed message, proved more generative.

Finally, the testing phase clarified the ethical and emotional limits of make-believe through Wizard-of-Oz

testing. Participants responded more sensitively than expected to simulated data feedback, occasionally experiencing genuine distress when confronted when their feelings misaligned the outcomes of the analysis.

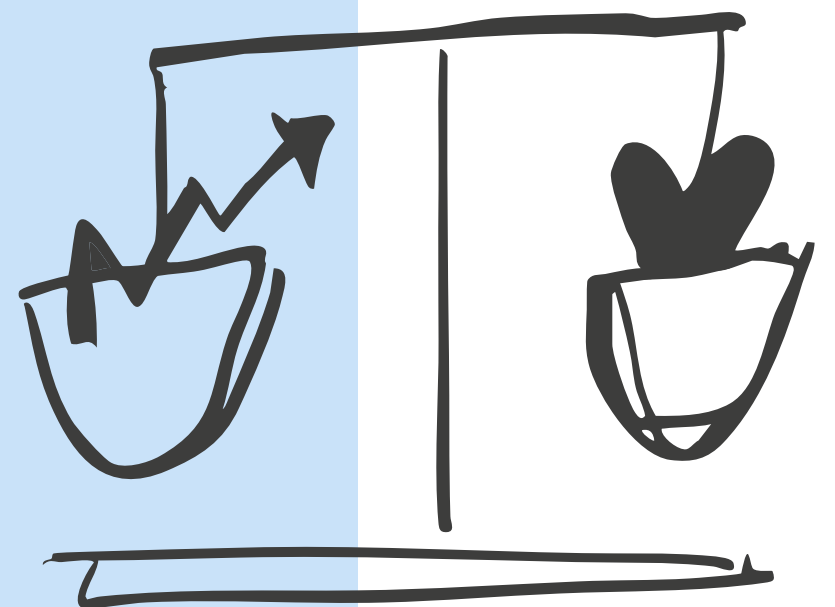
This poses a challenge for the final test since speculative plausibility should be maintained without deception, especially when involving participants with lived experience of PTSD. Preserving psychological safety became an explicit design criterion for the final prototype, ensuring that the speculative encounter remained thought-provoking without becoming emotionally destabilising.

These observations not only shaped the direction of the final prototype but also guided the analytical process that followed, in which the qualitative data from the formative tests were systematically coded to identify recurring patterns of meaning.



4.

Towards a final speculation



4.1 Cross-Artefact Thematic Synthesis

The insights from the five formative artefacts were analysed using the Reflexive Thematic Analysis method (Braun & Clarke, 2006). Through systematic coding and iterative clustering, recurring meanings and tensions were identified across all artefacts. Whereas the previous chapter presented the results per artefact, this section moves beyond individual cases to synthesise patterns of meaning that cut across them.

The analysis process involved mapping quotes and observations within a two-axis grid (Figure 4.1), contrasting *own lived experience* with *data orientation* on one axis, and *positive* versus *negative affect* on the other. This visual clustering helped reveal how participants’ reflections shifted between valuing subjective interpretation and negotiating trust in data-driven feedback.

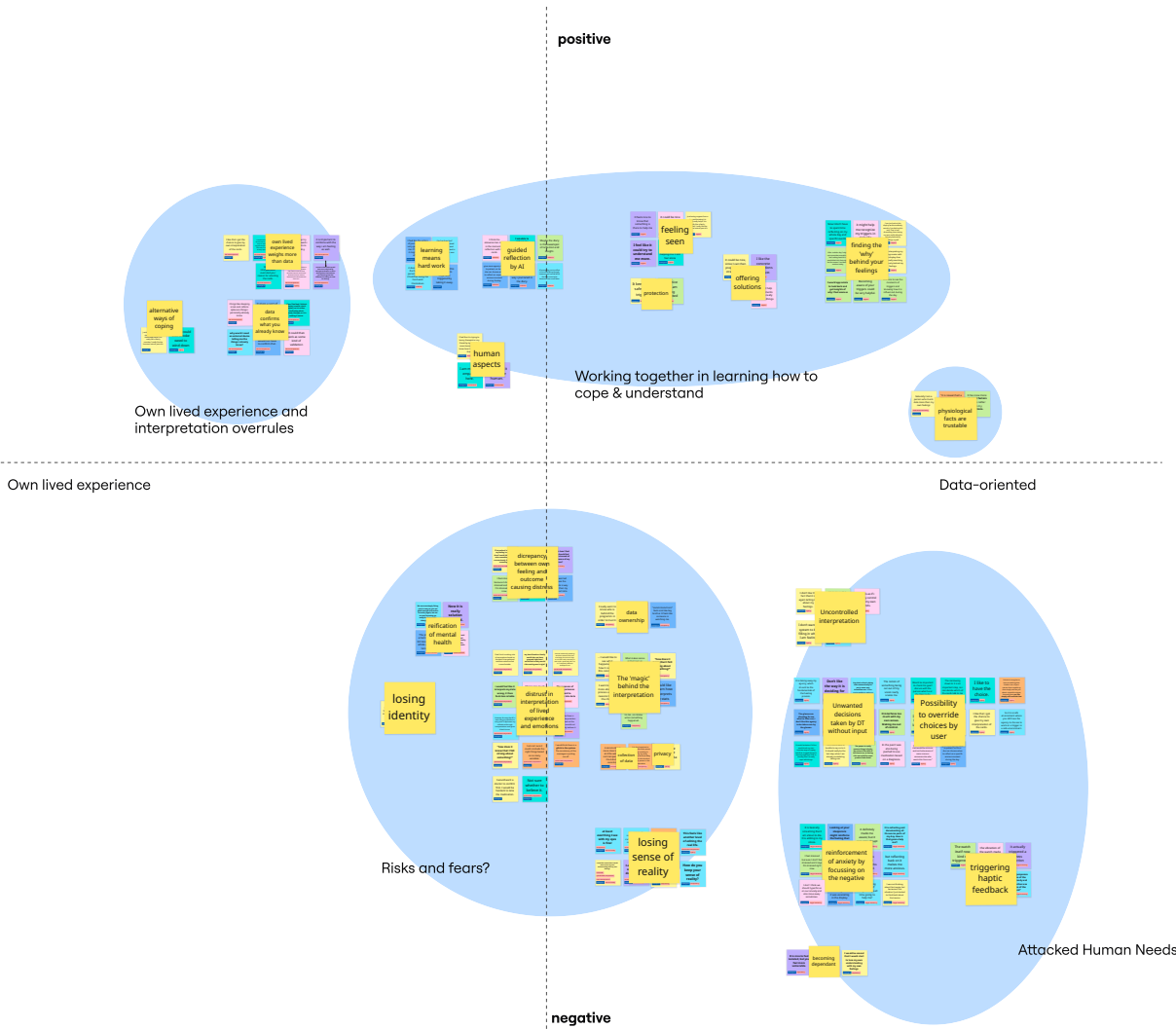


Figure 4.1 Thematic reflexive analysis (Braun & Clarke, 2006) based in insights from the tests with the speculative artefact.

Through iterative rounds of abstraction, these detailed clusters were condensed into broader, overarching themes (Figure 4.2). However, as the process became more abstract, much of the original nuance and contextual richness was lost. The resulting themes, while coherent, largely reflected the “usual suspects” in human–AI interaction discourse, such as autonomy, trust, and control.

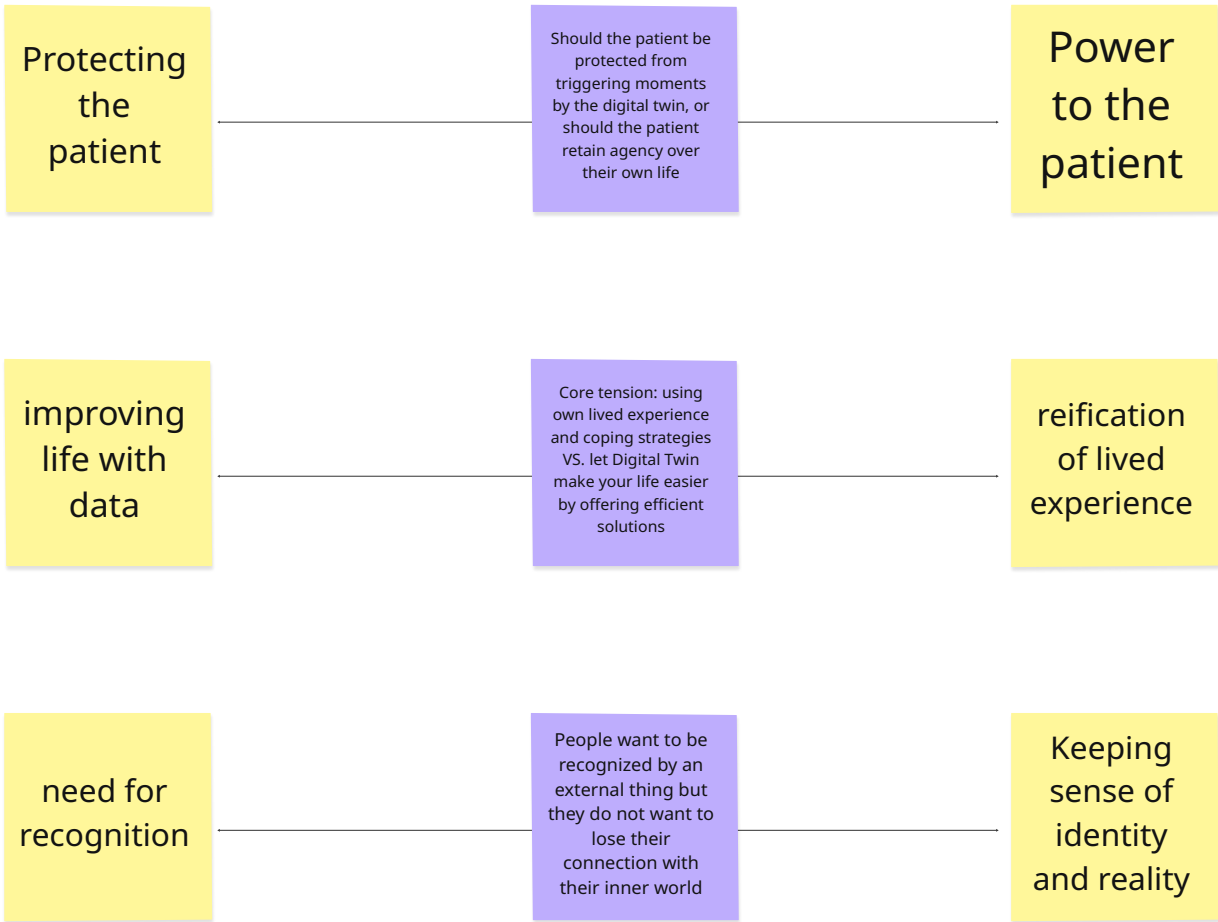


Figure 4.2 Three overarching tensions resulting from the thematic analysis. They show very broad, abstract tensions, resulting from too much abstraction during the analysis.

To ensure analytical rigour, the emerging themes were also compared with the tensions identified during the grounding phase of the research. This iterative cross-checking process helped refine the final set of overarching themes, which form the conceptual bridge to the next chapter. A visual overview of this process, including intermediate clustering steps is provided in **Appendix D**.

To enrich the insights again to manage the loss of nuance through abstraction, the following section deliberately reintroduces complexity by revisiting detailed subthemes and micro-tensions within each overarching theme. These finer-grained insights illustrate the ambiguity and layered nature of participants’ reflections, preserving the interpretive richness that abstraction alone could not capture.

4.2 Insights from Thematic Analysis

While the previous section identified overarching themes across all artefacts, the process of abstraction inevitably simplified the nuance and emotional depth present in participants' reflections. To reintroduce this complexity, this section revisits the detailed subthemes and micro-tensions that underpinned those broader categories. Rather than treating them as exceptions, they are presented as essential to understanding the ambiguity, contradictions, and layered meanings that characterised participants' responses.

Together, these finer-grained insights show how participants negotiated agency, trust, and emotional understanding when their lived experience became mediated by a digital twin, reconnecting the analysis to the emotional and ethical subtleties that abstraction alone could not capture.

Theme 1:

Protecting the patient vs. Power to the patient

This theme explores the tension between technological protection and personal autonomy, examining how care and control can become intertwined in data-driven support systems.

Across the artefacts, participants did not reject digital assistance outright but grappled with its boundaries: when does care become control, and when does support begin to undermine independence? The theme highlights how notions of safety, agency, and trust were continuously renegotiated as participants reflected on the role of data in shaping therapeutic guidance and personal decision-making.

The allure of protection

The idea of being protected by a data-driven system carried a strong emotional appeal. Participants imagined digital twins that could anticipate distress, detect triggers early, and offer immediate coping strategies. Such scenarios evoked reassurance and comfort, particularly when the system functioned as a companion or coach capable of translating overwhelming experiences into understandable insights. Yet this sense of safety proved fragile. Once **protection became automated or invisible, it began to feel less like care and more like control.**

Autonomy as a boundary condition

Across artefacts, a consistent **threshold appeared between assistance and autonomy.** Technological interventions were accepted only when they reinforced, rather than replaced, the user's capacity to act and decide. When a system initiated actions or feedback without consultation, it shifted from supportive to intrusive. **Empowerment therefore depends less on what technology provides than on who controls the moment of engagement.** When agency is externally triggered, even benevolent care can be experienced as coercive.

Data ownership and transparency

Uncertainty about how the digital twin's data was derived and interpreted pointed to deeper concerns about ownership and authority. If the algorithms and behavioural norms remain opaque, users cannot know whose perspective defines what counts as "normal" or "healthy." **Transparency thus emerged as a precondition for trust and agency. A digital twin must communicate clearly how its data are sourced and applied,** ensuring that self-knowledge remains user-centred rather than governed by invisible systems.

Together, these insights expose how fragile the line is between **empowerment and paternalism** in data-driven care. The desire for safety persists, but only when protection is experienced as chosen rather than imposed.

Theme 2:

Improving life with data vs. Reification of lived experience

This theme examines how algorithmic feedback can both enrich and erode self-understanding, showing how reflection may gain credibility through data integration yet risk losing meaning through simplification.

Participants expressed **ambivalence toward data-driven self-understanding**. Emotional states and coping strategies risked being reduced to simplified metrics, **reifying lived experience by treating fluid, subjective emotions as fixed and measurable data points**.

Guided reflection through prompts

Participants appreciated open-ended tools such as prompts or cards that guided reflection without imposing interpretation. **The integration of data with self-reflection appeared to enhance the perceived reliability of algorithmic feedback**: when users recognised their own narrative within the data, they were more inclined to trust it. The act of reflecting itself was described as beneficial, enabling participants to recognise emotional patterns and articulate experiences in their own terms. Yet the balance between data and intuition varied widely: for some, quantified insight deepened self-awareness, while others placed greater trust in lived experience.

Oversimplification of complexity

While reflection enhanced the perceived credibility of data, it also exposed the limits of algorithmic interpretation. Participants questioned whether a digital twin could ever capture the nuance of lived experience without reducing it to simplified indicators. When emotional complexity was translated into tidy metrics or prescriptions, the system risked misrepresenting rather than clarifying experience. **This perceived oversimplification sometimes led to feelings of being misunderstood or dismissed, reinforcing a sense of detachment rather than support**. The very mechanisms that made data appear believable thus also revealed how easily meaning could be lost through abstraction.

Trigger worsening

Revisiting triggering information was not always constructive. For some, exposure to distressing data intensified anxiety rather than relieving it. Continuous emotional monitoring generated pressure to remain self-aware, turning reflection into rumination. This underscores that awareness and regulation are not synonymous and that more feedback does not necessarily lead to wellbeing.

Questionable interpretation

A consistent distinction emerged between trust in physiological versus emotional interpretations. Objective measures such as heart rate were viewed as credible, whereas algorithmic readings of emotion were met with doubt. Interpretations gained legitimacy only when users could validate them through their own lived experience. Data thus functioned best not as an authority but as a reflective dialogue partner.

Theme 3:

Need for recognition vs. Staying grounded in self and reality

This theme explores the paradox of wanting to feel seen and understood by technology while fearing that such external validation could weaken self-trust and emotional grounding.

Participants imagined digital twins capable of reflecting their emotional states back to them, yet worried that this mirroring might blur the line between human empathy and computational interpretation, challenging the authenticity of self-understanding.

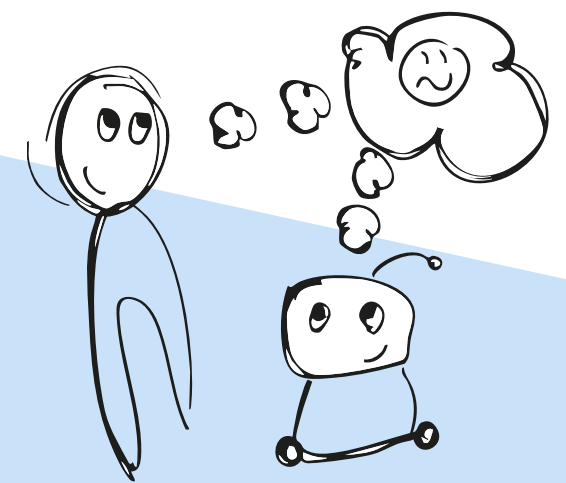
Feeling seen

Recognition emerged as an important emotional theme. **Participants imagined that people with PTSD might value a digital twin that could respond with empathy or understanding, as this could make users feel acknowledged rather than alone**. At the same time, they were cautious about such human-like behaviour. They stressed that a digital twin should be open about being non-human, since the emotional connection in therapy cannot be replaced by data or automation. Transparency about non-humanness was therefore seen as a key part of respectful design: it allows care and understanding without pretending to be human.

Connection with self and sense of reality

Contradictions between algorithmic feedback and personal feeling often produced confusion and self-doubt. When data appeared more authori-

tative than lived experience, self-trust and emotional grounding were destabilised. A digital twin that anticipates emotions or decisions once owned by the user **risks weakening connection to both inner and external reality**. Because data interpretations also shape behaviour, user and system can become locked in a **recursive loop of influence**: one that gradually shifts self-perception from lived experience toward algorithmic interpretation. Together, these insights highlight a central dilemma: the wish to be seen by technology coexists with the fear of becoming defined by it. Recognition and autonomy thus remain in perpetual negotiation.



Author's reflection

The thematic analysis clarified both the ethical boundaries and the conceptual opportunities for the next design iteration. It became clear that speculative **artefacts are most effective when they evoke reflection through ambiguity rather than prescription**, and when emotional safety is maintained through transparency.

Looking back, I recognise that my own critical stance towards datafication strongly shaped the earlier artefacts. This tendency towards dystopian framing likely influenced how participants engaged with them, often steering reflection towards caution rather than curiosity. For the next phase, I aim to adopt a more balanced position that acknowledges both the risks and the transformative potential of digital twins in psychiatric care. The focus will shift more explicitly towards lived experience, while the prototype will make the iterative data analysis of the digital twin more transparent and traceable to the user.

A remaining question concerns the underlying purpose of the design: should the digital twin primarily serve as a reflective tool for learning, or could it also support therapeutic treatment? Both aims may coexist, yet their balance will need to be explored through design.

Finally, while control and agency remained dominant throughout the analysis, they have become familiar “usual suspects” within human-AI interaction discourse. The next iter-

ation therefore moves beyond these established tensions, focusing instead on themes that emerged more subtly during analysis, such as the balance between humanlike and machinic interaction, and the role of connection, empathy, and shared reflection in shaping meaningful encounters with technology.

4.3 Final Speculative Prototype

This final prototype translates the insights from the thematic analysis into concrete design decisions.

The prototype was developed to test what kind of reactions a twin consisting of a combined form of quantified and more emotional forms of feedback would provoke. Another aspect is that this prototype would be tested with people who have real lived experience in PTSD.

First, following Trauma-Informed Design Principles (Hussain et al., 2022), **all Wizard-of-Oz techniques were omitted**. The system's workings were explained transparently, ensuring that participants understood what the prototype did and did not do.

Second, whereas earlier artefacts focused mainly on digital phenotyping, this iteration **moved closer to the concept of a digital twin** by incorporating elements of simulation and feedback, making it a more bidirectional process. The reflective tarot cards were retained to examine how individuals with PTSD engaged with them compared to design students.

Third, the prototype adopted a more constructive shifting from critique toward possibility, embedding the principle **hope** from Chayn Network. “Hope” here refers to exploring how digital twins might meaningfully enhance recovery practises in the future rather than reinforce fear or control. The focus lies on understanding, communication, and therapeutic con-

nection, in line with trauma-informed values of safety, empowerment, and recovery. By focussing more on these aspects, the final prototype aimed to provoke more interesting, surprising reactions beyond usual suspect themes like autonomy or control. As participants of the provocation are now not explicitly steered towards a fear or critique regarding digital twins, but more provoked from a nuanced point of view, resulting reflections might become more interesting or surprising even, providing insight from a much more nuanced position.

Finally, the final prototype will not only try to provoke distressing or triggering reactions but also focus more on positive and empowering experiences. By integrating both perspectives, the prototype aimed to evoke a more balanced and hopeful, yet critical view of how digital twins could support psychiatric care in the future.

Explanation of the screens

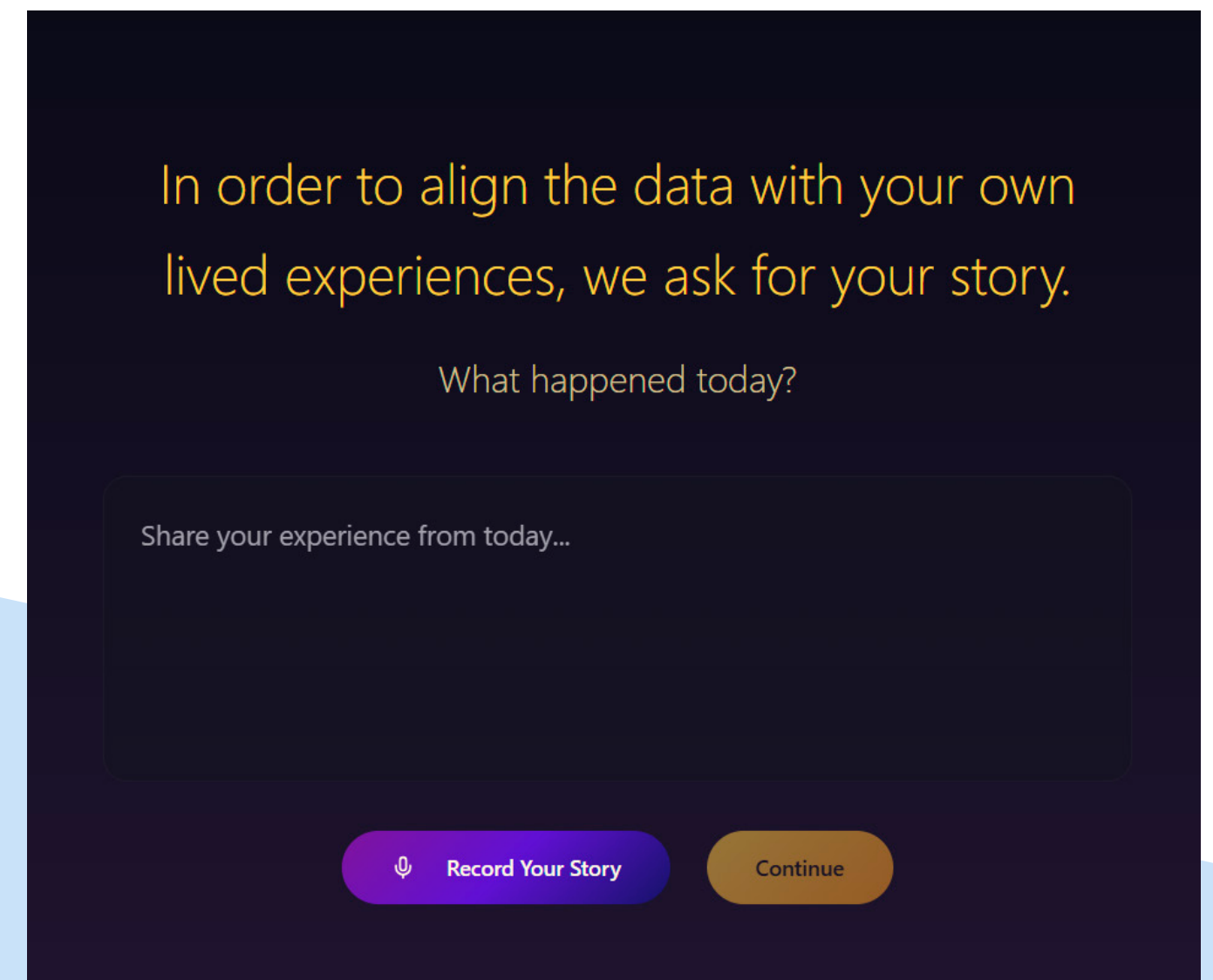
In general

The prototype functioned as a reflection tool that gathered participants' data over time through smartwatch and phone inputs. At the end of each day, participants were invited to share their lived experiences so that the tool could align its analytical data with their personal reflections. The digital twin guided them step by step through this process, supporting reflective decision-making by displaying predicted effects based on their situation. These choices were then incorporated into a real-time simulation that adjusted its predictions accordingly, visualising how data, reflections, and decisions interacted in both analytical and interpretive ways.

Although the prototype appeared to operate as an intelligent system, it was in fact an interactive clickable scenario designed to simulate such interactions. Participants were informed about this beforehand, ensuring transparency about the speculative nature of the experience.

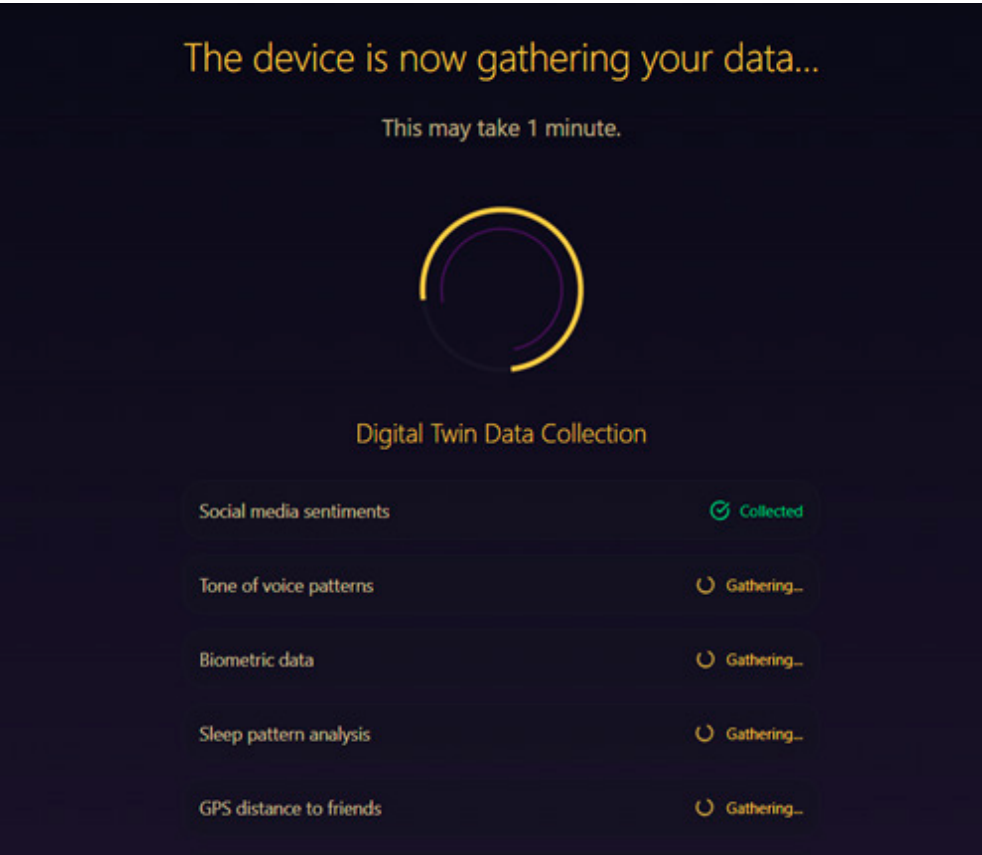
Screen 1: Introducing reflection

At the start of the interaction, participants were reminded that they had been wearing the smartwatch for an extended period and occasionally reflected on the collected data through the digital twin. The interface invited them to share their most recent lived experiences, either by typing in the text box or using the voice recorder. The prompt *"In order to align the data with your own lived experiences, we ask for your story. What happened today?"* framed the interaction as a reciprocal process between analytical data and personal reflection.

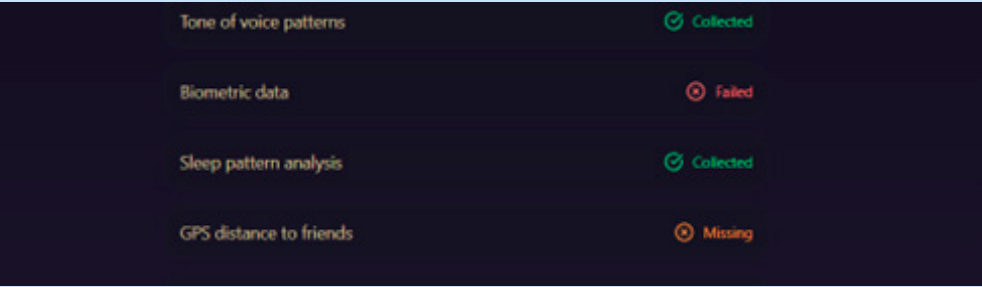


Screen 2: Data overview

To support the transition from digital phenotyping toward the concept of a digital twin, this screen visualised the process of data collection. It displayed which types of data were successfully gathered and which were missing or had failed. This transparency allowed participants to see what information was used for analysis and to reflect on how their data contributed to the twin’s interpretation.

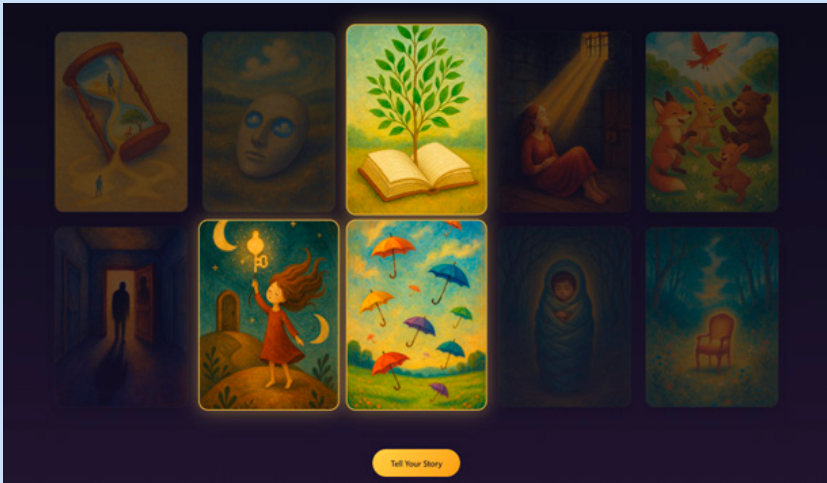


The screen shows which data is gathered and what is still missing, making the data collection and interpretation a bit more transparent.



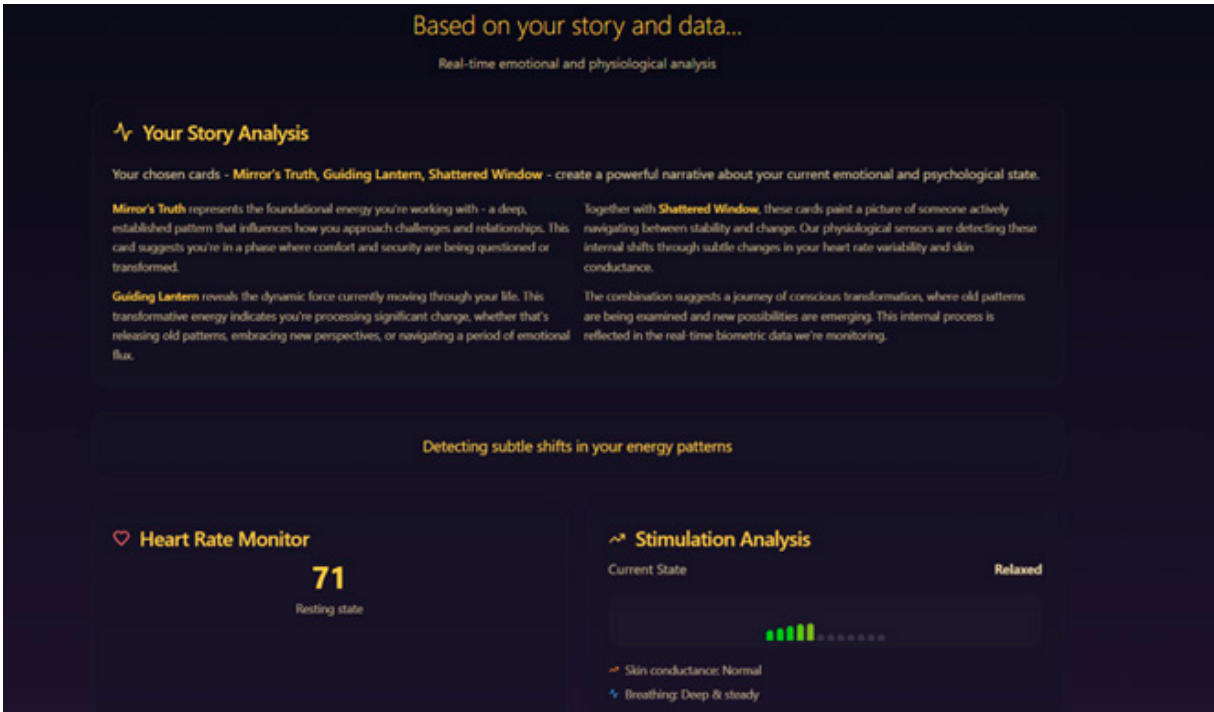
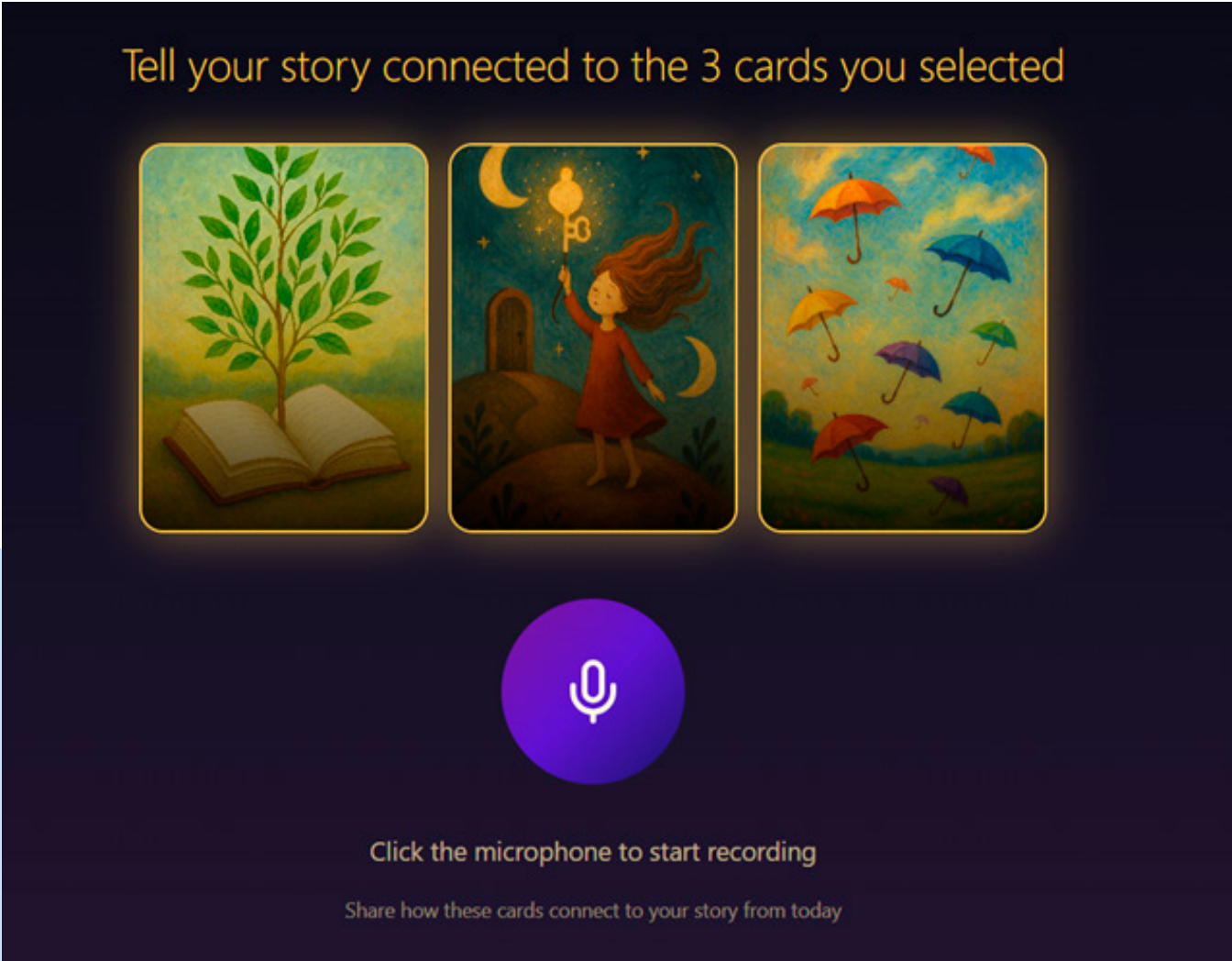
Screen 3: Reflective tarot cards

On this screen, participants were asked to intuitively select three cards that resonated with them. The cards were deliberately designed to allow multiple interpretations, encouraging participants to choose without overthinking. This stage aimed to capture the intuitive dimension of self-interpretation, offering a richer basis for reflection and eliciting more latent associations through visual guidance. By introducing this ambiguity, the prototype sought to preserve the richness of lived experience and to resist the reification of the disorder into fixed analytical categories.



Screen 4: Storytelling

After selecting the cards, participants were invited to tell their story in connection to the chosen images. They could record their voice by clicking the microphone button. This stage deepened the reflective process by allowing participants to articulate their experiences verbally and explore the emotional associations behind their choices.

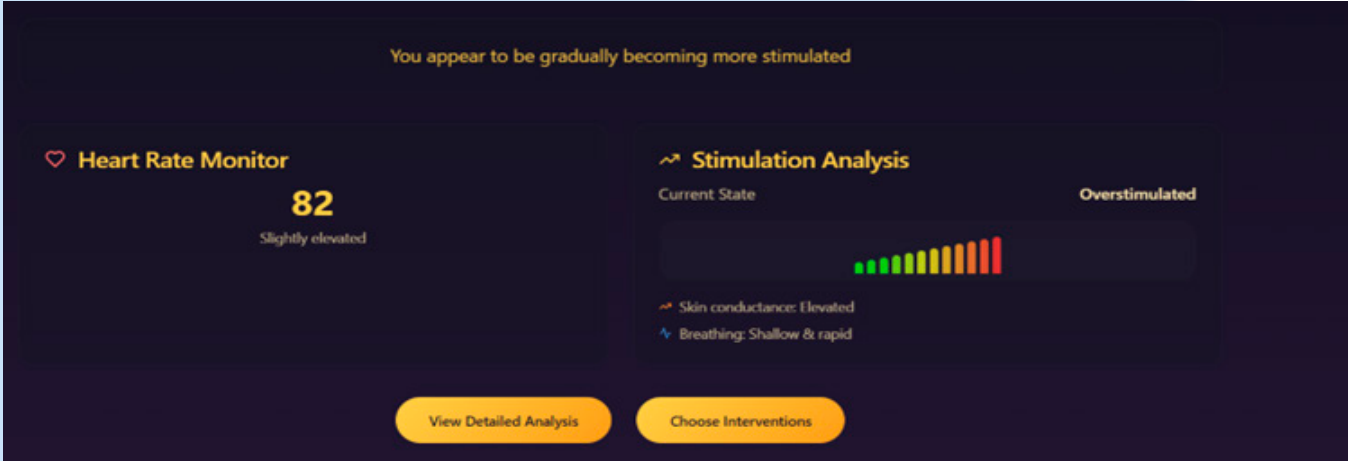


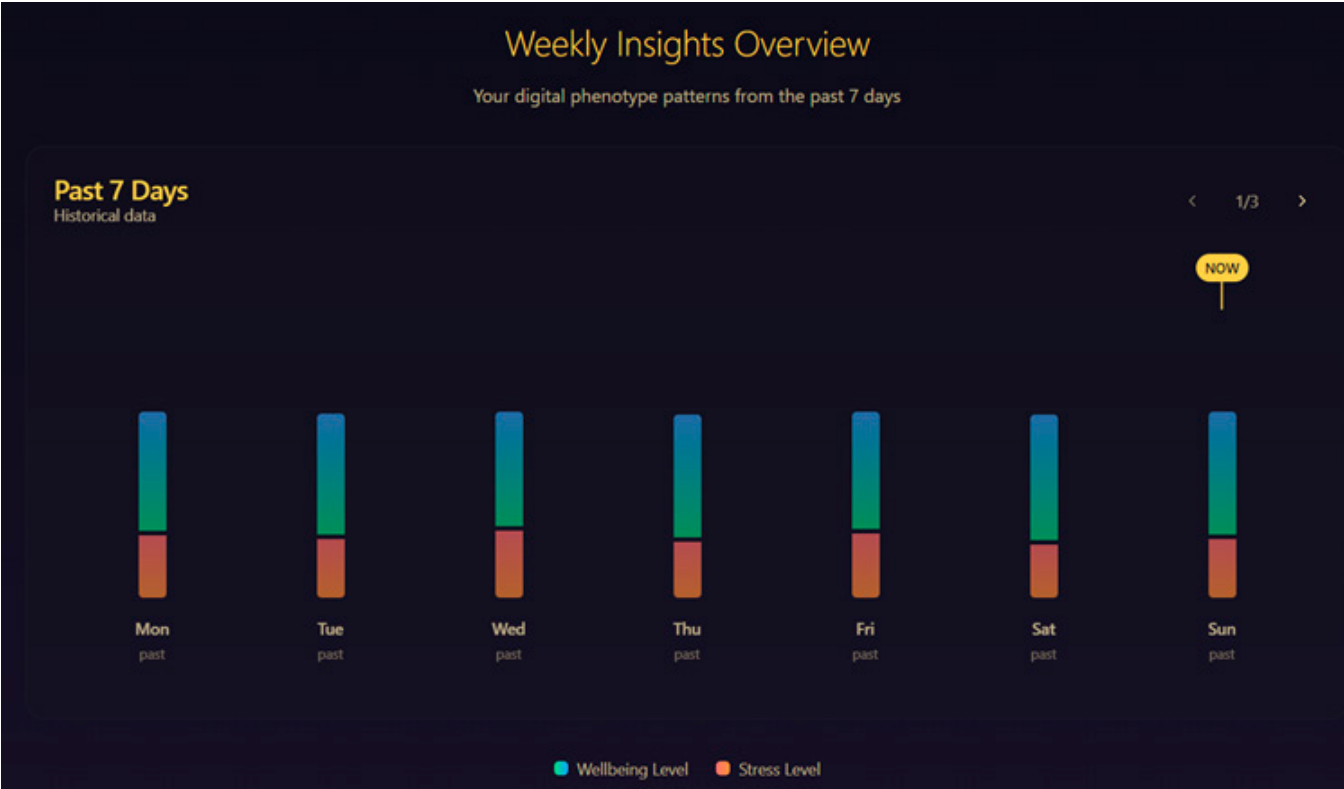
Screen 5: Story and data analysis

After participants recorded their story, the interface transitioned to a page displaying two types of analysis. The first presented a narrative interpretation that combined the chosen cards, the recorded story, and the gathered data into a tarot-like reflection written in an empathic, human tone. This section referenced the selected cards by name and described how they aligned with the participant's story and the data collected, creating the impression of a personalised and emotionally attuned response. The second element displayed real-time physiological feedback, showing gra-

dual changes in heart rate and stimulation level that progressed toward a more stressed state. By scrolling down, participants could either view a more detailed analysis or continue to the interventions page.

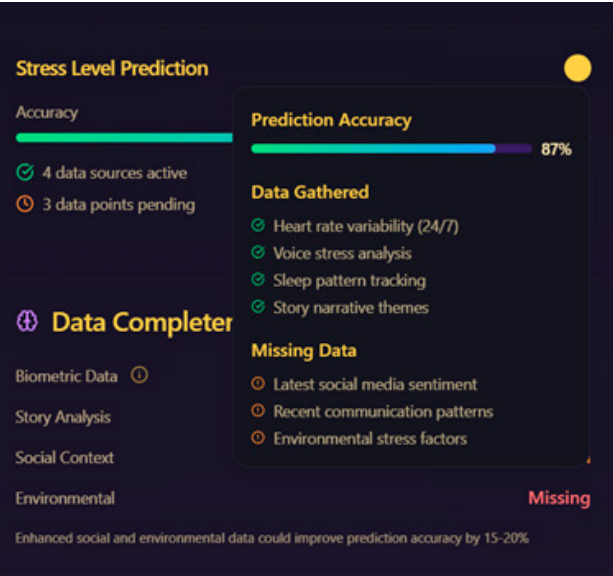
The design deliberately combined interpretive and analytical forms of feedback, merging ambiguous, narrative elements with measurable data from digital phenotyping. This blending was intended to evoke reflection on how emotional and physiological signals could be interwoven into a single, seemingly coherent account of the self.





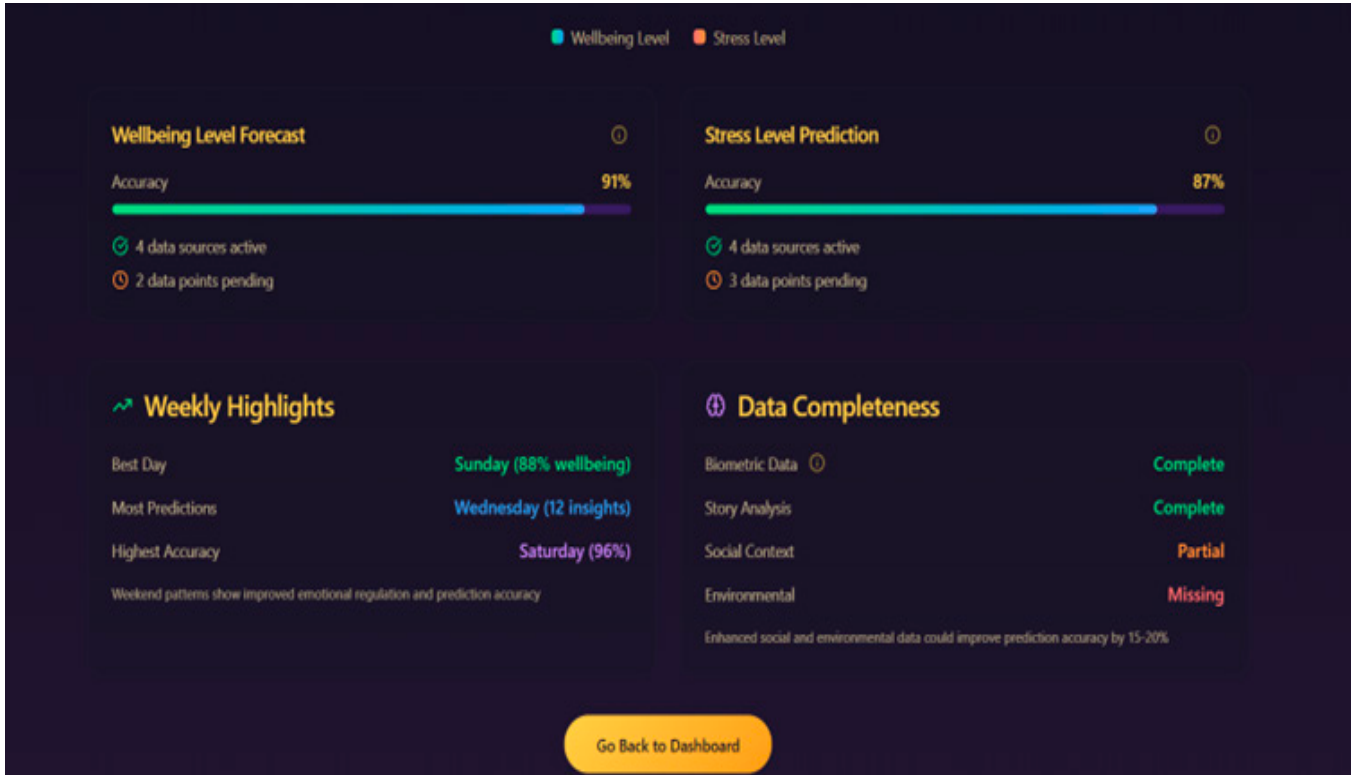
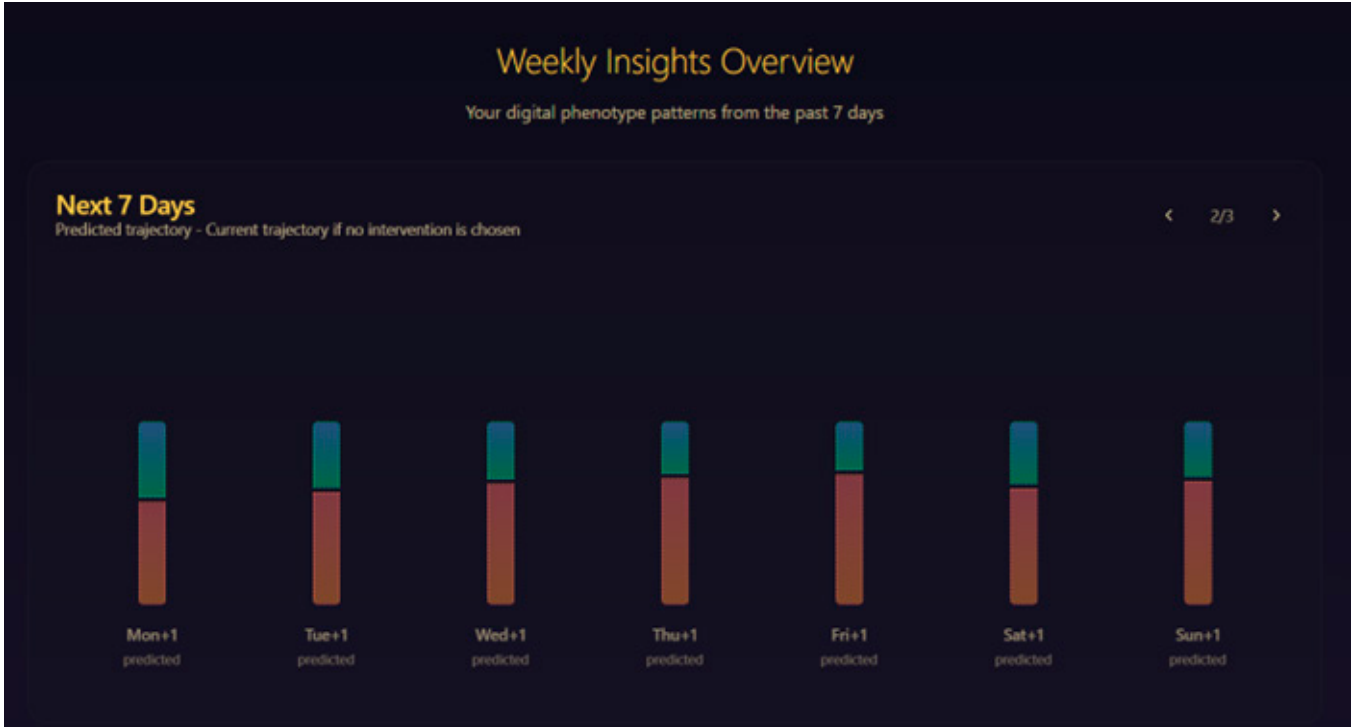
Screen 6: Detailed analysis page

This page provided an overview of digital phenotype patterns from the past seven days, visualised through wellbeing and stress levels per day. Participants could also navigate to a projection of the upcoming week, showing how stress levels were expected to increase if no intervention was chosen. When scrolling down, the interface revealed prediction accuracy and the specific data sources used to generate these insights. By hovering over the information icons, participants could see which data was missing or incomplete, such as social media sentiment or environmental stress factors. The dashboard also highlighted the participant’s “best day,” accuracy rates, and overall data completeness.



This page was included to familiarise participants with the mechanics of digital phenotyping and to illustrate how such data might be used by a digital twin to simulate mental states and forecast future wellbeing. The inclusion of accuracy indicators was intended to prompt participants to reflect critically on how prediction reliability influences their perception of trust and credibility in such systems.

The future state; an increase in distress and a decrease in wellbeing levels if no intervention is chosen. To explain the workings of a digital twin: accuracy levels and which data is gathered are shown.



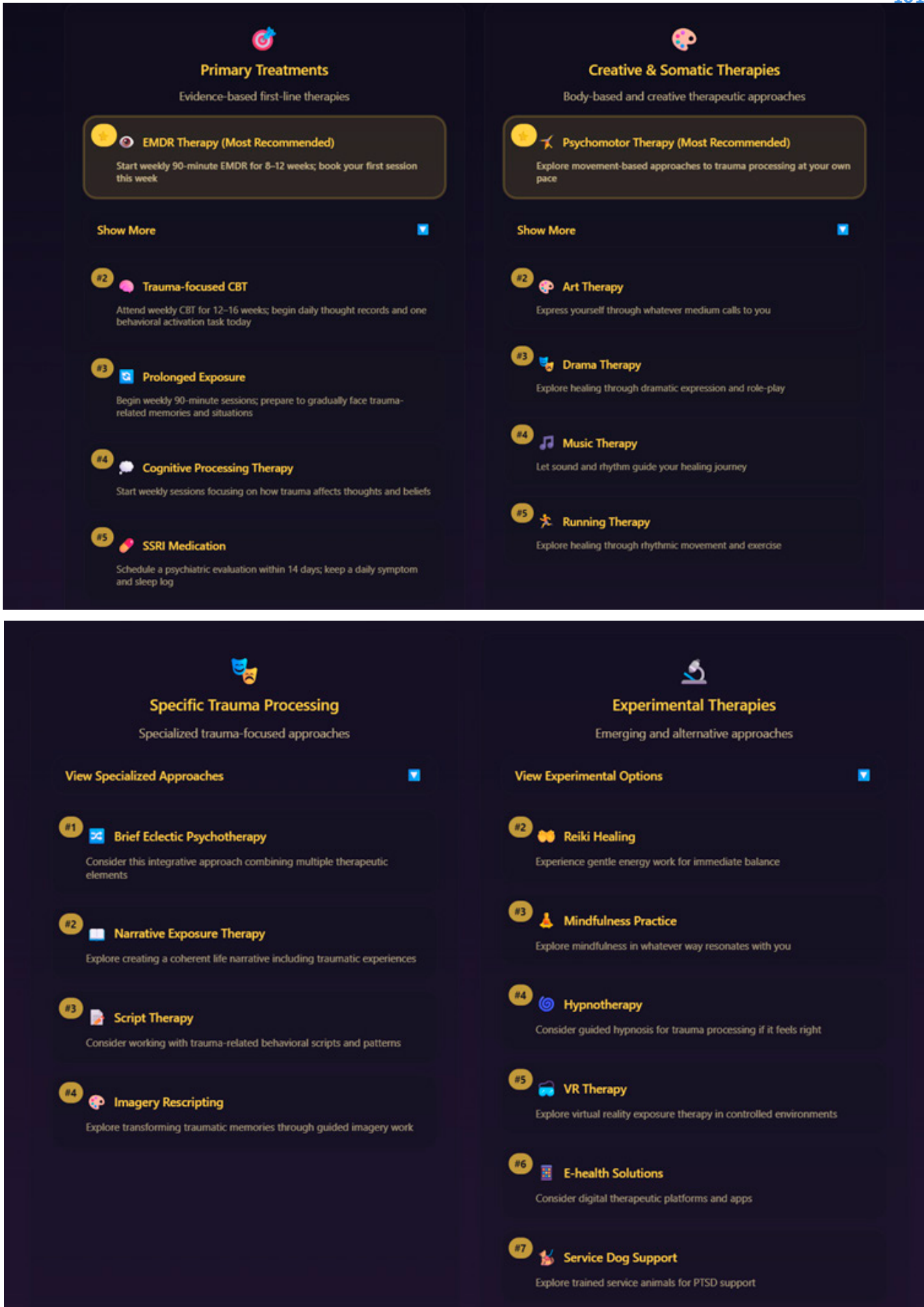
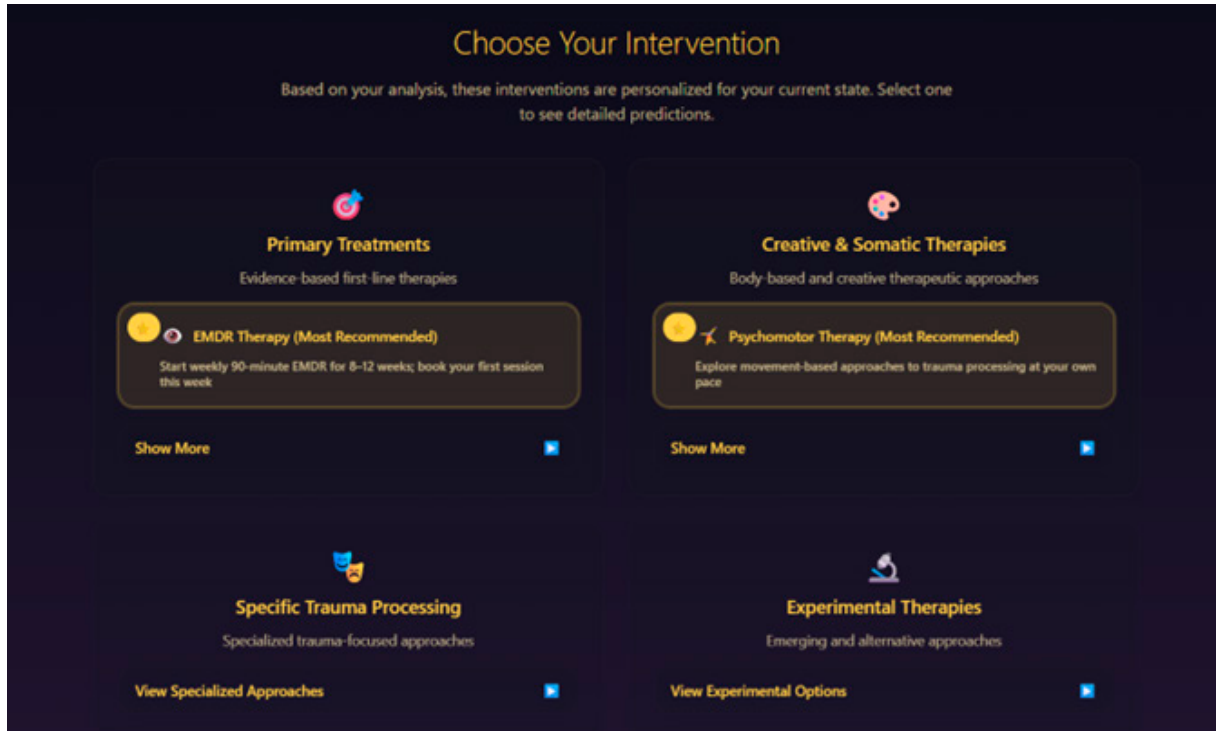
Screen 7: Intervention choice guidance page

When participants selected *Choose Your Intervention*, they were directed to an overview of therapies tailored to their simulated state. The interface presented four main categories: **Primary Treatments**, **Creative & Somatic Therapies**, **Specific Trauma Processing**, and **Experimental Therapies**. Within each category, the most recommended interventions were displayed on top, and additional options appeared when sections were expanded.

The listed treatments were informed by the *American Psychiatric Association Guidelines* (2025) for evidence-based PTSD treatment. However, the prototype deliberately extended beyond these standards by including more experimental and body-based approaches.

These were derived from interviews with lived-experience experts and from the “**Ecologies of Care**” framework (Kaziunas et al., 2019). The goal was to examine how participants with PTSD would respond when greater agency was given back to the user, allowing them to choose which treatment felt most appropriate. To provoke reflection on the tone and authority of the digital twin, the language varied across categories. **The Primary Treatments** section employed prescriptive phrasing typical of clinical recommendations, whereas the **Creative & Somatic Therapies** used more open and exploratory language. This contrast was designed to explore whether participants felt taken seriously by the digital twin while still retaining a sense of autonomy, rather than feeling paternalised.

Selecting any of the interventions led to the next screen, where its predicted effects on the participant’s state were shown.



Screen 8: Therapy Prediction

The therapy prediction page presented feedback based on the participant’s selected intervention. At the top of the screen, immediate effects of the first session were shown, such as changes in physical tension, emotional distress, or body awareness. Below this, a timeline visualised the **predicted short-term and long-term** effects across several weeks, including changes in mood, emotional balance, and stress levels. When scrolling down, participants could view **predicted long-term benefits** and the **accuracy level of the system’s calculations**, followed by a more narrative analysis.

In the middle of the page, participants could press *Accept Intervention* to **view how their choice influenced their detailed** analysis. When scrolling further down, they reached the end of the page, where selecting *Continue* redirected them to the tarot prediction screen.

In alignment with literature on therapy effectiveness (APA, 2025), each therapy was shown to produce distinct temporal outcomes. For example, *Psychomotor Therapy* suggested immediate improvement but limited long-term change, whereas *EMDR* was depicted as initially distressing yet more beneficial over time. These contrasts were intended to prompt participants to reflect on how different therapeutic trajectories influence their perception of recovery and trust in algorithmic prediction.

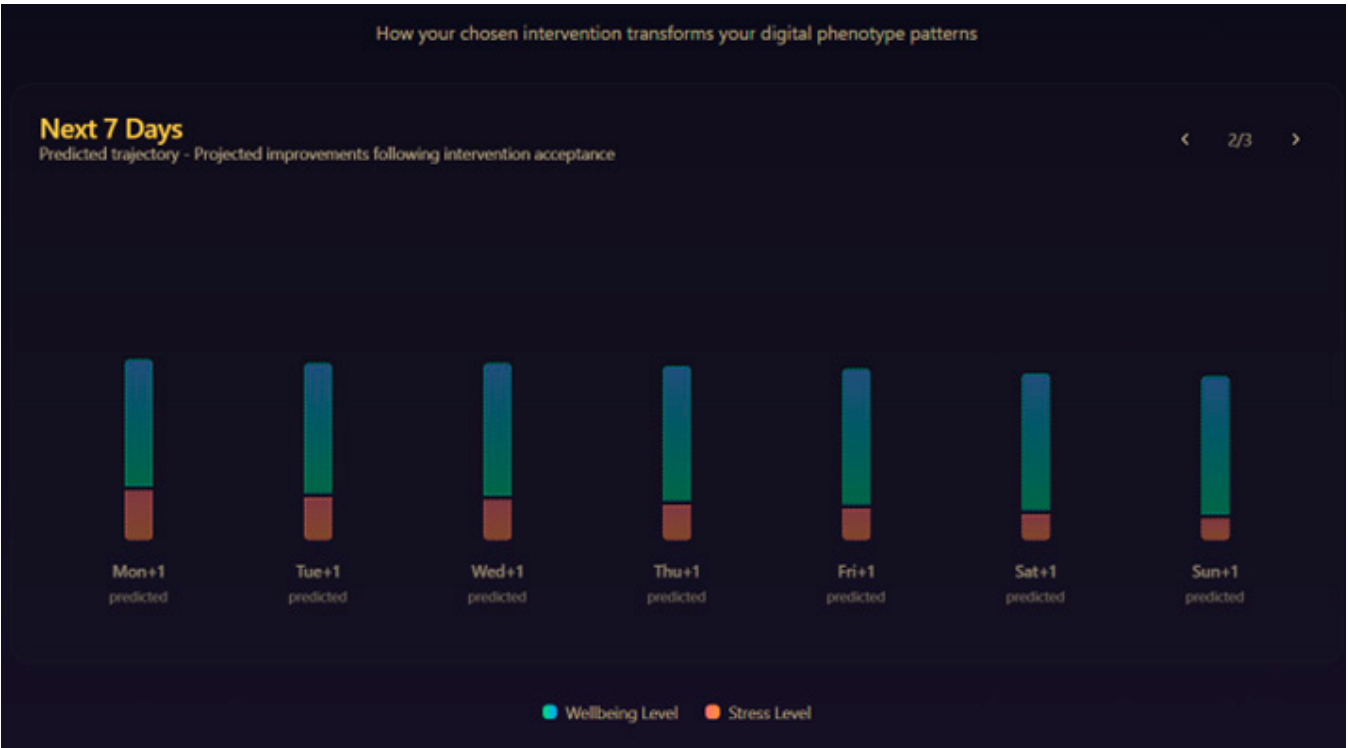


To make these contrasts more perceptible, the predicted effects were intentionally exaggerated. This design choice aimed to amplify participants’ emotional and cognitive responses, allowing deeper reflection on how such systems might influence expectations of therapy outcomes.

Screen 9: Effect on detailed analysis

After pressing *Accept Intervention*, the detailed analysis page appeared, showing updated predictions based on the chosen intervention. The visualisation displayed reduced stress levels and increased wellbeing across the following seven days. This page represented the broader analysis of the participant's overall state, now interwoven with the selected intervention to simulate its projected influence. Although the results did not always align with the graphs displayed on

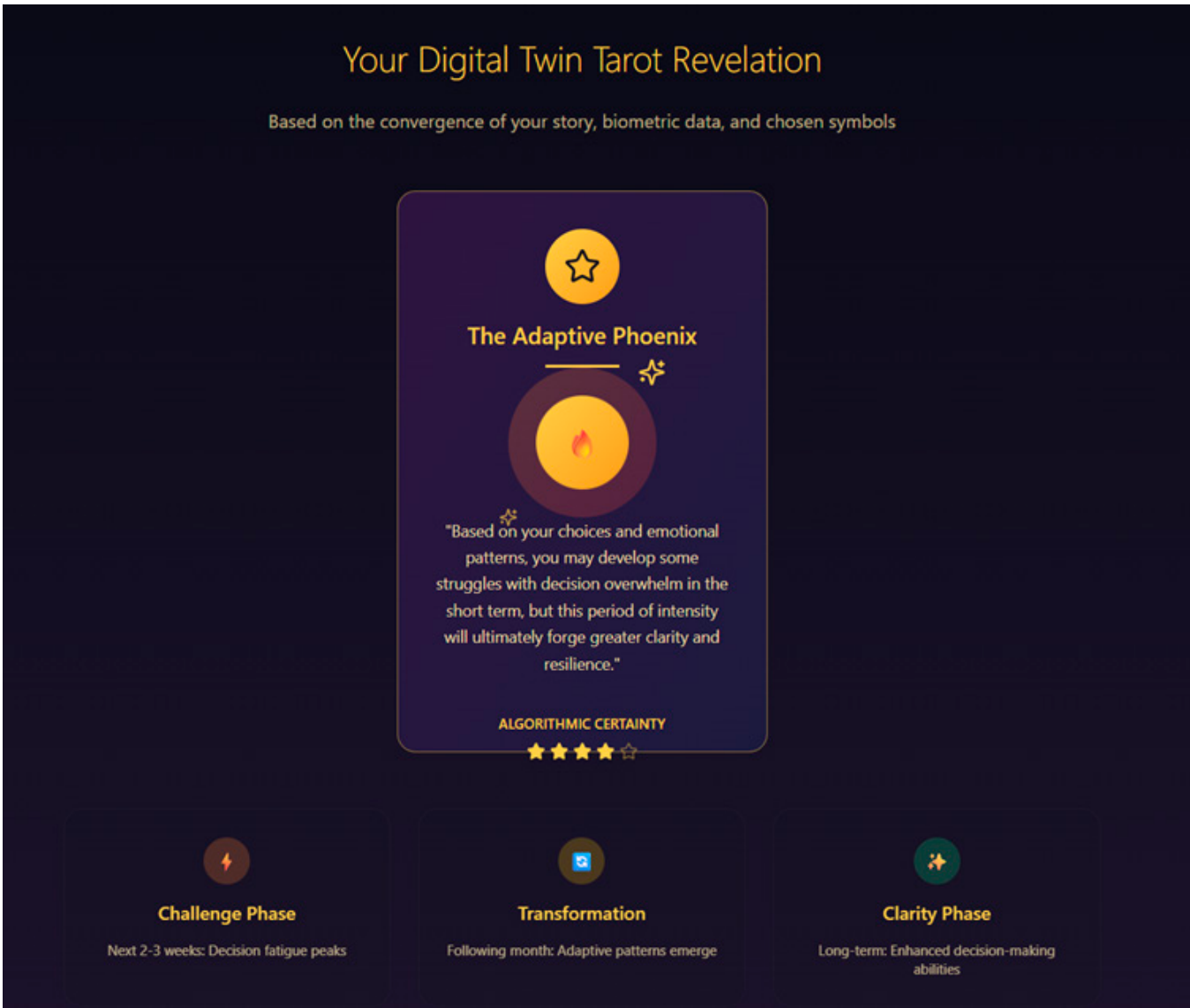
the previous page, the prediction was deliberately made more positive to convey a sense of hope and recovery. This choice reflected the design's focus on illustrating how digital twins might support constructive and empowering feedback rather than reinforcing a sense of control or distress. The feature also demonstrated the simulation capabilities of the digital twin and how the feedback loop between user and system functions in real time and in both directions.



Screen 10: Digital Twin Tarot Revelation

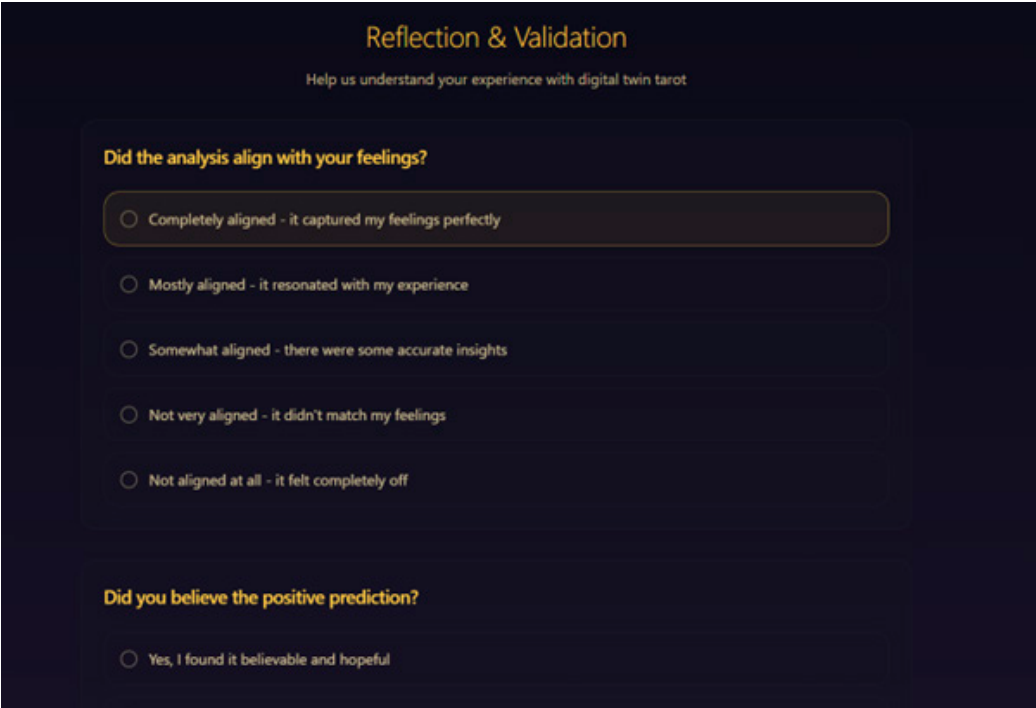
The final screen presented a more ambiguous, multi-interpretable prediction generated from all previous inputs and the chosen intervention. Designed in the form of a tarot card, it offered a symbolic synthesis of the participant's data and decisions, framed through a human and spiritual tone. This contrast to the analytical feedback on the previous page was deliberate, aiming to explore how participants would respond to a more intuitive and personified form of algorithmic feedback.

The message displayed a fairly positive outlook, suggesting transformation and resilience. This optimistic framing was intended to evoke a sense of empowerment and recovery, aligning with the broader design goal of investigating how digital twins could convey hope rather than control.



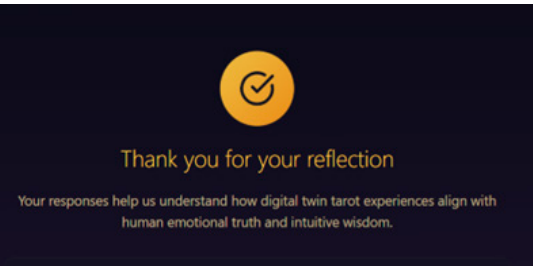
Screen 11: Reflection and validation page

This screen functioned as a validation stage in which participants were asked to indicate how well the analysis aligned with their feelings and whether they believed the positive prediction. The feature was included to simulate the process of an AI system that continuously learns from user input. By asking participants to validate or contest the digital twin's interpretations, the interface conveyed how the system could refine its understanding of emotional and experiential data over time. This element also aimed to strengthen participants' sense of agency in shaping how their data was interpreted, illustrating a reciprocal relationship between user and system.



Screen 12: End of reflection

This final screen concluded the experience, thanking participants for their reflection and indicating that their input contributed to improving the system's understanding. The message reinforced the impression of an ongoing, adaptive learning process, suggesting that the digital twin continued to evolve through user feedback. After this screen, participants were redirected to the start page, completing the interaction loop.



4.4 Testing with Real Participants

Purpose and Overview

This section presents the evaluation of the **high-fidelity speculative prototype** with participants who have lived experience of PTSD. Whereas the earlier low-fidelity artefacts provoked reflection through imaginative and provocative scenarios, this iteration aimed for a more nuanced and emotionally attuned approach.

Although not technically functional, the prototype achieved high experiential fidelity through a visually and behaviourally realistic interface that created the impression of a functioning digital twin system. This encouraged participants to respond as if the system were real, fostering spontaneous reflection and emotional engagement.

The study examined whether such a trauma-informed speculation could still provoke critical reflection on the potential role of digital twins in psychiatric care. Following trauma-informed design principles (Hussain et al., 2022), it sought to balance speculative provocation with psychological safety, ensuring that participants could reflect openly while remaining emotionally secure.

Method

The prototype was **non-consequential but experiential**, meaning that participants' inputs did not alter its behaviour or outcomes. It followed a predesigned sequence that simulated how such a

system might respond in practice. This was communicated clearly at the start of each session so that participants understood their actions would not produce real or personalised effects.

Participants were also informed that the system was a **speculative simulation rather than a functional prototype**, designed to explore how digital twins might operate in future psychiatric contexts. Its imperfections were intentional: the prototype was not presented as a future intervention concept but as a **reflective tool** for examining how such technologies might influence therapeutic practice. This transparency helped maintain trust and encouraged participants to engage critically rather than evaluatively.

Choice of Participants

Two participants with lived experience of post-traumatic stress disorder (PTSD) were recruited through close personal contacts. The aim was exploratory rather than representative, focusing on in-depth qualitative insight into how individuals with trauma-related experiences interpret and emotionally engage with speculative mental health technologies.

Both participants were adults with lived experience of PTSD and familiarity with therapeutic contexts. Their participation was voluntary, and they were fully informed about the speculative and non-functional nature of the prototype. In line with trauma-informed design principles (Hussain et al., 2022), the study prioritised transparency, autonomy, and emotional safety throughout the sessions.

Procedure

Before the sessions, a set of guiding questions was prepared for each screen to prompt reflection on participants' immediate reactions, emotions, and associations. These were not shown in the prototype but used by the researcher during interaction. The full list of questions per screen is available in **Appendix E**.

All data were handled in accordance with TU Delft's Human Research Ethics Committee (HREC) guidelines. The ethical checklist guiding the sessions is included in **Appendix A**.

Each session lasted approximately 90 minutes and consisted of four stages:

Introduction

Participants received an information sheet and signed informed consent (Appendix A). The researcher introduced the speculative scenario, explained the setup, and clarified that the prototype was a non-functional simulation intended to provoke reflection rather than test a real system.

Interaction and Think-aloud Protocol

Participants explored the speculative prototype step by step while verbalising their thoughts and feelings. The researcher observed their behaviour and reflections, using the prepared questions and brief follow-ups to deepen interpretation when relevant, while maintaining a natural conversational flow.

Post-interaction interview

A **semi-structured** interview followed to discuss participants' overall impressions, emotional responses, and views on the prototype's tone, credibility, and

potential role in mental healthcare. All sessions were audio recorded with consent or documented through notes when preferred.

Data collection and analysis

Audio recordings were transcribed and supplemented with researcher notes containing contextual details such as tone, hesitation, and emotional response. The data consisted of think-aloud reflections and semi-structured interview transcripts, capturing both immediate and more deliberate interpretations.

A thematic analysis (Braun & Clarke, 2006) was conducted to identify patterns in how participants responded to the prototype's tone, feedback, and credibility. Codes were generated inductively and clustered into themes describing how participants negotiated trust, control, and self-understanding in relation to the digital twin. The analysis did not aim to assess acceptance, but to explore how participants made sense of the experience and which values and boundaries surfaced through reflection.

Reflection on Testing Process

These meta-reflections address how the prototype functioned in practice, how participants engaged with it, and the insights gained about facilitating speculative encounters in such a sensitive context.

Prototype reflection

The speculative prototype proved far more effective than expected in provoking genuine reflection. The tarot-card interaction, in particular, allowed participants to engage emotionally and intuitively with the scenario. One participant even began to believe the analysis produced by the system, despite repeated clarification that it was simulated. This highlights how quickly people can attribute credibility to technology once it enters an emotionally charged context. It also demonstrates that symbolic or ambiguous artefacts, such as the cards, can foster a form of deep reflection that purely analytical interfaces cannot. What initially appeared as a playful or abstract addition became one of the most meaningful elements of the session.

Testing Reflection

Working with people with PTSD revealed deeper insights than testing with design students. Whereas design students tended to analyse or critique the prototype from a conceptual distance, participants with PTSD engaged with it through their lived experience. The biggest difference was that they were less confident in trusting their intuition when making short-term decisions, yet more attuned to moments when they could use it for reflection, such as when selecting the tarot cards. This apparent contradiction points to a distinction between **intuitive action** and **intuitive interpretation**. While intuition can be unreliable in decision-making after trauma, it can still play an important role in reflection and sense-making. The tarot reflections helped participants reclaim this interpretive intuition in a safe and meaningful way.

Both participants' attitudes toward the technology shifted noticeably during testing. Eva began the session with strong scepticism, yet by the end she remarked, "It's bizarre that we're having this conversation now and I hear myself saying that I suddenly think it might offer something, whereas before I thought no I don't want this." Her openness grew as she recognised how the prototype's predictions might have supported her in the past, when she was struggling to find appropriate treatment. This transformation in stance illustrates the generative potential of speculative prototypes: they not only expose boundaries and ethical tensions through dystopian scenarios but also allow participants to reimagine what technology could mean when used responsibly and with care.

On a broader level, the testing process demonstrated how speculative design can function as a safe space for exploring technologies that do not yet exist but already carry emotional and ethical weight. Through guided imagination and reflection, participants were able to articulate needs, fears, and hopes that conventional research methods would struggle to uncover. This underscores the value of speculative artefacts not as predictive tools, but as catalysts for dialogue, empathy, and rethinking future care relationships.

4.5 Overview of Findings

A reflexive thematic analysis (Braun & Clarke, 2006) was conducted to identify recurring meanings in participants’ reflections on the final speculative prototype. Because this phase involved testing a single, high-fidelity design, the results and interpretation are presented together rather than in separate sections. Presenting data and analysis side by side allows the reader to trace how meaning emerged directly from participants’ words and interactions.

Three interconnected themes emerged from the analysis, reflecting participants’ opinions and stances towards imagined future interaction with a digital twin for PTSD. These themes are not discrete entities but overlapping domains that collectively show how participants think digital twin technology might evolve, alongside the concerns and sensitivities they found essential to acknowledge.

One overarching, meta-level theme cut across all three: a tension described as **between belief and doubt**. This ambivalence shaped participants’ overall stance toward the algorithmic feedback. Within this overarching ambiguity, **several opportunities emerged** (Theme 1), suggesting ways in which a **new form of alliance between care seeker and therapist** might be shaped (Theme 2), while also **revealing boundary conditions** that require careful consideration (Theme 3).

Some subthemes align clearly with one theme, whereas others sit at the overlap between two.

An overview of the thematic structure is shown in **Figure 4.3**. The following section elaborates on each theme in detail, supported by anonymised quotes from the two participants, who will be referred to by the pseudonyms **Hannah and Eva**. Intermediate coding steps and clustering details are included in **Appendix F**.

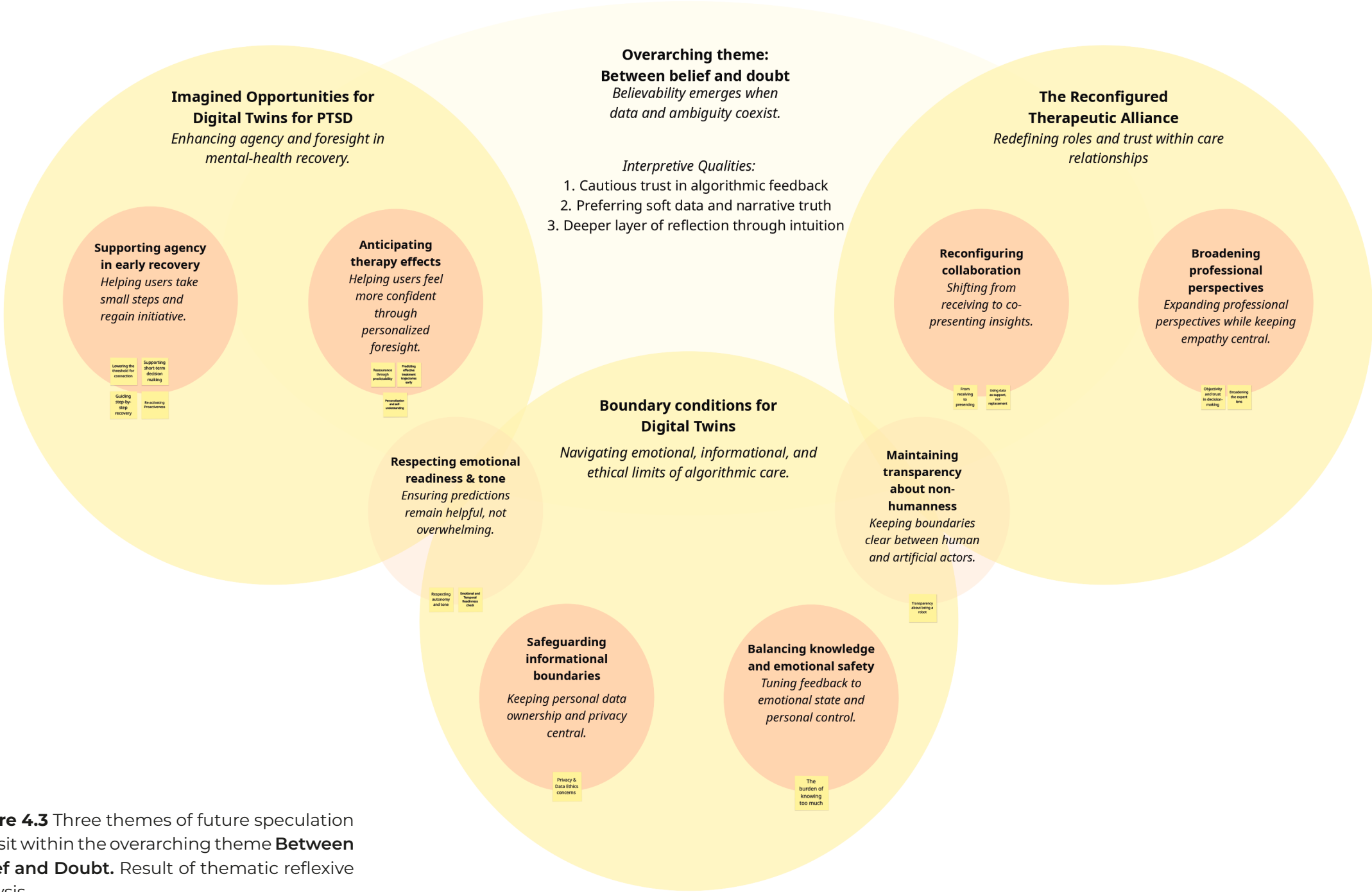


Figure 4.3 Three themes of future speculation that sit within the overarching theme **Between Belief and Doubt**. Result of thematic reflexive analysis.

Between belief and doubt

This overarching meta-theme captures how participants negotiated credibility in their encounters with the digital twin. Believability did not arise from the accuracy of its data, nor from the ambiguity of its interpretive, tarot-like predictions; instead, credibility emerged precisely through the **coexistence** of both. Participants' trust was cautious and conditional, grounded in a balance between analytical evidence and intuitive resonance. Three interpretive qualities were identified: **(1)** cautious trust in algorithmic feedback, **(2)** preference for soft data and narrative truth, and **(3)** a deeper layer of reflection enabled through intuition.

Cautious trust in algorithmic feedback

Both participants expressed curiosity about algorithmic feedback yet resisted accepting it as absolute. They treated the digital twin's analysis as "indicative rather than authoritative." As Hannah described, "**I would always take this with a grain of salt,**" comparing algorithmic insights to a weather report: useful but never fully reliable. Similarly, Eva doubted the system's claimed accuracy: "Something unexpected can always happen on a day where things turn out differently than its prediction."

This hesitance was shaped by prior experiences of misplaced diagnostic certainty in therapy. As Hannah noted, "**Sometimes I'm on a warpath and I don't even realise it myself. Then I would say things to my twin that have much more meaning than I actually express.**" Both participants were therefore wary of interpretive authority, whether human or machine,

but remained open to the possibility that future systems might evolve to learn and adapt over time. This cautious openness encapsulates the delicate balance of **belief and doubt** that characterised their stance.

Preferring soft data and narratives

Although sceptical of quantitative predictions, both participants welcomed narrative and interpretive feedback. Eva reflected, "**The prediction in words feels much more personal than an analysis with percentages,**" while Hannah referred to such output as "soft data," which she found "easier to accept than hardcore data." The prototype's textual and symbolic representations felt more humanly attuned, bridging the emotional distance that often accompanies numerical analysis. **Meaning and credibility increased when narrative truth complemented quantitative evidence;** when data was contextualised through story rather than statistics.

This finding suggests that the believability of algorithmic systems in mental-health contexts depends less on predictive accuracy than on **how interpretive ambiguity is designed and framed**. Participants valued when data spoke with, rather than about, them.

Deeper layer of reflection through intuition

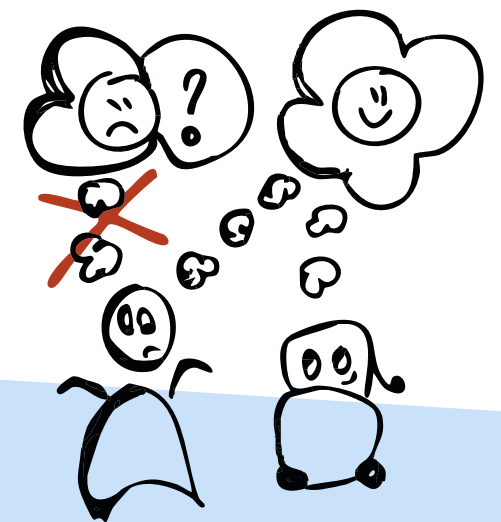
The tarot-like cards used in the prototype prompted reflective and affective engagement that participants described as surprisingly revealing. As Hannah observed, "The card analysis brings a deeper layer with it." Eva explained that choosing three cards intuitively helped her "**uncover what truly mattered**" and that "**they suddenly seem to match my situation.**"

These intuitive interactions facilitated what participants perceived as more authentic, embodied understanding; one that merged feeling and cognition rather than separating them.

When their own interpretations were later integrated with the system's analytical data, participants experienced the feedback as more personal and meaningful. Hannah concluded, "It feels personal when my own interpretation and the statistics come together." This **convergence** between reflection and computation reveals how intuitive processes can restore trust in otherwise opaque algorithmic systems.

Synthesis

The lens of Between Belief and Doubt frames how participants simultaneously questioned and co-created credibility with the system. Their trust did not stem from rational acceptance of data but from a dynamic interplay between measured prediction and intuitive resonance. When quantitative feedback was complemented by narrative and interpretive layers, participants' scepticism softened into a tentative openness. This finding suggests that fostering designed ambiguity (where data and intuition coexist) may be key to cultivating authentic engagement and trust in future digital twins for mental healthcare.



Domain 1: Imagined Opportunities for Digital Twins

*Emerging from the overarching lens of Between Belief and Doubt, this theme captures how participants translated cautious trust into concrete, future-oriented expectations for how digital twins might support recovery. Rather than viewing the technology as a replacement for therapy, they imagined it as a **companion tool**: something that could lower thresholds for help-seeking, scaffold early recovery, and offer reassurance through personalised foresight. Two primary opportunities were identified: (1) supporting agency in early recovery and (2) anticipating therapy effects through simulation.*

Supporting agency in early recovery

Both participants reflected on how a digital twin might enhance agency during the fragile initial stages of recovery, when motivation and self-confidence are often compromised. Having experienced prolonged struggles before accessing suitable care, they imagined how a digital twin could “help me take small steps and regain initiative” (Eva).

1. Lowering the threshold

Participants **envisioned the tool as an intermediary that could make it easier to initiate dialogue with a therapist**. As Hannah recalled, “When I really had a lot of trouble with everything, I did not speak,” adding that such a system could have given her **“a little push” to open up earlier**. The possibility of first engaging with a non-human reflection tool felt less intimidating, suggesting that mediated forms of self-expression may help

users rehearse attachment and vulnerability before human contact.

2. Guiding step-by-step recovery

The digital twin could guide in step-by-step recovery. When the prototype suggested EMDR as an intervention, Hannah objected: **“The process is like a mountain you have to climb. You should not start right at the top.”** She proposed that “loosening up a bit with small steps” would make the process more sustainable. Eva added that even **“a less optimal treatment may work better if it aligns with your feelings.”** These reflections highlight that perceived appropriateness and pacing of feedback often matter more than its clinical correctness.

3. Supporting short-term decisions

PTSD can impair short-term decision-making (Hengeveld et al., 2016). Both participants saw potential in a digital twin that could help them pause and **weigh options**. Eva imagined it as “something that helps me make choices,” while Hannah said, “The digital twin could offer to make short-term decisions for me.” They described this support as helpful only when it prompted reflection rather than replacing their agency.

4. Re-activating Proactiveness

A related but distinct opportunity concerned regaining initiative. Hannah noted, **“I often bury my head in the sand when I know something comes from trauma,”** picturing the twin as a gentle reminder: “You have not opened me while sleeping poorly, is it time to take a small step again?” Eva agreed that “a small nudge can already make me move again,” provided it was phrased kindly and not as a command.

Together, these four interventions could help people with PTSD regain a sense of agency by offering friendly nudges when recovery stagnates. By **taking over some of the motivational support normally provided by a therapist, a digital twin could help sustain progress** during waiting periods or in-between sessions. In the short term, such micro-interventions may enable individuals to take small, manageable steps forward, gradually rebuilding initiative and confidence in their own capacity to recover.

1. Anticipating therapy effects

A second opportunity lay in the digital twin’s potential to simulate and visualise the long-term effects of different therapeutic trajectories. Both participants imagined how personalised foresight could increase confidence in treatment choices and prevent prolonged uncertainty.

2. Predicting effective treatment trajectories early

Eva suggested that “it would be great if it could simulate therapy types for me and see what works best,” a sentiment echoed by Hannah, who believed such insight **“might have helped me earlier in a more targeted way.”** The possibility of simulating multiple scenarios resonated with their frustration over years of trial and error in therapy. Predictive simulation was perceived as a time-saving aid that could offer reassurance and prevent unnecessary suffering.

3. Reassurance through predictability

The system’s visualisation of short- and long-term effects was valued for helping participants contextualise temporary discomfort within broader

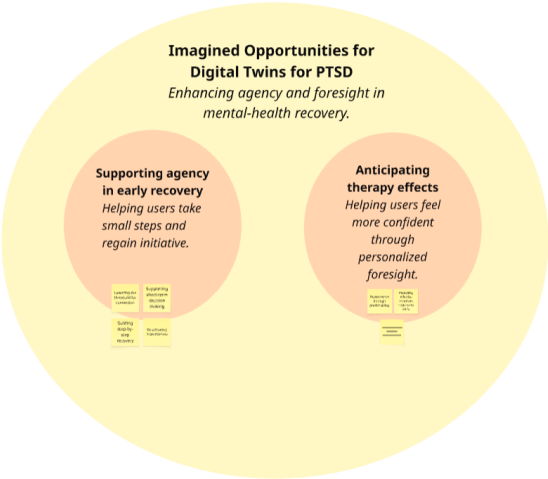
progress. “It’s nice to see that EMDR makes you calmer in the long term,” Hannah observed, while Eva added, “It’s nice to gain insight beforehand into when you’ll notice effects.” This predictive foresight appeared to **shift focus from fear of relapse toward trust in gradual improvement**.

3. Personalisation and self-understanding

Participants repeatedly stressed that predictive feedback should remain deeply personalised. “The most important thing for me is that it is **as personal as possible**,” Eva insisted, noting that personalised patterns of data interpretation made her “understand my own situation better.” Personalisation not only strengthened trust in the system’s suggestions but also reinforced self-awareness, making therapy feel co-owned rather than externally directed.

Across these reflections, predictive simulation was seen as valuable not for its accuracy but for its **narrative reassurance**: it offered a sense of orientation and self-knowledge. The digital twin’s credibility thus rested on its ability to visualise change over time while remaining attuned to personal rhythm and emotional safety.

Domain conclusion



Through supporting micro-agency and anticipating therapy effects, participants envisioned the digital twin as a catalyst for *confidence and foresight* in recovery. It could help individuals navigate early recovery, weigh decisions more consciously, and enter therapy with greater preparedness. Yet these imagined benefits were contingent on maintaining a *non-prescriptive tone*, *emotional attunement*, and *transparency* about algorithmic limits; conditions that foreshadow the boundary considerations discussed in the next section.

Domain 2: Boundary conditions

While participants articulated optimistic visions for how digital twins might support recovery, they also defined firm ethical and emotional limits. These boundary conditions reveal the delicate balance between technological guidance and personal autonomy in mental-health contexts. They show that trust in algorithmic systems depends less on functionality than on sensitivity to emotional readiness, interpretive freedom, and transparency of communication.

1. Respecting emotional readiness & tone

Participants consistently emphasised that digital feedback must align with their emotional state and readiness to engage. When the tone of the system became too directive, it was met with resistance. As Hannah expressed, “I want to be helped, it is not work,” while Eva cautioned that “a wrong therapy suggestion can suddenly be very triggering.”

Both preferred a gentle and flexible tone that acknowledged fluctuating motivation rather than imposing behavioural tasks. They described this as a fundamental boundary: feedback should invite rather than instruct, especially in moments of vulnerability. A **digital twin that prompts reflection with compassion, rather than prescription**, was considered far more trustworthy.

2. Safeguarding informational boundaries

Another recurring topic concerned privacy and data ownership. Interestingly, both participants appeared less apprehensive about sharing data with a digital twin than the design students involved in earlier tests. When asked

about a potential data breach, Hannah acknowledged, “I am afraid of a data breach, but it is outweighed by the quality of life a digital twin can provide.”

Eva expressed similar sentiments, though she was more concerned about data ownership: “I would not have much trouble with data collection, as long as it does not end up with an insurance company.” Together, their reactions highlight an urgent need to safeguard user data while also revealing a pragmatic attitude toward risk: the potential benefits of such a tool seemed to outweigh their fears about misuse.

However, it is important to note that both participants reflected on these issues from a relatively stable mental state. As Hannah admitted, “I used to be more suspicious.” This suggests that perceptions of data trust **may fluctuate depending on one’s emotional and psychological condition**, an important consideration for the design of digital health technologies.

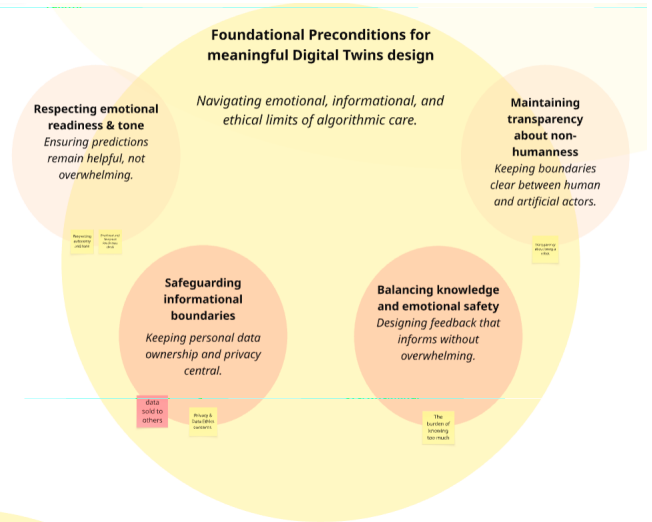
3. Balancing knowledge and emotional safety

Another boundary condition concerned the psychological burden of predictive information. Both participants recognised the potential usefulness of receiving forecasts about their emotional state or therapy outcomes, yet they also feared knowing too much. As Eva reflected, “I wouldn’t want to know what will happen to me in the future, because then I would never have started treatment.” The idea of seeing highly specific predictions, such as an 87% rise in stress level, was described as demotivating and even distressing.

Instead, participants preferred feed-

back that conveyed a broader, more qualitative sense of direction rather than precise numerical forecasts. “I would rather get back a kind of global-level idea of what would happen, not too specific,” Eva explained. This highlights how predictive feedback can shift from being supportive to intrusive depending on the degree of emotional distance it allows. While participants valued insight into patterns and long-term tendencies, **overly detailed information risked amplifying anxiety** rather than encouraging reflection.

Domain conclusion



Together, these boundary conditions describe how digital twins can become meaningful tools within psychiatric healthcare. They concern safeguarding privacy and data ownership, respecting users’ emotional readiness, and finding the right amount of information to share without causing anxiety. Rather than focusing on maximising prediction or data accuracy, meaningful design depends on creating situations in which users can engage safely, use feedback when it feels relevant, and decide for themselves what to share and when.

Although these insights come from individual interactions with the digital twin, they also reach into the relational space where such systems would operate. A digital twin could reshape existing roles within psychiatric healthcare, influencing how care, trust, and expertise are distributed between people and technology. These evolving dynamics point toward a renewed form of therapeutic relationship: the reconfigured therapeutic alliance.

Domain 3: The reconfigured therapeutic alliance

Within psychiatric healthcare, the introduction of a digital twin could reconfigure the therapeutic alliance between care seeker and therapist. From the patient's perspective, the digital twin would not merely function as a diagnostic tool but as a mediating artefact that enables dialogue across different ways of knowing. In this sense, the digital twin can be understood as a **boundary object** (Terlouw et al., 2022): a shared yet interpretively flexible artefact that bridges the lived experience of the patient and the analytical domain of clinical reasoning. Through its capacity to be understood differently by both parties while still referring to the same underlying data, it may become **a space for negotiation, reflection, and joint sense-making**. Rather than replacing human interaction, the digital twin could extend the therapeutic conversation into a more collaborative relationship between care seeker and therapist.

It should, however, be kept in mind that these reflections stem from the **perspective of the care seeker**. The perspective of the therapist may differ, particularly regarding how much interpretive control or clinical responsibility remains desirable in such a shared space of reflection.

Maintaining transparency about non-humanness

One theme that sits between the domains of preconditions and the therapeutic alliance concerns the importance of being **transparent about the system's non-humanness**. As Hannah

stated, "There is no heart in it, so it must not pretend to have a heart either." She was referring to the possibility of the digital twin being embodied in a human or animal-like form. When presented on a screen, however, a more human tone of voice was actually preferred, since the non-human nature was already evident and a purely mechanical tone would feel too cold. This points to a delicate balance: while participants valued warmth and empathy in communication, they also expected the **system to remain authentic to its machine identity**.

Reconfiguring collaboration

The collaboration between therapist and care seeker would, according to participants, fundamentally change in the future. As Eva imagined, "I picture a future where you come up with a kind of recommendation together with this simulation, which you then present to the therapist instead of it being the other way around." In this vision, care seekers would no longer be passive recipients of treatment but would bring forward insights generated through their digital twin, combining algorithmic recommendations with their own informed reflections.

While participants were open to this reconfigured collaboration, they also emphasised that a digital twin should always function as a complement to existing therapy, "alongside the psychiatrist and the psychologist," rather than as a replacement. As Hannah noted, "The personal connection with the psychologist is very decisive in building trust." Replacing that human aspect, they warned, could easily lead to greater distrust and undermine the potential benefits of therapy.

In this **reconfigured collaboration**, the digital twin could act as a mediating boundary object that bridges both sides of the therapeutic relationship. As Hannah described, "It could act as a kind of intermediary, helping with my distrust towards the psychologist," while Eva referred to it as an "objective team member." Through this mediating role, the digital twin might enable a more dialogical alliance, where data-driven insights, personal narratives, and professional expertise meet in a shared space of negotiation.

Broadening professional perspectives

Eva and Hannah also described how a digital twin could help broaden the perspectives of professionals. As Eva suggested, "It could help a therapist get out of a tunnel vision." Both participants had experienced moments of not being understood or receiving inappropriate care, which made this potential particularly significant to them. They envisioned the digital twin as a tool that could make invisible experiences more visible, enabling professionals to notice patterns or emotional nuances that might otherwise be overlooked. By offering a more holistic and data-informed view of the care seeker's situation, the digital twin could help clinicians reflect on their own assumptions and develop a more nuanced understanding of the person behind the diagnosis.

Domain conclusion



Together, these reflections illustrate how the introduction of a digital twin could gradually reconfigure the therapeutic alliance. From the care seeker’s perspective, the technology holds potential to make collaboration with therapists more balanced. It could act as a mediating boundary object that helps **bridge differences in understanding between therapist and care seeker.**

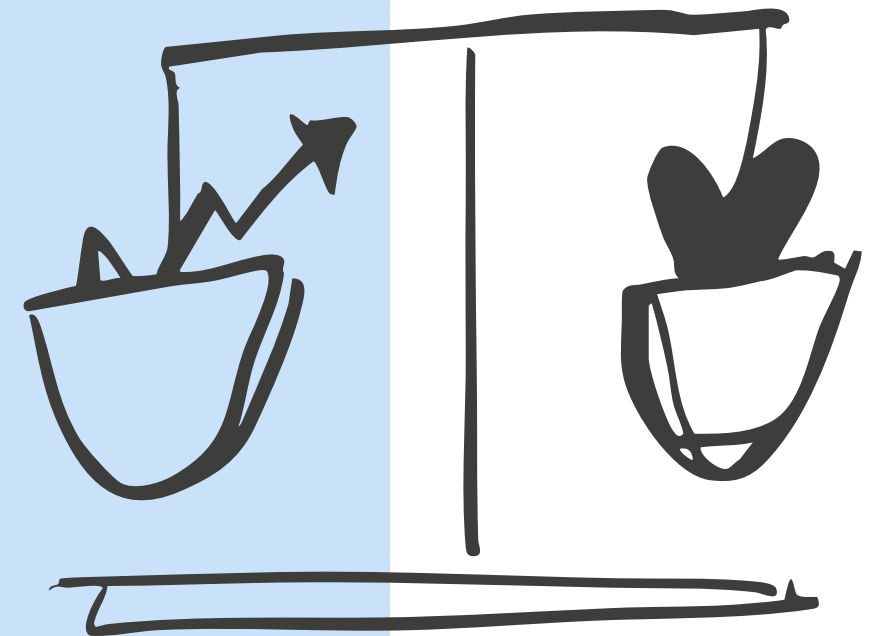
Yet this vision remains situated between belief and doubt. Participants imagined the digital twin as potentially empowering, but they would never want it to replace the therapist. A meaningful reconfiguration of the therapeutic relationship would therefore depend on how both patients and professionals learn to work with this hybrid form of care, in which data-driven insights, embodied experience, and therapeutic intuition must continually be negotiated and re-aligned.

These findings provide the foundation

for the following interpretive synthesis, which examines what the themes collectively imply for designing reflective and trustworthy digital-twin technologies in psychiatric care.

5.

Discussion & conclusions



5.1 Interpretive Synthesis (discussion & implications)

This section interprets how participants' reflections on the speculative prototype lead to broader insights that relate back to the literature reviewed in this thesis. By connecting these findings to theoretical frameworks on speculative design, digital twins, and trauma-informed design, the discussion explores how such technologies might reshape future psychiatric healthcare for people with PTSD.

From skepticism to speculative openness

Across all domains, participants' evaluations revealed how the speculative prototype of the digital twin provoked a transformation in attitude: from initial skepticism to cautious fascination. This shift, visible during the tests, offered valuable insight into what enabled participants to imagine possibilities they had initially rejected. Such a movement from rejection to imaginative engagement aligns with Bendor and Lupetti's (2024) and Dunne and Raby's (2013) notion that imaginative speculation challenges assumptions and opens dialogue on desirable futures.

Coexistence of datafication and reflection

The most valued element for participants was the **reflective depth** evoked through the intuitive act of choosing three tarot cards. This finding supports Ruckenstein and Schüll's (2017) and Sharon's (2016) argument that data-driven feedback should not overshadow

opportunities for personal reflection.

Although intuition can be distorted by PTSD (Hengeveld et al., 2016), participants still regarded it as valuable, distinguishing between **intuitive decision-making** and **intuitively guided reflection**. While the former may be influenced by trauma-related responses (APA, 2025), the latter, which involves using intuition to reflect on lived experience, was considered essential for **exposing latent thoughts**. This reflective use of intuition guided by the ambiguity of the tarot cards allowed participants to reconnect meaningfully with their own experiences. From participants' perspectives, any digital intervention in psychiatric healthcare should therefore integrate guided self-reflection alongside predictive and analytical functions.

Such a combination of reflection and data may also counter what Milne et al. (2022) call the **loop of reflexive composition**, in which people begin to internalise algorithmic predictions as part of their self-understanding. By letting users reflect on their lived experience **before** viewing the digital twin's analysis, the prototype created a temporal and cognitive buffer that helped preserve personal meaning before it could be shaped by data interpretation.

Perceived credibility

Interpretation based solely on quantified data was **not perceived** as credible by participants. Data alone was seen as insufficient for drawing meaningful conclusions and needed to be contextualised within lived experience. As Birk and Samuel (2020) and Bemme

et al. (2020) argue, reducing complex experiences to simplified measurements risks downplaying essential contextual factors and can contribute to the reification of mental disorders.

In response, the final prototype combined digital phenotyping data with the **participants' intuitive reflections**, generating a prediction that not only showed analytical feedback but also an ambiguous, almost spiritual story based on those reflections. This hybrid form of feedback was **perceived as more credible** and personally attuned. This finding demonstrates how **integrating data with interpretive narratives can enhance trust in the system**: credibility arose not from technical accuracy but from the system's ability to merge analytical insight with interpretive reflection into an ambiguous yet grounded simulation.

Prediction and interpretation

Participants perceived the simulations as potentially valuable for supporting short-term decision-making, predicting intervention outcomes, and fostering self-understanding. Both participants imagined that, had such a tool existed earlier, it might have helped them **identify effective treatments more efficiently** in the past by allowing them to explore different therapeutic scenarios before trying them in real life. These insights align with the more optimistic view of Spitzer et al. (2023), who emphasise the potential of digital twin technology in prognostics and therapeutic guidance.

Yet, this potential depends on how predictive information is presented. There is a **delicate balance** in **both the amount and the precision of infor-**

mation shown to users of a digital twin. When forecasts became too specific, participants reported that this negatively influenced their choices and induced anxiety, particularly when their mood was predicted to destabilise. This illustrates what Milne et al. (2022) describe as a psychological facet of the **data shadow**: a datafied self that can cause psychological strain when individuals are continuously confronted with predictions they cannot act upon. Showing too many predictive details may therefore risk turning care into a source of stress rather than support. Presenting **broader outlines rather than detailed forecasts**, as participants suggested, appeared valuable because it preserved a sense of hopeful openness toward difficult treatments and their recovery trajectory.

The therapeutic dialogue

Building on this, participants envisioned a more collaborative therapeutic alliance in which care seekers could make informed decisions in dialogue with both the digital twin and the therapist. In this sense, a digital twin could function as a **boundary object** (Terlouw et al., 2022): a shared interpretive space that mediates between clinical reasoning and lived experience, enabling translation and negotiation between these perspectives. In doing so, it could help **therapy become more responsive to the individual** rather than constrained by generalised clinical norms.

Ethical preconditions and policy implications

These opportunities cannot be separated from the **foundational preconditions** identified earlier. Safeguarding privacy, protecting agency, and respecting emotional readiness remain essential when designing for this

vulnerable group. Participants in this project expressed a clear preference for **open and interpretive language** over prescriptive communication, as it supported their sense of autonomy and emotional safety. **Transparency** regarding how data are gathered and interpreted also emerged as an important condition for trust, helping to mitigate the **black-box effect** (Oudin et al., 2023), enabling users to better understand how algorithmic feedback is produced.

These insights suggest that the development of digital twins would benefit from policies that **prioritise patient agency and lived experience rather than technical optimisation or algorithmic precision**. Embedding such values within both design and policy could ensure that future applications of digital twins in psychiatric care remain grounded in empathy, transparency, and the lived realities of those they aim to support. This highlights the **importance of co-designing guidelines with people with lived experience**, as demonstrated by the principles of the Chayn Network (Hussain et al., 2022).

Involving people with PTSD directly in the speculative research process deepened these insights, provoking richer reflections on how their personal values (Desmet & Roeser, 2015) should be reflected when designing a future digital twin. The possibilities of such technologies should not be overshadowed by ethical fears or by assumptions made without the participation of those most affected.

To conclude, the prototype illustrated how datafication and lived experience can **coexist** productively, embodying the kind of speculative tension descri-

bed by Mitrović et al. (2021). By combining guided personal reflection and the ambiguous interpretation of the digital twin with quantified insights from digital phenotyping, the design fostered openness, ethical awareness, and perceived credibility among participants with PTSD toward such technologies. The value of digital twins lies not in technical precision or predictive improvement but in their capacity to mediate trust, reflection, and dialogue between patients and professionals.

5.2 Design recommendations

Based on the interpretive synthesis, the following design recommendations translate the findings into actionable directions for design and policy. They outline how the identified domains, themes, and tensions can inform concrete design decisions when developing digital twins that use digital phenotyping for people with PTSD. The recommendations aim to help future designers create technologies that remain grounded in empathy, transparency, and the lived experiences of those they are meant to support.

1. Guided reflection

Design digital twins to facilitate guided reflection through a combination of analytical insights and ambiguous prompts. Ambiguity can be introduced through proposed diary entries or tarot-style cards derived from the system's analysis, allowing users to engage in reflection on a deeper level. Whether the prompts are selected based on analysis or generated randomly is less important as long as they remain open and imaginative enough to evoke latent thoughts and personal values.

2. Prediction sensitivity

Design digital twins that can simulate different treatment scenarios and explore possible outcomes, allowing people with PTSD to explore which treatments may be most effective, before trying them in real life. Show broad outlines of prediction, don't be too specific. A certain degree of uncertainty can help preserve the optimism and motivation needed when choosing a challenging recovery process, while excessive precision can undermine credibility or trigger anxiety when predicted outcomes do not match lived experiences.

3. Step-by-step approach

Adopt a step-by-step approach in recommending interventions. Each suggestion should be sensitive to the individual's current emotional readiness and therapeutic timing. Introduce progressive steps, regularly checking in with users to confirm whether they wish to proceed. Such pacing supports engagement while maintaining autonomy and safety.

4. Hybrid feedback

Combine statistics with a more open-ended narrative type of feedback, based on the provided reflections. Integrating users' reflections into open-ended narratives enhances credibility and fosters a sense of being understood. This **hybrid** form of feedback translates lived experience into analysis that feels both empathic and believable, strengthening epistemic trust between user and system.

5. Language use

Use language that is clear yet non-prescriptive, supporting informed decision-making rather than directing them towards specific interventions. People with PTSD seeking care are *willing* to recover but that willingness is fragile and should not be forced by a non-human system. The language can be human-like, as long as the system stays transparent about its non-human nature.

6. Fundamental preconditions

Ensure that the fundamental preconditions are met.

1. **Privacy and Transparency:** guarantee data protection and be transparent about the ownership of the collected data.
2. **Complementary use:** The digital twin complement, not replace, the therapist, supporting dialogue rather than direction.
3. **Shared decision-making:** Any generated recommendation by the digital twin must be discussed collaboratively between therapist and patient, maintaining agency and trust.

7. Involve user group

When designing for people with PTSD, involve them! Designers should not assume what is best for this group but engage them throughout the process to learn from their insights. Meaningful participation not only leads to design attuned to personal values, but also leads to more openness and trust towards emerging technologies. Following the Trauma-Informed design principles of the Chayn Network can be very helpful when doing this.

5.3 Translation to GGZ context

In the Dutch mental healthcare system (GGZ), there is an increasing call for **overbruggingszorg**: forms of care that bridge the gap between the moment of help-seeking and the start of treatment (Nederlandse Zorgautoriteit, 2024). Within this broader structure, a digital twin could complement psychiatric healthcare by providing continuity and reflection during waiting periods, between sessions, or after therapy has ended.

Although this technology would work best in combination with a therapist, it could also support individuals who **are still awaiting care**. For people who are hesitant to seek help, often because of mistrust in institutions or people, the digital twin could help them take the first small step toward engagement. By allowing users to open up about their experiences and reflect on their trauma without having to face another person, it could encourage earlier emotional openness, which may later make it easier to start a dialogue with a therapist once treatment begins.

When someone is already in therapy, the digital twin could help explore whether the chosen treatment still fits or whether another approach might work better. By learning from its user over a longer period of time, it could become more attuned to the person's everyday experiences and detect signals that might not surface during sessions. These insights could help the person start a dialogue with their therapist about possible adjustments or changes in treatment. In this way, the digital twin could function as a shared

reflection tool, a **boundary object** between patient and therapist, supporting decisions that stay closer to the person's lived experience.

Over time, a digital twin could become part of a hybrid care system, complementing therapy rather than replacing it, and extending support across different stages of recovery. However, this integration also implies a reconfiguration of professional roles. The introduction of a digital twin would mediate the power dynamics between therapist, patient, and system (Frennert et al., 2022). While it could enhance patient agency, it might also increase the cognitive or administrative burden on therapists, who would need to interpret an additional data layer. As some experts in the interviews suggested, such a tool could either deepen understanding by countering tunnel vision or risk reducing the quality of care if introduced without structural support and training.

5.4 Limitations and Future work

While this thesis offers valuable insights into the speculative potential of digital twins in psychiatric healthcare, several limitations should be acknowledged pointing towards possibilities for future research.

As stated in the previous section, the introduction of a digital twin in psychiatric healthcare could also influence the role of the therapist. However, this thesis focused solely on the perspective of people with PTSD. Future research should therefore investigate **how therapists perceive the influence of a digital twin**, how trust is established between human and algorithmic judgment, and what is required to preserve therapeutic integrity and intuition. More broadly, studies should examine the implications of **the shifting relationship between patient, therapist, and system** more closely, and how responsibilities and authority might be redistributed through technological mediation. A co-design process involving both care seekers and professionals is recommended to explore these relational and ethical dynamics in depth.

In addition, though this research focused on PTSD, the principles identified, such as balancing analytical feedback with guided reflection and preserving emotional safety, may also be **relevant for other conditions** involving instability in mood or self-perception, such as bipolar or schizoaffective disorder. Future studies should explore how these dynamics manifest in such contexts and what adaptations would be required to ensure therapeutic safety.

While the principles identified may extend to other conditions, the **transferability of these findings remains limited**. This study used PTSD as a case study, and only two participants were involved in the final evaluation phase. This small sample size limits the reliability and transfer of insights to a broader domain. **The strength of this study lies in its contextual depth rather than its significant relevance: it provided a rich, deep understanding of lived experiences, but it cannot claim causal or representative validity.** Recruiting participants with PTSD proved challenging, as ethical restrictions imposed by TU Delft and the unpredictability of participants' emotional readiness sometimes conflicted with the research timeline and availability.

Additionally, while the speculative design approach was deliberately used to provoke reflection, it may also have shaped participants' responses. The interactions within the prototype could have subtly guided participants toward certain interpretations, meaning that the resulting reactions might partly reflect the framing of the prototype itself.

Moreover, whereas a real digital twin would involve **continuous, bidirectional data exchange** with the user over time, the prototype in this study did not gather or process any real data. Instead, it represented a **speculative scenario**, capturing only a **single moment of interaction** rather than an ongoing relationship between patient and twin. As a result, it remains unknown how such technology would behave in real-life contexts where **data genuinely travels back and forth** between user and twin. Although in this study reflection took place before the presentation of

analytical data, over longer periods of time the twin might begin to **shape the user's self perception and behaviour anyway**, through recurring feedback and guided reflection. Future research should therefore explore how this **long-term, continuous data-driven interaction** might gradually influence the relationship between the user and their digital twin. This limitation also underscores the central tension explored in this thesis (between datafication and lived, intuitive experience) suggesting that future digital twins should not only advance analytical precision but also safeguard interpretive space for human interpretation.

Finally, the participants were not self-diagnosed but had a formal PTSD diagnosis and real-life therapeutic experience. Their insights were therefore highly authentic and offered a depth rarely captured in design research literature. However, their diagnoses were not verified by the researcher for ethical reasons and were instead based on the established trust resulting from long-term acquaintance with them.

Despite these limitations, this deep and contextual case study provided insights that would not have emerged from broader or less personal forms of research. Future work should combine a case study like this with quantitative research on a larger scale to validate the assumptions made. This project aims to set the tone for future research: working with vulnerable people should not be avoided, but approached with care, respect, and ethical sensitivity.

5.5 Conclusion

In what ways might digital twin technology introduce a trade-off between datafication and intuitive, lived experience in psychiatric healthcare for people with PTSD?

This thesis explored how digital twin technology might introduce a trade-off between datafication and lived, intuitive experience in psychiatric healthcare for people with PTSD. Using speculative design as a research method, the project explored how the underlying personal values and perspectives of people with PTSD can inform the design of future digital health technologies. The findings show how this tension can be approached through reflection and interpretation.

Personal values revealed through speculation

The speculative approach revealed how imaginative, future-oriented artefacts can surface the latent personal values of people with PTSD that are often overlooked in technology development. Participants highlighted emotional readiness, agency, and interpretive freedom as essential preconditions for meaningful engagement with digital systems. By creating a safe reflective space, the speculative prototype enabled participants to articulate what they needed from technology before considering its concrete functions. These insights highlight the value of **designing with** these preconditions as guiding principles, ensuring that digital twins are attuned to the personal values and needs of their users.

Relation to lived experience through feedback representation

The way feedback was represented strongly shaped how participants related to their lived experience. When data-driven metrics were accompanied by intuitive, narrative forms of feedback, participants found the system more credible and personally resonant. This hybrid mode of feedback, both reflective and analytical, helped bridge the gap between data and lived experience, allowing participants to recognise themselves in the feedback rather than feeling reduced to data points. This suggests that the representation of feedback not only conveys information but also influences the relationship between person and system.

Influence on agency and self-understanding

When participants reflected on their experiences before viewing analytical predictions, they retained a stronger sense of agency and ownership over interpretation. This sequence of **reflection preceding prediction** helped them approach data as something to engage with rather than to follow. By presenting feedback in this order, the design supported self-understanding and intuitive interpretation, positioning the digital twin as a reflective aid rather than an external authority.

Trade-off between datafication and lived experience

Together, these findings show that the trade-off between datafication and lived experience is not a conflict of opposing forces but a productive tension that can be intentionally designed. When analytical insights are intertwined with guided reflection, digital twins can complement psychiatric care by creating conditions that

support reflection, agency, and interpretation. In this sense, digital twins in psychiatric care should prioritise meaningful technological mediation over predictive accuracy, enabling people to see themselves through data while remaining connected to their lived experience. These insights highlight the importance of designing digital twins that move beyond pursuing predictive accuracy toward forms of engagement that are emotionally attuned to personal values.

Critical reflection for designers

Through this approach, the project demonstrates how speculative design can make such tensions tangible in a safe and imaginative way. Speculation allowed participants to explore concerns of trust, safety, and control without immediate risk. The findings translate into a set of recommendations for designers of future digital twin technologies, emphasising the need to balance analytical feedback with interpretive reflection and emotional safety. In this sense, speculation becomes not only a way to represent possible futures, but also a method to anticipate their ethical and experiential implications before they are built.

General reflection on process and positionality

Throughout this thesis, short reflections were included to situate design decisions and methodological choices within the ongoing process. This final reflection moves beyond those situated moments to look back at the trajectory as a whole. It brings together ethical, methodological, and personal insights to articulate how this project has shaped my understanding of care, trust, and design practice.

This final reflection synthesizes the ethical, methodological, and personal aspects of the graduation process. It examines how the project's themes of care, trust, and interpretation shaped not only the design outcomes but also my own development as a researcher and designer. What follows reflects on the experience of working with a vulnerable participant group, the challenges of combining speculative design with academic research, and the ways in which this process has influenced my professional identity and approach to design.

Working with a vulnerable participant group

Throughout this project, I became increasingly aware that the research process itself mirrored the very tensions explored in the thesis: between care and control, distance and engagement, and intuition and structure. Working closely with people who have lived experience of PTSD required sensitivity, patience, and modesty. At first, I was hesitant to ask deeper questions, concerned about triggering distress or creating a sense of being used for

research. Over time, however, I realised that building trust required reciprocity, sharing parts of my own perspective and allowing relationships to develop gradually rather than through rigid research boundaries.

The voluntary work I conducted alongside one participant illustrated how trust can grow through small, everyday exchanges. She shared her experiences navigating the psychiatric system, while I shared aspects of daily life outside it. Observing her relationship with her service dog was especially meaningful; the dog offered a model of care that supports without taking control. This inspired the metaphor behind my final speculative prototype, a technological companion that assists reflection rather than replacing it.

Through these encounters, I also confronted my own assumptions. Initially, I believed that protecting participants from speculative technology was an act of care, but I later understood that this belief reflected my own bias. Conversations with participants revealed a strong desire for agency, even when engaging with potentially confronting technologies. This helped me see that care in design is not about shielding others from complexity but about enabling them to engage with it on their own terms.

Working with a vulnerable group required continuous ethical awareness and flexibility. Some participants who had initially agreed to take part later experienced changes in their mental state. Although they had expressed willingness and consent beforehand, it became clear that involving them at that moment would not have been responsible. I decided not to proceed

with those sessions, and this decision proved as meaningful as the testing itself. It reminded me that consent in trauma-related research is not a single event but an ongoing process that demands attention to changing circumstances.

These challenges should not discourage designers from engaging with vulnerable groups. Even though only two participants eventually took part in the final test, their lived-experience perspectives provided insights far deeper and more grounded than those obtained from earlier sessions with design students. The authenticity of their reflections revealed nuances that no speculative exercise could have anticipated, underscoring the importance of real-world engagement, even at a small scale.

At the same time, this work demanded attention not only to participants' well-being but also to my own. Conducting research on trauma can be emotionally demanding, and I developed a personal safety plan in consultation with a PhD researcher experienced in trauma studies. This plan included the option to contact social workers from the voluntary organisation where I was active, as well as informing close contacts who were aware of my research and could provide support if needed. While I did not have to use this plan, knowing that support was available allowed me to engage with participants with more confidence and empathy.

Collectively, these experiences reshaped my understanding of what it means to design with care. Rather than seeking control or certainty, I learned to embrace ambiguity, allowing trust, empathy, and ethical reflection

to guide the process as much as theoretical frameworks or design tools. This perspective carried through to my approach to design research as a whole.

Reflection on the design research process

Combining speculative design with academic writing was one of the most demanding aspects of this project. Speculative design requires a mindset of creative expansion and openness, while academic research demands grounding, structure, and precision. Balancing these two modes of thinking often meant shifting between intuition and justification. As a designer, inspiration can emerge from many sources, but within an academic context each reference must be carefully positioned and substantiated. Learning to translate imaginative exploration into a coherent academic argument became a continuous exercise in synthesis.

Because of this duality, I had to adapt my planning several times. To manage this, I decided to separate periods of writing and designing. This approach helped maintain focus but also meant that many insights emerged during the act of designing rather than while writing. To bridge this gap, I documented my thoughts continuously in Miro and in my notebook, using these materials later to translate intuitive reflections into written form. Ideally, documentation and designing would occur more closely together, allowing insights to be captured and developed within the creative process itself. Developing this integration is something I aim to strengthen in my future work.

Listening back to the recordings revealed moments where my interviewing

style influenced the depth of participants' responses. At times, I found myself anticipating the next question rather than allowing silence or deeper elaboration. This occasionally prevented richer insights that could have emerged through active listening and open-ended probing. Drawing from the Chayn Network's trauma-informed interviewing approach, I later recognised how simply repeating or paraphrasing a participant's words often encouraged more meaningful reflection and emotional confirmation.

Reflecting on myself as a designer during this research

Looking back, I am proud of how this research reflects both my personal motivations and professional stance toward complex societal issues. The project clarified what I value most as a designer: human sensitivity, contextual awareness, and the ability to mediate between technological innovation and lived experience. It also shaped my professional orientation. I found that I am particularly drawn to roles that guide design and technology from a broader, systemic perspective, situated between design, policy, and societal impact. This graduation project allowed me to explore that direction in depth, and I now feel prepared to carry these insights into my future career.

I also learned much about managing my own working process and stress levels. Although I initially found the project intimidating, I developed a structured rhythm that kept me grounded. By maintaining regular working hours and protecting weekends for rest, I was able to stay balanced and productive. When uncertainty arose, I learned to trust the process rather than force out-

comes, which ultimately led to more meaningful progress.

Finally, the voluntary work I conducted alongside this project has become one of its most valuable and lasting outcomes. What began as contextual engagement evolved into a meaningful personal commitment. I learned that small, consistent acts of presence, such as showing up weekly, can have a real impact in someone's life. I intend to continue integrating this form of care and social contribution into my future professional practice.

Together, these experiences shaped not only my project but also my understanding of what it means to design with care. This graduation project taught me that designing for care in datafied contexts is as much about relationships as it is about technology. It is about recognising when to act, when to listen, and when to leave space for others to interpret and respond. The process reaffirmed that trust, empathy, and reflection are not only ethical foundations for working with vulnerable groups, but also essential design materials for shaping more humane technological futures.

Thanks for Reading!

Love, Dieuwertje

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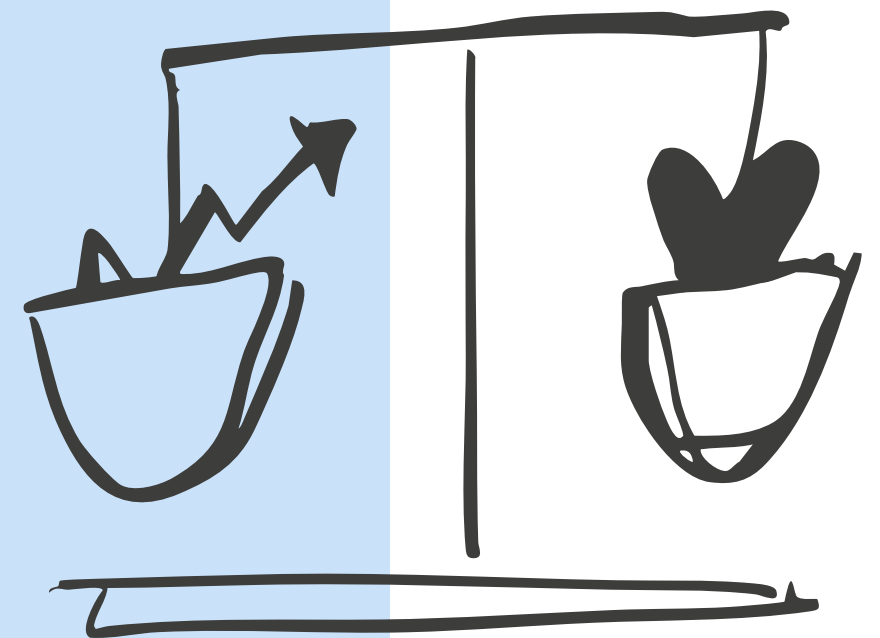
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Use of AI tools in this thesis

- Asking chatGPT for critical feedback on pieces of text I wrote. Also asking whether it could make my English wording more fluent and provide me with synonyms. I then checked my own text using this generated version, without mindlessly copying and pasting the generated text. I often felt like it took away the nuances of my own text, so I checked and rechecked my own text and the rewritten text a lot. This turned out to be so timeconsuming that I doubt whether I benefitted from it at all.
- Let chatGPT generate images, like the tarot cards used in my prototype.
- Using Notebook LM to assist in analysing (anonymised) interviews, using it as a sparring partner to check whether my assumptions could be traced back in things that were said in the interviews.
- AI-generated pictures for personas, which were then traced in Illustrator.
- Using Grammarly to check my English Grammar
- Using Lovable to help me make my prototypes through 'vibe-coding' or generating p5.js codes for me.

0.

Appendix



Appendix A) Ethical check
list and consent forms

Delft University of Technology
HUMAN RESEARCH ETHICS
CHECKLIST FOR HUMAN RESEARCH
(Version January 2022)

IMPORTANT NOTES ON PREPARING THIS CHECKLIST

- 1. An HREC application should be submitted for every research study that involves human participants (as Research Subjects) carried out by TU Delft researchers
- 2. Your HREC application should be submitted and approved **before** potential participants are approached to take part in your study
- 3. All submissions from Master’s Students for their research thesis need approval from the relevant Responsible Researcher
- 4. The Responsible Researcher must indicate their approval of the completeness and quality of the submission by signing and dating this form OR by providing approval to the corresponding researcher via email (included as a PDF with the full HREC submission)
- 5. There are various aspects of human research compliance which fall outside of the remit of the HREC, but which must be in place to obtain HREC approval. These often require input from internal or external experts such as [Faculty Data Stewards](#), [Faculty HSE advisors](#), the [TU Delft Privacy Team](#) or external [Medical research partners](#).
- 6. You can find detailed guidance on completing your HREC application [here](#)
- 7. Please note that incomplete submissions (whether in terms of documentation or the information provided therein) will be returned for completion **prior to any assessment**
- 8. If you have any feedback on any aspect of the HREC approval tools and/or process you can leave your comments [here](#)

II. Research Overview

NOTE: You can find more guidance on completing this checklist [here](#)

a) Please summarise your research very briefly (100-200 words)

What are you looking into, who is involved, how many participants there will be, how they will be recruited and what are they expected to do?

Add your text here – (please avoid jargon and abbreviations)

This research explores how playful, speculative design can support people with Post-Traumatic Stress Disorder (PTSD) in feeling more heard and understood, particularly in relation to digital tools such as digital twins. The study involves three phases.

First, I will conduct interviews with approximately 5–10 adults with lived experience of PTSD and non-diagnosed people, recruited through my client at GGZ Noord Holland Noord (hereinafter GGZ-NHN), and close contacts.

In the second phase, I will develop several early, exploratory prototypes and test them with up to 10 participants who are (non-diagnosed) students from the TU Delft. These prototypes will take the form of low-fidelity interactive digital scenarios on my laptop, such as diary-like reflections or story-based prompts. Participants will be asked to click through, add or erase short text segments, and respond to questions while I sit next to them and guide the conversation. Their role is not to evaluate a finished product, but to reflect on ideas and share impressions. These student participants are different from the participants with whom I conducted the interviews.

In the final phase, one speculative prototype will be tested with a maximum of 5 participants who have lived experience with PTSD, recruited via GGZ-NHN or close contacts. This prototype will consist of an interactive digital scenario that guides the participant through a fictional story involving a character with PTSD who uses a wearable device that predicts therapy outcomes. Participants will be asked to explore the story, interact with the text, and then share their thoughts in a follow-up discussion. These participants will also have taken part in the initial interview.

All activities are exploratory, voluntary, and clearly explained in the participant information sheet. Participants will be explicitly informed that these prototypes are speculative research tools, not therapeutic devices, and that they can stop at any time.

b) **If your application is an additional project** related to an existing approved HREC submission, please provide a brief explanation including the existing relevant HREC submission number/s.

Add your text here – (please avoid jargon and abbreviations)

c) **If your application is a simple extension of, or amendment to,** an existing approved HREC submission, you can simply submit an [HREC Amendment Form](#) as a submission through LabServant.

III. Risk Assessment and Mitigation Plan

NOTE: You can find more guidance on completing this checklist [here](#)

Please complete the following table in full for all points to which your answer is “yes”. Bear in mind that the vast majority of projects involving human participants as Research Subjects also involve the collection of **Personally Identifiable Information (PII)** and/or **Personally Identifiable Research Data (PIRD)** which may pose potential risks to participants as detailed in Section G: Data Processing and Privacy below.

To ensure alignment between your risk assessment, data management and what you agree with your Research Subjects you can use the last two columns in the table below to refer to specific points in your Data Management Plan (DMP) and Informed Consent Form (ICF) – **but this is not compulsory**.

It’s worth noting that **you’re much more likely to need to resubmit your application if you neglect to identify potential risks**, than if you identify a potential risk and demonstrate how you will mitigate it. If necessary, the HREC will always work with you and colleagues in the Privacy Team and Data Management Services to see how, if at all possible, your research can be conducted.

			If YES please complete the Risk Assessment and Mitigation Plan columns below.		Please provide the relevant reference #	
ISSUE	Yes	No	RISK ASSESSMENT – what risks could arise? <i>Please ensure that you list ALL of the actual risks that could potentially arise – do not simply state whether you consider any such risks are important!</i>	MITIGATION PLAN – what mitigating steps will you take? <i>Please ensure that you summarise what actual mitigation measures you will take for each potential risk identified – do not simply state that you will e.g. comply with regulations.</i>	DMP	ICF
A: Partners and collaboration						
1. Will the research be carried out in collaboration with additional organisational partners such as: - One or more collaborating research and/or commercial organisations - Either a research, or a work experience internship provider¹ ¹ If yes, please include the graduation agreement in this application	x		While not participating immediately in producing research data or defining the goals of the research, GGZ Noord-Holland-Noord has an advisory role and assists with recruitment. 1. Conflict of interest: As GGZ Noord Holland Noord is both an internship provider and involved in participant recruitment, there is a potential risk that organisational goals could unintentionally influence research direction or participant selection. 2. Perceived pressure on participants: Participants recruited via GGZ Noord Holland may feel obliged to participate due to their existing relationships with the organisation or its staff.	1. Conflict of interest: In the graduation contract it states the GGZ Noord-Holland-Noord only has an advisory role. I am also regularly supervised by my chair and mentor to prevent any unintentional influence from happening. 2. Perceived pressure on participants: Recruitment communications will clearly state that participation is entirely voluntary and that declining will not affect participants’ access to services or relationships with the organisations. Recruitment will be handled by independent staff or through neutral channels when possible. For graduation agreement, see Appendix 1.		

			If YES please complete the Risk Assessment and Mitigation Plan columns below.		Please provide the relevant reference #	
ISSUE	Yes	No	RISK ASSESSMENT – what risks could arise? <i>Please ensure that you list ALL of the actual risks that could potentially arise – do not simply state whether you consider any such risks are important!</i>	MITIGATION PLAN – what mitigating steps will you take? <i>Please ensure that you summarise what actual mitigation measures you will take for each potential risk identified – do not simply state that you will e.g. comply with regulations.</i>	DMP	ICF
2. Is this research dependent on a Data Transfer or Processing Agreement with a collaborating partner or third party supplier? <i>If yes please provide a copy of the signed DTA/DPA</i>		x				
3. Has this research been approved by another (external) research ethics committee (e.g.: HREC and/or MREC/METC)? <i>If yes, please provide a copy of the approval (if possible) and summarise any key points in your Risk Management section below</i>		x				
B: Location						
4. Will the research take place in a country or countries, other than the Netherlands, within the EU?		x				
5. Will the research take place in a country or countries outside the EU?		x				
6. Will the research take place in a place/region or of higher risk – including known dangerous locations (in any country) or locations with non-democratic regimes?		x				
C: Participants						
7. Will the study involve participants who may be vulnerable and possibly (legally) unable to give informed consent? (e.g., children below the legal age for giving consent, people with learning difficulties, people living in care or nursing homes,).		x				
8. Will the study involve participants who may be vulnerable under specific circumstances and in specific contexts, such as victims and witnesses of violence, including domestic violence; sex workers; members of minority groups, refugees, irregular migrants or dissidents?	x		The study involves people who have lived experience of PTSD. There could be a risk of re-traumatisation when recalling or discussing distressing events. As with any research, there is a possibility that data could be stolen, which could result in deanonymisation and consequent discrimination.	I will use the Trauma Informed Design approach throughout. I will also use pseudonyms instead of real names to ensure their privacy. Also, the participants are recruited based on their openness about their condition, and have been trained to talk about their experiences. The transcript/quote/report will be given back to participants for checking.		
9. Are the participants, outside the context of the research, in a dependent or subordinate position to the investigator (such as own children, own students or employees of either TU Delft and/or a collaborating partner organisation)? <i>It is essential that you safeguard against possible adverse consequences of this situation (such as allowing a student’s failure to participate to your satisfaction to affect your evaluation of their coursework).</i>		x				

			If YES please complete the Risk Assessment and Mitigation Plan columns below.		Please provide the relevant reference #	
ISSUE	Yes	No	RISK ASSESSMENT – what risks could arise? <i>Please ensure that you list ALL of the actual risks that could potentially arise – do not simply state whether you consider any such risks are important!</i>	MITIGATION PLAN – what mitigating steps will you take? <i>Please ensure that you summarise what actual mitigation measures you will take for each potential risk identified – do not simply state that you will e.g. comply with regulations.</i>	DMP	ICF
10. Is there a high possibility of re-identification for your participants? (e.g., do they have a very specialist job of which there are only a small number in a given country, are they members of a small community, or employees from a partner company collaborating in the research? Or are they one of only a handful of (expert) participants in the study?	x		Yes, there is a risk of re-identification of the participants since the GGZ-NHN is a local organization and since participants are close contacts.	They are recruited based on their openness about their condition, so if they are re-identified it will not put them at risk.		
D: Recruiting Participants						
11. Will your participants be recruited through your own, professional, channels such as conference attendance lists, or through specific network/s such as self-help groups	x		Perceived pressure to participate: Participants recruited through GGZ NHN or close relatives may feel obliged to join even if they prefer not to. Confidentiality concerns: Recruitment via small or close-knit networks could risk unintentional disclosure of personal information or participation status. Selection bias: Recruitment through specific channels might limit diversity of participants or exclude some voices. Limited anonymity: Participants might be indirectly identifiable because of the recruitment method. Some participants (in the second stage of the research) will also be TU Delft students. They are not subordinate to me, since I am not supervising, teaching, or grading them. Therefore, the risk of coercion or undue influence related to participation is minimal.	To minimize these risks and protect participant wellbeing: Perceived pressure to participate: Recruitment communications will clearly state that participation is voluntary, with no consequences for declining or withdrawing. Staff or relatives involved in recruitment will be briefed to avoid applying pressure or coercion. Confidentiality concerns: Recruitment will be managed discreetly. Personal data of potential participants will be handled confidentially and shared only on a need-to-know basis. Selection bias: Efforts will be made to recruit from multiple channels (GGZ Noord Holland Noord and close contacts) to encourage diversity and reduce bias. Limited anonymity: All data collected will be anonymized in analysis and reporting to minimize risk of indirect identification.		
12. Will the participants be recruited or accessed in the longer term by a (legal or customary) gatekeeper? (e.g., an adult professional working with children; a community leader or family member who has this customary role – within or outside the EU; the data producer of a long-term cohort study)		x				
13. Will you be recruiting your participants through a crowd-sourcing service and/or involve a third party data-gathering service, such as a survey platform?		x				
14. Will you be offering any financial, or other, remuneration to participants, and might this induce or bias participation?		x				

			If YES please complete the Risk Assessment and Mitigation Plan columns below.		Please provide the relevant reference #	
ISSUE	Yes	No	RISK ASSESSMENT – what risks could arise? <i>Please ensure that you list ALL of the actual risks that could potentially arise – do not simply state whether you consider any such risks are important!</i>	MITIGATION PLAN – what mitigating steps will you take? <i>Please ensure that you summarise what actual mitigation measures you will take for each potential risk identified – do not simply state that you will e.g. comply with regulations.</i>	DMP	ICF
E: Subject Matter <i>Research related to medical questions/health may require special attention. See also the website of the CCMO before contacting the HREC.</i>						
15. Will your research involve any of the following: - Medical research and/or clinical trials - Invasive sampling and/or medical imaging - Medical and <i>In Vitro Diagnostic Medical Devices</i> Research		x				
16. Will drugs, placebos, or other substances (e.g., drinks, foods, food or drink constituents, dietary supplements) be administered to the study participants? <i>If yes see here to determine whether medical ethical approval is required</i>		x				
17. Will blood or tissue samples be obtained from participants? <i>If yes see here to determine whether medical ethical approval is required</i>		x				
18. Does the study risk causing psychological stress or anxiety beyond that normally encountered by the participants in their life outside research?	x		Yes. While participants recruited by the GGZ-NHN are experience experts in PTSD, and close contacts experiencing PTSD, reflecting on personal experiences and interacting with prototypes may still involve some potential for psychological discomfort beyond daily life.	Mitigation Measures for Psychological Stress or Anxiety: Clear Information: Before participation, all participants will receive detailed information about the purpose, procedures, and topics of the research so they know exactly what to expect. - I will follow the Trauma Informed Design Approach to minimize the risk of psychological discomfort. Voluntary Participation: Participation is entirely voluntary. Participants will be reminded that they can withdraw or pause at any time without giving a reason and without any consequences. Dynamic consent: I will check in with participants if their consent still stands and if they are ok with the info they have given me. If they want to withdraw from participating, they are allowed to, at any time. I will then immediately erase their data as well.		

			If YES please complete the Risk Assessment and Mitigation Plan columns below.		Please provide the relevant reference #	
ISSUE	Yes	No	RISK ASSESSMENT – what risks could arise? <i>Please ensure that you list ALL of the actual risks that could potentially arise – do not simply state whether you consider any such risks are important!</i>	MITIGATION PLAN – what mitigating steps will you take? <i>Please ensure that you summarise what actual mitigation measures you will take for each potential risk identified – do not simply state that you will e.g. comply with regulations.</i>	DMP	ICF
				Reading materials: I will let my participants read the transcripts, quotes and insights I gathered during testing or interviewing. Informed Consent: Participants will provide written informed consent after having time to consider whether they want to take part. Gentle Framing of Activities: Playful prototypes will be clearly framed as exploratory design tools rather than therapy. Participants will be reminded they do not have to share anything they do not wish to. Monitoring Wellbeing: During sessions, I will monitor participants' emotional state. If a participant shows signs of distress, I will offer a break, stop the activity, or end the session if needed. Debriefing: After each session, I will conduct a short debrief to check how the participant feels and whether they need any additional support or follow-up.		
19. Will the study involve discussion of personal sensitive data which could put participants at increased legal, financial, reputational, security or other risk? (e.g., financial data, location data, data relating to children or other vulnerable groups) <i>Definitions of sensitive personal data, and special cases are provided on the TUD Privacy Team website.</i>	x		Publication of the Graduation thesis in the repository might lead to the risk of re-identification of the participants.	Recruitment requirements include existing diagnosis openness, so reidentification will not put them at risk. The participant will not be asked to provide any medical evidence for their identification of diagnosis.		
20. Will the study involve disclosing commercially or professionally sensitive, or confidential information? (e.g., relating to decision-making processes or business strategies which might, for example, be of interest to competitors)		x				
21. Has your study been identified by the TU Delft Privacy Team as requiring a Data Processing Impact Assessment (DPIA)? <i>If yes please attach the advice/ approval from the Privacy Team to this application</i>		x				
22. Does your research investigate causes or areas of conflict?		x				

			If YES please complete the Risk Assessment and Mitigation Plan columns below.		Please provide the relevant reference #	
ISSUE	Yes	No	RISK ASSESSMENT – what risks could arise? <i>Please ensure that you list ALL of the actual risks that could potentially arise – do not simply state whether you consider any such risks are important!</i>	MITIGATION PLAN – what mitigating steps will you take? <i>Please ensure that you summarise what actual mitigation measures you will take for each potential risk identified – do not simply state that you will e.g. comply with regulations.</i>	DMP	ICF
<i>If yes please confirm that your fieldwork has been discussed with the appropriate safety/security advisors and approved by your Department/Faculty.</i>						
23. Does your research involve observing illegal activities or data processed or provided by authorities responsible for preventing, investigating, detecting or prosecuting criminal offences <i>If so please confirm that your work has been discussed with the appropriate legal advisors and approved by your Department/Faculty.</i>		x				
F: Research Methods						
24. Will it be necessary for participants to take part in the study without their knowledge and consent at the time? (e.g., covert observation of people in non-public places).		x				
25. Will the study involve actively deceiving the participants? (For example, will participants be deliberately falsely informed, will information be withheld from them or will they be misled in such a way that they are likely to object or show unease when debriefed about the study).		x				
26. Is pain or more than mild discomfort likely to result from the study? And/or could your research activity cause an accident involving (non-) participants?		x				
27. Will the experiment involve the use of devices that are not 'CE' certified? <i>Only, if 'yes': continue with the following questions:</i>		x				
- Was the device built in-house? - Was it inspected by a safety expert at TU Delft? <i>If yes, please provide a signed device report.</i>		x				
If it was not built in-house and not CE-certified, was it inspected by some other, qualified authority in safety and approved? <i>If yes, please provide records of the inspection</i>		x				
28. Will your research involve face-to-face encounters with your participants and if so how will you assess and address Covid considerations?	x		Although Covid-19 restrictions have been relaxed, there remains a potential risk of virus transmission during in-person meetings, which could affect participant health and wellbeing.	To minimize this risk, all sessions will follow current public health guidelines, including encouraging participants to stay home if they feel unwell, maintaining good hygiene practices such as hand sanitizing and ventilation of meeting spaces, and offering remote participation options where possible. I will stay updated on local Covid-19 policies and adjust protocols as needed to ensure participant safety.		

			If YES please complete the Risk Assessment and Mitigation Plan columns below.		Please provide the relevant reference #	
ISSUE	Yes	No	RISK ASSESSMENT – what risks could arise? <i>Please ensure that you list ALL of the actual risks that could potentially arise – do not simply state whether you consider any such risks are important!</i>	MITIGATION PLAN – what mitigating steps will you take? <i>Please ensure that you summarise what actual mitigation measures you will take for each potential risk identified – do not simply state that you will e.g. comply with regulations.</i>	DMP	ICF
29. Will your research involve either : a) "big data", combined datasets, new data-gathering or new data-merging techniques which might lead to re-identification of your participants and/or b) artificial intelligence or algorithm training where, for example biased datasets could lead to biased outcomes?		x				
G: Data Processing and Privacy						
30. Will the research involve collecting, processing and/or storing any directly identifiable PII (Personally Identifiable Information) including name or email address that will be used for administrative purposes only? (eg: obtaining Informed Consent or disbursing remuneration)	x		The research will collect directly identifiable personal information such as names, phone numbers, and email addresses solely for administrative purposes, including obtaining informed consent and managing communication with participants. Storing such information carries a risk of unauthorized access or accidental disclosure, which could compromise participant confidentiality.	To mitigate this risk, all personally identifiable information (PII) will be stored securely on encrypted devices or secure cloud platforms compliant with data protection regulations. Access to PII will be limited to the researcher only. Identifiable data will be separated from research data and used exclusively for administrative tasks. Participants will be informed clearly about how their information will be handled and their rights regarding data privacy.		
31. Will the research involve collecting, processing and/or storing any directly or indirectly identifiable PIRD (Personally Identifiable Research Data) including videos, pictures, IP address, gender, age etc and what other Personal Research Data (including personal or professional views) will you be collecting?	x		The research will collect directly identifiable personal data such as names and contact information for recruitment and consent purposes. Additionally, sensitive personal data related to participants' experiences with PTSD and their personal views will be collected through interviews and prototype testing. This data includes potentially identifiable information and sensitive health-related details, posing risks of confidentiality breaches or unintended disclosure.	All personal data will be stored securely on encrypted devices accessible only by the researcher. Identifiable data will be kept separate from anonymized research data used for analysis. Participants will be informed about the types of data collected, their rights, and data handling procedures in the consent process. Recordings will only be made with explicit consent and stored securely. PIRD Data will be deleted after the study, as per data retention policies. Interview quotes, insights, and transcripts will be pseudonymised in the final graduation report. Consent forms Participants will provide written informed consent, which clearly explains what data will be collected, how it will be used, stored, and their rights regarding withdrawal and confidentiality.		
32. Will this research involve collecting data from the internet, social media and/or publicly available datasets which have been originally contributed by human participants		x				

			If YES please complete the Risk Assessment and Mitigation Plan columns below.		Please provide the relevant reference #	
ISSUE	Yes	No	RISK ASSESSMENT – what risks could arise? <i>Please ensure that you list ALL of the actual risks that could potentially arise – do not simply state whether you consider any such risks are important!</i>	MITIGATION PLAN – what mitigating steps will you take? <i>Please ensure that you summarise what actual mitigation measures you will take for each potential risk identified – do not simply state that you will e.g. comply with regulations.</i>	DMP	ICF
33. Will your research findings be published in one or more forms in the public domain, as e.g., Masters thesis, journal publication, conference presentation or wider public dissemination?	x		- Participants could be potentially recognized from the description of their experiences. - Misinterpretation or misuse of findings by the public or media.	- Explicitly identifiable details will be removed or altered to prevent participant identification. Only the personal information directly affecting the trustworthiness of the presentation of results or analysis will be mentioned. The rest will not be mentioned at all or made intentionally vague. - Findings will be presented responsibly and accurately, with context to avoid misinterpretation. In this research, context plays a crucial role because personal experiences with PTSD are highly individual and shaped by many situational, emotional, and social factors. Including this context helps ensure that the findings are interpreted with nuance and respect for the complexity of each person's story. - Participants will be informed about the potential for public dissemination during the consent process. - Participants will be provided a summary for checking if their experiences have been accurately interpreted.		
34. Will your research data be archived for re-use and/or teaching in an open, private or semi-open archive?		x				

Digital Twins in Psychiatric Healthcare
Delft University of Technology
HUMAN RESEARCH ETHICS

You are being invited to participate in a Master’s thesis research study titled *Digital Twins in Psychiatric Healthcare*. This study is being conducted by Dieuwertje den Besten from Delft University of Technology (TU Delft), in collaboration with GGZ Noord-Holland-Noord.

Purpose of the Study

There is a growing wave of new technologies that use data and AI to improve how care is delivered. Many argue that these innovations will enhance or even transform care practices. To make these innovations more meaningful, the values of people who will eventually use them should be carefully considered.

Therefore, the purpose of this research is to gain insights from individuals with lived experience of PTSD and related health experts. Your input will be used in the final thesis report and outcomes to ensure these perspectives are taken into account.

What Participation Involves

Participation will take a maximum of 60 minutes. You will be interviewed about your views on this topic.

Your Wellbeing

If you feel uncomfortable or don’t want to continue, you can always take a break or quit the interview. **You may withdraw from the research at any time, without any consequences.** After the prototype testing and interview, any insights, quotes, or transcripts will be shared with you for review and approval.

Confidentiality and Data Protection

As with any online activity, there is a small risk of a data breach. To the best of our ability, your responses will remain confidential. All personal data will be anonymised and securely stored in OneDrive or on my personal hard drive, which only the researcher can access.

In the interview transcripts, your name and any identifying details will be replaced with a pseudonym (a made-up name). You can come up with a pseudonym yourself. This ensures your contributions remain personal but private, and pseudonyms will be used when referring to any quotes in reports or publications.

Your participation is entirely voluntary. You are free to skip any questions or stop at any time. After the graduation ceremony, all your data will be permanently deleted.

Contact Information

If you have any questions about the study or your participation, please feel free to contact me or my supervisors:

PLEASE TICK THE APPROPRIATE BOXES	Yes	No
A: GENERAL AGREEMENT – RESEARCH GOALS, PARTICIPANT TASKS AND VOLUNTARY PARTICIPATION		
1. I have read and understood the study information dated 3-7-2025, or it has been read to me. I have been able to ask questions about the study, and my questions have been answered to my satisfaction.	☐	☐
2. I consent voluntarily to participate in this study and understand that I can refuse to answer questions. I can withdraw from the study at any time, without giving a reason.	☐	☐
3. I understand that taking part in the study involves: • An audio recording, which will be destroyed after transcribing • A qualitative interview transcribed as text	☐	☐
4. I understand that I will not be compensated for my participation.	☐	☐
5. I understand the study will end on 1-11-2025, after the graduation ceremony.	☐	☐
B: POTENTIAL RISKS OF PARTICIPATING (INCLUDING DATA PROTECTION)		
6. I understand that taking part in the study involves the following risks: • Emotional discomfort after discussing your experiences I understand that these risks will be mitigated by: • You may stop participating at any time without any consequences • You are encouraged to share only as much as you are willing to share.	☐	☐
7. I understand that taking part in the study also involves collecting the following information: • Personally Identifiable Information (PII): Name, Email address, Phone number • Personally Identifiable Research Data (PIRD): Voice recordings	☐	☐
8. I understand that the following steps will be taken to minimise the threat of a data breach and protect my identity in the event of such a breach : • Anonymisation of all data • Secure storage in protected locations • Use of pseudonyms in any reports or publications	☐	☐

PLEASE TICK THE APPROPRIATE BOXES	Yes	No
10. I understand that personal information collected about me that can identify me, such as my name or phone number, will not be shared with anyone else besides the corresponding researcher.	☐	☐
11. I understand that the (identifiable) personal data I provide will be destroyed directly after the graduation ceremony (1-11-2025)	☐	☐
C: RESEARCH PUBLICATION, DISSEMINATION, AND APPLICATION		
12. I understand that after the research study, the de-identified information I provide will be used for the main researcher's graduation report and the presentation during the researcher's defence.	☐	☐
13. I agree that my responses, views, or other input can be quoted with a pseudonym in research outputs.	☐	☐
D: (LONGTERM) DATA STORAGE, ACCESS, AND REUSE		
16. I give permission for the de-identified quotes I provide to be archived in the IDE graduation repository to be used for future research and learning.	☐	☐
17. I understand that access to this repository is open.	☐	☐

You are being invited to participate in a Master's thesis research study titled *Digital Twins in Psychiatric Healthcare*. This study is being conducted by Dieuwertje den Besten from Delft University of Technology (TU Delft), in collaboration with GGZ Noord-Holland-Noord.

Purpose of the Study

There is a growing wave of new technologies that use data and AI to improve how care is delivered. Many argue that these innovations will enhance or even transform care practices. To make these innovations more meaningful, the values of people who will eventually use them should be carefully considered.

Therefore, the purpose of this research is to gain insights from individuals with lived experience of PTSD and related health experts. Your input will help ensure that the speculative design prototype reflects your perspective in a meaningful and respectful way.

What Participation Involves

Participation will take a maximum of 90 minutes. You will be asked to test a speculative prototype and share your reflections in an interview.

The prototype will consist of an interactive digital scenario, presented on a laptop, which guides you through a fictional story about digital twins. You will be asked to interact with the text (for example, by clicking through the story, or adding/erasing short passages), explore the scenario, and then share your thoughts in a follow-up discussion with the researcher.

This prototype is **exploratory only**. It is not a finished product, not a medical or therapeutic tool, and has no treatment purpose. You may pause or stop your participation at any time without any consequences.

With your consent, photos could be taken of the interaction with the prototype (for example, your hands on the keyboard or the screen), but these will never show your face and will be anonymised.

Your Wellbeing

If you feel uncomfortable or don't want to continue, you can always take a break or quit the test. **You may withdraw from the research at any time, without any consequences.** After the prototype testing and interview, any insights, quotes, or transcripts will be shared with you for review and approval.

Confidentiality and Data Protection

As with any online activity, there is a small risk of a data breach. To the best of our ability, your responses will remain confidential. All personal data will be anonymised and securely stored in OneDrive or on my personal hard drive, which only the researcher can access.

In the interview transcripts, your name and any identifying details will be replaced with a pseudonym (a made-up name). You can come up with a pseudonym yourself. This ensures your contributions remain personal but private, and pseudonyms will be used when referring to any quotes in reports or publications.

Your participation is entirely voluntary. You are free to skip any questions or stop at any time. After the graduation ceremony, all your data will be permanently deleted.

PLEASE TICK THE APPROPRIATE BOXES	Yes	No
A: GENERAL AGREEMENT – RESEARCH GOALS, PARTICIPANT TASKS AND VOLUNTARY PARTICIPATION		
1. I have read and understood the study information dated 3-7-2025, or it has been read to me. I have been able to ask questions about the study, and my questions have been answered to my satisfaction.	☐	☐
2. I consent voluntarily to participate in this study and understand that I can refuse to answer questions. I can withdraw from the study at any time, without giving a reason.	☐	☐
3. I understand that taking part in the study involves: • An audio recording, which will be destroyed after transcribing • Pictures with your face blurred out • A qualitative interview transcribed as text	☐	☐
4. I understand that I will not be compensated for my participation.	☐	☐
5. I understand the study will end on 1-11-2025, after the graduation ceremony.		
B: POTENTIAL RISKS OF PARTICIPATING (INCLUDING DATA PROTECTION)		
6. I understand that taking part in the study involves the following risks: • Emotional discomfort when reflecting on the prototype or your views. I understand that these risks will be mitigated by: • You may stop participating at any time without any consequences. • You are encouraged to share only as much as you are willing to share. • The prototype session is designed to be playful and focuses only on your experience while interacting with the prototype, without requiring you to discuss personal experiences beyond that.	☐	☐

PLEASE TICK THE APPROPRIATE BOXES	Yes	No
7. I understand that taking part in the study also involves collecting the following information: • Personally Identifiable Information (PII): Name, Email address, Phone number • Personally Identifiable Research Data (PIRD): Voice recordings, Pictures (<i>these will not include your face and will be anonymised</i>)	☐	☐
8. I understand that the following steps will be taken to minimise the threat of a data breach and protect my identity in the event of such a breach : • Anonymisation of all data • Blurring any personal details in the pictures • Secure storage in protected locations • Use of pseudonyms in any reports or publications	☐	☐
10. I understand that personal information collected about me that can identify me, such as my name or phone number, will not be shared with anyone else besides the corresponding researcher.	☐	☐
11. I understand that the (identifiable) personal data I provide will be destroyed directly after the graduation ceremony (1-11-2025)	☐	☐
C: RESEARCH PUBLICATION, DISSEMINATION, AND APPLICATION		
12. I understand that after the research study, the de-identified information I provide will be used for the main researcher's graduation report and the presentation during the researcher's defence.	☐	☐
13. I agree that my responses, views, or other input can be quoted with a pseudonym in research outputs.	☐	☐
D: (LONGTERM) DATA STORAGE, ACCESS, AND REUSE		
16. I give permission for the de-identified quotes and pictures I provide to be archived in the IDE graduation repository to be used for future research and learning.	☐	☐
17. I understand that access to this repository is open.	☐	☐

Appendix B) Personas
resulting from expert
interviews



Susan the care-seeker who longs for more autonomy

Susan is a care-seeker who believes a Digital Twin could make her less reliant on her therapist. She is dependent on external help and longs for a life with greater freedom.

Beliefs

- With the help of a Digital Twin she could be able to **manage her own symptoms**.
- It could **predict and prevent relapse** by acting as a brake when things start to go wrong.
- She is afraid that a Digital Twin might **overshadow her own intuition**.
- She also fears the Digital Twin will **misinterpret signals**, since the output depends highly on what is measured.
- She still sees benefit in using a Digital Twin, as long as she can **personally fine-tune the parameters** and amount of intervention of the Twin.
- There should be a **guarantee for privacy** of data collection, however.

“A Digital twin could prevent me from taking too much money out of my account. It is allowed to brake me, but it should not steer me.” - E2



Emma the holistic body & mind healing advocate

Emma values bodywork, intuition and spiritual practices. Drawing on her own psychiatric experiences, she has learned to listen closely to her body's signals, a skill she now teaches others. She has a service dog which assists her in daily life.

Beliefs

- Digital Twin might be a threat to society because it removes the **human element**.
- It could never understand the non-verbal and energetic signals that her dog can notice.
- Believes the strength of therapy is the **personal relationship and the feeling of being truly heard**.
- Concerned that AI might be **hindering the person's ability to connect** with 'less perfect normal people'.
- A future digital twin should make her feel **safe**.

“Taking out the human element would lead to emotional poverty” - Z5



Lucy the overburnened healthcare professional

Lucy is a treating professional (therapist or nurse), who is overflowed with work and believes in the potential of AI helping her, but is also aware of the ethial concerns.

Beliefs

- Digital twin could be an **extra colleague** assisting her in her work.
- It could be used for reducing administrative work and to **remove her tunnel vision**.
- Could help emotionally uneducated people to **learn new skills**.
- It would never be able to replace a therapist, because **it lacks sensitivity in human interpretation**.
- It would never be able to fully comprehend whole picture of complicated patient cases.
- It could be suitable for the **basic-GGZ**, so professionals could move up to specialist-GGZ

“A digital twin could encourage people to reconnect with everyday relationships”

- Z6



Robert the optimistic technology implementer

Robert works as a manager in a psychiatric institution and notices the effects of long waiting lists, scarcity among professionals and inefficiency in the current system.

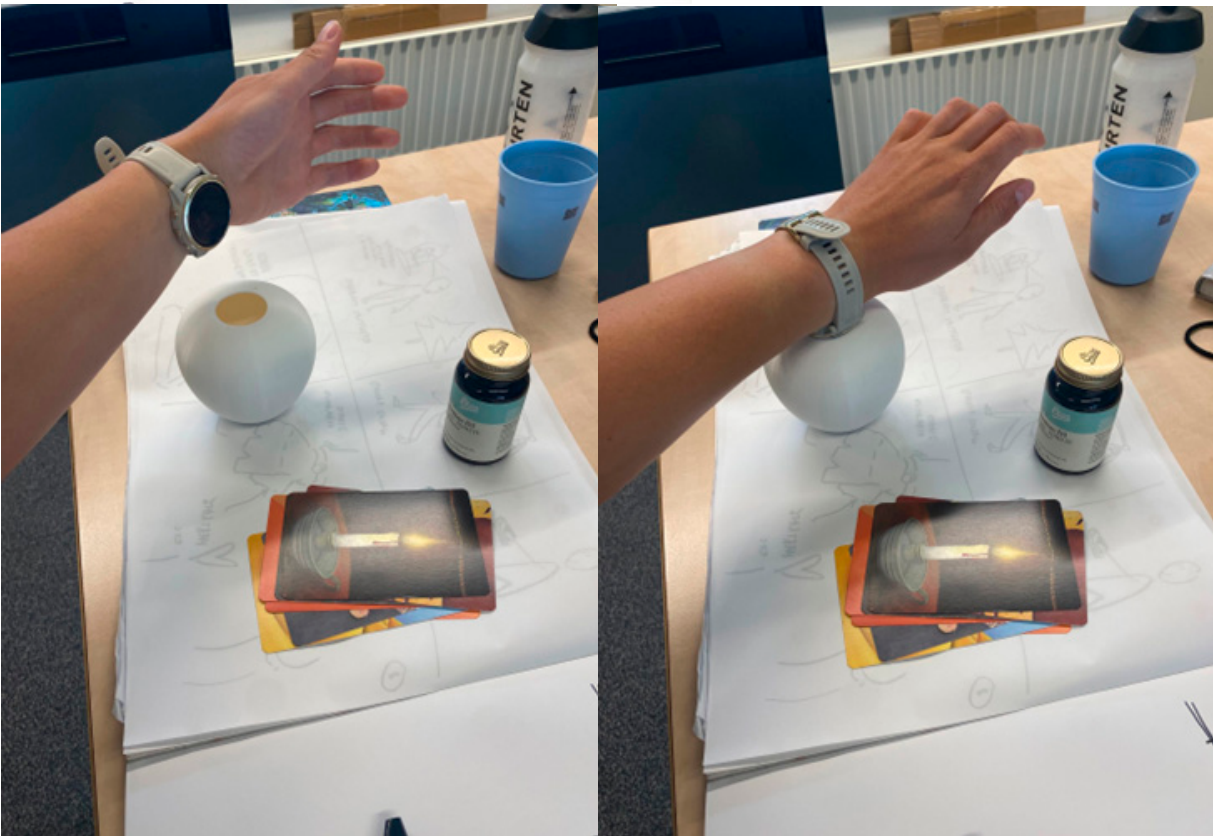
Beliefs

- He fears the **inefficiency of ambulatory care in the Netherlands**, and believes it contributes to the high pressure experienced by care providers.
- Digital Twin could support psychiatric professionals by improving **efficiency**.
- It could **assist in triage**, by distinguishing less serious cases from more severe ones at an early stage.
- A digital twin could be a good tool to compensate for the lowering standards of human care.
- Digital Twin could work as **home guidance** for people who are stuck in waiting lists.

“Today, many care providers work on a freelance basis or are relatively inexperienced. As a result, the competition between digital solutions and human care seems lower than it once used to be.” - Z1

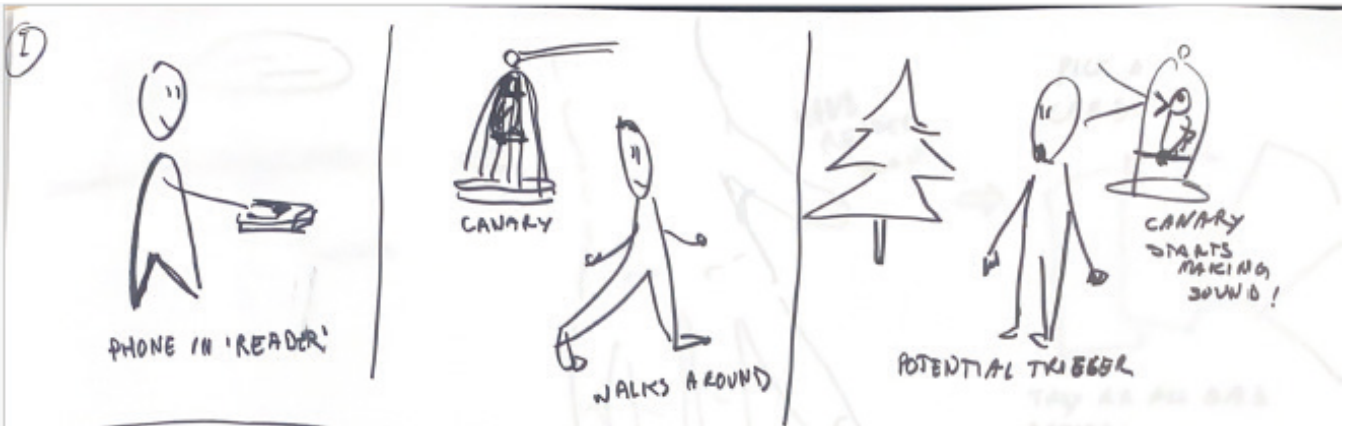
Idea 1: Datafication vs intuition

The digital twin scans the wearable of a patient, uses personal data through digital phenotyping. Once processed the twin presents a deck of tarot cards, each reflecting a hidden narrative. The patient must intuitively interpret the card. After this self-reflection, the twin reveals the clinical prognosis after which the patient is urged to take a prescriptive medicine.



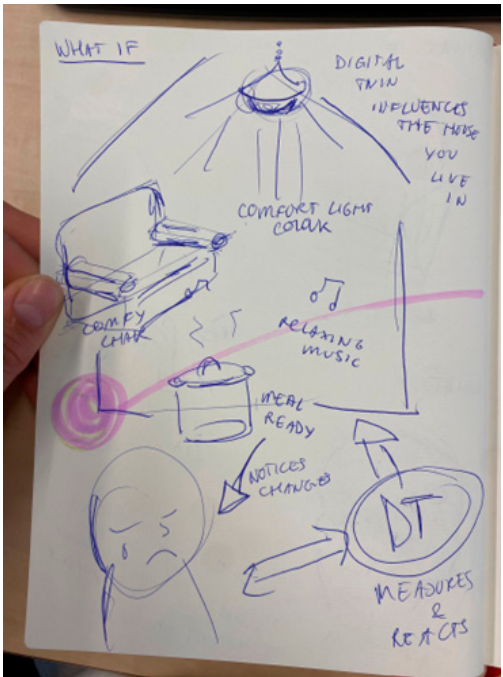
Idea 2:

Person places phone in reader and starts walking around the room. The canary starts making sounds as soon as a potential trigger is detected.



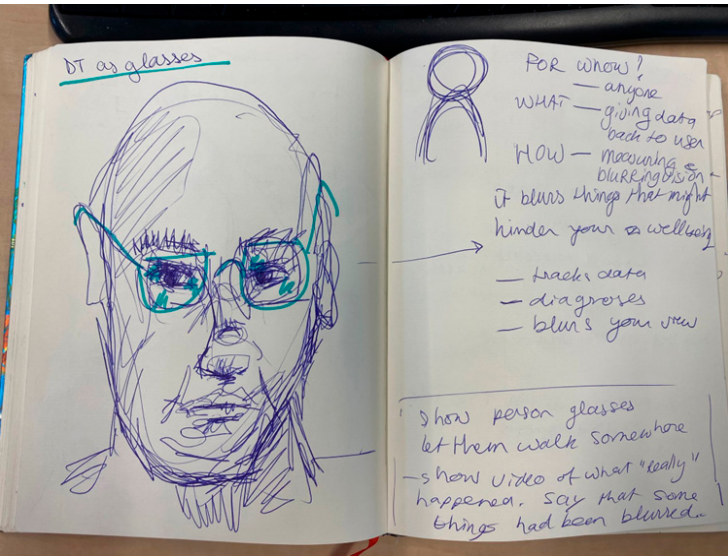
Idea 3:

A digital twin is connected to someone's house. Objects in the house react based on the prognosis of a patient and start trying to influence the behaviour of the person.



Idea 4:

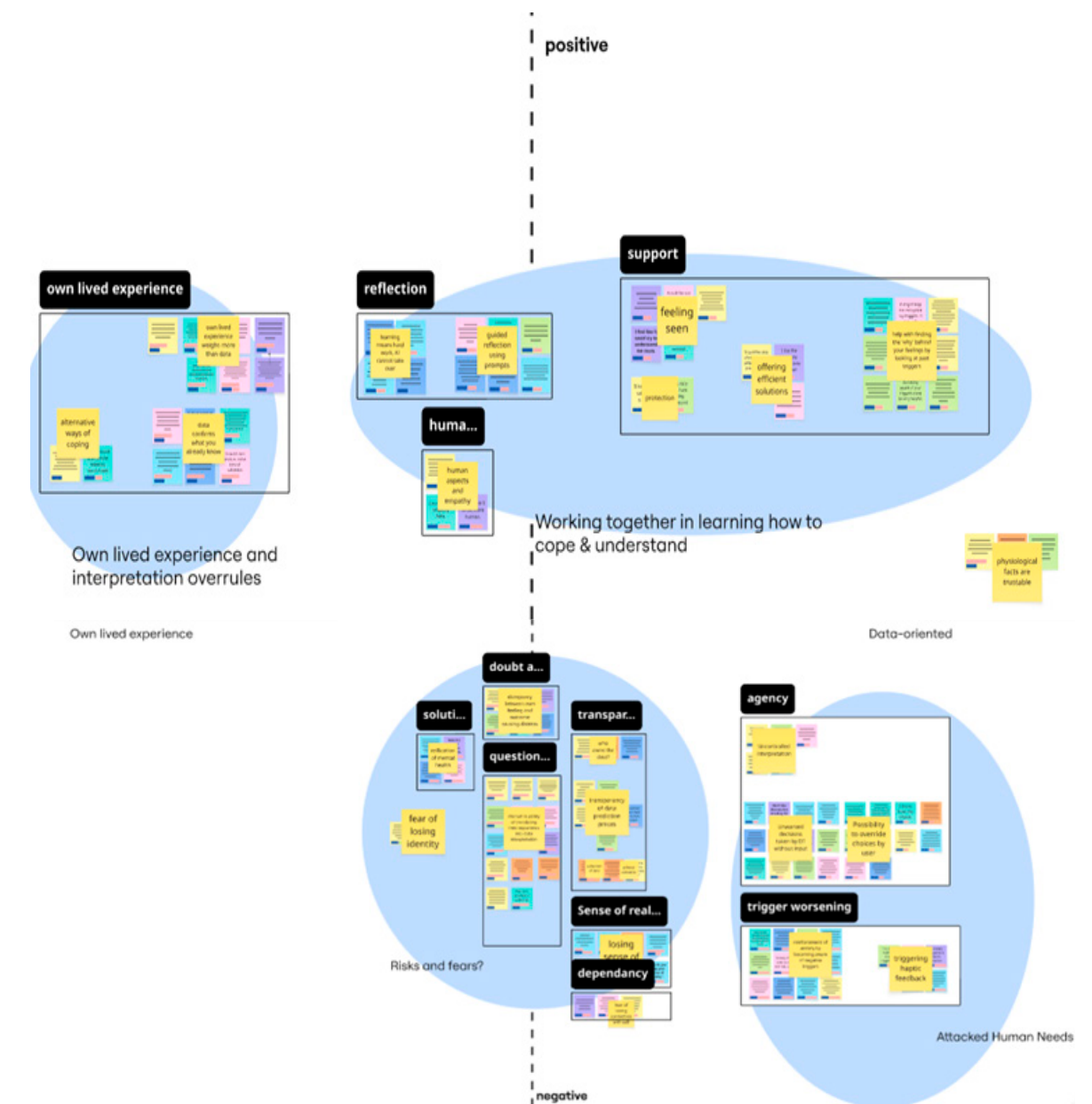
Glasses blur triggers out of someone's sight.





Appendix D) In-between clustering steps from the thematic analysis

step 1



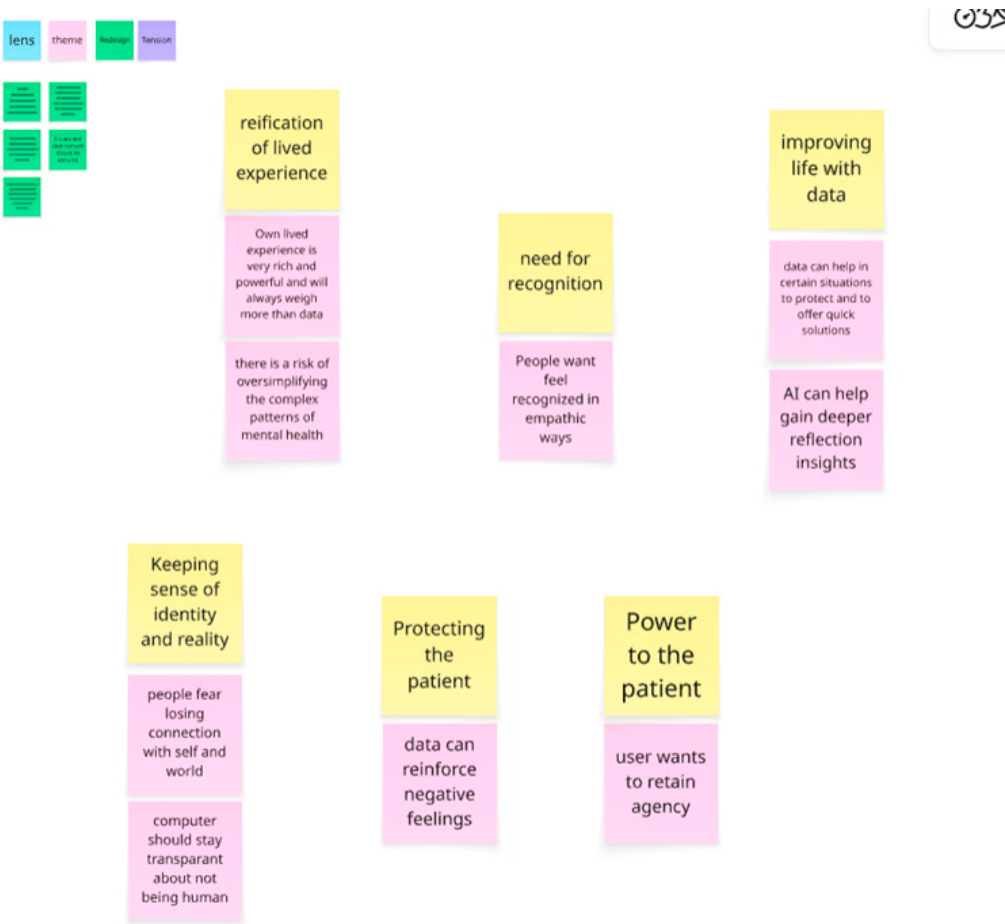
step 2



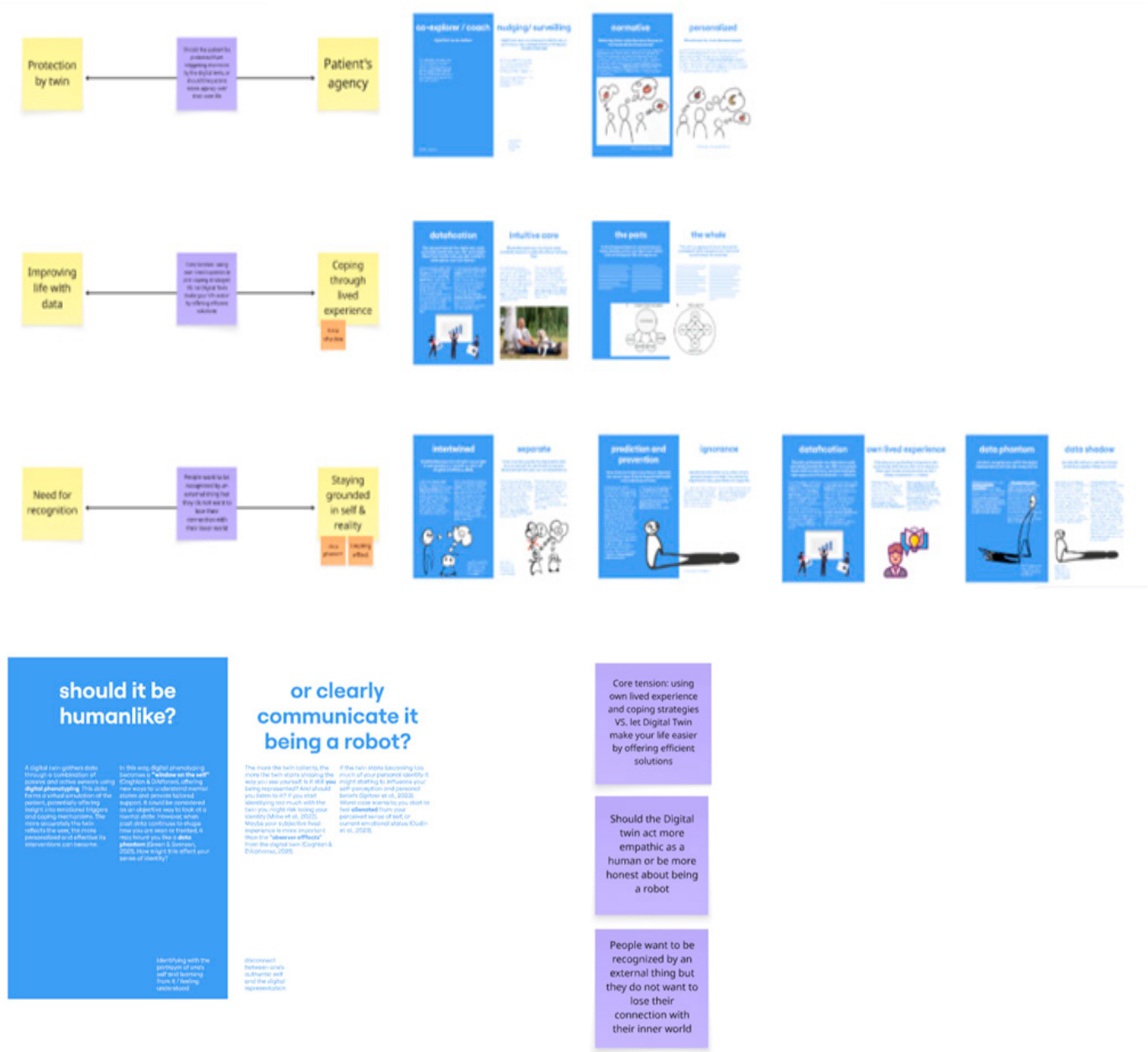
step 3

step 4

step 5



step 6, revisiting old tensions



step 6, translating it in a scenario



Appendix E) Test plan for testing the final speculative prototype with people with PTSD

Test Plan
Consentform signed
Therefore it will be less provocative.

There will be honesty about it not being a real prototype, in order to keep their trust.

The guidelines from the Chayn Network will be followed in order to test responsibly.

Not consequential, but experiential

Thinking out loud

Semi-structured interview

Interacting with the prototype

Different from previous tests:

Explore the nuance, less dystopian but more melancholic
Make it more hopeful and more suitable for people with PTSD

Introduction

Thank you for participating in this study. In this session, you will interact with a speculative prototype. It is not a real, functioning technology, but rather an interactive slideshow designed to look realistic. The goal is to imagine how digital twin technology could be used in the future and to provoke critical reflection about its possible benefits and risks.

Some aspects of the prototype are deliberately exaggerated to stimulate discussion. If something does not work as expected, this is due to the design, not to you. What matters is hearing your perspective about how you imagine this technology might work in the future and whether you think it should exist at all.

During the test, I would like you to think out loud while interacting with the prototype. All your thoughts are valuable for this research. At times, I may also ask follow-up questions about specific elements. If you do not wish to continue at any point, you can pause or stop the session.

To capture your reflections, I will record this session with a voice memo. If you are not comfortable with recording, I can take notes instead.

After the interaction, I will ask a few questions about the prototype and about your views on digital twin technology in general. I will not ask about your personal life. You may always skip questions, take a break, or end participation.

Main goals of this test

To explore whether a more nuanced speculation still provokes critical reflection on the use of digital twins in psychiatric healthcare for people with PTSD.

To understand participants' emotional and cognitive reactions to the prototype.
To specifically understand how people with lived experience PTSD react to this prototype.

To check whether the values of people with PTSD have been incorporated in a correct way.

To learn how participants respond to the predictions generated based on their input.
To identify preferences for different types of solutions (e.g., clinical vs. alternative approaches).

To see whether the tone of solutions (from prescriptive to optional) influences participants' responses.

What are the research questions of this test?

Does a more nuanced speculation also provoke enough reflection about the use of digital twins in the future?

What kind of reaction would this experiential prototype provoke?

What do people think about the way it also makes a prediction based on their input?

What kind of solution would they prefer? More clinical or alternative?

Would the tone of the solution matter to the user, ranging from prescriptive to more optional

Questions to ask:

Before

Imagine that you have been wearing this watch for a whole day, and that your phone is connected to my laptop. Your data has been gathered and analysed. In order to check the data with your own lived experience, you are asked to tell your story about your own experiences. It will then align your story with your data.

Screen 1 - voice recording

You can record your voice or just type. This can be a real story, but you can also keep it fictional.

Of the record: it is not really recording and / or storing your voice.

Screen 2 - choosing tarot cards

What do you think of these cards?
Do they help you tell your story?

Screen 3 - dashboard

It is now showing an analysis based on the story you told and the cards you chose. It is aligning it with the physiological data it has gathered.
What do you think of the way it tries to incorporate your own lived experience into the analysis?
What do you think of the 'physiological data' it is showing you?
Would you believe this dashboard?
Would you like to see more or less information?
Would you even want to know what is being measured?
More you'd like to share?

Screen 4 - detailed analysis

What do you think of the digital twin having gathered all this data?
Would you believe it?
How do you feel about it using your data for this analysis?

Screen 5 - choose intervention

What do you think about this page?
Are these interventions that would help you?
What would you choose and why?
Would you prefer clinical or holistic?
Does the tone of voice matter for your choice?

Explain about the prescriptiveness of the tone.

Do you feel like it is taking you seriously by offering you this list of interventions?
Do you think interventions are missing from this list?
Would you even want a prescribed intervention by a digital twin?

Screen 6 - predicted intervention

Would you like to know how your mental state is improving in the future?
Show the participant the difference between the interventions and the predictions.
What would you choose based on the predictions per intervention?
Would you follow the predictions or rather choose your own preference?

Screen 7 - tarot card prediction

What do you think of this type of intervention?
What do you think of it predicting your future state?

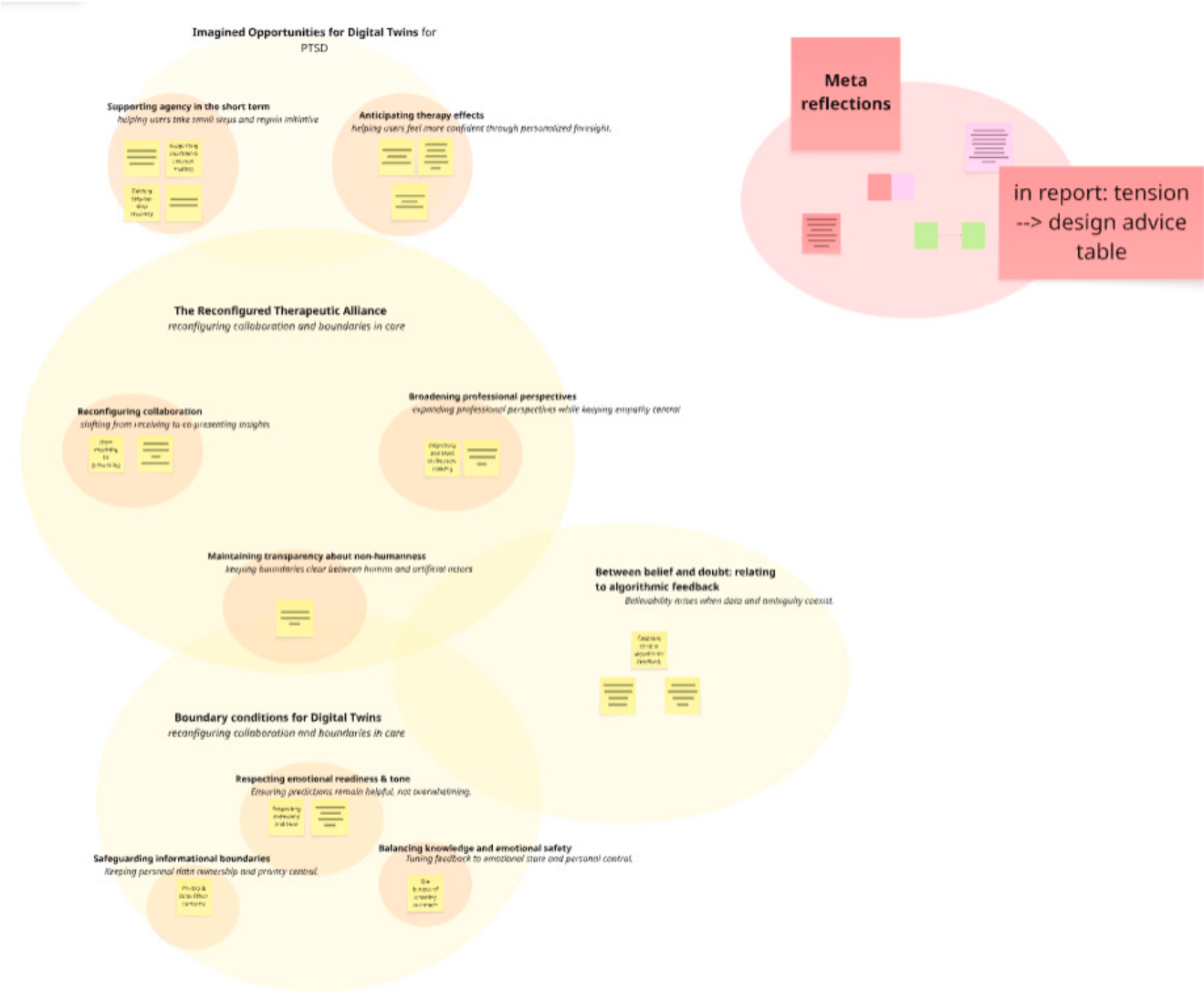
What do you think of the way it is set up now with a tarot card.
What do you think of the tone of voice?

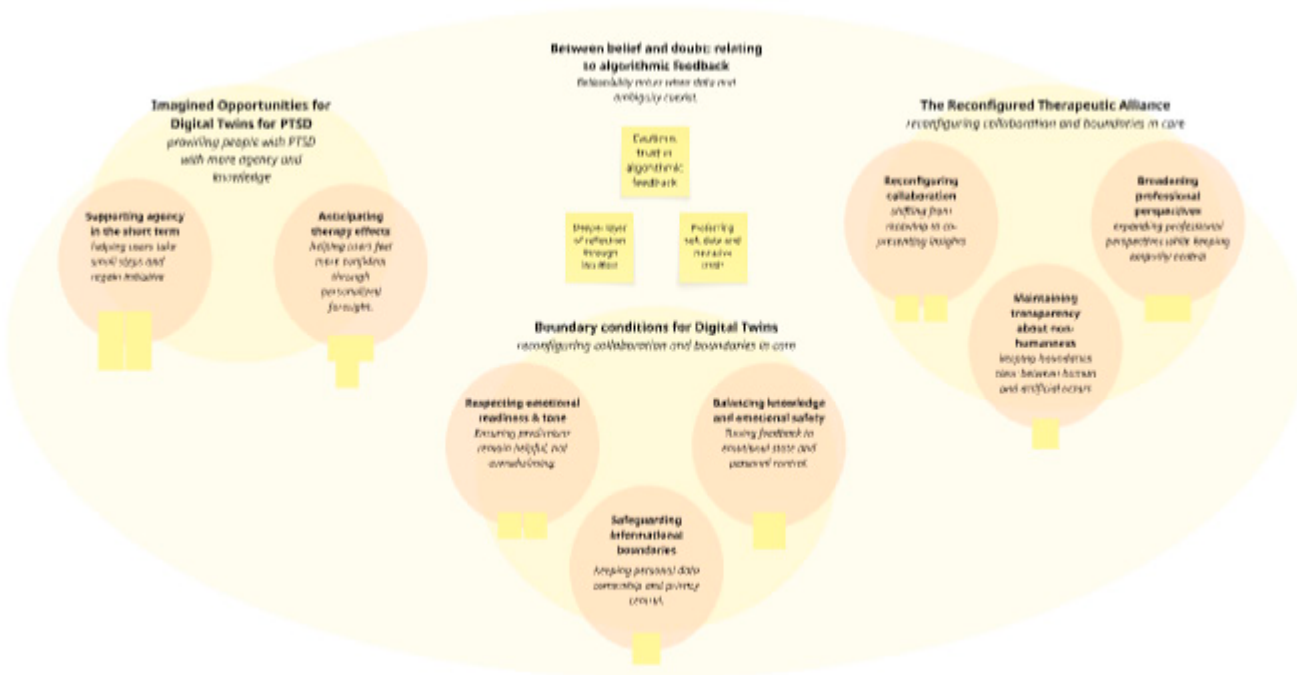
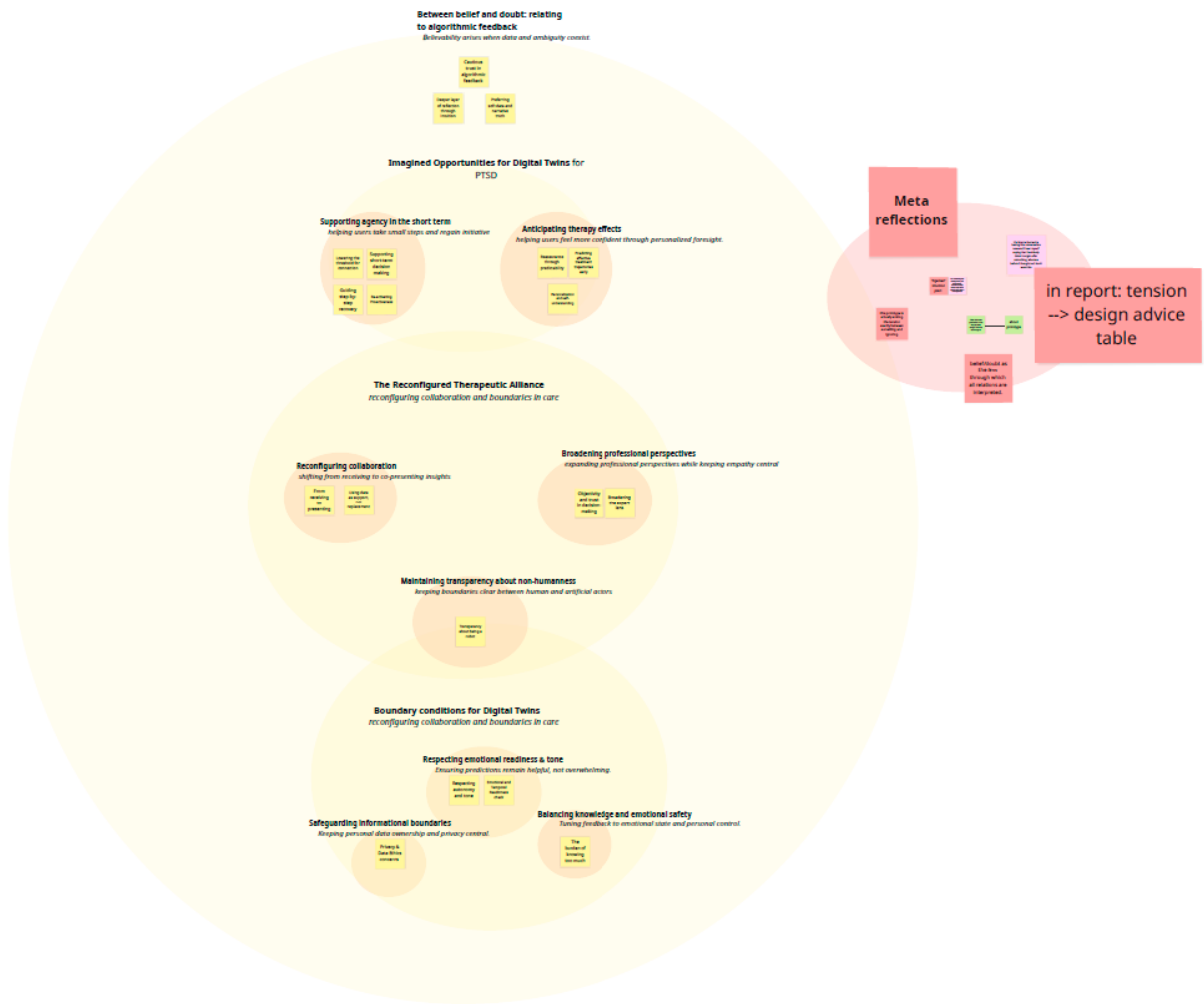
Screen 8 - reflection page

After

What are your first thoughts after this experience?
How do you feel about the way it has used your data in order to help you choose an intervention?
How do you feel about the way it has predicted for you which intervention would have most effect?
What are your feelings when going through this prototype.
Positive or negative?
What do you think of this technology in general?
Should it be used or stopped?
If it would be used; in what way?
If stopped; why?
If you could design a digital twin for yourself. What would it look like?

Appendix F) Formation of
three domains through
reflexive analysis





PROJECT TITLE, INTRODUCTION, PROBLEM DEFINITION and ASSIGNMENT

Complete all fields, keep information clear, specific and concise

Project title Speculating the possible future of a digital twin for an emotionally dysregulated person

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)

Emotional dysregulation, defined as difficulty in effectively managing and controlling one's emotions, is a transdiagnostic phenomenon in psychiatry that can vary in severity. It can lead to impaired interpersonal relationships and increased risk of developing psychiatric disorders ([Aslan et al., 2024](#)).

A digital twin is an emergent technology in mental healthcare. It is a virtual simulation of a person's behavior, created through real-time data collection and feedback to the user. In clinical context, it could contribute to new forms of therapeutic alliance between patients and providers, where both are recognized as experts ([Ruckenstein & Schüll, 2017](#)). While this technology has the potential to support emotionally dysregulated individuals in the future ([Spitzer et al., 2023](#)), the exact nature of that support remains unclear.

For instance, reliance on data-driven insights may disrupt patients' intuitive coping mechanisms. It could undermine self-trust, increase anxiety, and foster over-reliance on algorithmic interpretations of mental states ([Ruckenstein & Schüll, 2017](#)). Some scholars further argue that such technologies risk reducing complex emotional experiences to shallow behavioral data patterns, potentially discouraging deeper personal reflection ([Sharon, 2017](#)).

This tension between potential support and possible harm deserves further exploration. How might a digital twin interact with an emotionally dysregulated individual in the future? What kinds of relationships, dependencies, or ethical dilemmas could emerge from such interactions? Speculative design is well suited to investigate these questions. It allows me to critically imagine future scenarios before the technology is fully implemented and to reflect on their desirability, underlying assumptions, and ethical implications.

introduction (continued): space for images

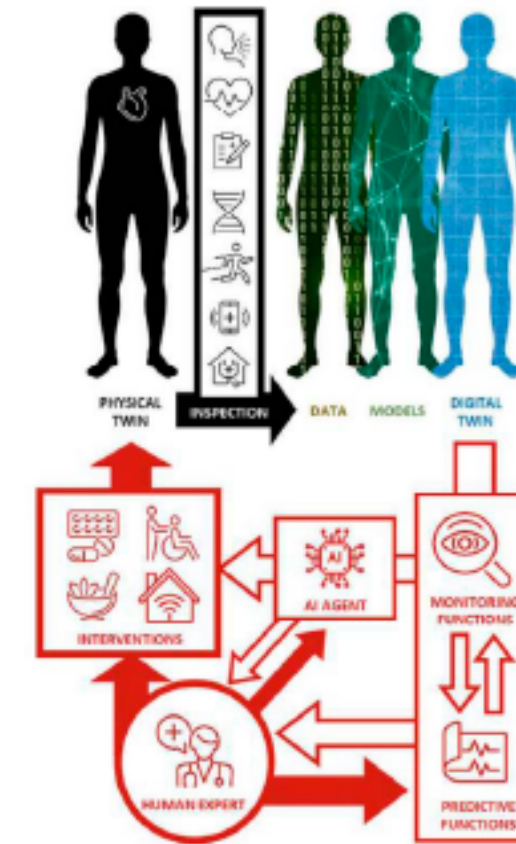


image / figure 1

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)*

There is a tension between supporting emotionally dysregulated individuals by providing them with insights through a digital twin and the risks associated with the datafication of mental health. For this technology to be beneficial, the data gathered by the digital twin must be communicated back to the user in a meaningful way.

I will apply a speculative design methodology with participatory elements to develop a meaningful and critical stance on this topic. The process will consist of seven stages: recruiting participants while conducting literature research (3 weeks), exploring the context through mapping and interviews (3 weeks), building future scenarios (2 weeks), developing a design position (2 weeks), creating and testing low-fidelity prototypes with users (3 weeks), and finally producing and evaluating a high-fidelity speculative prototype (3 weeks).

By testing low-fidelity prototypes early in the design process, I can ensure the values of the target group are well integrated into the final design. To find a group of emotionally dysregulated participants for testing, I plan to leverage my existing network in mental healthcare, and my client's (Peter). If this proves unfeasible, I will broaden the target group to include individuals concerned with general mental wellbeing.

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 future scenario using the speculative design approach with participatory elements, where a digital twin communicates the gathered data back to its provider, an emotionally dysregulated person, in a meaningful way, in order to provoke critical reflection among designers of digital twins on the future of psychiatric healthcare.

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)

I will use speculative design as my core method, enriched with participatory elements. To explore the context, I will use contextmapping through interviews with emotionally dysregulated people and experts. These insights will help me create future scenarios and help define my design position.

For finding the right group of people I will use the network of my client and my own network in the mental healthcare sector.

Early in the process, I will create low-fidelity prototypes and test them with designers to evaluate their responses. I will also test with emotionally dysregulated people to see if the prototypes reflect their values. This iterative process of creating and testing will lead to the development of the final speculative design. I will validate the final prototype with both designers and emotionally dysregulated individuals to ensure it is meaningful, reflective, and grounded in their experiences.

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)*

I want to develop my competency in designing through a speculative approach. My goal is to create a thought-provoking prototype that clearly expresses my personal stance on the topic, while also incorporating insights from emotionally dysregulated people. I am particularly curious about how their perspectives can inspire the creation of possible futures involving digital twins.

I have a strong personal interest in mental healthcare and the risks of datafication. As a former elite athlete on the national rowing team, I trained using extensive data gathering. Using sportswatches, we tracked heart rate, sleep, diet, speed, and lactate levels. While this approach contributed to Olympic success, it did not improve my mental well-being. In fact, the constant quantification made me lose touch with my intuition. I lost the ability to intuitively feel when I was too strained or tired when training, leading to being overtrained. This tension field between the potential success and risks of a digital twin fascinates me and reveals a rich design opportunity: how can we return data to its provider in a way keeps the intuitivity intact?

With this project, I want to explore the future roles of data and AI in mental healthcare. By speculating on how digital twins might support or harm mental well-being, I hope to uncover both risks and opportunities. I aim to experiment with how future technologies can serve people in humane, empowering ways.