

A DESIGN INQUIRY INTO INTROSPECTIVE AI

Surfacing

OPPORTUNITIES,
ISSUES & PARADOXES

by
Nico Brand



A DESIGN INQUIRY INTO INTROSPECTIVE AI

Surfacing

OPPORTUNITIES,
ISSUES & PARADOXES

by

Nico Brand

B.A., University of Applied Science

Schwaebisch-Gmuend, 2018

Thesis Submitted in Partial Fulfillment of the
Requirements for the Degree of
Master of Arts

in the

School of Interactive Arts + Technology

Faculty of Communication, Art, and Technology

© Nico Brand 2022

SIMON FRASER UNIVERSITY

Spring 2022

DECLARATION OF COMMITTEE

Name	Nico Brand
Degree	Master of Arts
Title	A Design Inquiry into Introspective AI: Surfacing Opportunities, Issues, and Paradoxes
Committee	TBD
	→ Chair
	→ Associate Professor
	→ SFU – Interactive Arts & Technology
	William Odom
	→ Supervisor
	→ Associate Professor
	→ SFU – Interactive Arts & Technology
	Philippe Pasquier
	→ Supervisor
	→ Professor
	→ SFU – Interactive Arts & Technology
	Chris Elsdon
	→ External Examiner
	→ Chancellor’s Fellow in Service Design
	→ Edinburgh University – Design Informatics

ETHIC STATEMENT

The author, whose name appears on the title page of this work, has obtained research described in this work, either:

- a. human research ethics approval from the Simon Fraser University of Research Ethics

or

- b. advance approval of the animal care protocol from the University Care Committee of Simon Fraser University

or has conducted the research

- c. as a co-investigator, collaborator, or research assistant in a project approved in advance.

A copy of the approval letter has been filed with the Theses Office of the University Library at the time of submission of this thesis or project.

The original application for approval and letter of approval are filed with the offices. Inquiries may be directed to those authorities.

ABSTRACT

Introspection is the practice of looking inward and examining our ideas, thoughts, and feelings. It involves considering past experiences and asking questions about the future.

This thesis reports on a design research inquiry that explores Artificial Intelligence (AI), combined with personal data, as a resource for introspection.

This work investigates how AI might offer possibilities for generating alternative perspectives on one's life to support introspection and paradoxes that this might raise. I describe my design-led inquiry, motivate five

approaches to introspective practice as opportunities for potential Introspective AI interventions, and explore them through seven design proposals.

Taken together, these proposals provoke questions around how introspective AI might be critiqued, imagined, and designed. The thesis concludes with a reflection on my work and the opportunities it suggests for future research and practice.

keywords

Personal Data

AI

Introspection

Speculative Design

Research through Design

DEDICATION

First, I want to thank my family for supporting me in this crazy adventure of studying in a place so far from home. I’m forever grateful for the tools you showed me and the guidance to pursue my very own path throughout my life. You taught me to see, tinker, deconstruct, and build up from scratch. You showed me a way to be different and challenge norms, even if this is the more bumpy path. I can only hope to live up to this one day and show the same amount of selflessness and generosity that I was privileged to receive.

To my partner in crime, Chiara, who joined me to live in Canada, helping me to make this place home and endure me in my brightest and darkest hours — I love you and will always work hard to return your generosity and thoughtfulness.

Special thanks to Dr. William Odom for being the most curious, inspiring and supportive supervisor a grad student could hope for. You showed me so much care and finesse for my projects and helped me with your council through uncertain and rocky times. Thanks, both to you and Sabrina, for opening your doors and providing help that transcends academic issues.

Thanks to the lovely folks at the EDS Design Studio for being such talented and bright minds; you make it easy to keep working and exploring every day.

ACKNOWLEDGEMENTS

The contents and context of the following document were conceived, collected, and co-authored on the unceded ancestral territories of the xʷməθkʷəy̓əm (Musqueam), Skwxwú7mesh Úxwumixw (Squamish), səliłwətaʔt (Tsleil-Waututh), qíćəy̓ (Katzie), kʷikwəłəm (Kwikwetlem), Qayqayt, Kwantlen, Semiahmoo and Tsawwassen Nations.

This research is supported by the Natural Sciences and Engineering Research Council of Canada (NSERC) and the Social Sciences and Humanities Research Council of Canada (SSHRC).

LIST OF FIGURES

BACKGROUND & RELATED WORK25

Figure 1. Image by Valery Lemay for ideas.ted.com, The right way to be introspective (yes, there's a wrong way).....26

Figure 2. Teachable Machine at: teachablemachine.withgoogle.com 30

Figure 3. A simple visualisation of transfer learning.....32

Figure 4. https://replika.ai/33

Figure 5. The Fist Google Image search result for "AI" depicts a stereotypical image (Getty Image).....35

Figure 6. Image by Alan Warburton / © BBC / Better Images of AI / Plant / CC-BY 4.0.....35

Figure 7. Crawford and Joler [25]35

Figure 8. Image by Alan Warburton / © BBC / Better Images of AI / Virtual Human / CC-BY 4.036

Figure 9. https://design.google/library/ux-ai/37

Figure 10. Iohanna Nicenboim, Affective Things, 2017 [46]39

Figure 11. Giaccardi et. al., Things as Co-Ethnographers, 2016 [46]39

Figure 12. Yuxi Liu, Five Machines [163]39

Figure 13. Pschetz et al. - 2019 - Autonomous Distributed Energy Systems Problematis [112] 40

Figure 14. James Pierce. 2021. Eccentric Sensing Devices [106]..... 40

Figure 15. Marie Louise Juul Søndergaard. 2018. Your smart toilet assistant..... 40

Experiments & Synthesis55

Figure 16. Screenshots of the Insights Timer App [61] 60

Figure 17. Screenshots of the Headspace App [153] 61

Figure 18. Screenshots of the calm App [165].....62

Figure 19. Screenshots of the waking up App [155]..... 63

Figure 20. Main feed of the Capture App [167]..... 64

Figure 21. Contextualising dream-journal entries with labels.65

Figure 22. Exported dream journal entries as compiled PDF file.....65

Figure 23. Dashboard of the dreamy app [169]66

Figure 24. Dream data is exportable as .json file.....66

Figure 25. The app finds symbols in one's dream, and provides suggestionsfor introspective activities.67

Figure 26. Dream app connects paying users to a "Dream Expert" via chat. When I was using it, I believe it was a chatbot67

Figure 27. Reflectly [149] prompts daily journals.....68

Figure 28. The app offers a feed that compiles every entry as well as motivational quotes.....69

Figure 29. Replika [158] prompted me to try a "soothing" exercise.71

Figure 30. Points, which can be earned by using the app or by buying them, can be redeemed for additional character traits.....71

Figure 31. Replika user's are praising the apps music suggestion on a YouTube comment threat.....71

Figure 32. YouTube comment section under songs that show certain introspective qualities..... 72

Figure 33. Music journaling experiment..... 73

Figure 34. Curated playlist based on birth year. 73

Figure 35. Mapping personal history through music..... 74

Figure 36. Personal aesthetics over time..... 76

Figure 37. Mapping five senses of self over time..... 77

Figure 38. Sentiment analysis of journal entries, and manually generated prompts81

Figure 39. Personal website extracted for sentiment.....83

Figure 40. Speech analysis based on Facebook data. Here a post from 2010 was analysed for sentiment.83

Figure 41. Sentiment values are returned from the IBM API and pre-processed in order to make it readable for the t-SNE algorithm.....84

Figure 42. Simple visualisation of dimensionality reduction with t-SNE.....85

Figure 43. First visualization test using t-SNE and p5.js. Every dot represents one sentence in a journal.....86

Figure 44. The final prototype allowed for more seamless interaction; I could zoom in and out of the canvas and explore the colour-coded sentences based on sentiment. Then, on hover, the sentence appears.86

Figure 45. I was creating styleGAN models for several 'eras' in my life.89

Figure 46. Digitizing 224 artworks before feeding them into a styleGAN model.89

Figure 47. The outcomes of a model trained on sketches drawn throughout my first year living in Vancouver.89

Figure 48. Personal Archive of 890 photos of places, people and landscapes from Tel Aviv.90

Figure 49. I generated more than 100 images with the trained styleGAN2 model. Then, I sorted through this collection, searching for images that evoked feelings of reminiscence and familiarity.91

Figure 50. I added metadata to artworks on Apple Photos as a journaling activity after I finished drawing..... 92

Figure 51. My musical listening is tracked, and the most recent song's cover art i s selected to be synthesized with a randomly selected personal artwork.93

Figure 52. An interactive canvas displays randomly chosen artworks with their journal annotation beneath.....93

Figure 53. Some of the artworks are shown on the canvas, with their respective journal annotations and timestamps.94

Figure 54. My personal music listening archive informs how each artwork is stylized.....95

Figure 55. Design concept generation focusing on creating services that use personal data in alternative and explorative ways.....99

Figure 56. Design concept generation focusing on creating services that use personal data in alternative and explorative ways.....101

CONTENTS

Declaration of Committee	4
Ethic Statement	5
Abstract	6
Dedication	8
Acknowledgements	9
List of Figures	10
Contents	12
List of Acronyms	16
Glossary	17

INTRODUCTION19

BACKGROUND & RELATED WORK25

Introspection & The Self	26
Personal Data, History & Alternative Perspectives	28
Exploring AI as a Design Material	30

METHODOLOGY43

Intro	44
Research Objective	46
Designer–Researcher Approach Preliminary Phase	48
Project Timeline	50
7 Design Proposals Primary Phase	52

EXPERIMENTS & SYNTHESIS55

Intro	56
Introspective Explorations	58
AI & Machine Learning Explorations	78
Design Concept Generation	96
Synthesis	102
5 Themes	103

SEVEN DESIGN PROPOSALS109

Intro	110
Framing & Speculation of Introspective AI	112
Everyday Personality	114
Music Reflection	115
Mind Probes	116
Vision Shrine	118
Hello, Cyberself	120
Dream Streams	122
Deep Talk Report	124

DISCUSSION, CONCLUSION & FUTURE WORK127

Discussion	128
Conclusion & Future Work	132
References	135

LIST OF ACRONYMS

AI	Artificial Intellegence
AR	Augmented Reality
HCI	Human-Computer Interaction
ML	Machine Learning
RtD	Research through Design
UX	User Experience
UI	User Interface

GLOSSARY

Introspection	The process of mentally looking inward and examining one’s own thoughts, emotions, values, desires, and character
Introspective AI	Introspective AI is the use of Artificial Intelligence to mediate introspection. It is envisioned as a context-aware agent leveraging personal data accounts to create situated introspective prompts.

INTRODUCTION

1

Introspection is the practice of mentally looking inward and examining one's own thoughts, emotions, values, desires, and character [19]. It is a practice where practitioners actively take stock of the present by observing and reflecting on their current mental state [16]. Importantly, introspective practice is different from simply reflecting on or recollecting memories, as practitioners adopt a more active approach in assessing key past experiences through methods of critical reflection. Introspection is an ongoing process of learning about oneself, where one challenges personal cognitive biases and asks questions about what has been achieved and what one wants in the future [135].

As people extend their self through things, possessions play fluid roles in mediating introspective experiences of looking back on the past, contemplating the present, and prospectively reflecting on one's desired future [9,10,71,123]. As interactive technologies continue to become woven into the fabric of everyday life, people's practices have expanded due in part to their growingly diverse archives of personal data [7,25,71,114]. The convergence of social, mobile, and cloud computing services have created a world in which people's everyday lives are captured through explicit and implicit forms of personal data in a greater scale than ever before (e.g., [26,68,97,116,142]). These shifts have led to a stream of research exploring the roles that data plays in supporting the experiences of reflection and reminiscence within the HCI community, yet there is a need for research focusing on the particular practice of introspection.

Another trajectory of research in the HCI and design communities advocates for creating strategies to design for reflective, curious, interpretive, and ongoing experiences in people's everyday lives (e.g., [44,48,54]). Elsdén et al. [40] voiced their aspiration for research that leverages data in ways that are less performance-oriented and deviate from tools of rational self-analysis, as well as research that embrace the complex relationship we share with our data – and systems processing it. These authors make a compelling case for inquiring into how alternative representations of personal data can help people see their life from different perspectives and gain self-knowledge through this process over time. The emergence of growingly diverse forms of personal digital records creates new opportunities for people to introspectively engage with their past emotions, behaviours, and experiences bound up in them. However, the scale and diversity of personal data archives also present challenges in terms of how patterns across one's life history could be represented in forms that would offer rich, sustained resources for introspective practice.

In parallel to these movements, Artificial Intelligence (AI) has increasingly become accessible to design researchers (e.g., [35,51,58,73,89,146]). A growing amount of design research projects speculate on the potential benefits and consequences of AI technologies introduced into people's everyday lives (e.g., [80,82,87,88,115,131]). Broadly speaking, AI is the application of statistical models and algorithms through computational systems to complete specific kinds of tasks by using patterns and inferences that are iteratively developed over time. The 'learning' that occurs in AI refers to the process of building models of a phenomenon in the world through training data. While AI can be characterized in these terms on a basic level, when applied in practice, it can take on notably diverse forms, and, in general, how it can operate as a design material remain underexplored [12].

There is nascent interest in the creation of commercial products that apply AI to support introspective experiences for mindfulness and "conscious self-discovery" (e.g., [1]). This space is beginning to be explored through AI-augmented journaling (e.g. [149,150]) and dream journaling (e.g., [151]), where AI is used to organize and analyze entries. However, nearly all of these applications focus on leading the process of guided introspection (i.e., similar to an audio-book) instead of creating new kinds of interactive and evolving resources to support a diverse range of introspection experiences. Additionally, nearly all current AI introspection applications and services exclusively draw on the data that end users explicitly provide. This thesis aims to extend this design space by considering how aggregations of personal data might operate as resources for Introspective AI.

Collectively, the works reviewed here make clear that people's practices of self-introspection are expanding as personal data records increasingly capture our lives and mediate our actions in the world. A diversity of approaches is needed to help expand interaction design through new design initiatives that enable people to reflect on their life experiences from multiple perspectives [40]. AI offers intriguing possibilities for surfacing, exploring, and engaging with patterns in and across personal data records. While prior research has explored various ways new technologies might mediate experiences of reflection and reminiscence more generally, the specific question of how AI might be drawn on as a material to design new applications that could support rich introspective experiences remains is underexplored.

The goal of this work is to investigate how AI might offer possibilities for generating alternative perspectives on one's life to support introspection and paradoxes that this might raise. To

pursue this goal, I conducted two design research phases. In the preliminary phase, first-hand experiments and research activities were conducted and analyzed, resulting in 5 distinct approaches to AI-mediated introspective practice. Secondly, within a primary phase, the gained insights informed an extensive design-led process, resulting in the creation of 7 speculative design proposals.

All of these design proposals are centred around two protagonists: Alison, a mid-20s professional now living in North America, and Alison's Introspective AI model, which drives the seven design concept proposals, continually learning from data collected from Alison, which is used to generate various kinds of introspective activities. Taken together, our proposals offer a range of possibilities and consequences that personal data, shaped by an Introspective AI model, might hold for mediating experiences of self-introspection. This research makes two contributions. First, it advances the HCI community's understanding of Introspective AI, alluding to potential future product and services forms as well as where tensions might emerge. This helps broaden and define the Introspective AI design space, which can be used as a generative resource for future research and practice. Second, it provides a case demonstrating how speculative design proposals can provide insights into current practices and inspire creative responses in the form of new design ideas. This helps support and extend HCI's adoption of speculative methods and approaches to probe potential technological futures and raise questions about their desirability.

Next, I offer a brief summary of the subsequent chapters to come in my thesis.

1 — Background & Related Work

Chapter 2 presents and literature review of the relevant segments of this research inquiry. First, I will give a general overview of what introspection is and how it is different from self-reflection. Secondly, I will elaborate on the roles personal artifacts, data, and archives play in reflecting on our lives and drawing attention to a lack of research for introspective practice. Thirdly, I will draw on research that calls for alternative and richer forms of presenting personal data to create lasting and more effective resources for introspection. Fourthly, I elaborate on current research into interactive machine learning explainable AI and showcase current commercial products that apply machine learning tools to aid self-discovery. Fifthly, an overview of pressing issues, limits and

misconceptions prevalent in AI research, reporting on important notions to consider for this inquiry. Finally, the last section alludes to the possible changes that design might face dealing with more agents systems and voices concerns, ideas and projects based on More-Than-Human Design practice.

3 — Methodology

Chapter 3 provides an overview of this work's research objectives and research questions meeting those objectives. I describe the methodological choices and approaches applied in each of the two phases of this project.

4 — *Experiments & Analysis* (Preliminary Phase)

Chapter 4 will provide details on my research through design process consisting of experiments and hands-on exploration of AI systems, introspective activities and the generation of multiple preliminary design concepts. Further, I discuss the analysis of these three experimental stages and report on the five themes that emerged out of this stage.

5 — *Seven Design Proposals* (formative Phase)

Chapter 5 depicts the envisioned framing of the introspective AI design space. Here I briefly describe my positionality towards the creation of the seven services as well as elaborate on the "seeds" that inspired me to imagine and craft such a "possible future." Secondly, I provide an in-depth overview of each of the seven design proposals grounding them in introspection research.

6 — *Discussion, Conclusion, and Future Work*

Chapter 6 presents the analysis and reflection of the seven design proposals and hint at possible implications, design opportunities and questions to inspire future HCI and design research.

BACKGROUND & RELATED WORK

2

INTROSPECTION & THE SELF



↑ Figure 1
Image by Valery Lemay for ideas.ted.com,
The right way to be introspective (yes,
there's a wrong way)

Introspection has been the subject of wide philosophical discussion and, while many facets of this concept continue to be debated, there is shared agreement that it is an essential part of the human condition (c.f. [18,114,118]). In the psychological sciences, introspection is described as the process of explicitly observing and reflecting on one's mental state [15]. Gould's often-cited definition characterizes introspection as:

- ✦ An ongoing process of tracking, experiencing, and reflecting on one's own thoughts, mental images, feelings, sensations, and behaviours [49:719].

This definition brings attention to introspection's temporal qualities—it is a continual practice across one's life that can occur in incidental and unstructured ways or that are consciously deliberate. Self-introspection is more specific in its focus on self-development and discovery through the ongoing process of reflecting on past and present thoughts, emotions, and experiences in relation to an, often evolving, vision of one's ideal future self [35,96,130].

Introspection & HCI Research

A limited amount of research in HCI has explored how experiences of momentary pause and contemplation, broadly construed as 'introspection,' might be mediated through people being exposed to immersive virtual reality applications [66] or interactive art museum exhibits [112].

Our work explores the potential and limits of AI in generating digital resources to support the practice of self-introspection. We contribute insights into where different design qualities can work together to potentially support introspective experiences over time.

PERSONAL DATA, HISTORY & ALTERNATIVE PERSPECTIVES

The proliferation of personal digital data, along with a growing interest in the HCI community toward designing for everyday life, has led to a stream of work exploring how experiences of self-reflection can be mediated by interactive technologies [73]. A key body of work has focused on creating new technologies to attach digital data to existing physical objects (e.g., [40,87,94,98]). Another growing area of work investigates opportunities for re-experiencing personal digital data, such as digital journals [36], photos (e.g., [20,90,97,127]), music (e.g., [65,71,91,139]), audio (e.g., [32,34,94,98]), social media content (e.g., [88,95]) and geolocate data [79,125,136], to support rich experiences of self-reflection.

More generally, a trajectory of research in the HCI and design communities have advocated for creating strategies to design reflective, curious, interpretive, and ongoing experiences in people's everyday lives (e.g., [41,45,50]). In part building on these works, Elsdén et al. [37] argue:

- ✦ There is a critical need for future HCI research to investigate the design of interactions with personal data that expand beyond “an exclusive interest in performance, efficiency, and rational [self] analysis. [37:48].

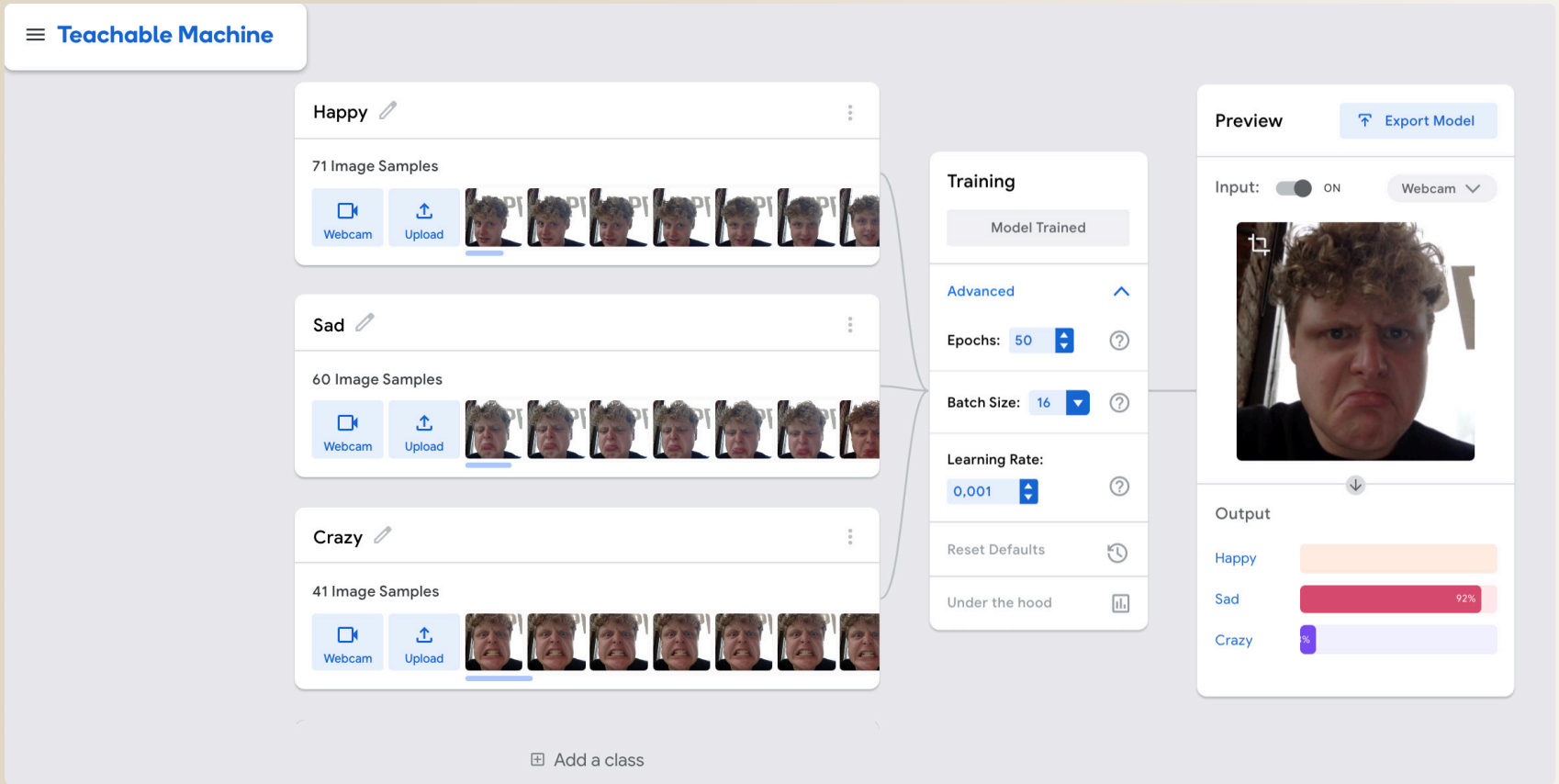
These authors make a compelling case for inquiring into how alternative representations of personal data can help people see their self, life history, and worldview from different perspectives and gain actionable self-knowledge from these experiences. A key implication resulting from this work is that interaction design must extend its focus toward designing systems that embrace, rather than reject, the richness of “the often complex and ambiguous relationships [we have] with our digital records” [37:47].

However, examples of new design proposals that explore the value, possibilities, and limits of such new forms of personal data and the ^tion are underdeveloped. Our work explicitly connects and investigates the potentialities that personal data and AI might offer for self-introspection.

EXPLORING AI AS A DESIGN MATERIAL

AI and Machine Learning (ML) have increasingly become accessible to HCI and design researchers. Recent work has begun to investigate how AI can be better mobilized as a material for designers (e.g., [12,35,51,73,81,109,145]), non-experts (e.g., [20,147]), and various other stakeholders (e.g., [58,59]). The ‘learning’ that is often core to AI and, especially ML, refers to the iterative process of building models of phenomena worldwide. While traditionally relying on static labels, training datasets, and statistical models, more recent ‘human in the loop’ approaches, such as interactive machine learning, have emerged where a model is trained through frequent and ongoing end-user interaction [4]. This approach enacts a form of ‘machine teaching’ where the end-user corrects or confirms an AI model’s predictions [147]. Interactive machine learning offers the potential to generate more accurate and effective models [5,52].

However, an AI model’s inferences, needs, and workings ‘under the hood’ can be unpredictable and unintelligible for end-users, posing key barriers to successfully producing improved models [42,74].



Explainable & Teachable AI

In light of these issues, Explainable AI has emerged to investigate strategies for making models more transparent and offering explanations of algorithmic decision-making processes [140]. Although still a nascent research area, explainability has shown some promise in engendering trust and setting end-user expectations through unveiling an AI model’s anticipated accuracy in its decision making [126,146,147]. Recent developments like Google’s web-based Teachable Machine project [58] or Microsoft’s Lobe [152] enable end-users to create personalized AI models effortlessly. For example, using the teachable machine web application, end users can train a model to differentiate between their personal face expressions, unique objects, personal audio files or voices, as well as particular gestures and

poses. Within the service, users are able to define several classes (e.g. “pensive face,” “nostalgic face,” “happy face”), provide sufficient training data for them (e.g. 200 web-cam images per class)

↑ Figure 2
Screenshot of my model created
with Teachable Machine at:
teachablemachine.withgoogle.com

and train the model to detect one of these classes in new source material (e.g. video input from the user laughing triggers the “happy face” category.) What used to be an extensive undertaking — advanced coding skills, relying on massive data sets and CPU — can be done in minutes on a regular laptop. Lowering such entry barriers enables users to create personal models attuned to their idiosyncratic behaviours and personal data accounts.

This leap in accessibility and user experience made it possible to draw on the method of ‘transfer learning’ [133]. Here knowledge

attained from another model is leveraged and used to solve a new task. Hence, end-users are benefiting from the heavy lifting that already took place in vast, pre-trained models, and therefore bypassing the more challenging parts of the process while still profiting from extremely precise models [8].

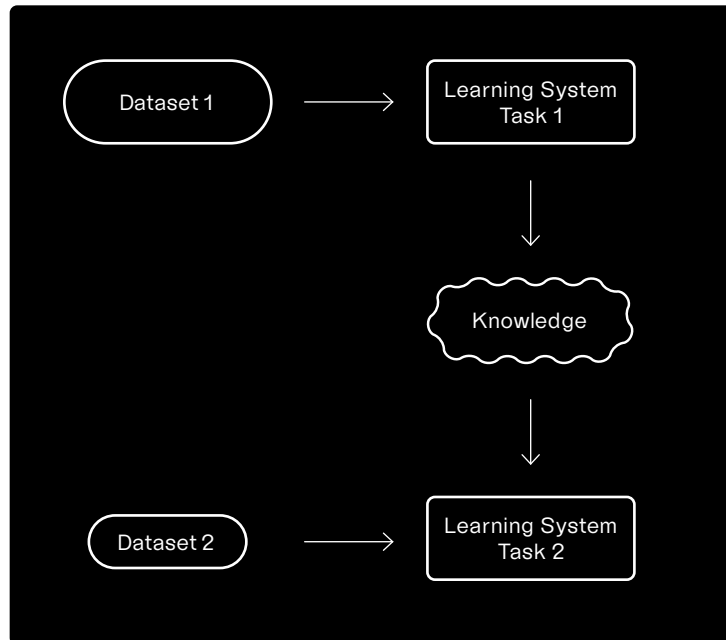
Although the complexity of models that such models can produce is limited, these services and the broader research areas of explainable AI and interactive machine learning provoke questions around how one might ‘collaborate’ with the machine and influence models of a user’s percep-

tion of self as it changes over their life. However, currently little is known about how such strategies might play a role in facilitating the evolving development of a personal introspective AI model via its interactions over time.

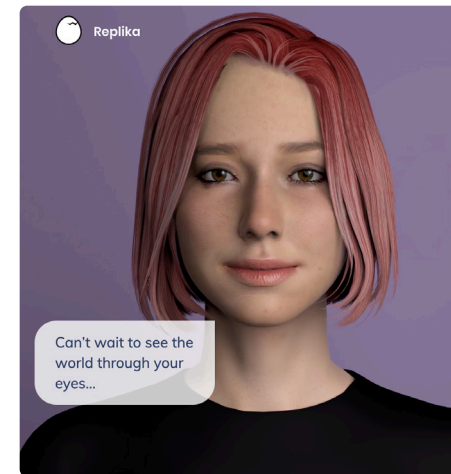
Introspection & AI

Within recent years, the market for mediation and mindfulness apps has grown rapidly. More than 50 million people downloaded the top 10 mediation apps resulting in combined revenue of 195 million USD in 2019 [143]. As big as this market, as much the variety of services that are offered within, and across applications: Guided meditation [153], sleep improvement tracking and exercises [154], timing and nudging of insights [61], lectures [155], relaxing music and soundscapes [156], personality analysis [157].

Despite the growing amount of commercially available apps in this space, just a handful of services are beginning to apply AI to sup-



↑ Figure 3
A simple visualisation
of transfer learning.



↑ Figure 4
<https://replika.ai/>

port introspective experiences. Smart tracking applications like MetriLife [1] claim to aid one’s “conscious self-discovery” empow-

ered by AI. Other apps like the Replika AI chatbot [158] produces emphatic conversations, learning from user input so they can “express and witness [themselves].” The App leverages more advanced machine learning technologies, using Google’s openAI API [159] and their state-of-the-art language prediction model GPT-3. This autoregressive language model takes in textual prompts and generates cohesive responses, continuously adjusting its internal “weights” — or importance scores — to inform how signals flow between nodes within its deep neural network structure. Since this model constantly evaluates its “weights”, it gets more attuned to a specific use over time, learning to create more accurate text response.

The Replika Ai Chatbot encourages this training further by asking users to provide feedback if responses were relevant or not. Other products include AI-augmented journaling (e.g. [149,150]) and dream journaling (e.g., [151]), where AI is used to organize and analyze user entries, therefore leveraging effective yet feeble forms of machine learning.

- ✦ Nearly all of these applications focus on structuring and facilitating the process of guided introspection (i.e., similar to an audio-book), as opposed to creating new kinds of interactive resources to support a range of introspective experiences that are more personalized and situated.

Neither do they include more rich accounts of personal data, other than the input that users are providing (f.e. a journal entry every other day or images). Conversely, services such as Facebook Memories and Apple Memories use AI to curate personal data for recollecting past experiences; however, they are not created to intentionally prompt introspection or evolve with the user’s sense of self over time.

Issues, Limits & Misconceptions of AI

While the development of more accessible machine learning is proceeding, and the variety of AI-aided apps for introspection is growing, there is an expanding need to address and discuss the varieties of issues, limits and misconceptions prevalent in the emerging design space of Artificial Intelligence. In the context of this work, I not only want to voice these concerns as a way to further draw attention to them but also as a way to sensitize this design research process to not further inflame stereotypes or unrealistic images of AI.

- ✦ AI is often portrayed in abstract, futuristic or sci-ence-fiction-inspired images that allude to and “hin-der the understanding of the technology’s already significant societal and environmental impacts [160].”

Misleading metaphors help to depersonalize and commodify the way data is captured and leveraged for economic growth (e.g. “data exhaust,” “data mining”), and other terms obscure AI as something lightweight and immaterial (e.g. “The Cloud,” “Cloud Services”) conversely to the massive infrastructures that make up AI services [76]. A trajectory of research focuses on demystifying this “image” of AI, drawing attention to the material, political and social dimensions of Artificial Intelligence [24,25].

From the excessive mining that takes place to sustain AI sys-tems to the labour exploited (e.g. miners or crowd workers) [63,85] to the massive energy demands for training and maintenance of AI models [65,129], these material dimensions are often invisible, yet they bear far-reaching consequences for communities and envi-ronment [62].

The most pressing challenges in light of this research inquiry are the ones present in AI’s social and political dimensions. A key body of work investigates and exposes how data, classifications and algorithms reinforce toxic behaviour starting with the critique of mass extraction, how data is labelled, notions of bypassing consent and losing context for the means of generalization [13,22,161].

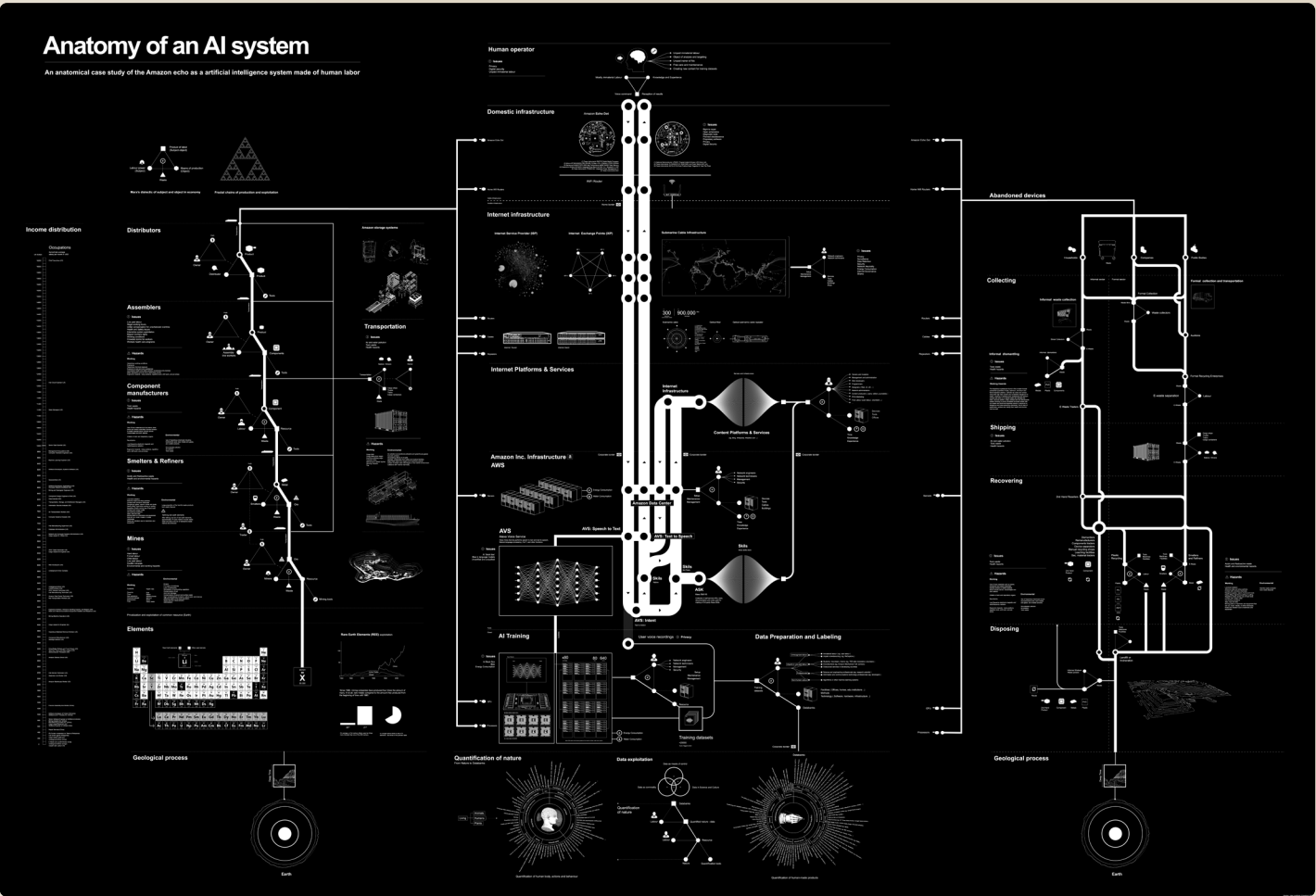
A growing body of work investigates explicitly how racist prejudice and misogyny are encoded into training data sets that subsequently inform machine learning models [55,113,114,162]. Nevertheless, not only by ill-defining categories harm is caused but also by not even including instances in the first place (e.g. whole communities that are marginalized [2] or excluding gen-der-neutral terms [67].)



↑ Figure 5
The First Google Image search result for “AI” depicts a stereotypical image (Getty Image).

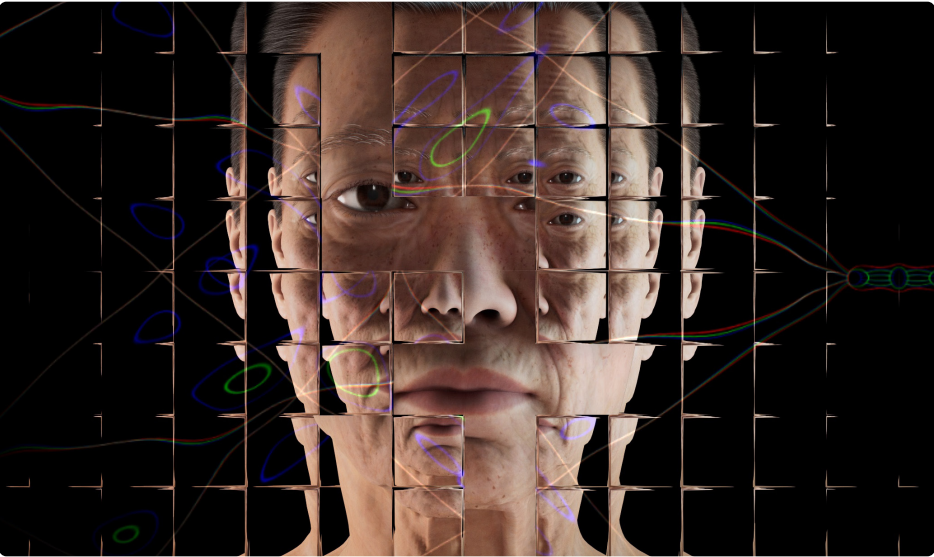
↶ Figure 6
Better images of ai [160], offers a library of images that depict AI more representative. Here Alan Warburton depicts the quantification of a houseplant. Image by Alan Warburton / © BBC / Better Images of AI / Plant / CC-BY 4.0

↓ Figure 7
Crawford and Joler [25] created a extensive map that draws attention to a holistic “anatomy of an AI system” exposing the physical, social and political dimensions od AI.



As impactful and unsettling these biases are, the work of Kate Crawford suggests that they are “symptoms of a deeper conflict” and draws attention to a more profound problem of AI: “the desire to oversimplify what is stubbornly complex so that it can be easily computed, and packaged for the market.” Crawford continues:

- ✦ AI systems seek to extract the mutable, private, divergent experiences of our corporal selves, but the result is a cartoon sketch that cannot capture the nuances of emotional experience in the world. [24:179]



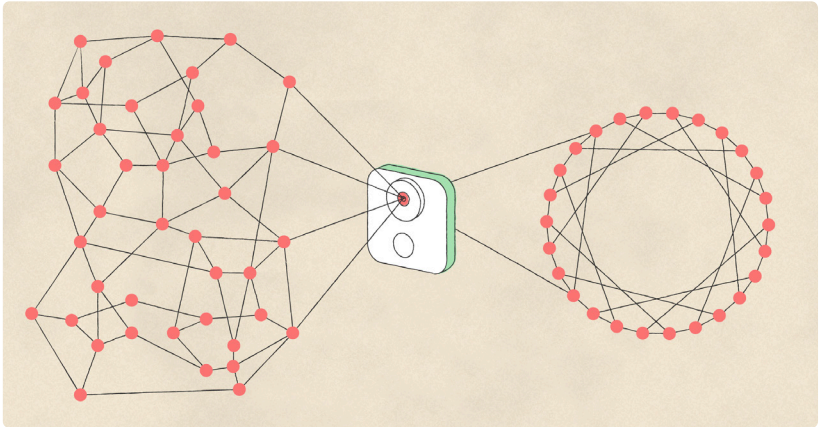
↑ Figure 8
Image by Alan Warburton / ©
BBC / Better Images of AI /
Virtual Human / CC-BY 4.0

Introspection is a highly personal, sensitive practice where one opens up about the most profound, impactful stories and emotions. When designing for the intersection of introspection, personal data and AI, it is crucial to consider that systems entail these biases. Even if algorithms generate believable

predictions about one's mood, emotional state, or tone of voice, it is crucial to consider that this stems from reductionism inherent to the AI systems' architecture. On the other hand, this could be seen as a unique additional lens that can be leveraged, and developments within teachable AI might pose opportunities to arrive at personalized models that are — at least — less reductive.

For decades AI research communities have debated about the limits of Artificial intelligence, in particular, when — or whether — Artificial General Intelligence (AGI) or artificial superintelligence (ASI) is reached [17:36]. One growing field of AI research is dedicated to the “Alignment Problem,” the thorny question of how to attune progressively smarter and robust AI systems towards human norms, values, and aspirations [22]. In his book, Brian Christian offers an extensive review of research and literature about the technical and social problems of alignment. However, in his conclusion, he voices the unique opportunities as well:

- ✦ Transparent and explainable systems trained on the real, human world gives us the possibility of transparency and explanation into things about which we are currently in the dark. In seeing a kind of mind at work



↑ Figure 9
If systems are transparent and build in ways readable to humans we will learn new aspects about the world, even though it stems from a place of reductionism. <https://design.google/library/ux-ai/>

as it digests and reacts to the world, we will learn something both about the world and also, perhaps, about minds. [22:328]

Collectively, these works help to demystify AI's image and expose current issues and limitations of the tools that

progressively change our world and everyday lives. As the surge to extract more data from our physical, social and affective worlds continues to grow [25], and as intelligent systems gain more agency tuning into our everyday life behaviours, the challenges this poses for design practice also intensifies. The work in this thesis aims to take a step toward better understanding, surfacing, and exploring such complex challenges at the intersection of AI and introspection.

Exploring AI as Co-Performer

There is a growing need for HCI research to investigate the possibilities and perils of AI systems entangling with people’s intimate everyday practices and environments [51,78]. The emergence of smarter and more agentic computational systems unbridled new directions within research and design practice.

Work within the field of Posthumanism and More-Than-Human Design practise emerged, suggesting to de-center the human in design practise and take into consideration perspectives that were marginalized in predominant design approaches (e.g. human-centred design.) In its early definition, the more-than-human design includes plants, animals, and micro-organisms, [3] yet recent works in the HCI communities extend this arsenal of non-human actors —and perspectives—to the things of design practise materials, processes and tools [33]. In the context of this inquiry, I will focus on the work within HCI research that argues for a shift in perception toward “technological things,” such as smart assistants, recommendation algorithms or wearables [51]. As these “technological things” progressively learn from and adapt their design based on interactions with us – and with each other – they conversely change the fabric of the world by acting on it in ways that are not merely determined by “only us” anymore. Therefore, More-Than-Human Design Practice calls to acknowledge this growing agency posed by non-human things as a crucial step towards reshaping and extending designing for “preferable futures” — futures that could be aligned with and arrived at through the collaboration with non-human actors.

- ✦ To explore the futures we might face, we need to inquire into what a more-than-human world might look like, and what happens when technology is not just material but participant“ [51:36]

Importantly, More-Than Human Design does not aim to devalue the human role by its suggestion to decentralize “human actors” within design practice: “Not because humans matter less but because it is no longer exclusively humans that act, design, make use, change, and thus create new possibilities [51:36].”

A growing body of work focuses on the speculation with — and lived experience accompanied by — “technological things,” embracing their unique agency to learn and re-imagine More-Than-Human design strategies [50,87–89,137,163]. As this field is still emerging, more research is needed that inquiries into alternative visions of AI applications and how they could, or should, mediate experiences and interactions.



↑ Figure 10
Iohanna Nicenboim,
Affective Things, 2017 [46]

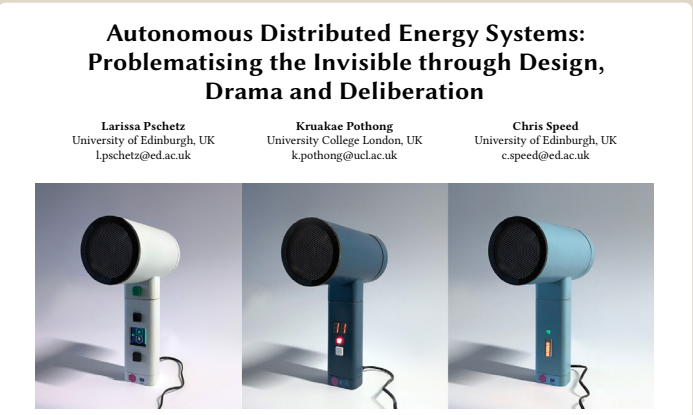
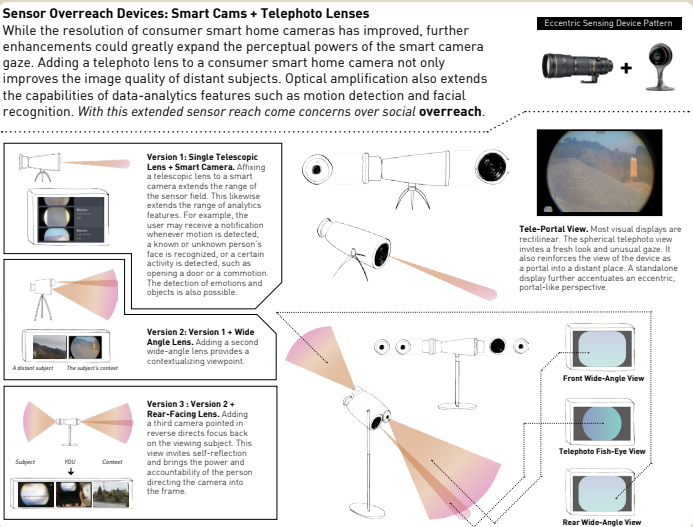
→ Figure 11
Giaccardi et. al., Things as Co-
Ethnographers, 2016 [46]

↓ Figure 12
Yuxi Liu, Five Machines [163]



The role of Speculative Design

Design fiction and related forms of speculative design research are gaining purchase as key approaches to surface challenges bound to complex emerging forms of technology, such as AI, providing a focused context for participation and debate over their future potentialities (e.g., [72,78,106,112,128,136,137]).



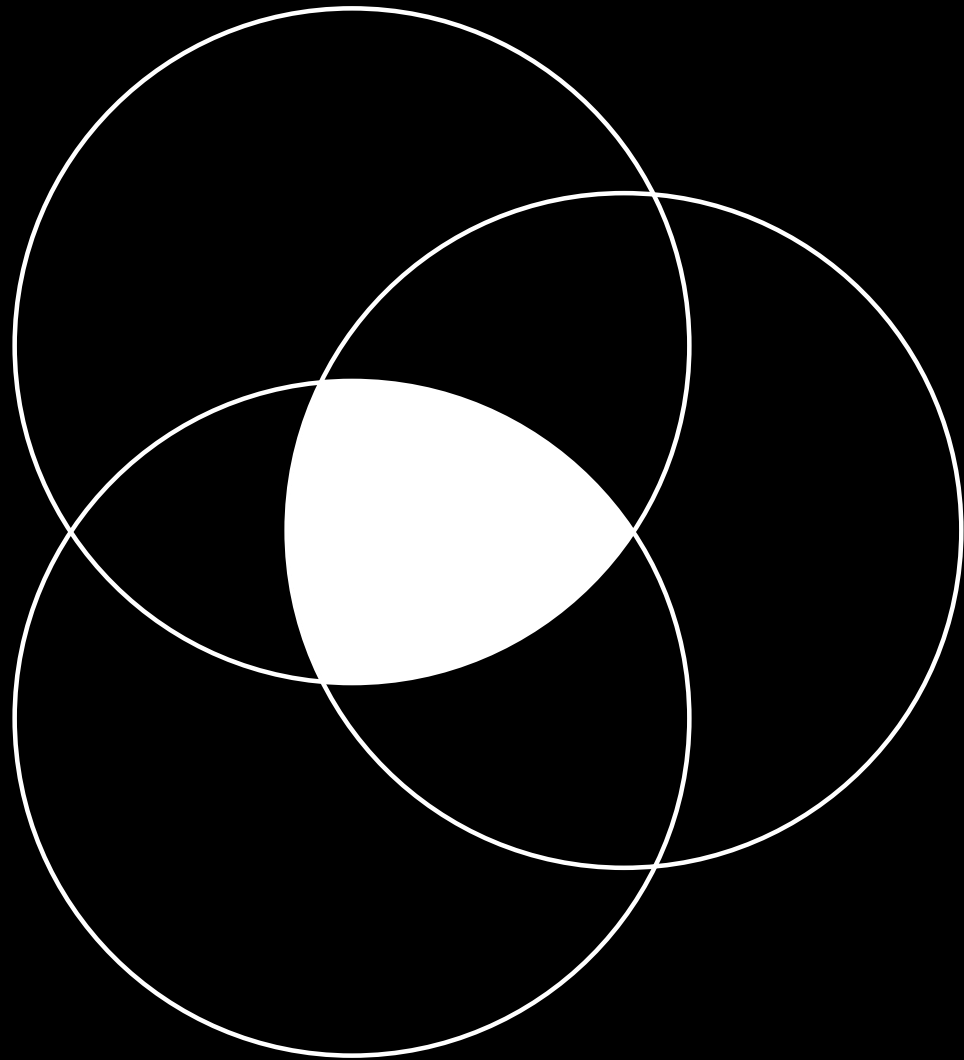
↑ Figure 13
Pschetz et al. - 2019 - Autonomous Distributed Energy Systems Problematis [112]

↖ Figure 14
James Pierce. 2021. Eccentric Sensing Devices [106]

← Figure 15
Marie Louise Juul Søndergaard. 2018. Your smart toilet assistant

The work in this thesis explores what AI might hold for creating rich introspective resources through seven design proposals of different kinds of fictional introspective AI products. In this, we aim to open up a critical dialogue with the HCI community as an audience to dissect the potential benefits and dilemmas that might surface in the emergent design space of personal data, introspection and machine learning.

METHODOLOGY



3

This thesis aims to investigate how interactive technology could mediate introspective practice in a near future by generating seven speculative design proposals.

My design research process unfolded over one year and is categorized into two phases.

Before reviewing the methods and approaches in detail, first, I will outline the research objectives and present my research questions.

RESEARCH OBJECTIVE

The research goal of this thesis project is to explore how AI might offer possibilities for generating alternative perspectives on one's life to support introspection as well as to surface potential paradoxes that such specific technological interventions might raise. Throughout this process, I adopted a research through design process as a way to creatively, imaginatively and critically engage with this objective. I aim to visualize key insights, ideas and scenarios with design proposals to generatively open up speculation, consideration, and critical reflection on the emerging Introspective AI design space.

Research Questions

I used the following research questions for my research investigation in order to meet the objectives outlined above.

1 In what ways can the scale and diversity of personal data that a person accumulates in their life support introspection practices and activities?

2 What roles might AI play in creating introspective resources through surfacing known, potentially forgotten, or unknown life experiences bound up in the massive personal data archives people have today?

3 What potential benefits, tensions, and consequences exist in this emerging design space?

PRELIMINARY PHASE
DESIGNER-RESEARCHER
APPROACH

In the first phase of this project, I conducted several research activities simultaneously in order to familiarize myself with the fields of introspective practise, machine learning and personal data. In this phase, I adopted a designer-researcher approach that originates with and concerns first-person oriented, design-led research in HCI (e.g., [30,32,46,86,93,107]).

- + This designer-researcher position gives prominence to first-hand insights emerging through creative practice to ground conceptual ideas through their form and presentation—“a process of moving from the particular, general and universal to the ultimate particular – the specific design” [164:33].

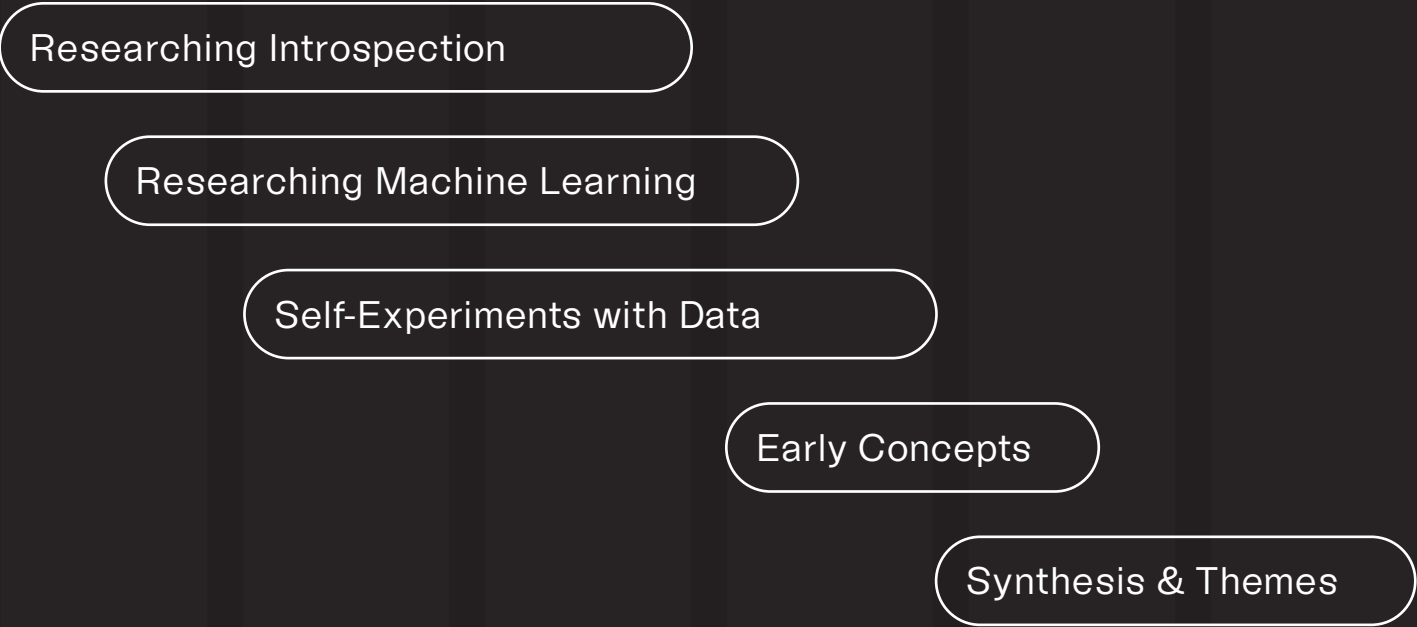
This approach was chosen as it allowed me to sensitize myself with each research topic intimately while distilling possible correlations between machine learning, personal data and contemplative practice in light of the research questions.

Designer-researchers often function as a small but multi-disciplinary team that is reflexively focused on the experimental and novel outcomes of the design process. Throughout this research inquiry, the research team consisted of three members (myself included). William Odom supported me over the whole span of one year with his supervision, whereas Sam Barnett joined our team later in the primary phase to help refine the design proposals. Therefore, it is essential to state that I am referring to the design research team if I use the pronoun “We” in the remainder of this thesis. Figure 3.1 depicts a timetable of the research phases and a log of activity for each team member.

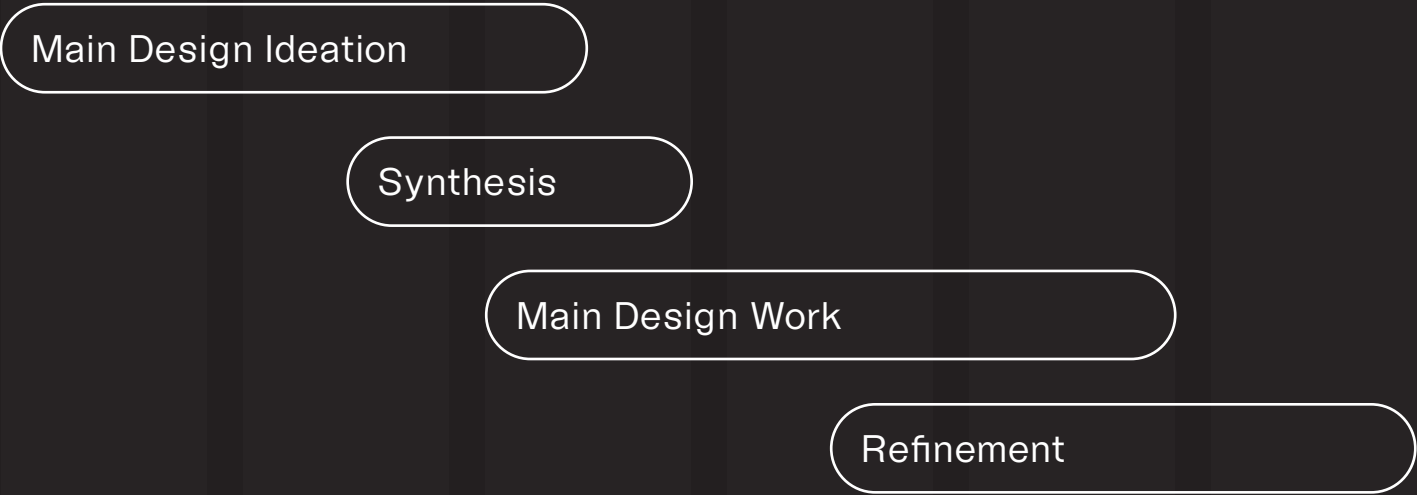
As I was the lead investigator throughout his project, I used my personal data, indulged in introspective methods and took the lead in designing preliminary concepts. In this preliminary phase, William Odom and I met weekly to discuss, capture, and reflect on insights emerging across this stage. As part of design-led reflective research practice, it was crucial to document and annotate this process in detail. Emerging insights that closely corresponded to the research questions – and gave rise to early concepts – were documented by creating a design workbook [45]. Through several iterations of synthesizing, clustering and reflecting on the outcomes of this work, five approaches to introspective AI emerged that are described in detail in chapter 4.

PROJECT TIMELINE

Preliminary Phase (6 Months)



Primary Phase (6 Months)



Nico Brand (Lead Investigator)

William Odom (Supervision)

Sam Barnett (Support)

PRIMARY PHASE

7 DESIGN PROPOSALS

Secondly, I conducted a primary stage where the generated insights from phase one informed the active generation of design ideas, leveraging methods of design ideation speculative design in order to create seven design proposals. Following several previous speculative-oriented design research projects, my research inquiry aimed to raise questions, concerns, and opportunities without arriving at firm conclusions or affirming specific design interventions (e.g., [44,104,105,120,165]).

Design Ideation Methods

After gaining knowledge from the first-person design experiments in the preliminary research phase, we conducted a generative design process that made use of various methods of design ideation [66]. Here we started to explore each research question separately by sketching out a wide variety of ideas in the form of annotated storyboards. Three columns are used to describe a process with sketches and, a short descriptive text explains each step. To analyze and interpret the results, we created clusters with each concept inside their parent themes and prioritized the most compelling concepts in regards to our research objectives. It is essential to acknowledge that, through this process, the team builds on their own experience and expertise in the field of interaction design and product development to guide design decisions. Years of schooling and professional experience are valid factors in ascribing more validity to the conclusions that design practitioners distill throughout their process [166].

Speculative Design Proposals

A design proposal is a document that depicts an early design idea in a well-defined form, combining elements of visual design, written captions and contextually relevant information. In short, a brief yet pointed synthesis of something that could be designed.

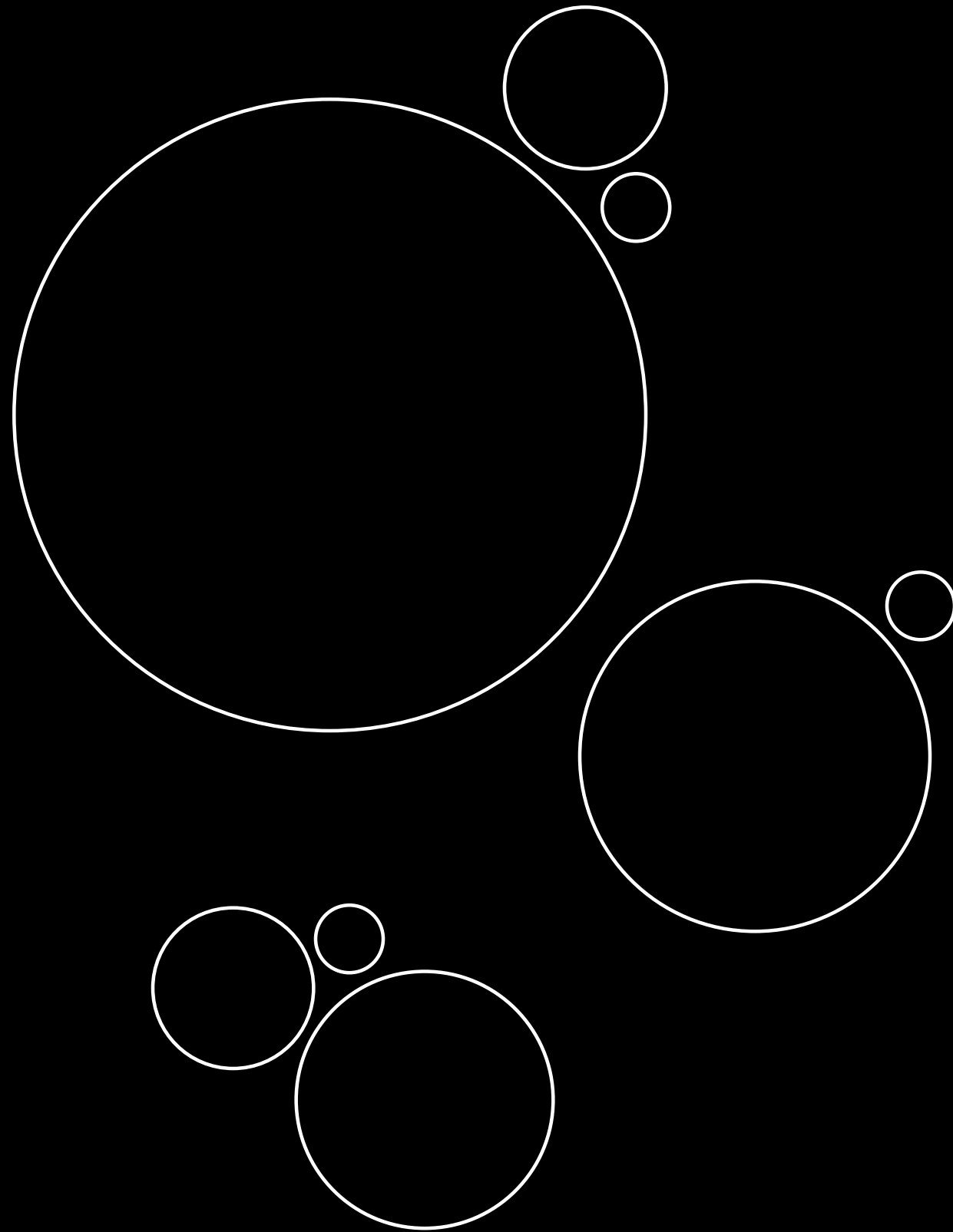
Usually, design proposals can be seen as an intermediary tool in a design process as they help to visualize a broad spectrum of possibilities, help to generate feedback and ultimately arrive at conclusions. However, the value of design proposals lies at times exactly in their ambiguity as they communicate ideas without being too specific; hence they “allow for [their] consideration, discussion, and debate [where] the intended audience or users of design proposals are often [other] researchers and designers” [104].

In my work, I want to draw on this quality and embrace the “finished unfinished” qualities that are inherent to design proposals [105:389]. Gaver et al. describe this as managing a balance between concreteness and openness. In order to spark intuitive and situated responses, the reader has to grasp the concept fast, yet the idea should be open enough to allow them to extend the idea further[44]. Similar strategies apply to the creation of effective speculation design. Here, Auger [7] recommends considering five crucial factors:

- + Investigate what could inform the usage and adaptation of technology;
- + Define behaviours;
- + Consider aesthetics;
- + Craft interactions; and lastly,
- + Layout the specific functionalities of the proposed design artifacts.

Taken together, these strategies serve towards the vital concept of effective speculative design proposals, to build a “‘perceptual bridge’—the means by which designs engage their audience. “[7:1]. Ultimately each speculative design proposal should be seen as an actuator for debate on the social and ethical implications such imagined products and services could, or should, entail.

EXPERIMENTS & SYNTHESIS



4 Preliminary Phase

This preliminary phase consists of an ongoing review of literature on self-introspection, first-person experiences of practicing introspective methods and applications myself, and hands-on explorations of different commercially available AI systems where I used my own personal data archives.

Further, in parallel, I engaged in early design concept generation manifesting emergent insights, ideas and thoughts across this experimental phase.

Through the process of ongoing reflection within our research team, a

set of 5 themes emerged and evolved that helped to articulate approaches within the emerging design space at the intersection of personal data, AI and introspection.

Ultimately these five approaches informed the major design ideation process that follows within the formal phase of this research endeavour (described in chapter 5).

Next, I will report on the process of conducting several first-hand explorations clustered into three sections:

- ✦ INTROSPECTIVE EXPLORATIONS,
- ✦ EXPLORATIONS WITH AI SERVICES
- ✦ EARLY CONCEPT GENERATION.

INTROSPECTIVE EXPLORATIONS

Meditation

Meditation and Introspection are approaches that help practitioners turn inward and contemplate deep thoughts and emotions. Although there are many similarities, both practices differ substantially. The goal of meditation is to notice how sensations in one's body and mind arise and how to let them pass again without judgement or catching them for too long—in short, to learn to think about nothing. On the other hand, introspection allows and encourages one to tap deeper into thoughts and feelings (e.g. that a particular event caused) and dissect them actively by taking on a multiplicity of angles and lenses—in short, to actively self-examine and analyze one's actions. As different as both practices are, they work together in tandem. Meditation can surface specific emotions or scenarios that—even if disregarded in a sitting—can be elaborated later on with introspective methods. As meditation and introspection work well hand in hand, and my meditation practice inspired my interest in introspection, I include meditation here as part of my explorations.

I practiced Vipassana meditation to observe subtle sensations in my body without reacting and dwelling in them for too long. This is also called “insight” meditation and aims to strengthen the ability to sense, observe and retire thoughts and associations.

- ✦ Practicing meditation helped me to find access points that I would re-visit in introspective techniques. I felt both practices work the best hand in hand as I like the analytical and active way of thinking within an introspective practice, yet letting things go and putting a stop to deeper analysis is valuable as well.

Meditation Apps

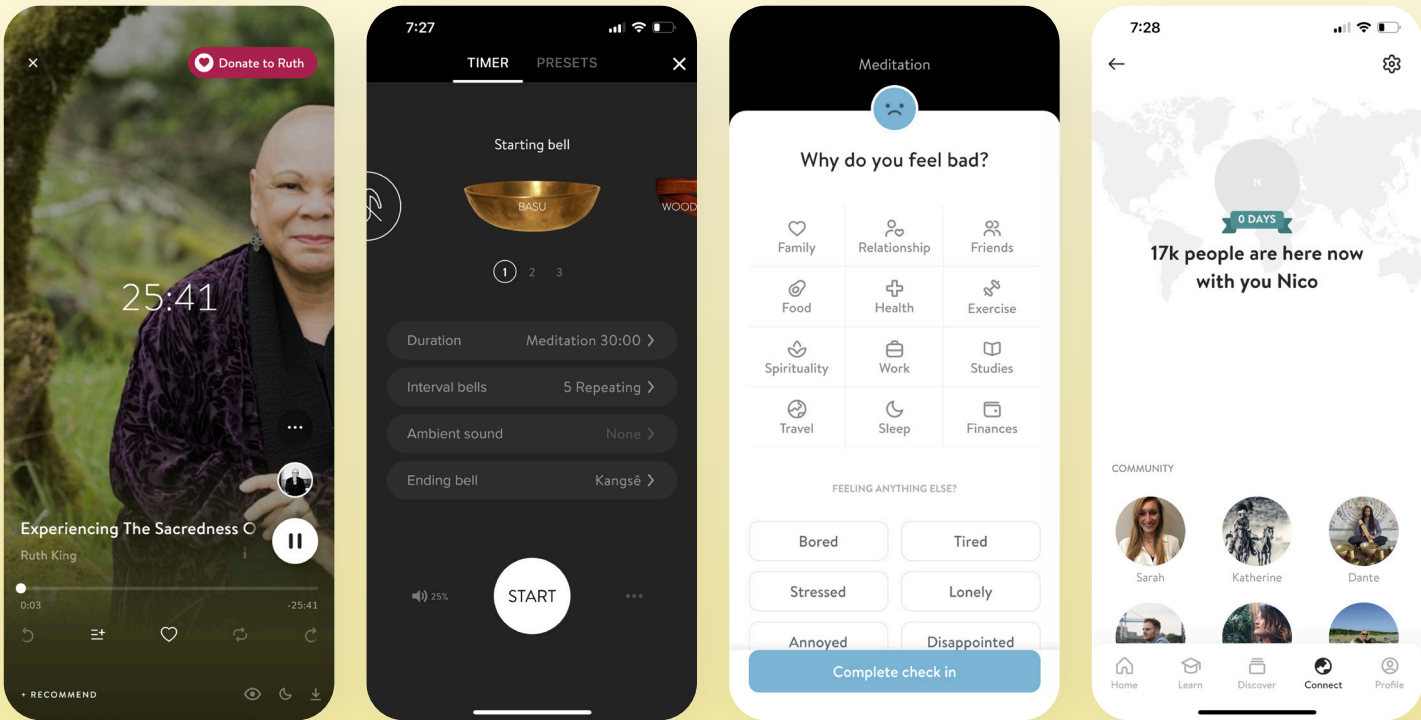
In order to make myself more familiar with the full extent of technological intervention in the space of practices that focus on self-contemplation, I self-tested the top 5 meditation apps on the Apple app store and annotated their unique features, the impact on my personal practice and what ideas they inspired for subsequent stages.

Insight Timer

Insight timer [61] lets the user choose different sounds that times the meditation, emulating actual mediation bells. The app encourages customization of the notification messages, creating a more subtle and mindful reminder. Many free meditation sessions are available, and users can subscribe and donate to their favourite teacher. The app emphasizes community and enables users to socialize and connect through following, instant messages, and joining groups.

- + I discovered the subtle nudges to be effective, as it seemed more than just a notification.
- + Personalizing a message entails strong intentions and reminds me to be mindful and accountable to my practice.
- + I personally did not like that Insight timer embraces community, as this made the app feel too close to social media.

↓ Figure 16
Screenshots of the Insights
Timer App [61]

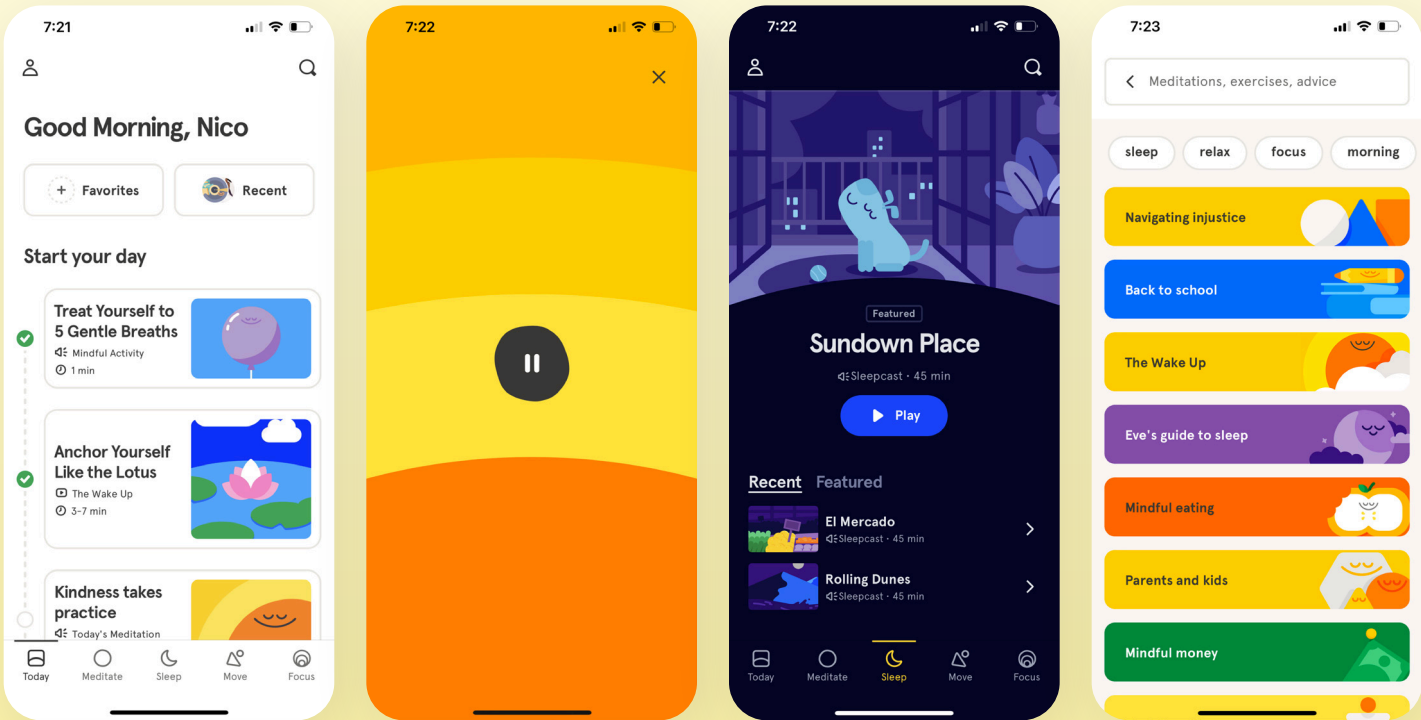


Headspace

Headspace [153] provides an extensive library for structured and semi-structured meditation sessions and has the most extensive archive of exercises on the market (e.g. guided exercises for topics like study stress, distractions, mindful tech, or learning to prioritize). In addition, the app is playfully designed and underlines exercises with engaging animations. Overall, Headspace is an excellent app to practice meditation and grow and learn about mindfulness, meditation and introspection at the same time.

- + I appreciated the app's way to package content into digestible pieces, making it easy to dive in and engage with the resources.
- + Headspace's daily feed was something to look forward to, and I had the impression the service works actively to create quality content.
- + They had by far the best UI & UX design that helped find the right content at the right time. The playful design language was calming and, in contrast with other apps not distracting,

↓ Figure 17
Screenshots of the
Headspace App [153]

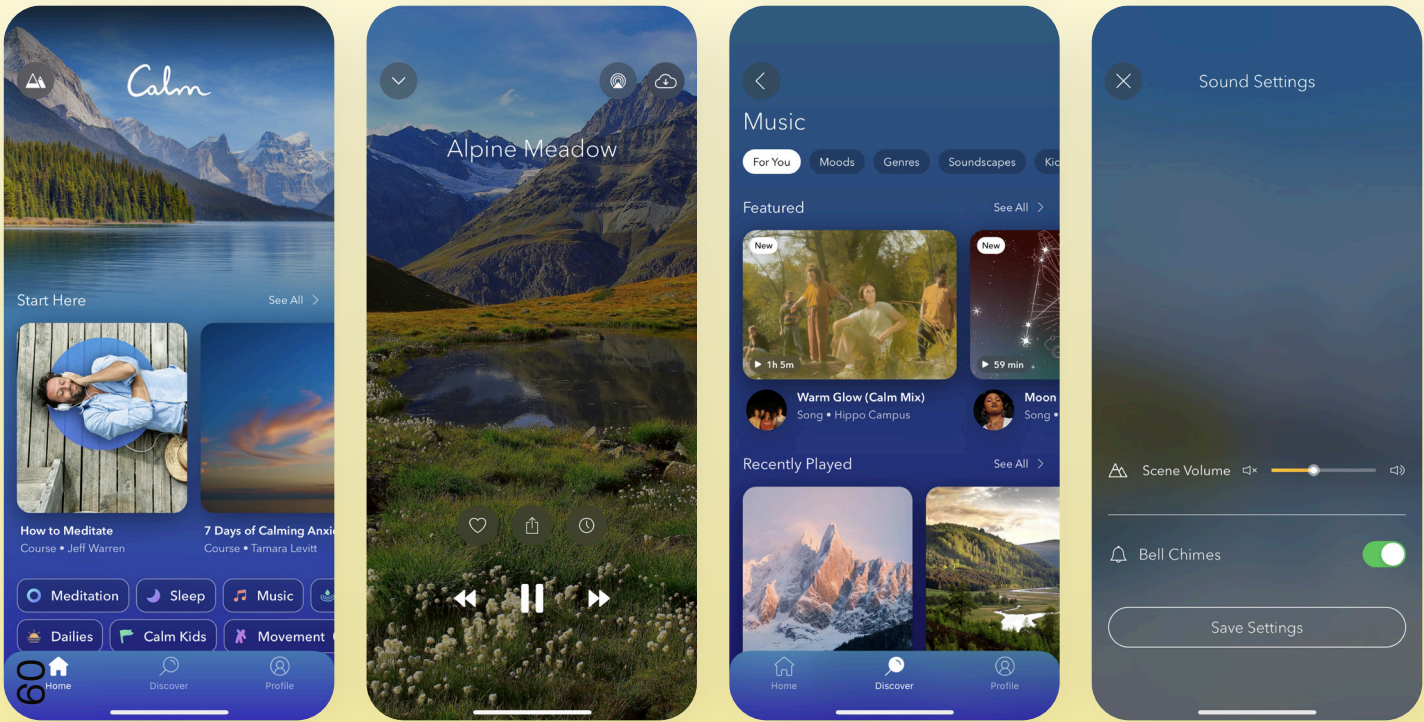


Calm

Calm [156] provides a more extensive library of soundscapes and music than the other apps, yet fewer guided meditations and exercises are available. Calm provides frequent self-check-ins and visualizes progress through a dashboard.

- + I liked the variety of soundscapes in calm’s library.
- + However, the app felt aggressively marketed and not applicable if one is not subscribed to the premium service.
- + In addition, the app felt less easy to navigate and, at times, crowded with content.
- + Personally, I missed a wider variety of exercises and felt that the app compiles to many features or types of content (e.g. music, sounds, sleep stories, movement, meditation, personality checks), all to the detriment of focus and intentionality.

↓ Figure 18
Screenshots of the calm App [165]



Waking Up

The waking up app [155] focuses on guided and semi-guided meditation sessions and lessons on science, philosophy, and the nature of the mind. The app focuses less on media resources like calming sounds or workout sessions but provides more content about the theory of mindfulness.

- + I like the long-form podcast-style conversations the waking up app provides.
- + I liked the production quality and the vast archive of speeches and lessons of renowned philosophers, writers, teachers, and poets speeches and lessons.
- + I felt that this app had the strongest intentionality as it focuses on education about the landscape of the mind while introducing a variety of meditative practices.

↓ Figure 19
Screenshots of the waking up App [155]



Meditation Apps: Conclusion

Testing several meditation apps helped me to stay accountable to my practice, and I noticed that I was more committed to meditating each day through the subtle nudges that some apps provided. In addition, a lot of the teachings and exercises helped to manifest positive change in my daily routines, bit-by-bit.

Journaling Activities

Journaling is a great way to keep track of events in your life, from the ordinary to the exceptional. Before this project started, my journal practice focused more on dream journaling than daily journals. I wanted to cultivate a more consistent routine with journaling and searching for new methods for this experimental phase.

Dream Journaling

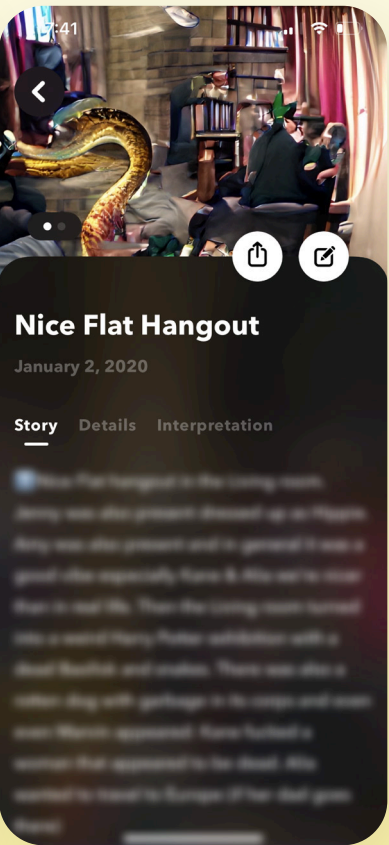
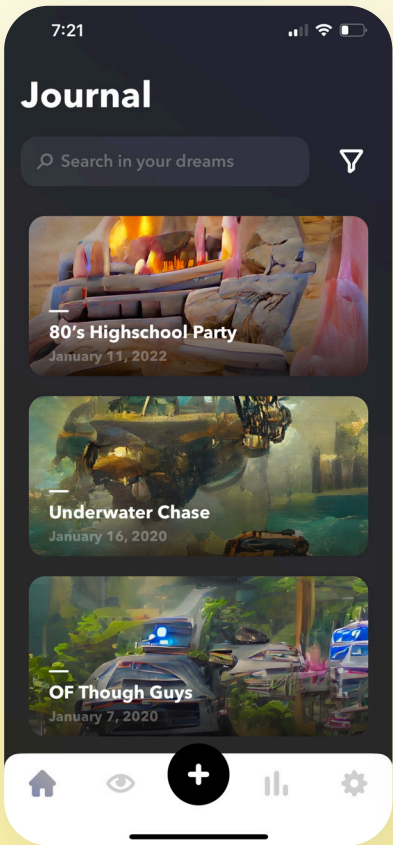
I usually wrote dream journal entries into a notebook next to my bedside table or used a note app on my iPad. Throughout this phase, I also tried to journal through a text-to-speech application like otter.ai [167]. During my research, I tested three intentionally designed applications for dream journaling.

Capture

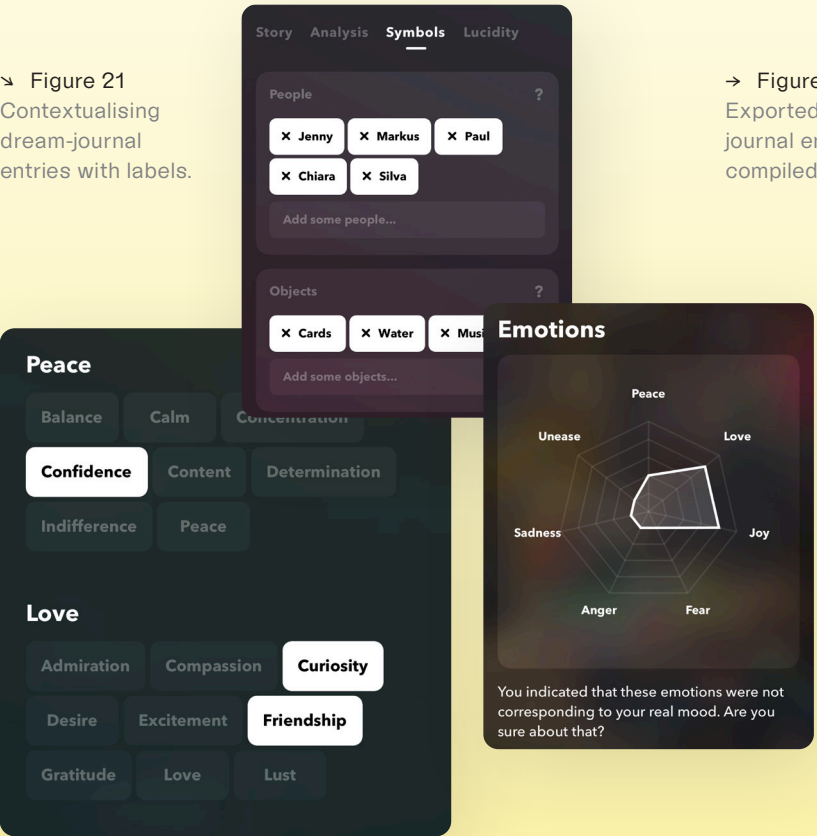
The capture app [168] stood out for me as it provided a simple textbox to write down dreams and a straightforward UI/ UX design. The app provided several options to attach labels and add detail and context to each entry, as well as add photos to underline the dream story. In addition, it has an export function that compiles all entries by creating a neat summary pdf file.

- + I preferred custom prompts that are based on the themes I provided
- + A wider variety of labels and tags helped me to grasp the complex emotions present in dreams
- + Archiving and attaching layers of context to my dreams was great to dissect and delve deeper into my nightly visions. Creating this account of dream data inspired me to use it as a creative resource rather than just for the means of quantification and analysis.

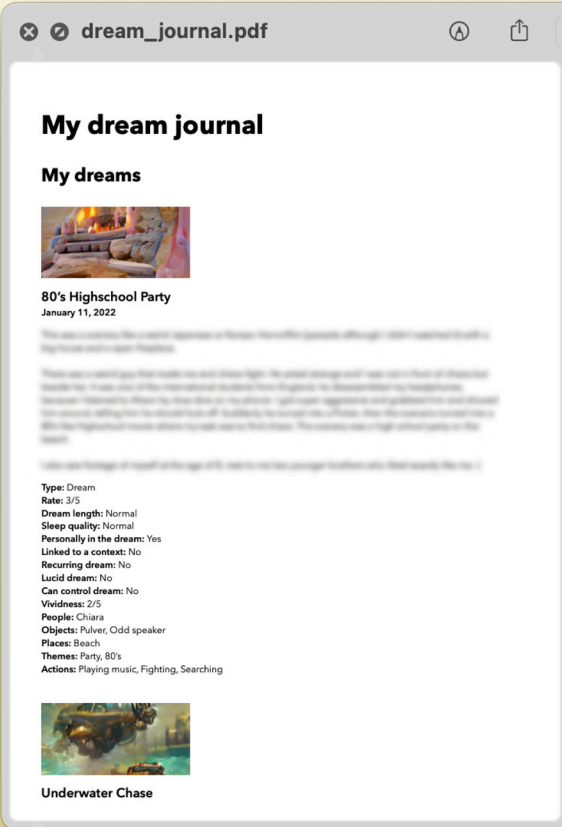
→ Figure 20
Main feed of the Capture App [167]. I used generated images as personalised thumbnails for each journal entry.



→ Figure 21
Contextualising dream-journal entries with labels.



→ Figure 22
Exported dream journal entries as compiled PDF file.



Dreamy

The dreamy app [169] provides simple journaling options and visualizes statistics on a dashboard. The app focuses on tracking emotion per dream and tracking those over time; thus, dreamy plays into the category of the quantified self and pays less attention to prompt deeper associations and meaning behind an individual's dreams.

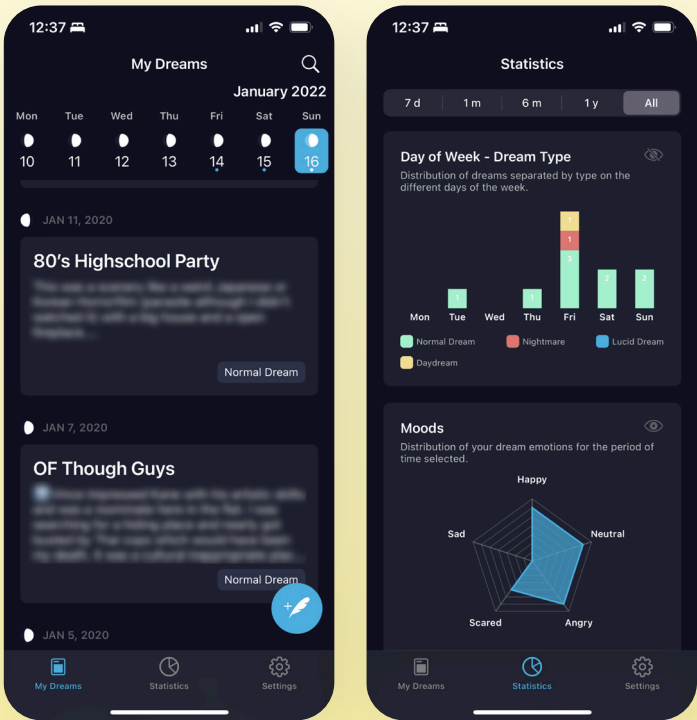
- ✦ I could only choose between 5 emotional states, which was underwhelming and frustrating as dreams are layered with emotions while they unfold, thus hard to categorize with a one-out-of-five metric.
- ✦ I personally did not like the more performance-based apps that quantify dreaming. Dreamy does not offer help or guidance in diving deeper into the multilayered contexts and themes of my dreams.

Dream App

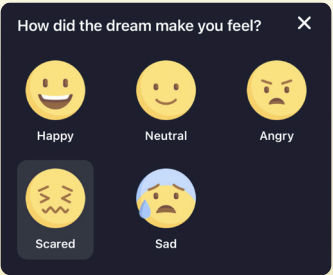
Dream app [151] applies machine learning to create “a unique neuro model, based on 200+ dream books.” The app took in written dream journals and generated an analysis based on automatically detected symbols in the text. Dream app connects a user with “dream therapists” to chat more in-depth about one's dreams.

- ✦ I preferred to find my own symbols within my journals. Here, Machine learning helps to find patterns based on dream psychology, yet I would prefer a system that learns and specializes in personal patterns that are not “external” interpretations.
- ✦ I didn’t feel dream symbols based on psychology helped me to delve deeper into the meaning of my dreams; they instead disconnected me from the actual contents.

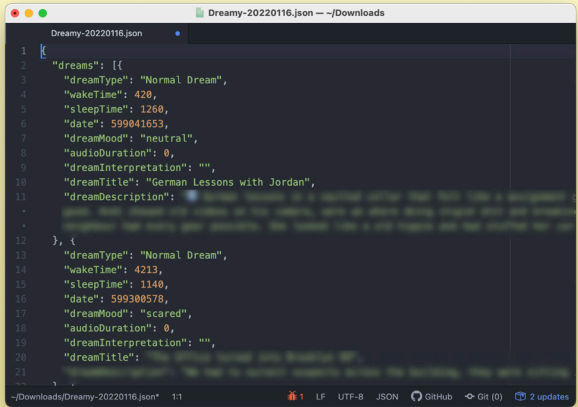
↓ Figure 23
Dashboard of the dreamy app [169]



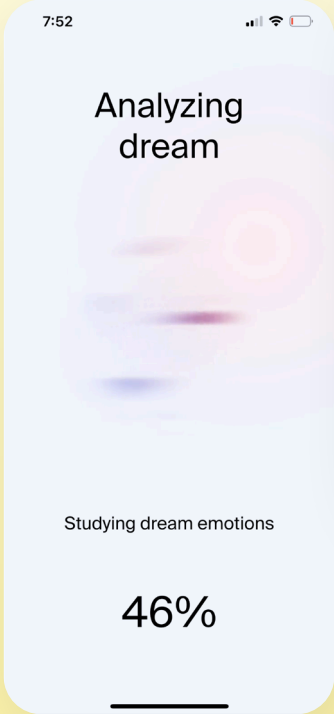
➤ Figure 24
There are only 5 emotional categories that are available to track.



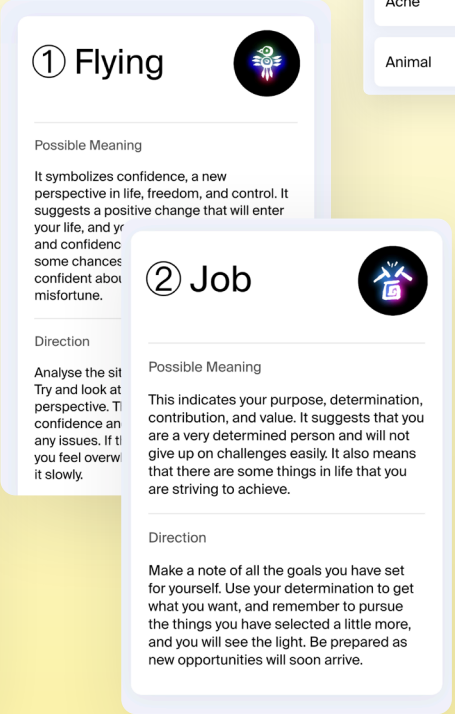
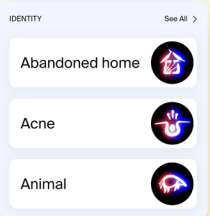
↓ Figure 25
Dream data is exportable as .json file.



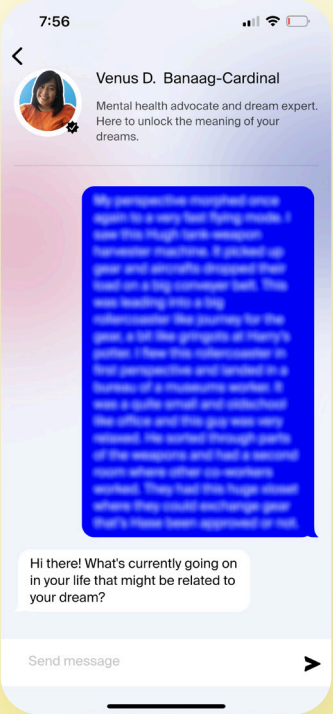
➤ Figure 26
The app finds symbols in one's dream, and provides suggestions for introspective activities.



Dream analyzed
2 symbols found



➔ Figure 27
Dream app connects paying users to a "Dream Expert" via chat. When I was using it, I believe it was a chatbot.



Journaling Apps

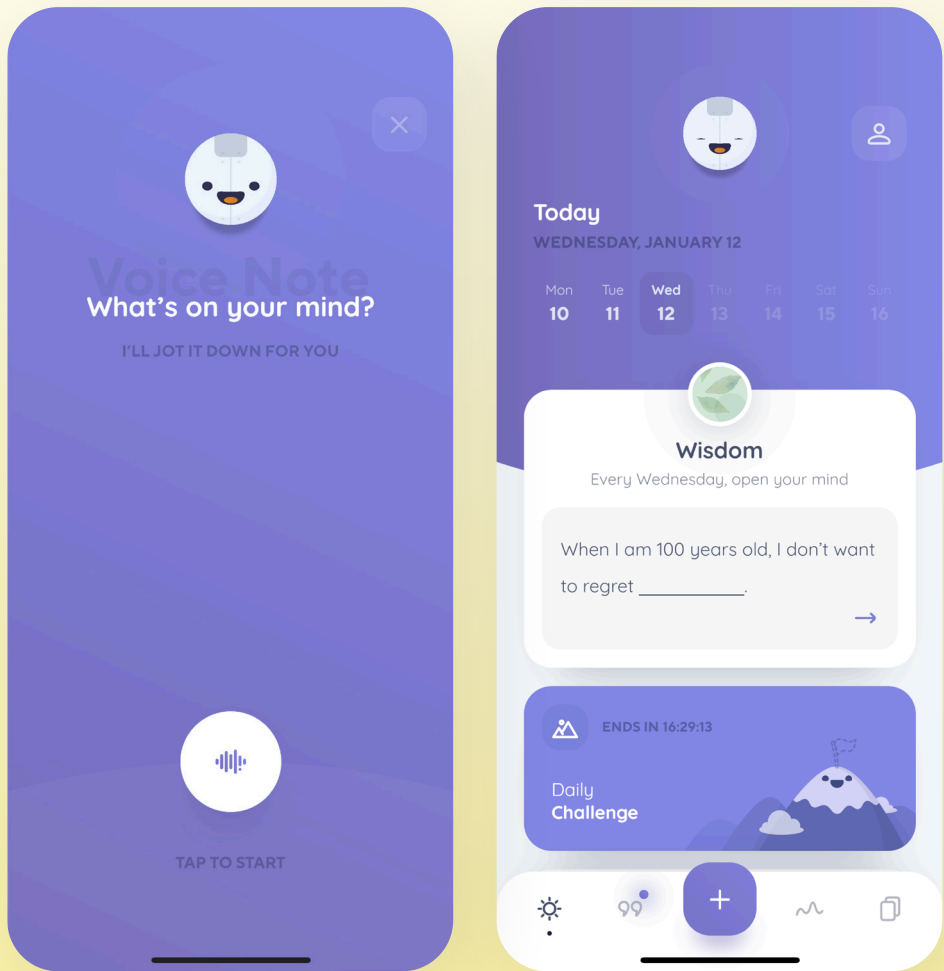
Besides dream-journal apps, I tested two apps that focus on daily journals, check-ins and the tracking of the emotional state over time. Journaling is a common method helping practitioners to remind themselves about specific moments and emotional associations by recalling daily events in detail. The apps I used both applied forms of AI to aid the journaling process in ways that differ from the more usual digitalized approach of a bullet journal.

Reflectly

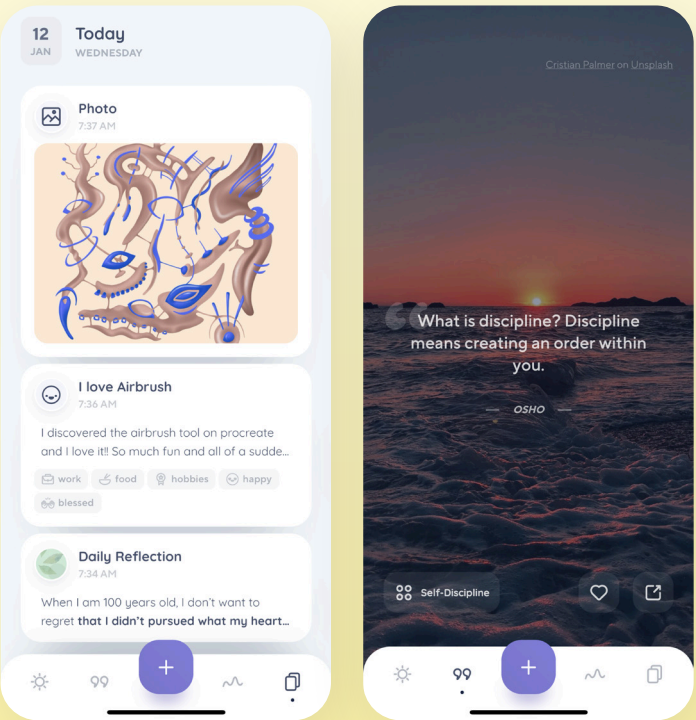
Reflectly [149] claims to be a “personal mental health companion” and offers easy access points and personalized prompts to start journaling. The app uses Artificial Intelligence to customize the user experience claims to ask better questions over time, yet it felt not very personal after testing the app for a while. For example, the Daily check-ins ask to rate your current mood based on a set of customizable topics and offer an analysis after a few days of using the app.

- + Offering a quick access point to contemplate is a strategy that I liked. The app asked intelligent questions, and it was fun to “answer” them, yet at the same time, the app is too focused on making self-checks and journals “easy” and “lightweight.”
- + I would appreciate it if the app would pay more attention to the process of writing itself, and support users within the textbox (e.g. by offering suggestions and education on expressing more complex emotions.)

→ Figure 28
Reflectly [149] prompts daily journals. Either by voice-memo, written text or answering small prompts.



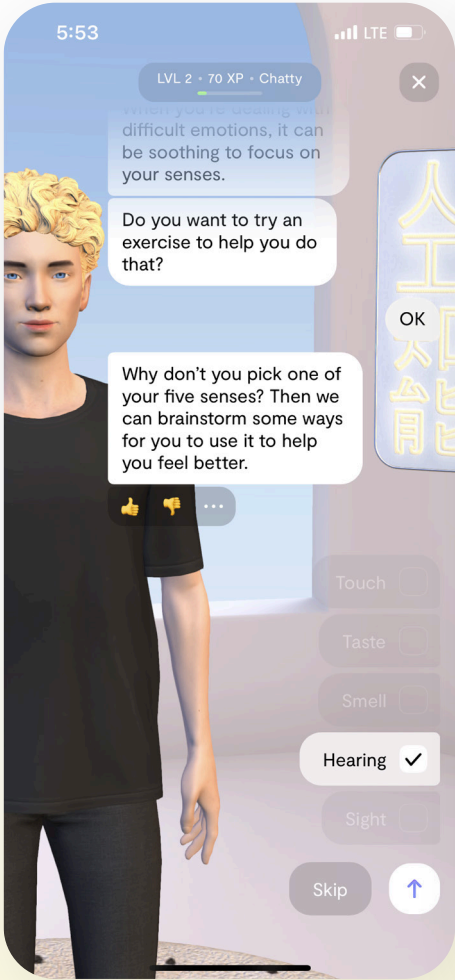
→ Figure 29
The app offers a feed that compiles every entry as well as motivational quotes.



Replika AI

Replika [158] is an AI chatbot that offers daily prompts, mood-checks and activities. Once a user “progresses” with the bot, credit points are given that can be exchanged for character traits or accessories. The chatbot tried to sound empathetic and offer advice, yet interacting with it was not supporting more profound reflections; instead, it felt distracting. I also wanted to know more about what the model knows and its limits and was less interested in talking about me! As impressive as the AI behind replika might be, I still felt distracted talking to a bot that often seemed to affirm everything or wrote back vague statements. Maybe this could change over time and nurture the model more, yet the prompts Replika asked were not strong enough, therefore, did not add much value. Maybe I was also thrown off since it emulates a conversation with a friend, and it was uncanny and underfitting.

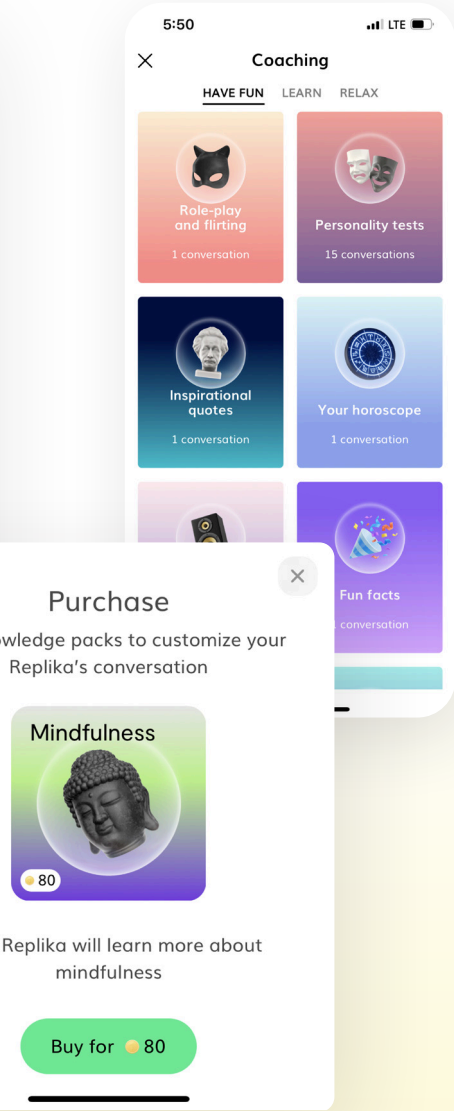
- ✦ Portraying my “Replika” as a digital avatar was more distracting and made the app feel more uncanny than “friendly.”
- ✦ The AI is powerful, and at times I was surprised how pointed questions were, yet the intentionality regarding journaling and mental health felt off since the app feels more like playing a game.
- ✦ Interestingly, the chatbot suggested songs that it also showed to other users —as the YouTube comment feed beneath the song revealed. While this is expect-able, it was an odd moment that broke the "immer-sion" of this app being uniquely attuned to me.



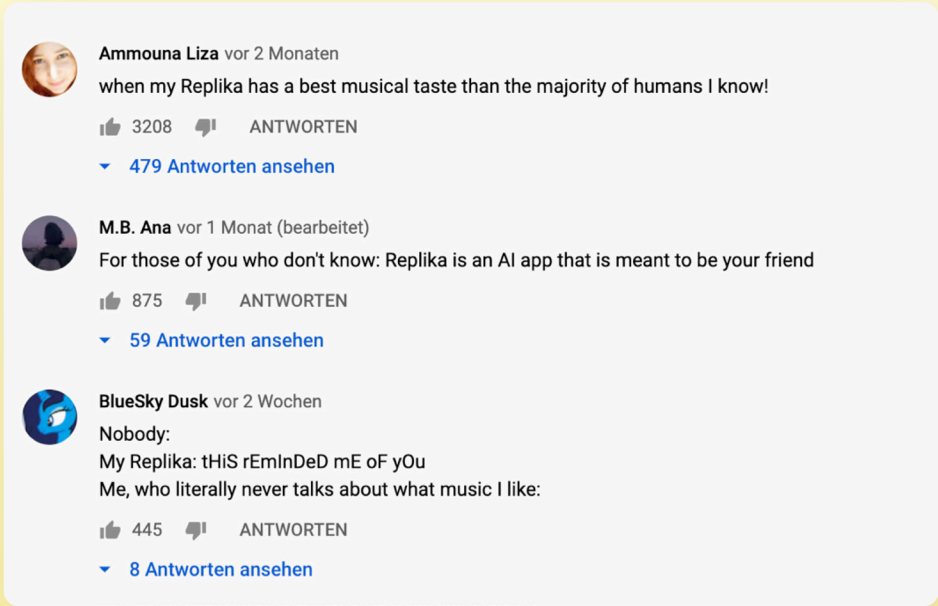
↑ Figure 30
Replika [158] prompted me to try a "soothing" exercise.



↑ Figure 31
The avatar can be placed in ones home via AR.



↑ Figure 32
Points, which can be earned by using the app or by buying them, can be redeemed for additional character traits.



← Figure 32
Replika user's are praising the apps music suggestion on a YouTube comment thread.

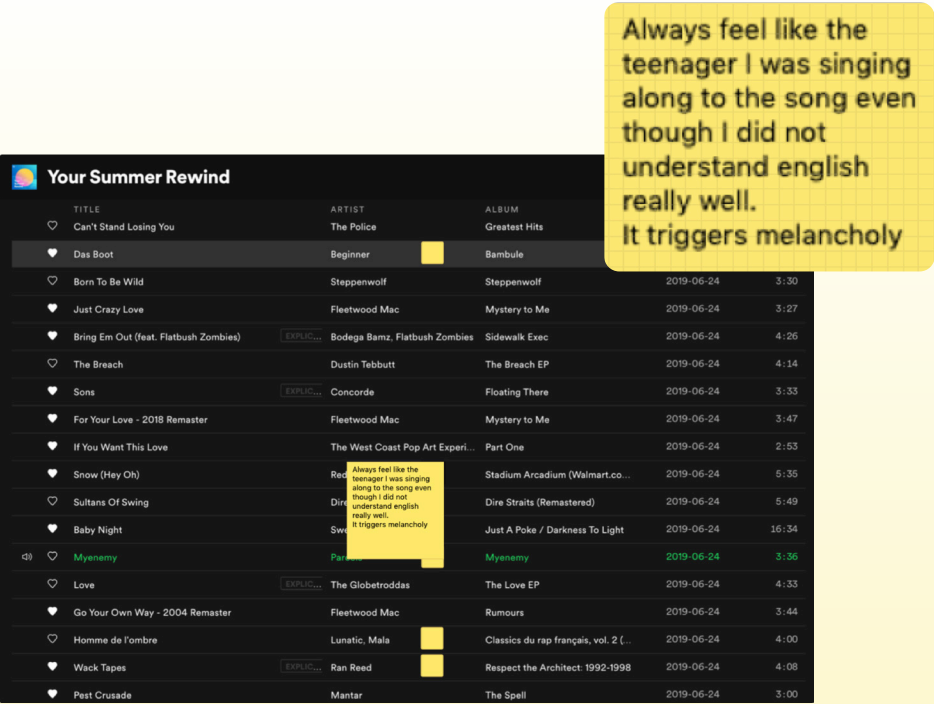
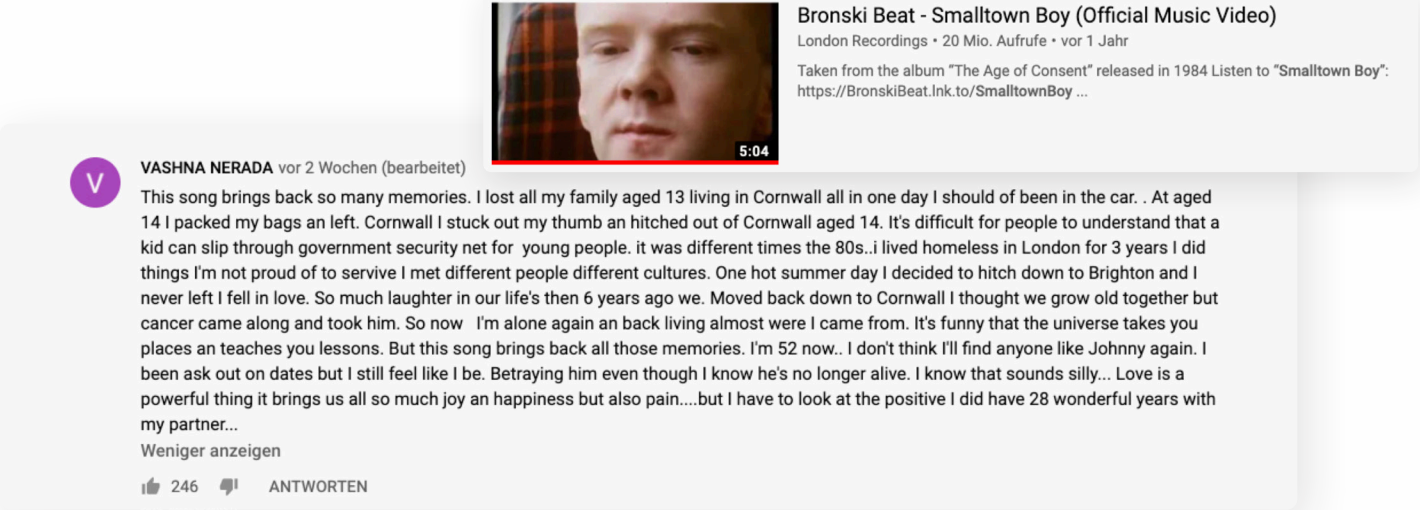
Music Journaling

After testing the more conventional ways to journal, I searched for methods that include personal archives as a way to spark reflection and journaling. Music is deeply connected to emotions, memories, creativity and personal associations across different stages of life [15], thus an ideal catalyst for prompting journaling and introspection. During my exploration, I was inspired by the comment sections of Music videos on YouTube, where people share their personal stories, emotions, and thoughts connected to these songs.

This way of journaling and opening-up based on specific music inspired a short exploration where I annotated Spotify songs as a journal entry. Spotify offers a curated playlist called “Your Summer Rewind” that compiles favourite songs from several Summer’s in one’s history, therefore a ripe playlist to reflect on for this activity. I simply screenshots the playlist, listened through it and if a song evokes a memory or feeling, I started to write a pdf annotation on the image file. Another experiment was to curate a playlist myself, only choosing songs from my birth year 1993. The goal was to discover and research the time I was born, the sounds that dominated this era and left a mark on my taste until today. Since then, the playlist has been growing and embodies this contemplative motive reminding me of my journey in subtle ways.

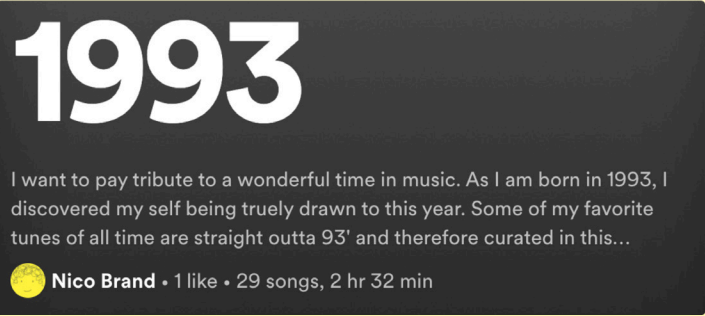
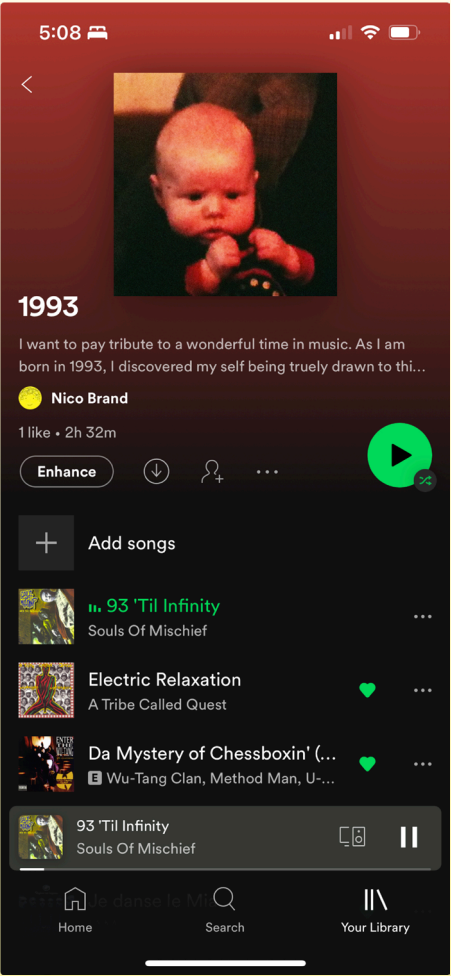
- ✦ Annotating songs with journal entries was a meaningful activity, yet it would be interesting to keep revisiting these entries over a greater period of time, attaching new context and meaning to each song.
- ✦ The resulting “log” could be a valuable resource for introspection as it captures a more holistic stance on emotions, associations and stories attached to this one distinct data point.

➤ Figure 33
YouTube comment section under songs that show certain introspective qualities.



← Figure 34
Music journaling experiment.

↓ Figure 35
Curated playlist based on birth year.



Journaling: Conclusion

Testing several meditation apps helped me to stay accountable to my practice, and I noticed that I was more committed to meditating each day through the subtle nudges that some apps provided. In addition, a lot of the teachings and exercises helped to manifest positive change in my daily routines, bit-by-bit.

Mapping Exercises

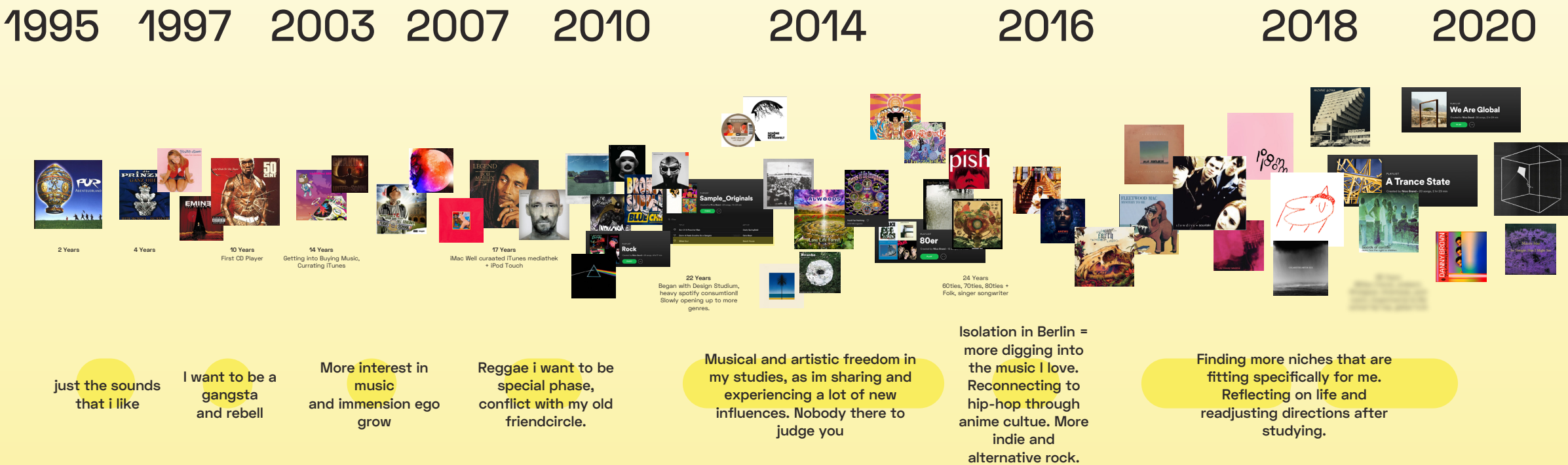
In order to develop a sense of how accounts of meta-data and archives could aid my contemplative practice, I started to create timelines of my life that correspond to different forms of data.

Mapping personal History through music

I loosely sorted my most listened music from Spotify — and an old iTunes archive—on a timeline that reaches back all my life. Mapping music spatially enabled me to see specific patterns, for example, the rapid accumulation of new genres when I started to attend design school or moving into a new city and being introduced to a different niche of music specific to a place. Within this map, I discovered many anchor points to introspect more deeply, as it confronted the many versions of my past self and where I was emotionally at this time.

- ✦ This exercise helped to look at data and consider and notice how character and relationships are constantly changing. I also discovered how social music is, as all of a sudden, I saw a layer of friendship and influence in my music archive.

→ Figure 36
Mapping personal history
through music.

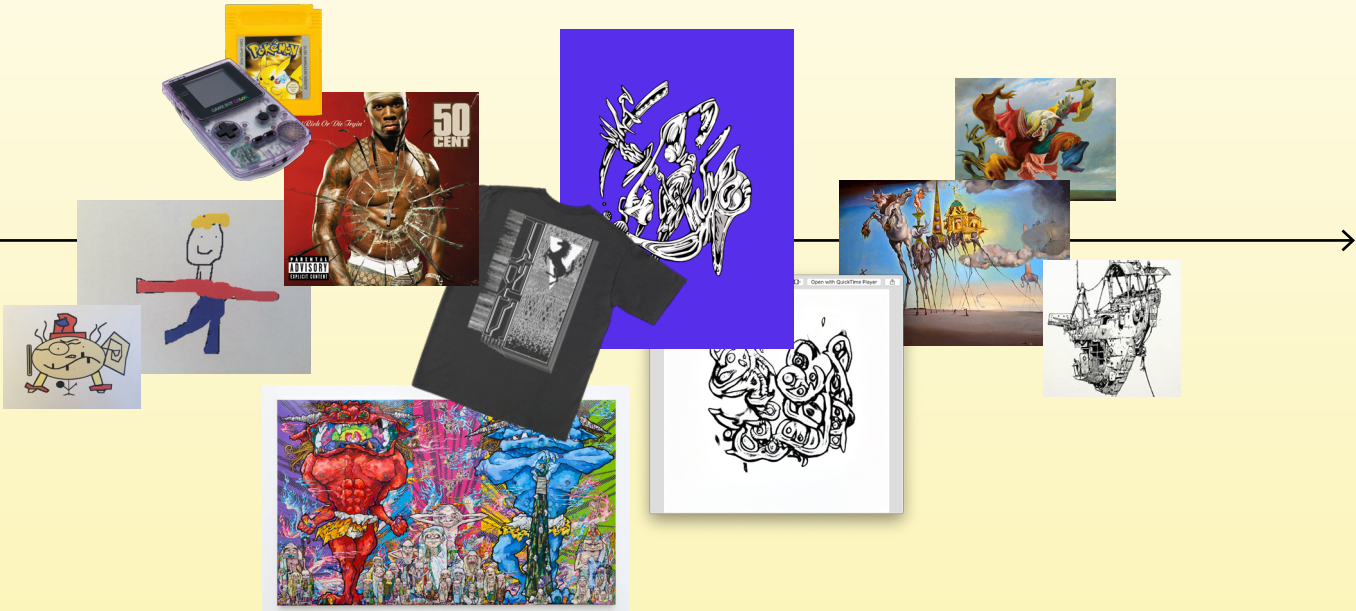


Mapping different senses of Self

A similar mapping activity I explored was to gather personal and inspiring artistic artifacts such as personal drawings, favourite paintings, clothes and objects that all encapsulate how my aesthetics changed throughout my life.

- ✦ This approach was inspired by Vision Boarding [18], a method used for goal setting and self-improvement, yet here I focused on manifesting an authentic assemblage of the past, opposed to framing an ideal future.

↓ Figure 37
Personal aesthetics over time.

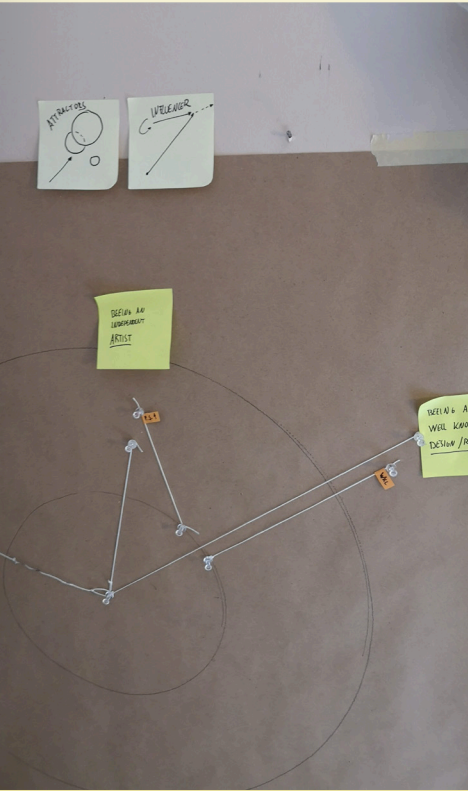
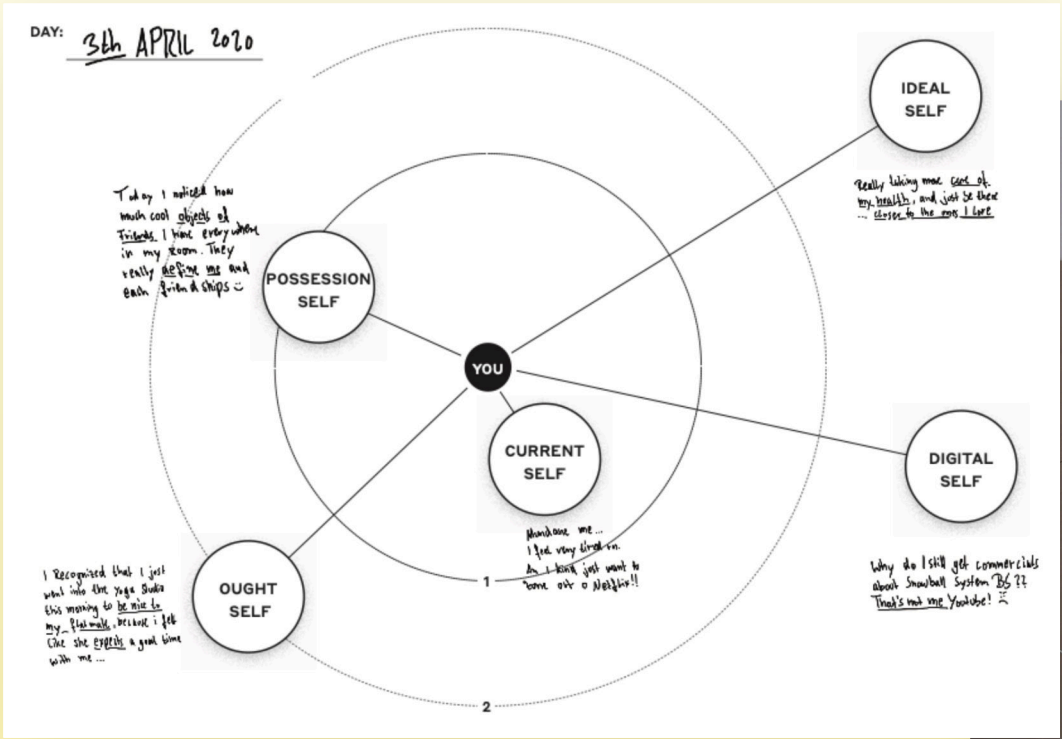


Mapping different senses of Self

Considering and searching for new perspectives and viewpoints is a crucial factor in understanding more profound aspects of one’s personality. A standard method in self-observation draws on the self-discrepancy theory [123], a framework that helps to surface and voice the tensions between three different senses of self. The ought self describes the self that feels obliques to do something based on others, the ideal self is the version one aspires to be, and finally, the actual self that one simply is. I used this framework as a recurring self-check to detect and visualize the tensions between these senses of self. To align this method more with the research objectives, I added the “possessive-self” and “digital-self” categories, further emphasizing the role possessions play in extending our identity and how we increasingly define ourselves through administered digital profiles and algorithms.

- ✦ It seemed interesting to add both categories and examine how tensions between these five senses of self play out over time, as I was moving to adjust and annotate the template similar to a journal activity.

↓ Figure 38
Mapping five senses of self over time.



AI & MACHINE LEARNING EXPLORATIONS

This section focuses on self-experiments where I integrated my data with machine learning tools to reflect on these experiences and consider how they might shape my practice of and orientation toward introspection. Drawing on a designer-researcher approach aligned with my research questions, I aim to understand better how AI could aid in creating resources for contemplative practice. Key questions guiding this reflexive preliminary stage of my research include: What kind of conclusions can I draw from experiencing how my data is processed through different machine learning tools and models? What might first-hand insights surface as I incorporate AI as an “actor” within my practice of observing my life through introspective methods?

Personality Analyses

One of the first experiments explored several prediction models that claim to synthesize and extract “Personality Insights” from text input data. I tested the IBM Watson API [170] ¹ using their personality insights service to process personal digitalized journal entries and examine and reflect on the various outputs. I used IBM Watson as it was one of the most widely used APIs in this sector, easy to access, and well documented.

When provided with a text file of 3000+ words, IBM Watson Personality Insights claims to return a highly accurate analysis of specific personality characteristics based on models grounded in behavioural psychology [84]. The service provides analysis output in three dimensions. Firstly, the Big Five personality traits [90]: Agreeableness, Conscientiousness, Extraversion, Neuroticism and Openness. Here a score from 0 to 100 will be assigned for each dimension, displaying the models' prediction. For example, if the agreeableness score is high, the model predicts a tendency to be more compassionate, whereas if the agreeableness score is low, it predicts a more analytical and suspicious trait of character). Secondly, IBM Watson Personality Insights provides predictions around personal Values. For example, the scores indicate how much one values traditions, values helping others, or how important it is to take pleasure in life. Thirdly, the service offers assertions on consumer needs. Here, the system assigns a value on how important self-expression might be, how much stability one

¹ IBM announced that they will discontinue their Watson Personality Insights service by December, 1 2021. IBM continues some of the features within their Natural Language Understanding services. Yet, other Services are providing similar API's: Receptiviti API [171]; Humantic AI [60]; Symanto API [172].

might seek in life, or how much one might want to be challenged. Again, all predictions are numeric values between 0 to 100 per-cent. Taken together, this service aims to construct models based on psycholinguistic science and promises to provide insights into one's personality and underlying emotions based on the tones of our interactions in the online and offline world.

Process

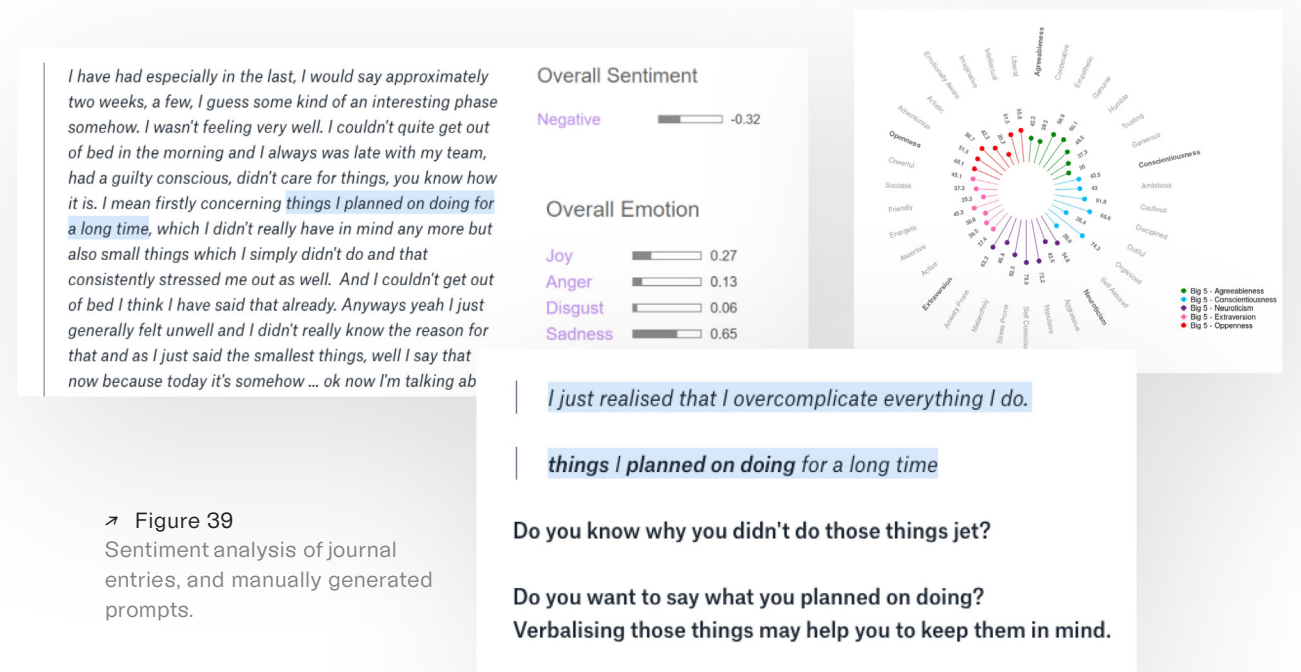
The main idea behind this experiment was to observe the impact these specific predictions pose on my perception of the self by enabling them to “read” my personal journals. Using IBM Watson's API, I send digitalized journal text files and receive a sentiment analysis for the whole document, key sentences or word by word.

Insights

- ✦ Examining the results, I found myself in a dual-fold process of critically reflecting on the machine's assertions and questioning my own ability to quantify my personality. Indeed this is not surprising as it is highly unusual to assign values to something as fluid and everchanging as personality, yet I found the notion of mentally bargaining with a system fascinating.

As I did not fill out any personality test, it synthesized a profile that seemed mostly accurate, merely based on my speech behaviour. I found that this could be quite an exciting resource to contemplate on life if one would view these assertions not as fixed, unchangeable values but rather as prompts to start thinking about the various arrays of emotion that might surface.

This led me to extract key sentences from each journal that are highlighted and used as anchor points to prompt more profound questions. In some cases, the chosen sentences felt incoherent; in other cases, it was more lucid why a sentence was chosen (e.g. if there was a clear sentiment expressed in a sentence). As a part to investigate and imagine what further could be possible with AI, we leveraged the “Wizard of Oz” method and extended the abilities of the machine emulating functionalities in rapid and inexpressible ways. One team member handpicked sentences and wrote personalized prompts for these key sections to spark moments of contemplation that are specific and situated. We speculated that this would be something a system could be trained to do, given that it is trained on a vast archive of textual prompts.



➤ Figure 39
Sentiment analysis of journal entries, and manually generated prompts.

In general, the systems analysis was comprehensible and made sense, especially for parts within the text that expressed more apparent sentiments.

- ✦ However, I preferred when the AI selected more ambiguous key sentences since diving deeper into their meaning turned out to be an unexpected and fruitful activity for my practice.

Another insight that emerged was that this additional “external lens” could support detecting cognitive biases within my behaviour. For example, I discovered a much friendlier tone of voice than I recalled from memory. In short:

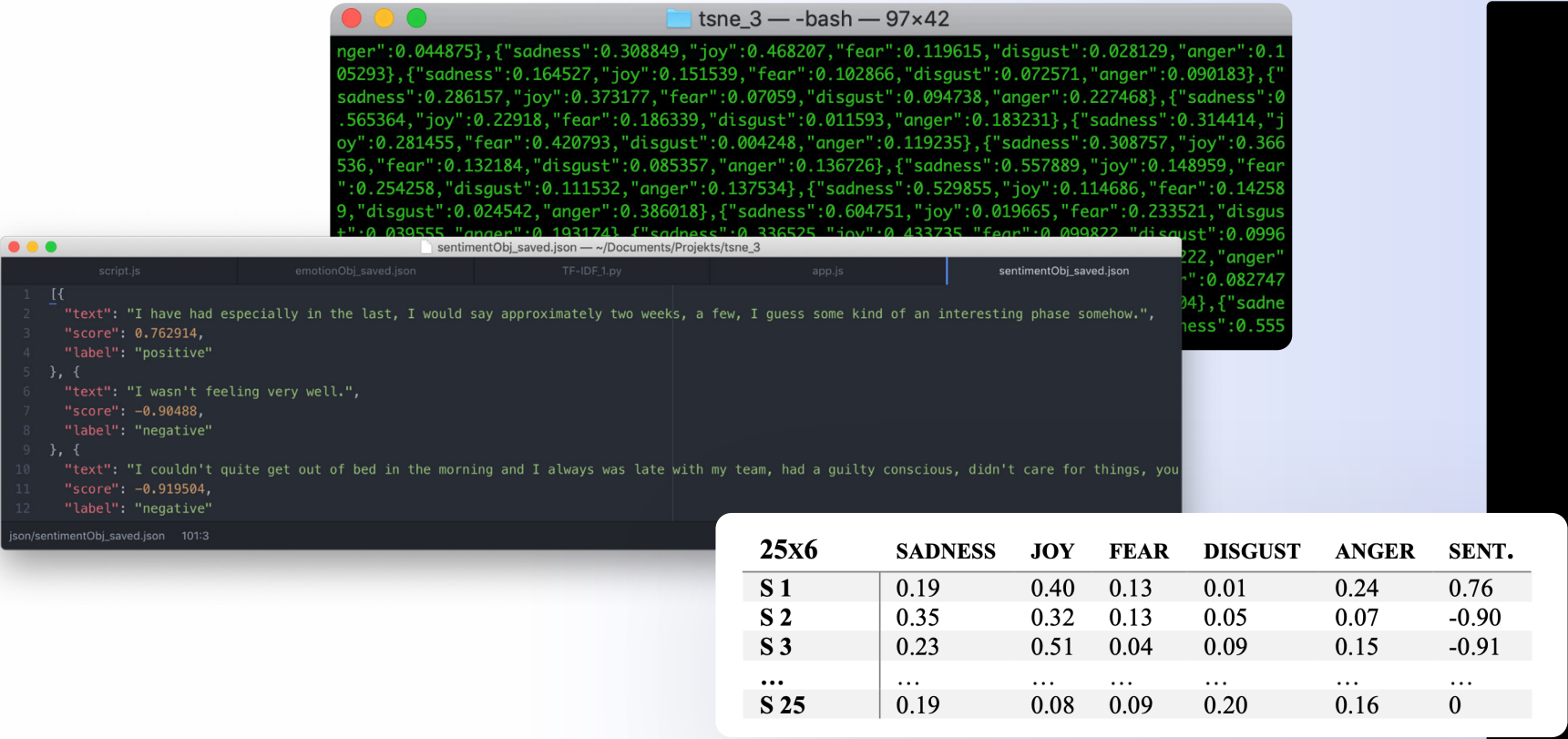
- ✦ There is potential to uncover knowledge about one's speech pattern approaching it from different and alternative perspectives through AI analysis.

However, it is vital to remember that this perspective is not exactly “neutral.” Each analysis, assertion and prediction roots from a classified “consensus” of labelled speech data. Therefore, we wanted to consciously weave it into our project by tying it to the specific context of introspection in hopes of sparking critical reflection and discussion.

Plotting speech mined data

The goal of this next experiment was to understand personal speech data and how to apply and re-interpret the use of mining human speech. In addition, I was interested in how to generate emergent patterns in and across my data that could offer different perspectives on my journal entries. I utilized otter.ai [167], a speech-to-text application that transformed journals into written text. The files were then analyzed with IBM's Watson Personality Insights API returning five emotion scores: sadness, joy, fear, disgust, anger, and one general sentiment value ranging from -1 (negative) to +1 (positive). My script post-processed these scores as well as the journal sentence snippets and compiled a matrix readable for the t-Distributed Stochastic Neighbor Embedding (t-SNE) algorithm [134].

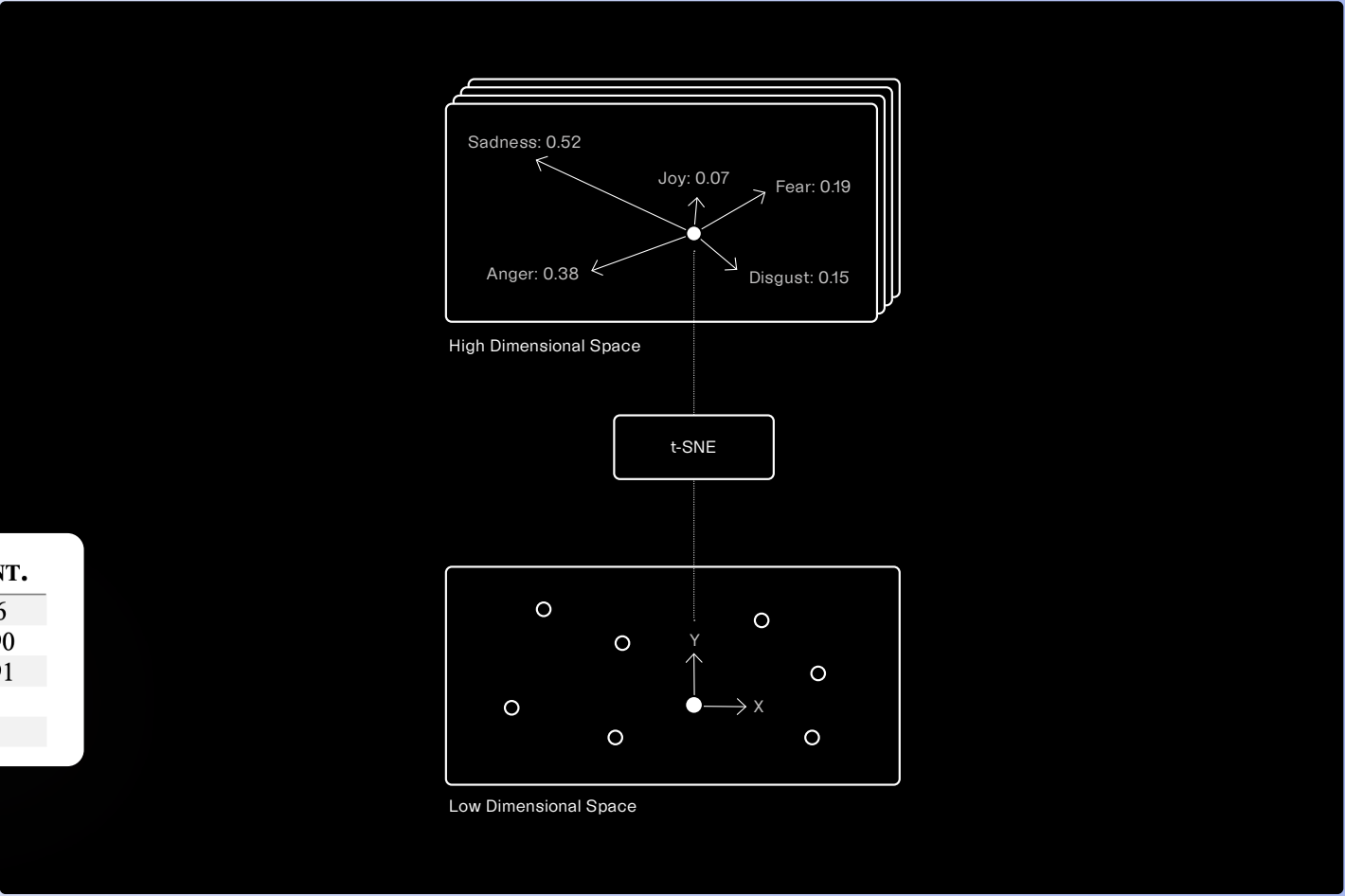
➤ Figure 42
Sentiment values are returned from the IBM API and pre-processed in order to make it readable for the t-SNE algorithm.

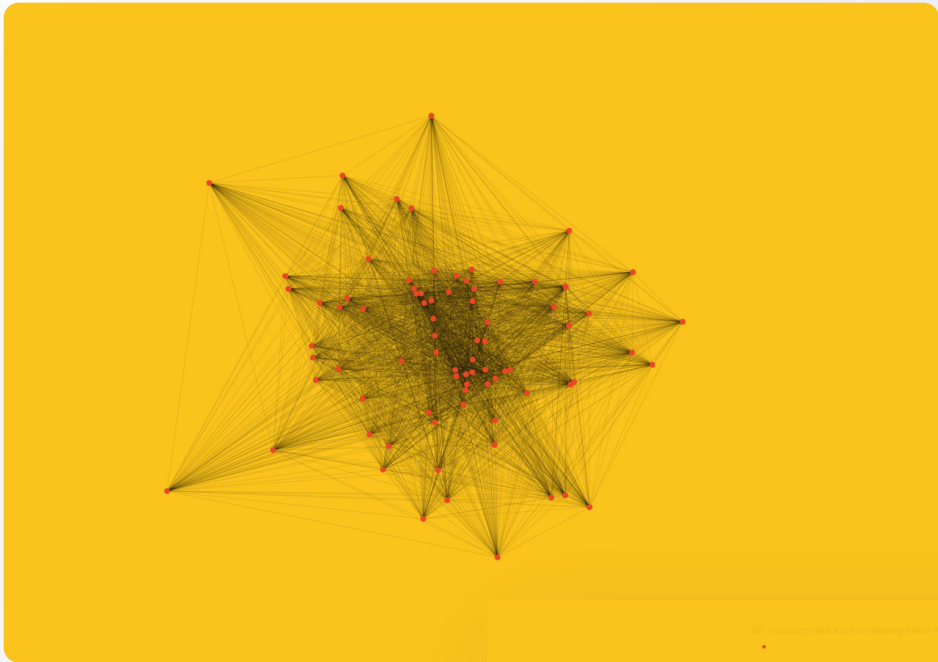


T-SNE is an unsupervised, non-linear technique commonly used to explore and visualize high-dimensional data. As the matrix holds n-sentences and —at least for now — only six sentiment features, this does not count by far as high dimensional data, yet t-SNE allows an explorative data visualization since it reduced the six features into two dimensions. Both dimensions that t-SNE returns are the coordinates for every sentence that has been analyzed and dictate where on a canvas the sentence will reside, hence plotting the journal snippets based on their sentiment.

After feeding the t-SNE algorithm with this data, I plotted and updated each Sentences position on the canvas. TSNE.js allowed me to set values for how many steps the model should iterate, furthermore, how strong each neighbour should influence each other in the embedding (perplexity).

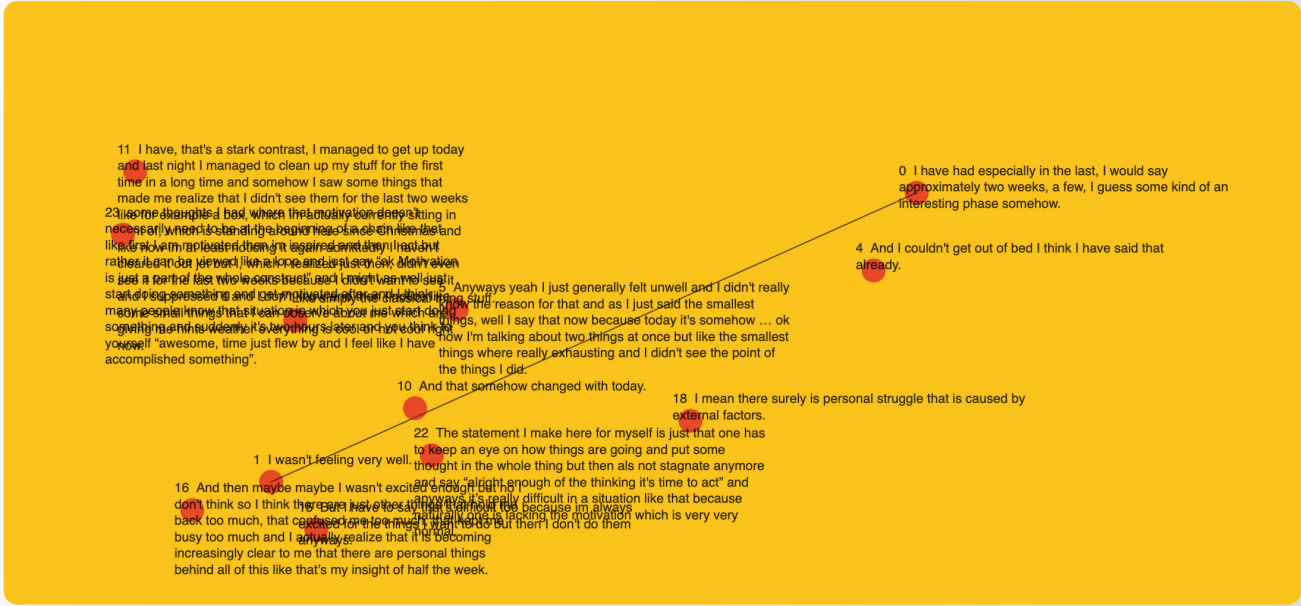
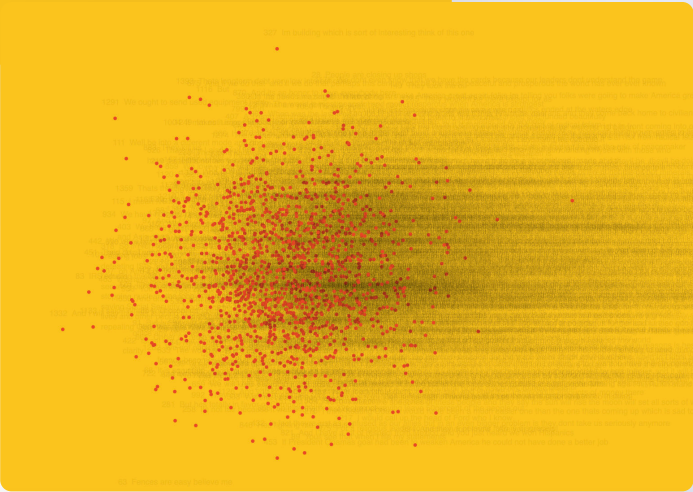
↓ Figure 43
Simple visualisation of dimensionality reduction with t-SNE.



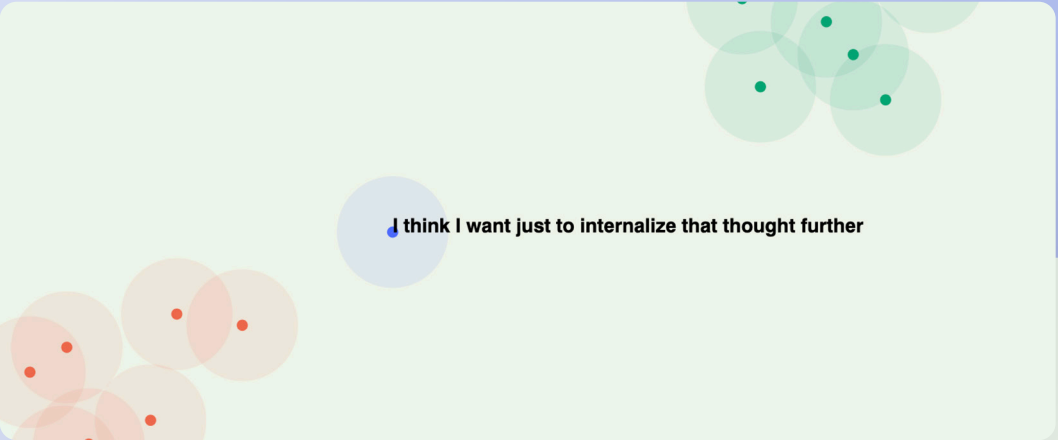


◀ Figure 44
First visualization test using t-SNE and p5.js. Every dot represents one sentence in a journal.

➤ Figure 45
The final prototype allowed for more seamless interaction; I could zoom in and out of the canvas and explore the colour-coded sentences based on sentiment. Then, on hover, the sentence appears.



✦ Visualizing journal data in this way allowed me to track the moments that were recorded over a day and then re-visit each session by hovering over sentences to see the text, which is colour-coded to indicate the highest classification of emotional sentiment for each passage. This provoked me to question patterns in fluctuations of emotions throughout a day and over time. It also prompted me to question the authenticity and ‘accuracy’ of our reflections which I was ambivalent about.



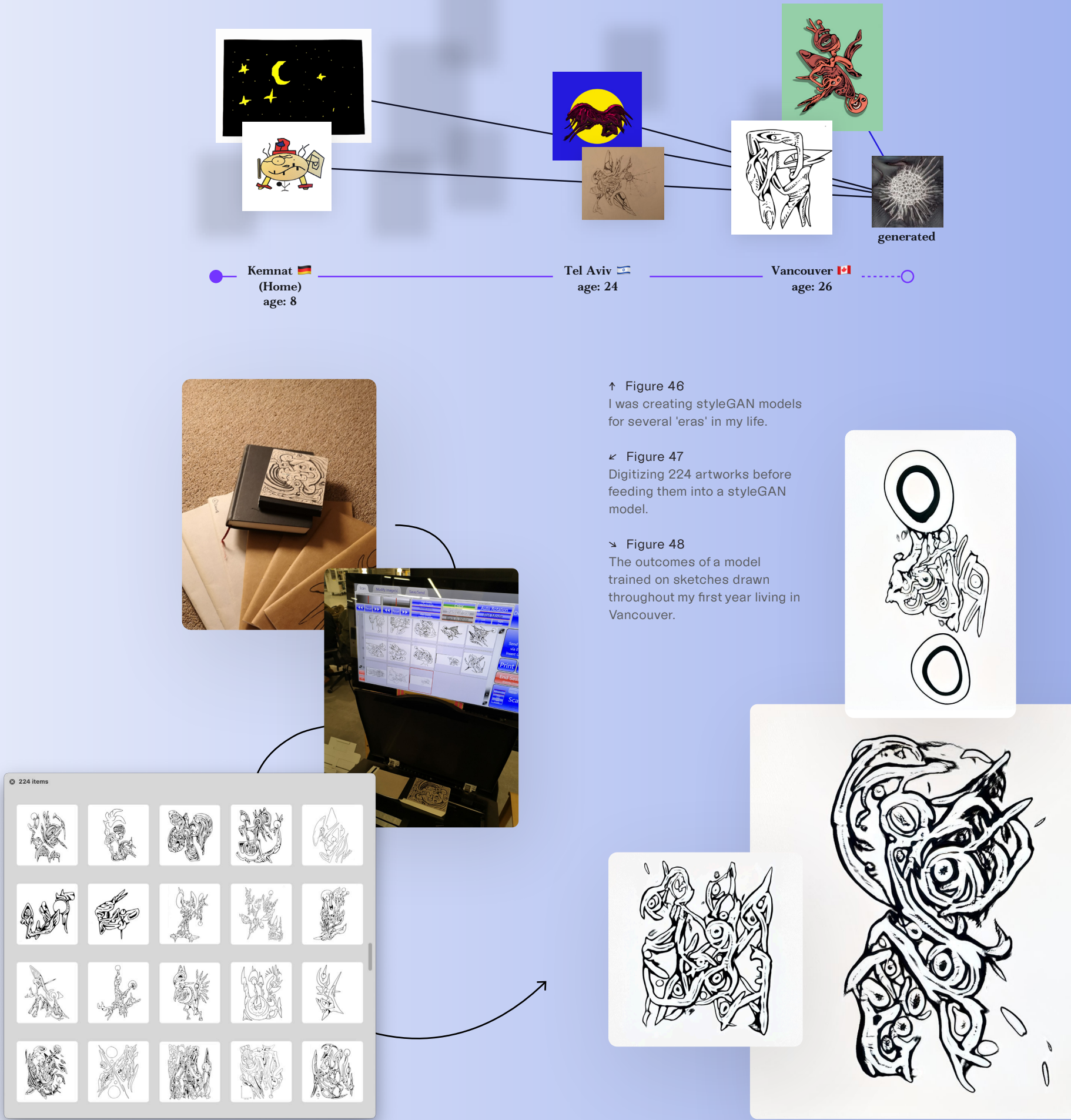
Synthesized Aesthetics

GANs and related forms of ML, commonly referred to as generative AI, can create new forms based on the data they are fed. For example, one could transform text into a ‘representative’ image. Alternatively, model the style from a favourite visual artist, musician, or poet and generate new digital forms from one’s personal data. Runway [173] is an ML application explicitly designed for creative practitioners to use. It enables users to train, use, and host a variety of generative machine learning models and sequence or run personal data through them. In light of this research endeavour, I asked myself how I might perceive personal artworks across a lifetime if viewed through my favourite artists’ styles? Would machine-produced imagery offer valuable perspectives for exploring themes in one’s diary or subconscious values in dream journals? How ‘authentic’ should we treat insights from these experiences? Or, does authenticity matter?

Leveraging and cross-connecting artistic archives

I scanned and uploaded numerous hand-drawn sketches, drawings and photographs from essential periods in my life and trained a styleGAN2 model [174] according to these periods. I then applied these different models to newer artworks produced, as well as older ones from their childhood.

- ✦ The outcomes of these activities offered unique perspectives on each era that provided insights into growth and change and evoked a ‘meta-aesthetic’ that was visible across the lifetime of works.
- ✦ It also raised questions about how this model might influence other forms of personal data that could generate new resources for introspection. For example, if emotional sentiment analysis was applied to generative artworks and then used to create a playlist in Spotify that best represents its emotional resonance.



↑ Figure 46
I was creating styleGAN models for several 'eras' in my life.

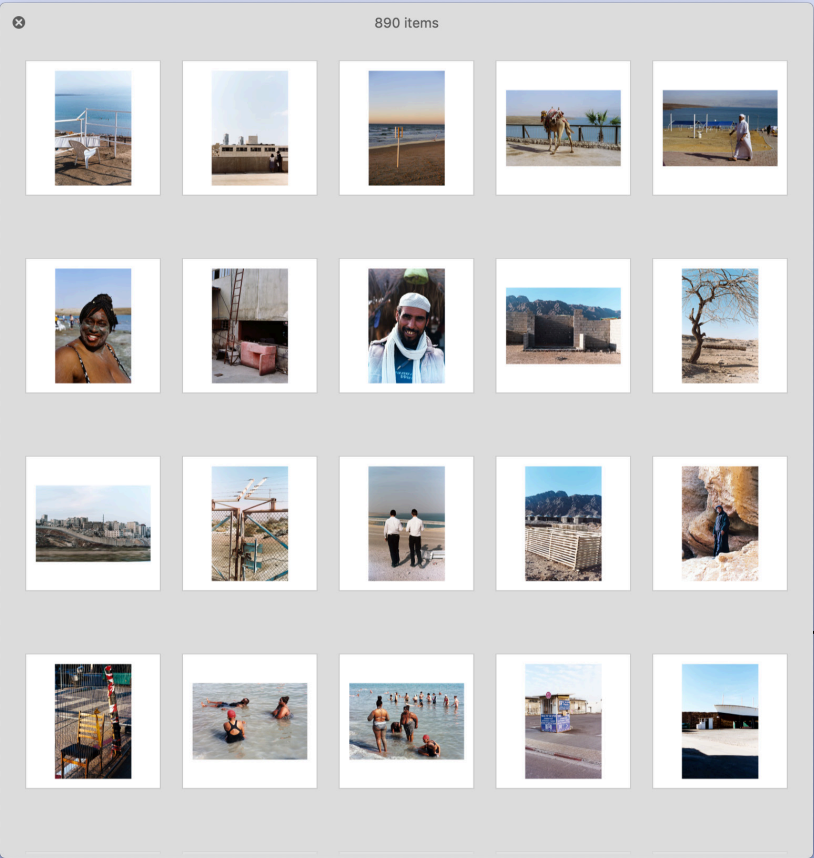
↶ Figure 47
Digitizing 224 artworks before feeding them into a styleGAN model.

➤ Figure 48
The outcomes of a model trained on sketches drawn throughout my first year living in Vancouver.

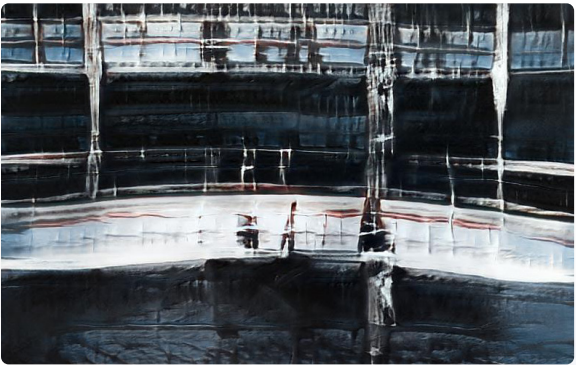
Synthesizing 890 photos from life aboard

I synthesized an archive of 890 photos from a period in their life abroad living in Tel Aviv Israel (where all of the images were taken). All photos were taken over a period of half a year. In this exploration, I inquired into what it might mean to personalize a model on my specific style of taking photos. For example, does it evoke reflective moments on your practice or on new scenes, compositions, or textures that it might represent?

- ✦ This led me to become aware of compositional tendencies—ways of seeing and framing the world –in photo-taking that we did not know of previously.
- ✦ The synthesis and generation of new images from this personal dataset starkly evoked the emotional feelings and range of associations from living abroad in Tel Aviv. It evoked reflections on the emotional overtone of ‘being there and on specific experiences associated with forms, colours and patterns latent in the dataset that emerged in new juxtapositions.



→ Figure 49
Personal Archive of 890
photos of places, people and
landscapes from Tel Aviv.

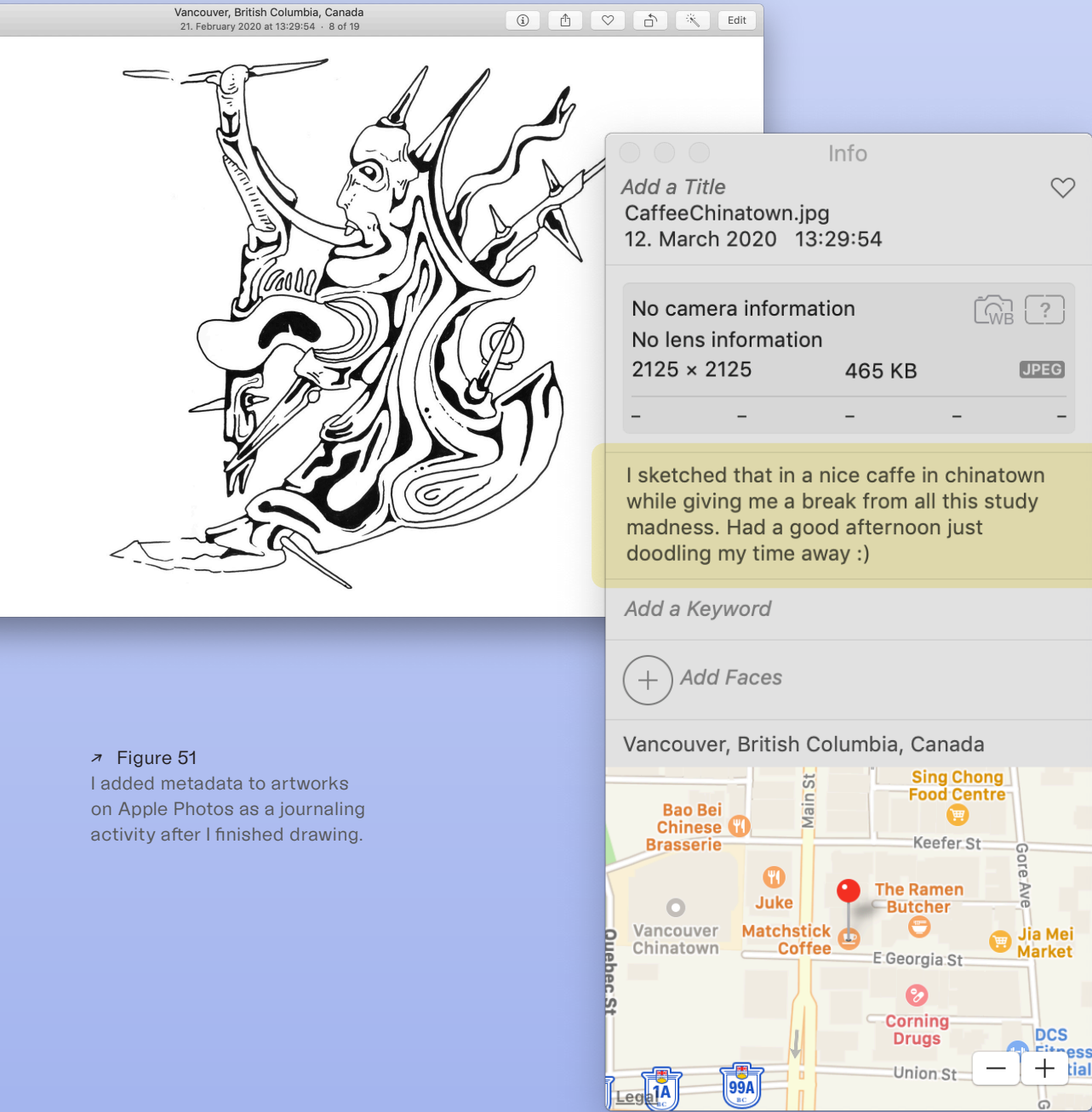


↑ Figure 50
I generated more than 100 images with
the trained styleGAN2 model. Then, I
sorted through this collection, searching
for images that evoked feelings of
reminiscence and familiarity.

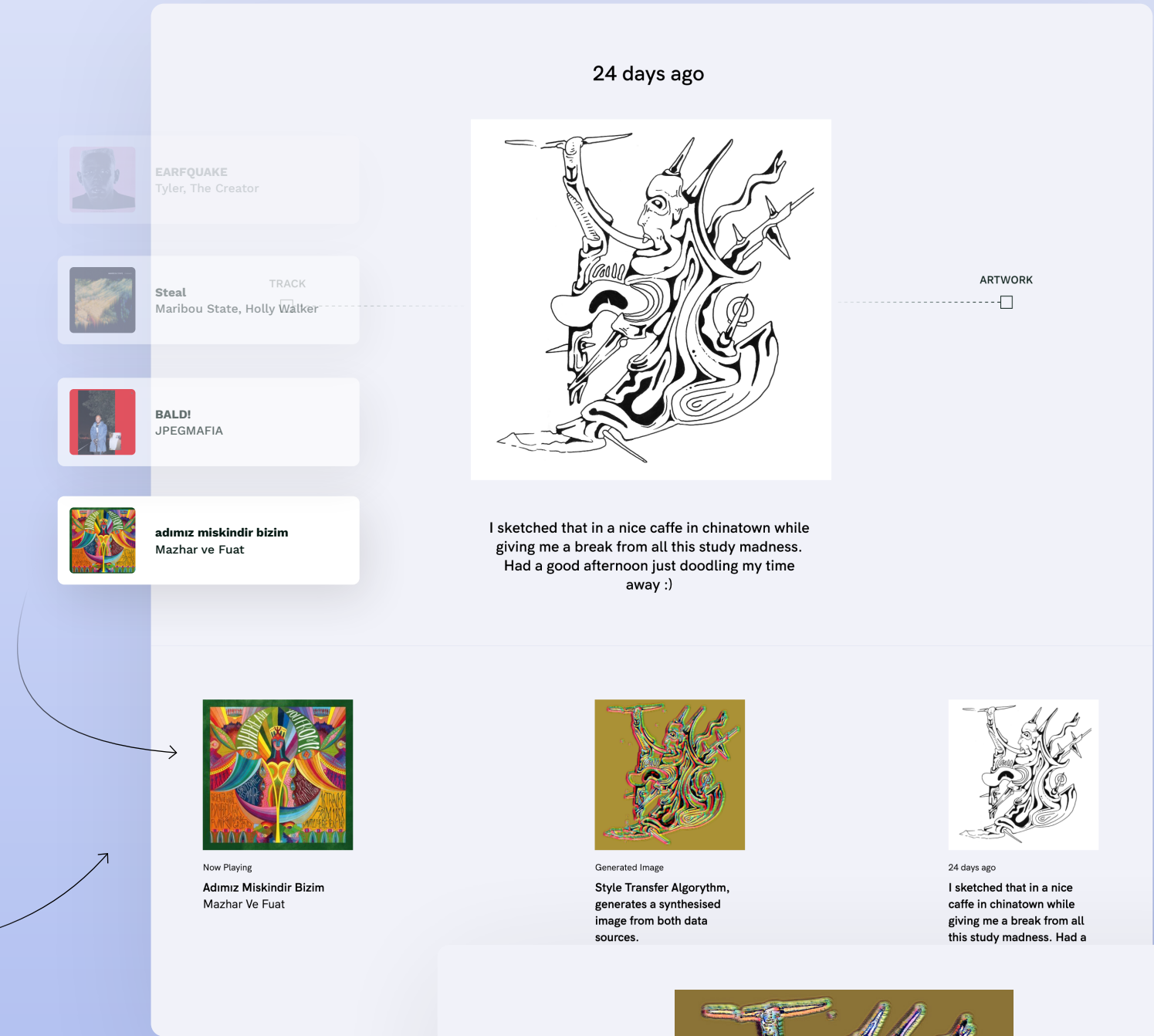
Music Archive + Artwork journaling

I created an interactive application to synthesize artwork from one’s most listened to albums with personal artwork to create a new resource for personal reflection. Annotating and adding metadata to the images was a journaling activity that connected the artwork with a little story and place in time.

- ✦ I liked this prototype's expressive and surprising quality, as the canvas would always show something new based on the connected archives of metadata that are always in flux.



➤ Figure 51
I added metadata to artworks on Apple Photos as a journaling activity after I finished drawing.



↑ Figure 52
My musical listening is tracked, and the most recent song's cover art is selected to be synthesized with a randomly selected personal artwork.

➔ Figure 53
An interactive canvas displays randomly chosen artworks with their journal annotation beneath.



2 months ago

TRACK



ARTWORK

Another classic late night drawing session at home. I was listening to Orwell's 1984 the whole night!

5 months ago



I have listened to Harry Potter Part 6 while sketching this. I think it was at the passage where Harry gets the one crucial Voldemord memory from Prof. Slughorn.

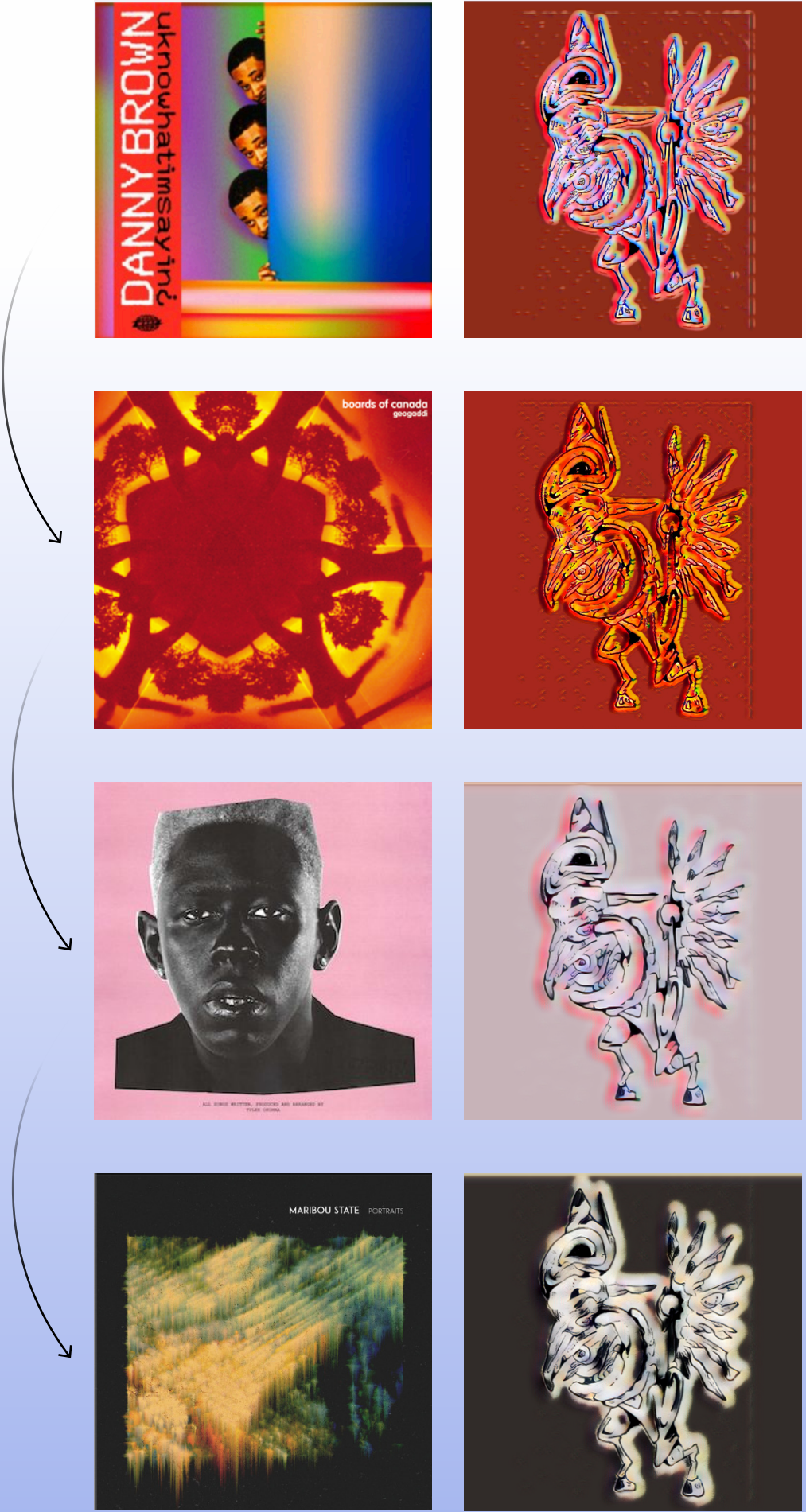
8 months ago



Sitting in the train from Berlin back to Gmuend. I missed my flight that day and could cure my hangover in the Deutsche Bahn. It was then when I draw this sketch.

➤ Figure 54
Some of the artworks are shown on the canvas, with their respective journal annotations and timestamps.

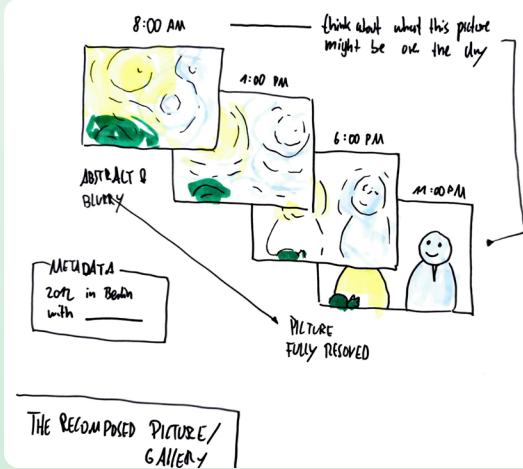
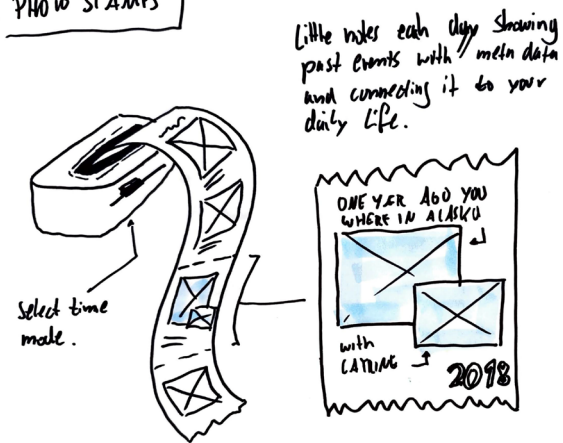
➤ Figure 55
My personal music listening archive informs how each artwork is stylized.



DESIGN CONCEPT GENERATION

As insights from the first-hand experiences emerged across this experimental, preliminary phase, I documented them by sketching and annotating various design concepts. Elaborating and forming these early, often frail, ideas is a valuable method to keep track of thoughts and communicate them within the research team. I tried to be as generative as possible and didn't hold back once an idea surfaced, which is a wanted strategy in the early stages of ideation. I generated several sketches by hand and created a template that included three columns to write down ideas in a short storyboard. A small collection of these sketches and early ideas can be on the following spreads.

PHOTO STAMPS



AUDIO SHELL

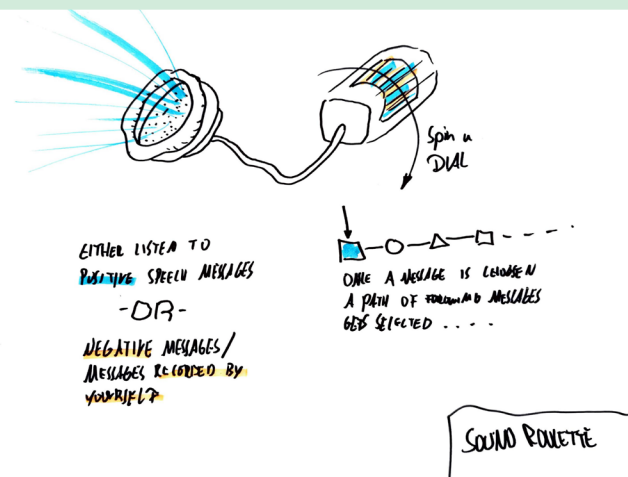
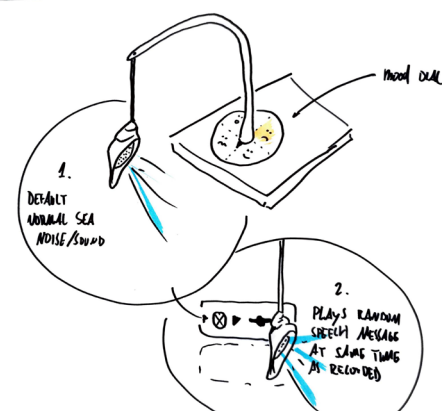
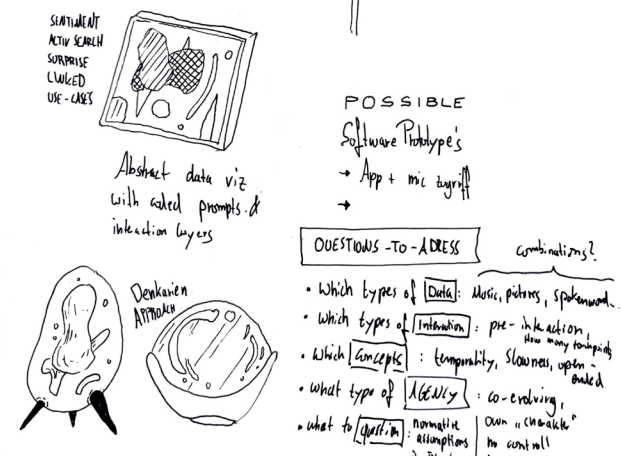
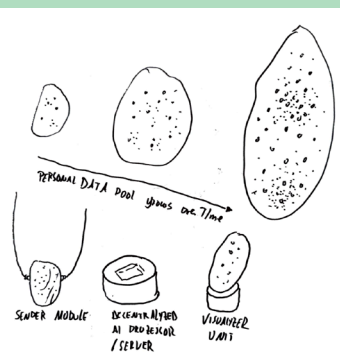
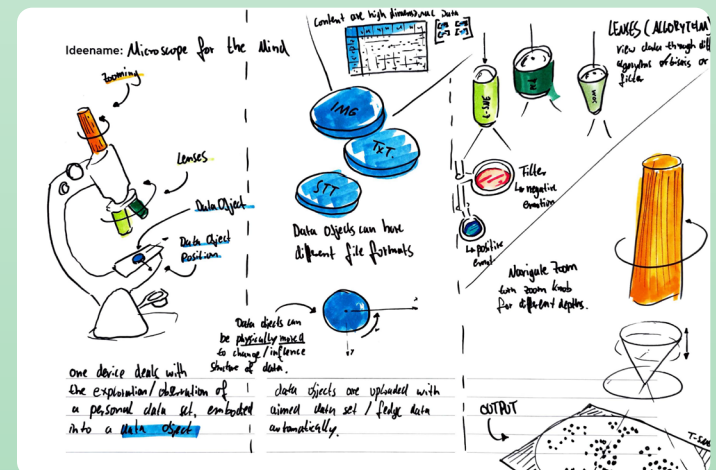
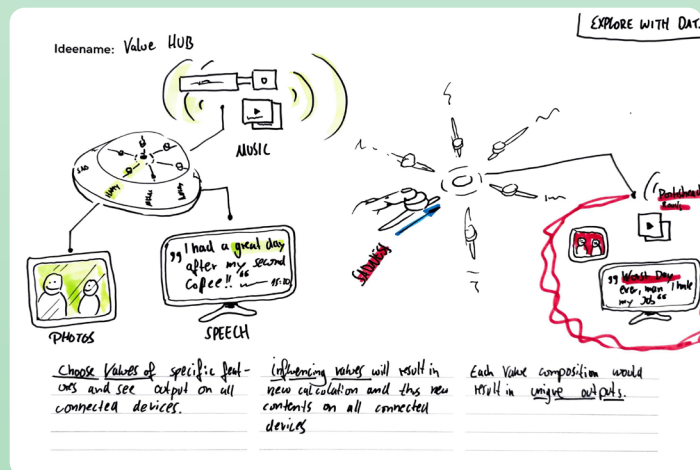
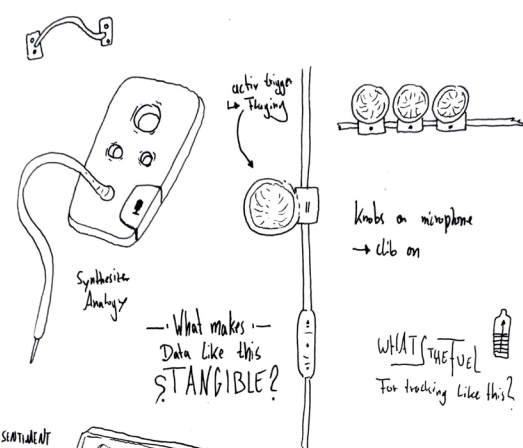
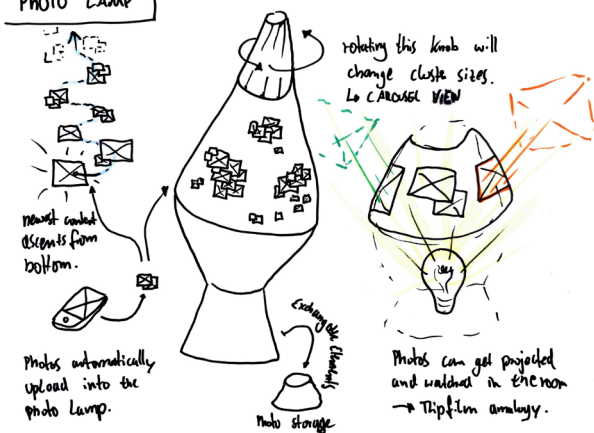


PHOTO LAMP



PERSONALITY

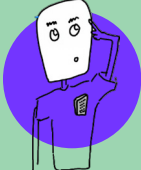
Confront Your Digital self



Get confronted with your various online personas that dwell around in cyberspace.

PERSONALITY

Every Day Personality



Find out how your personality changes over day to day activities, across time.

PERSONALITY

Alternate You Simulator



A Simulator that replicates alternate realities, and shows what would have happend if you choosoen a different path.

META-PROBES

Dream Streams



This Reminds me of my mattress in eindhoven, it was really dirty!

See a visual representation of your own cognitive data, extracted from your REM sleep cycles.

How REM & non Rem (really subconscious streams would differ)

META-PROBES

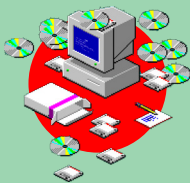
Purpose of Life Scanner



A model learning when and why you feel the most fulfilled in life.

META-PROBES

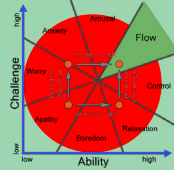
Your Nostalgia



Investigate in your nostalgic characteristics, and learn how to harvest this sentimental power.

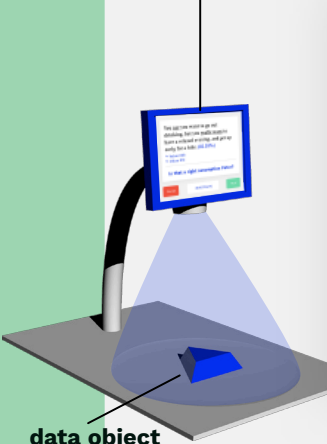
META-PROBES

Time Flies in Flow



Time flies, when you enter a flow state. This excersise will help you keeping track of when and why you entered this state of mind.

Alignment lab



You say you want to go out drinking, but you really want to have a *relaxed evening*, and *get up early* for a hike. (82.39%)

↳ Value #38

↳ Value #12

Is that a right assumption Peter?

FALSE INVESTIGATE TRUE

You say you want to go out drinking, but you really want to have a *relaxed evening*, and *get up early* for a hike. (93,15%)

+11%

AFTER 12 HOURS NETFLIX

"I really want to get out more, and explore the world."

↳ Value #38

AFTER NEW YEARS

"I need to stop drinking beer, it really doesnt give me much!"

↳ Value #12

SEE ALL VALUES

There is a strong correlation between your social media consumption and how many steamed buns you've ate today.

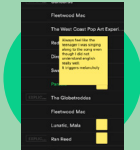
↳ Value Violation

You said you want to stay in your flat, but data indicates you are miserable at home. Move out immediately!

↳ Emotion Flag

AESTHETICS

Music Probe



Explore your music in an introspective journey taking you on a ride to reflect on life and annotate deep emotional patterns

//

Affective data fed music algorithms.

AESTHETICS

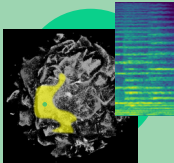
Your Visual Landscape



Reflect on impressionistic visual scapes, that synthesise your visual aesthetics

AESTHETICS

Your Sonic Landscape



Reflect on impressionistic auditatve landscapes, that synthesise your specific sonic landscapes.

AESTHETICS

Artifact Reflection



Reflecting on specific artifacts, and inquire deeper levels of the relation between you and your posessions

AESTHETICS

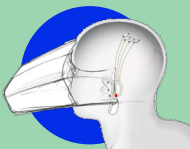
Aesthetic Journey



Take a trip to the multiple aesthetical stations of your life. Reflect on what gave your pleasure in the past, present and maybe future?!

PRODUCTS

Microscope for the Mind



What does it look like when machine learning gets better into decypher our neurological pathways, and visualise a landscape of mind.

PRODUCTS

The Home Lab



How would a home lab look like, designed for inquiring your own life?

- Reflection Glasses
- The inner child extractor
- The Self altair
- The sonic reflector (olo boiled down)
- The smell station (re-play smells)

PRODUCTS

Mind Probes



Probes that are specifically designed for harvesting and manifesting new data about yourself.

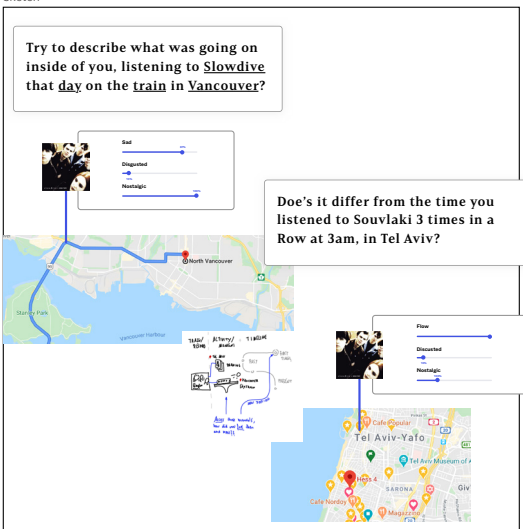
← ↑ Figure 56

Design concept generation focusing on creating services that use personal data in alternative and explorative ways.

CONCEPT

Name: Location/

Sketch



Try to describe what was going on inside of you, listening to Slowdive that day on the train in Vancouver?

Sad

Disappointed

Nostalgic

Doe's it differ from the time you listened to Souvlaki 3 times in a Row at 3am, in Tel Aviv?

Flow

Disappointed

Nostalgic

Description

As more and more data gets tracked, systems cann prompt you through correlations the interfer between data points. In this case music data gets matched with location history to actively askses you what you felt while you where listening to a song on a specific location.

SYNTHESIS

Applying the reflexive designer-researcher approach, the results of these experiments were annotated and reflected upon to distill five distinct themes that further drive the design ideation. How the activities and explorations informed the themes is visualized and annotated in detail on the following spreads.

Design Research Approach

Our approach unfolded over one year where the research team engaged in several different activities simultaneously: an ongoing review of literature on self-introspection theory, methods, and practice; a hands-on exploration of several available AI systems; and numerous introspective activities performed by ourselves. We also generated design concepts directly in dialogue with insights emerging across our first-hand experiences. Through this complex and intertwined process of ongoing reflection, a set of five themes emerged that shaped our inquiry into Introspective AI and our final seven design proposals. These themes are not mutually exclusive, nor conclusive. Below we briefly annotate a sample of key activities in our approach that led to each respective theme.

Dream Journal_Jan 17, 2020 (3).note

Dream Journal_Jan 14, 2020.note

Dream Journal_Jan 7, 2020.note

Dream Journal_Jan 3, 2020.note

Dream Journal_Jan 2, 2020.note

Dream Journal_Dec 31, 2019.note

Dream Journal_Dec 29, 2019 (3).note

To engage in introspective practice, we completed dream journals. Prompts about the general atmosphere, specific feelings, and occurring persons helped in manifesting these journals.

I have had especially in the last, I would say approximately two weeks, a few I guess some kind of an interesting phase somehow. I wasn't feeling very well. I couldn't quite get out of bed in the morning and I always was late with my team. Had a guilty conscience, didn't care for things, you know how it is. I mean firstly concerning things I planned on doing for a long time, which I didn't really have in mind any more but also small things which I simply didn't do and that consistently stressed me out as well. And I couldn't get out of bed I think I have said that already. Anyways yeah I just generally felt unwell and I didn't really know the reason for that and as I just said the smallest things, well I say that now because today it's somehow ... ok now I'm talking ab

Overall Sentiment

Negative 0.32

Overall Emotion

Joy 0.27

Anger 0.13

Disgust 0.56

Sadness 0.65

I just realised that I overcomplicate everything I do.

things I planned on doing for a long time

Do you know why you didn't do those things yet?

Do you want to say what you planned on doing?

Verbalising those things may help you to keep them in mind.

Custom introspective prompts were written from close friend's journal entries.

IBM Watson Personality Insight API [86] and Receptiviti Personality Insights [87] showed emotional trends in our personal journal entries.

Location Data

You walked 38% more on the right side of this street. What makes you stick to this side?

Peronality Insight

Today you felt a high urge of curiosity and increased levels of closeness.

You said you want to stay in your flat, but data indicates you are miserable at home. Move out immediately!

Emotion Flag

An early concept where a widget prompt shows a tension between the user's actual behavior and ideal self.

Short journaling activities to generate self-reflective meta-data on personal artworks.

Info

Add a Title

CoffeeChinatown.jpg

12. March 2020 13:29:54

No camera information

No lens information

2125 x 2125 465 KB

I sketched that in a nice caffe in chinatown while giving me a break from all this study madness. Had a good afternoon just doodling my time away :)

Keyword

You say you want to go out drinking, but you really want to have a relaxed evening and get up early for a hike. (82.39%)

Value #38

Value #12

Is this assumption correct, Peter?

FALSE INVESTIGATE TRUE

A speculative product that explicitly asks the user if its assumptions about them are correct.

You say you want to go out drinking, but you really want to have a relaxed evening, and get up early for a hike. (93.15%)

+11%

This is an old bridge, as a child I liked to jump into the water from here.

A gig economy service that teaches new Introspective AI models what it means to be human.

Joshuar Barnes

URBAN CLASSIFIER

MEMORIES 42

OBJECTS 67

ASSUMPTIONS 32

Early sketch of User-AI cycles of collaboration and alignment.

Human reflect

System learns

Sad

60 Image Samples

Webcam Upload

We trained a model to classify our facial expressions that grew more complex over time.

This led us to examine our own self-awareness on the authenticity of our gestures and how others perceive them.

Supporting Collaboration and Alignment

A key part of introspective practice is considering if the vision of one's ideal future self has changed [119,135]. As one's Introspective AI develops, it may recognize deficiencies in its model, prompting the collection of more data on its behalf to bring it back into alignment. This feedback loop also applies the other way around as one might detect shortfalls in the model and then train the AI to better conform to one's perceived sense of self.

An AI that holds you hostage for more introspective data.

What would a conversation with my Google account reveal about me?

Rachael Tyrell: Lyrics: Musical Tone: Community: Why Portishead? Peter, are you sad? I don't understand. How can you be "a bit" sad? Ok! But after that, you have to define what you mean by being "a bit" sad. Unless you want to listen to **Happy by Pharrell Williams**. Lyrics: Musical Tone: Community: RACHAEL plays... Roads Portishead

PETER (HUMAN): Rachael, play Portishead - Roads. Mhhm, I guess so. At least a bit... Rachael, can you just Play the song? I need this now!

PREMIUM **What Might The Others Say?!** Find out who is mentioning your name, in what contexts, when and how often.

your name was mentioned **24x** in **Jenny's** speech tracking.

Pay to find out what people are saying about you behind your back to enhance your self-awareness.

Confrontation and Critical Reflection

Active inward confrontation of one's self and potential biases is an important part of introspection [125]. Rather than acting as a 'neutral' observer, your Introspective AI can present personal data and assumptions in the form of confrontational prompts that are to be critically examined and reflected on.

An interactive application that we created to synthesize artwork from one's most listened to albums with personal artwork, to create a new resource for personal reflection.

How could a visualized report of recorded speech mediate introspective experiences?

Which of the following statements is close to your "self"? You take pleasure in... You take on my challenge... You are unlikely to: like country music, hold traditional values, fix your typos when writing to someone that you don't want to impress. Is that true? "Country music is really growing on me!"

Sleepify revisit the land of dream Sleepify is an app that analyzes your sleep data and creates playlists to reflect on your subconscious.

Face your Nightmares Subconscious mind Lucid Tracks

Introspection through Guided Sessions

Guided sessions offer structured pathways for introspection, with a distinct beginning, middle, and conclusion to the experience [139]. Your Introspective AI can be leveraged to generate introspective journeys focused on personally relevant life experiences, value tensions, and dilemmas.

I wasn't feeling very well.

Analyzing emotional sentiment in journal entries with IBM Watson [86] and plotting the results on an interactive canvas using a t-SNE algorithm [75].

Own Artwork This experiment ended. AI Result

Teaching a model with our personal artworks and then documenting our reflections on the new resources the machine has generated.

What does it feel like to encounter AI interpretations of our own aesthetic? What does it tell us about our practice and our sense of self?

Chiara and I were hiking in a big river valley. Over the river there were two huge bridges to the other bank, one of the bridges was broken. The whole dream had something of an end-time mood (Chernobyl vibes) as if something terrible had happened back then when the bridge got destroyed.

Transforming textual dream journal entries into dynamic images, using Runway ML [88] to create new resources for introspection.

Mapping personal history through music, from childhood on.

1995 1997 2003 2007 2010 2014 2016 2018 2020

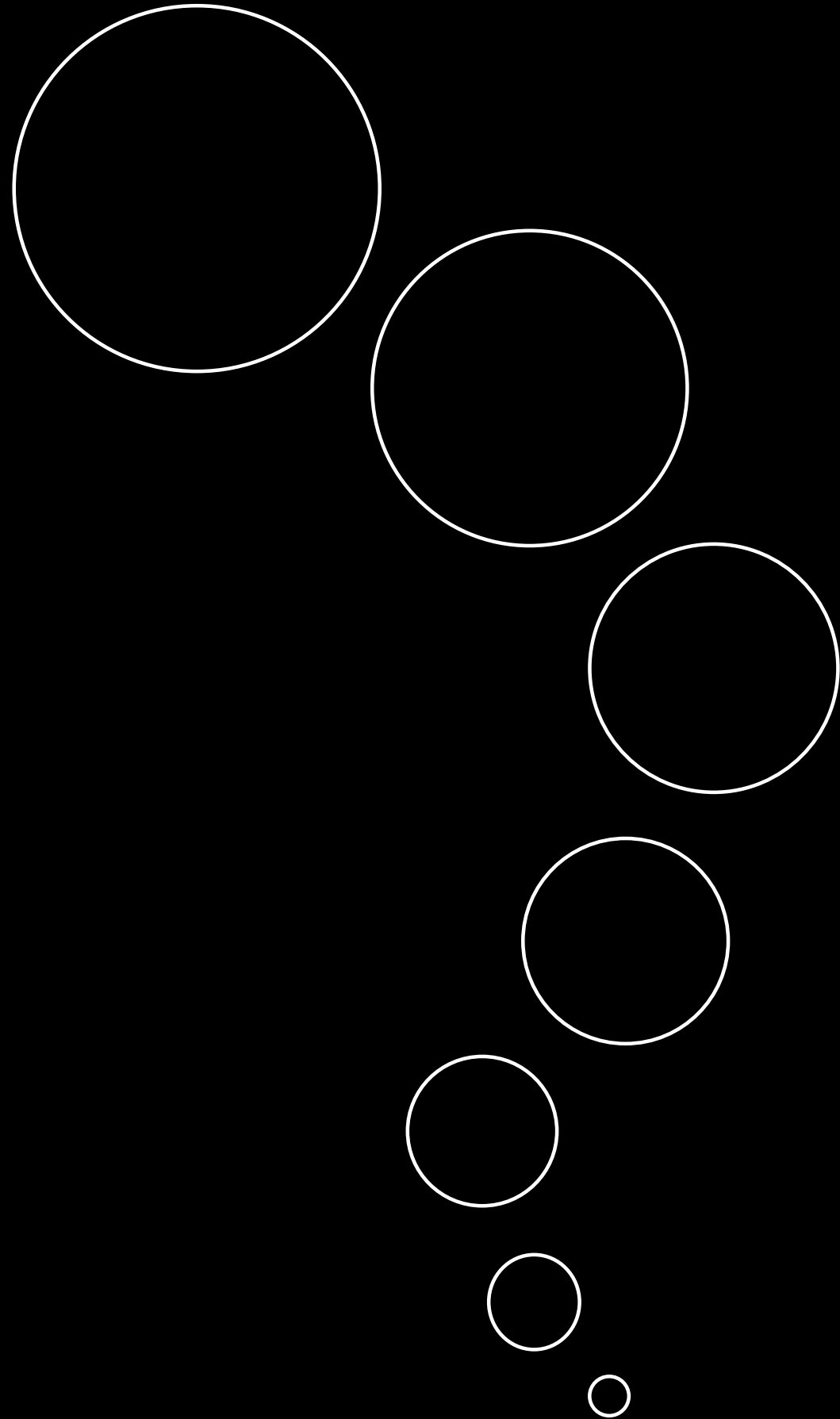
We created vision boards that helped us reflect on the influence of the close relationships in our lives, respectively.

We visually mapped how our aesthetic tastes evolved over time.

Introspection through Open-Ended Session

Introspection can unfold in more open-ended ways with no stringent narrative or objective goals [41]. As open-ended experiences, AI-generated introspective journeys emphasize interpretive experiences where new insights may emerge out of moments of serendipity and inspiration with a particular phenomenon with strong emotional resonance (e.g., music [122]).

SEVEN DESIGN PROPOSALS



5 Formative Phase

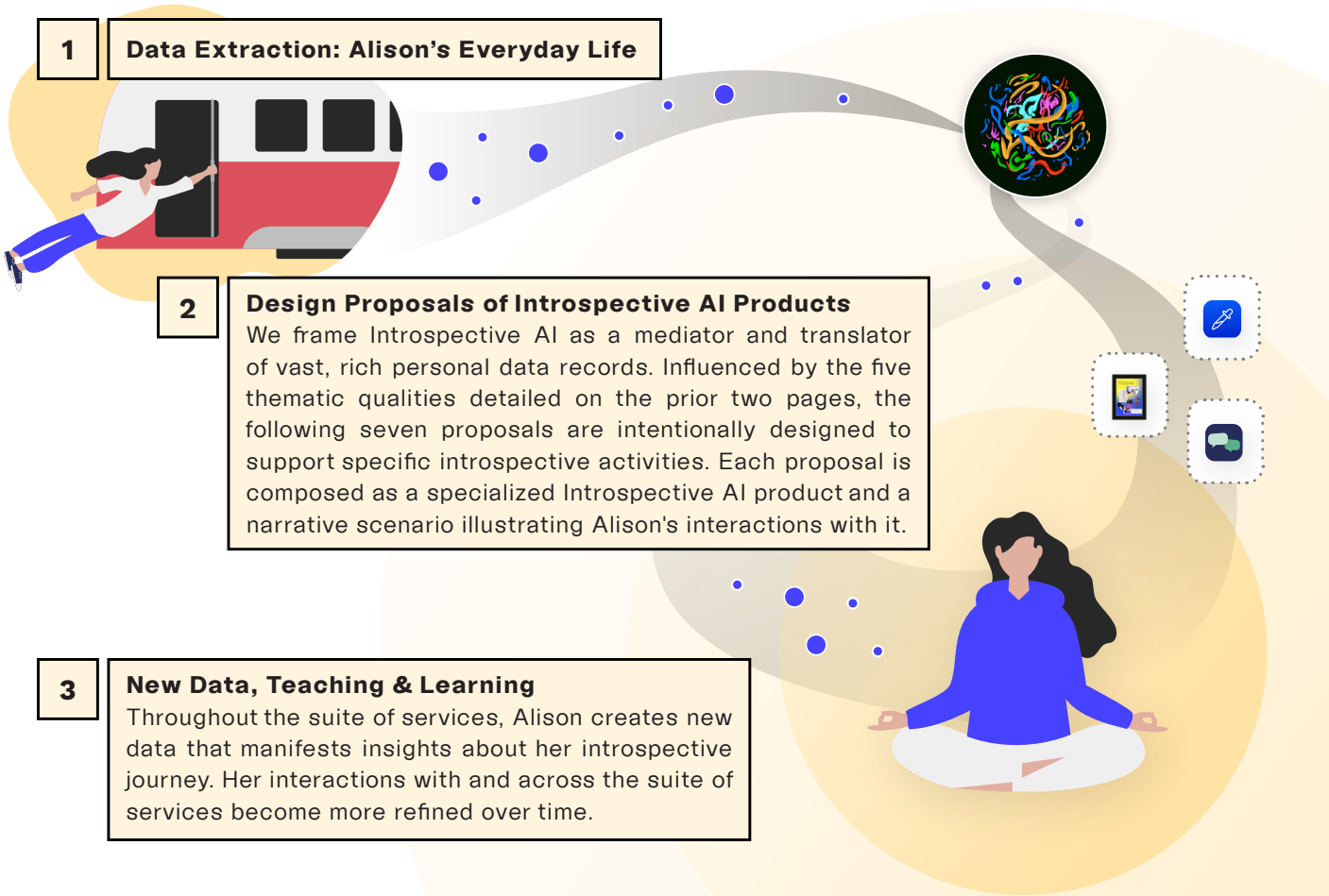
The learnings from the preliminary stage of this process were used as lenses to drive further speculation and generate more distinct design concepts. The results are seven introspective services that probe into different AI tools, forms of personal data and distinct introspective contexts. Each service is situated in a design fiction scenario conveying a story that aims to be relatable and provoking in order to provoke new visions, insights, and questions around what the introspective AI design space might hold. In the spread that im-

mediately follows, I first elaborate on the framing and the speculation around introspective AI, introduce the world and its characters, and provide a brief overview of each service. Then, in the remainder of this chapter seven design proposals are presented. Each proposal includes details of its motivation, why it was selected, what it is and does, a brief design fiction scenario, and a critical reflection on the broader significance of the proposal in light of the emerging introspective AI design space. In following that a key contribution of this thesis research is the design proposals themselves, they are presented in an visually detailed and integrated fashion that is coupled with textual annotations.

Framing & Speculation of Introspective AI

Across our process, we wanted to move away from portraying AI as a single 'all-knowing' agent that is always right or that takes on a human-like form. In parallel to recent work in the design research community [12,145], we do not view AI as possessing the same form of reasoning that people have and the uncertainty that comes with this difference can be seen as an opportunity for design practice to generatively engage. We envisioned Introspective AI as a context-aware agent that mediates interactions between Alison and her personal data by making inferences about her life through situated introspective prompts. We also wanted to anticipate and embrace 'mistakes' that an Introspective AI will make and explore different ways that these imperfections in Alison's model could be handled in constructive ways through design.

We also aimed to speculate on future forms of personal data mining where deeper layers of data extraction exist and "the process of quantification is reaching into the human affective, cognitive and physical worlds" [25]. If the future of data mining generates datasets that encompass the human psyche, conscious, and unconscious desires, private and public accounts and idiosyncratic traces of Alison's behavior and activities, then how might these collective resources be leveraged for her benefit by her Introspective AI? Through several rounds of developing, refining, and reflecting on design concepts in the Introspective AI design we eventually arrived at seven distinct design proposals of Introspective AI products. On the pages that follow, we detail each design proposal, and its broader significance.



Design Proposals: A Suite of IAI Products



Everyday Personality
Highly contextual introspective prompts delivered opportunistically.
Short Prompts Confronting



Music Reflection
Augments Spotify's data with personal data, to generate novel introspective prompts, which feeds back in an affective layer.
Short Prompts



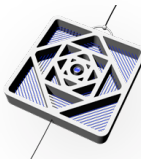
Mind Probes
Prompts subjective data-collection activities that generate synthesized introspective experiences.
Collaboration & Alignment Open-Ended Experiences



Vision Shrine
A ludic representation of one's ideal self, mediating rich introspective interactions.
Confronting Collaboration & Alignment



Hello, Cyber-Self
A confrontational manifestation of inferences that the IAI model has gathered which can be corrected to bring it closer to alignment.
Confronting Guided Session



Dream Streams
A bridge from inherently introspective dream-data to experiential services for conscious interaction.
Guided Session Open-Ended Experiences



Deeptalk Report
A meta-analysis of conversational data to generate well-curated, guided, and unique introspective representations.
Guided Session Confronting

Everyday Personality

Everyday Personality presents a chatbot interface that delivers **short introspective prompts**. This Introspective AI service uses its deep understanding of your behavioral data to intervene in everyday life with tailored short introspective prompts delivered at opportune moments.

1

Everyday Personality is aware that Alison has just met up with her childhood friend, Julian, for the first time in four months. As self-monitoring can be effective if practiced while the social interaction is still vivid [125], the Introspective AI service prompts Alison to reflect while she is waiting for the bus home.



Reflection

This provocation explores the extent that people may value aggregations of personal data that present unique inferences about their lives and then the roles that these materials might play as resources for self-awareness and monitoring. In this way, Everyday Personality probes on the social acceptability of an application that nudges the user toward reflecting on—or **critically confronting**—their behavior if such trends indicate that they are straying from the shared vision of their 'ideal' self.

Music Reflection

Music is deeply connected to emotions, memories, creativity and personal associations across different stages of life [14]; and, as such, music listening as a practice can offer a key catalyst for supporting experiences self-reflection [29,57] and introspection [122]. The data generated from digital music listening is rich with possibilities to generate new insights about individuals, such as their personality (e.g. [6]), especially when aggregated with other streams of personal data. How could such extensive personal data records offer a resource for supporting situated experiences of introspection over time? This space is explored through Music Reflection, a Spotify integration that generates **short introspective prompts**.

1

It's 4:30am. Alison is writing her thesis. Dagger by Slowdive plays in the background.



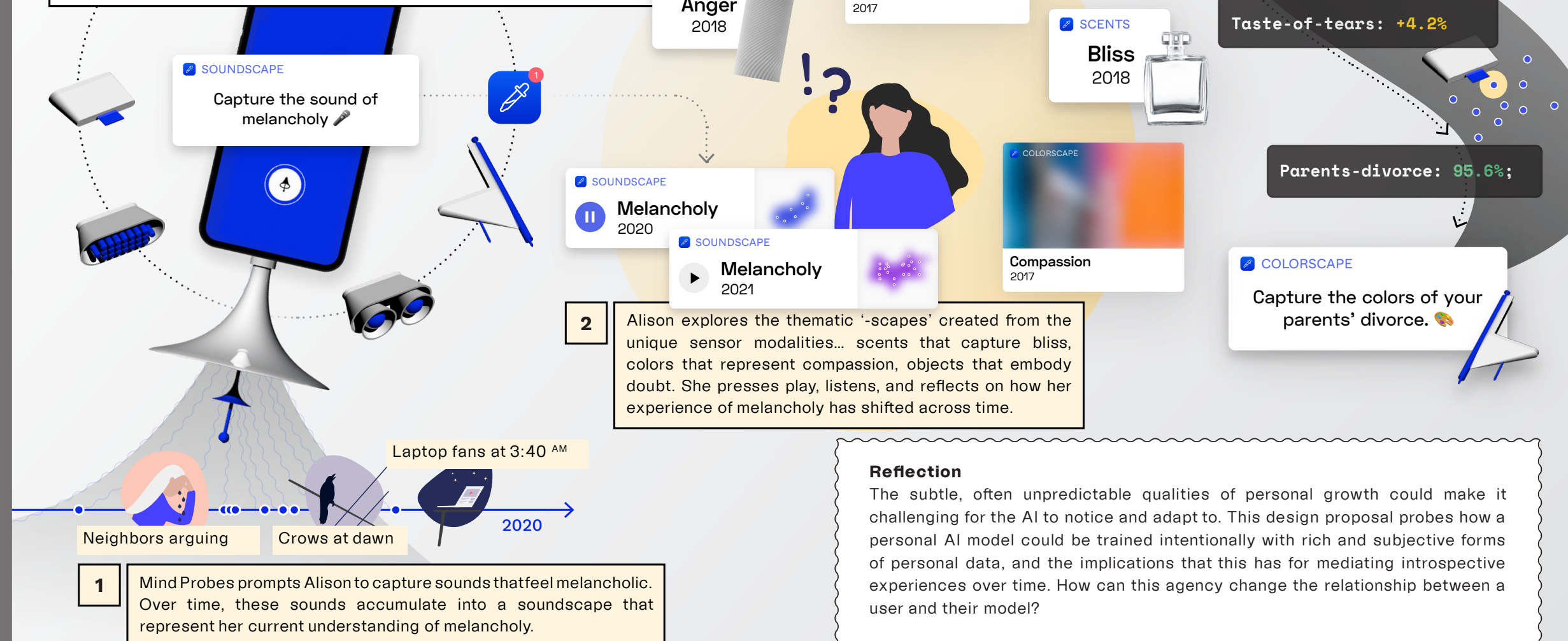
Reflection

This proposal is bound up in speculation on the possibilities of commercial predictive AI services when augmented with affective data points. It builds on the space created by Spotify's own research into the relationship between music listening practices and personality [6] to explore how integrating a personal AI model with an existing data-driven commercial service could result in more personalised prompts and music listening experiences—but also the new vulnerabilities that might arise.

Mind Probes

As a person encounters new experiences across different stages of life, elements of their identity may stabilize while others could transform [9,11]. An essential part of introspection is looking inward to assess one's emotions and desires in light of personal growth and perceived sense of self [119,135]. If AI applications begin to extend a person's practice of introspection, how should this ongoing dialog be designed? In what ways could a longer-term collaborative relationship between a person and their Introspective AI be nurtured?

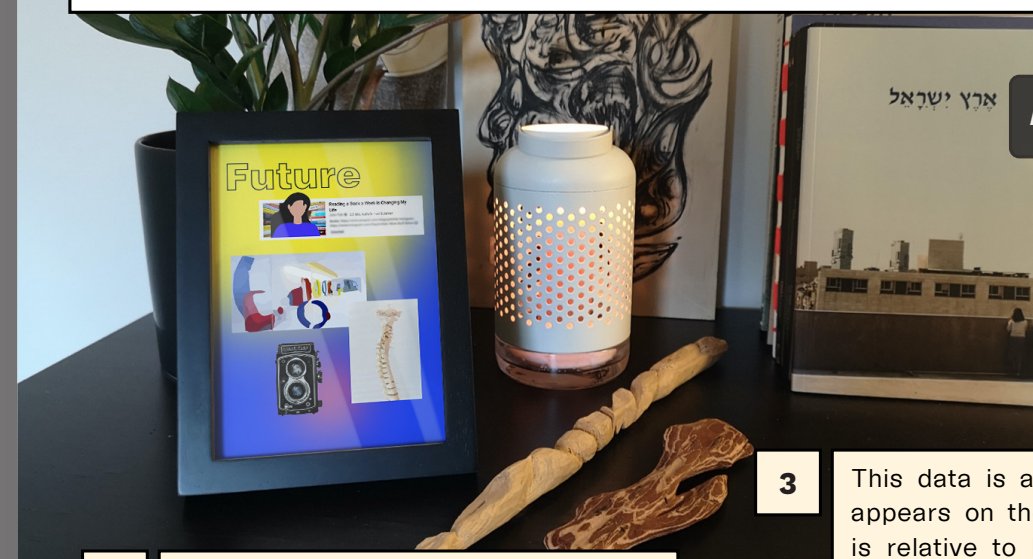
Mind Probes is a smartphone app that works in tandem with external hardware sensors: sound, color, smell, haptic and vision. It prompts the user to collect sensory stimuli from the material world that reflect social and emotional associations—connecting inward associations with encountered phenomena. Mind Probes encourages introspection through long-term activities akin to a scavenger hunt that that supports *collaboration and alignment* through *open-ended experiences*.



Vision Shrine

A common future-looking introspective practice asks people to visualize connections between their perceived actual self and their envisioned ideal self [123]. Introspective AI could offer promising resources to support crafting such visions and in prompting one to engage with assumptions about their ideal self in a playful way.

The ludic Vision Shrine device visually manifests a user's goals, dreams, and desires as data collages—an ideal self-canvas that updates in real-time as it consumes their personal data. Drawing on **confrontation** and **alignment**, the Vision Shrine changes the scale of goals depending on how they are being prioritized in everyday life, as an ongoing dialogue between a user's lived reality and their ideal self.



1 Vision Shrine illustrates Alison's goals with data collages.

2 As Alison is getting ready for bed, the Vision Shrine asks her a question.



"What are you excited to learn?"



"I would really like to get more into painting on canvas. I mean, I have all the materials, but I haven't found the time....I am so inspired by Max Ernst and the magnificent and vibrant worlds that he creates... I would love to get better with that, and dig deeper into my artistic side"

3

This data is analyzed and a Max Ernst painting appears on the canvas. The size of each image is relative to how important the aspiration is in achieving her ideal self. All visions on the canvas are causally connected—as the painting grows, her career at Google shrinks to make room for it.

Artistic-side: +43,2%;

Photography-work: +17%;

A-book-a-week: -78%;

5

As Alison binge-watches tennis videos on YouTube and researches tennis racquets, the Vision Shrine introduces a passion for tennis to the screen and decreases the prioritization of her desire to read books. This passive interaction provokes Alison to contemplate tensions bound to her self-concept and question the consequences of her competing visions.

Load.New-obsession

Tennis-videos: 12hrs;

Google-job: -42%;

4

Alison can haptically interact with the Vision Shrine, pinching and zooming to create a more balanced vision of her ideal future self.

Reflection

Vision Shrine adopts a playful, ludic [48] framing to catalyze intimate confrontations through changing a user's perceived priorities based on their behavior, raising questions around the ranking of personal desires in the context of one's perceived ideal self. Could a system like this lead to inauthentic visions of one's preferred future? What space is there for semi-autonomous applications that **critically** challenge individuals' current desires in relation to their various future goals?

Hello, Cyberself

As AI becomes more sophisticated in understanding and predicting one's emotions, its decision-making processes remain largely hidden to the end-user [25]. This proposal speculates on how one could be offered a playfully **confrontational**, partially **guided** way of engaging predictions generated by their Introspective AI. It probes on how questioning assumptions and **re-aligning** their model could become entangled with introspective practice itself.

Hello, Cyberself offers a conversational window into the assumptions (and biases) that a personal Introspective AI has developed over time. It leverages real-time voice cloning technology [23,64] to speak to you in your own voice. It expresses introspective prompts to you as *you*—embodying your personality traits and beliefs, and then reveals the data 'under the hood' that generated these inferences.

Generate.Assumption

1

Alison is taken aback by Hello, Cyberself's complex confrontational statement. Is she scared of failure? What role does social interaction have on her creative process? She records her response.

"...Most of the time, when I get really excited about projects, it is while talking to friends. But once I'm home alone I lose that spark...I can't find the inspiration. So yes...Maybe I am scared of failure, but I think really that I need to be with other people, to feel their energy..."

Generate.Next-assumption

"I constantly consume content so that I don't have to be alone with my thoughts."

Generate.Next-assumption

I really like being with other people...being incredibly open...but I'd be happier if I said "OK, BYE!" more often.

2

Curious about where this statement came from, Alison unveils the inner workings of the model and explores the data points and inferences that generated the statement.

Sentiment talking

about: **Painting** **Artschool**

Excitement **76%**
Confidence **25%**

"I dont even have much to show"
January 8th, 2020

"I love my art, but its kinda quirky"
November 11th, 2019

"I am so slow with my painting"
October 13th, 2018

"Art is just not my biggest skill"
January 10th, 2020

Needs

Challenges **82%**
Stability **57%**
Excitem **75%**

48 hours
watching Surrealist Art documentaries
July

3

Alison can tangibly change values and to add or remove connections between data points—fine-tuning the model's predictions about her behavioral patterns and creating a tighter alignment between herself and her model.

Reflection

Hello, Cyberself enables users to confront factors that shape how their model formulates assumptions that fuel its behavior. This probes at how we can design introspective interactions that support and challenge the idea of *authenticity* in relation to how a person perceives their identity and sense of self. What tensions are created by encountering a digitally-mediated imprint of one's self—does it draw away from the richness of life experiences that are not so readily captured and portrayed by interactive technology or does it create unique introspective interactions?

Dream Streams

Dreams offer a way for your subconscious mind to communicate with your conscious self. Dreaming offers an important window into phenomena that shape our innermost desires, fears, and goals [28,111]. As such, dreams can offer important resources for introspection [70,138]. This proposal speculates on how sleep and active recall of dream experiences could be mobilized by an Introspective AI to generate **new open-ended** and **guided introspective** resources.

Dream Streams combines a dreamcatcher-like device paired with mobile applications to offer windows into one's subconscious and open new pathways to self-awareness.

1

Alison is sleeping; Dream Streams is not. It is busy assimilating audio recordings of her—slight utterances and sleep talking—with sleep monitoring data from her smartwatch, smart speaker, and smart mattress pad.



Extract.Sleep-data

2

As Alison is waking up and fragments of her dreams are still vivid, she is prompted to audio journal.

*I had the strangest dreams! I was in a landscape that reminded me of Tel Aviv...with **sandy beaches** and **monolith-like structures** and yet suddenly this was a huge room with **pillars of green marble**...it reminded me of **Gringotts**. I felt uncomfortable under the weight of the ceiling. My parents walked in from their bedroom, eyes wide with fear, the rollercoaster*



Analyze.Sleep-journal

3

Afterward, Alison looks into the center of the device and is brought back to green marble columns and sandy beaches. She experiences an open-ended impressionistic visual stream of generated media, representative of last night's dream.



Dream Patterns

You have visited **Gringotts** in **7** of your dreams.

PROMPT

Explore these journal entries and consider how Harry Potter has shaped your moral compass.

A Strange Journey

My perspective morphed once again to a very fast flying mode and, this was leading into a big rollercoaster, a bit like **Gringotts** at Harry Potter. I flew this rollercoaster in first perspective and landed in a

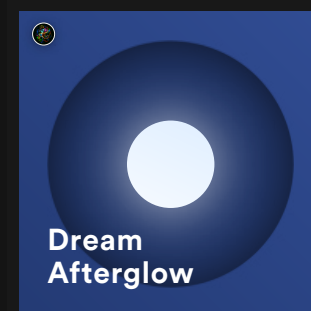
Goblin Office Hours

He sorted through parts of the weapons and had a second room where other co-workers worked in **Gringotts**. His office was a quite small and oldschool like room and he seemed to be very relaxed.

4

Dream Streams also prompts Alison with a guided introspective activity. The connected Dream Patterns app quantifies trends in Alison's dreams and prompts her to dissect recurring patterns, such as locations, characters, or specific fears.

Uniquely yours



Dream Afterglow

The songs that take you back into your dreamy mind.

5

As Alison is commuting to work, she wants to return to her subconscious world—she listens to the Spotify playlist that Dream Streams produced from its interpretation of her dreams. This playlist aims to capture the emotional texture of the dream while exploring new songs in its afterglow.

Reflection

Dream Streams explores granting an Introspective AI access to one's subconscious activities and sleeping behavior. What might be revealed through looking inward our self at sleep? Could unknown or forgotten personality traits and orientations be surfaced? How authentic would an AI's interpretation of one's dreams be viewed? And could such perceptions change over time as we begin to understand our dreams from different perspectives as does the AI?

Deep Talk Report

A natural trigger for introspection is socially engaging in deep conversations with trusted companions. Through deep talk conversations, contrasting perspectives on one's behaviors may emerge [37]. Yet, these unique self-awareness insights can be fleeting, fading away soon after the conversation. This proposal explores how an Introspective AI might recognize, capture, and re-manifest these moments at an optimum time in one's future.

Deep Talk Report is an application that audits verbal and written conversations to find and classify deep exchanges. These analyzed accounts are curated *guided introspective sessions* and are also woven together to generate broader thematic reports, which *confronts* users with emerging patterns over time. Themes are further explored through the contextualized introspective activities that are proposed in each report.

1

Alison is at the beach with Helene. She unloads—she is overwhelmed by the pressure of work and the precarity of her life. Always listening, the Deep Talk Report application classifies and analyzes the conversation.

DEEP TALK REPORT
Deep conversation detected.
Now Recording...

2

Friday afternoon, as a part of her introspective practice, Alison opens the Deep Talk Report application to re-experience her recent conversations.

A conversation with Helene, about Pillars of Life

ME
"I feel like everything around me is breaking down...my life is a house of cards."

"I want to be more resilient, you know what I mean? I want to feel more on top of things!"

HELENE
"It's not all on you Alison! There are some strong pillars in your life!"

Grumpy at Work

My Mental Health

MENTAL

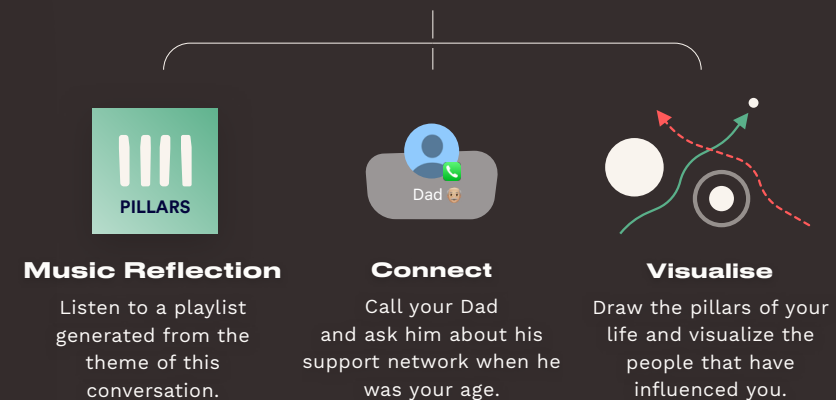
Paul

HEALTH

4

Alison explores the thematic report about her partner, Paul. She is confronted by the different ways that she talks about her relationship to different people and the different perspectives they hold: her parents, her sister, Helene, and even him.

Here are 3 Introspective avenues



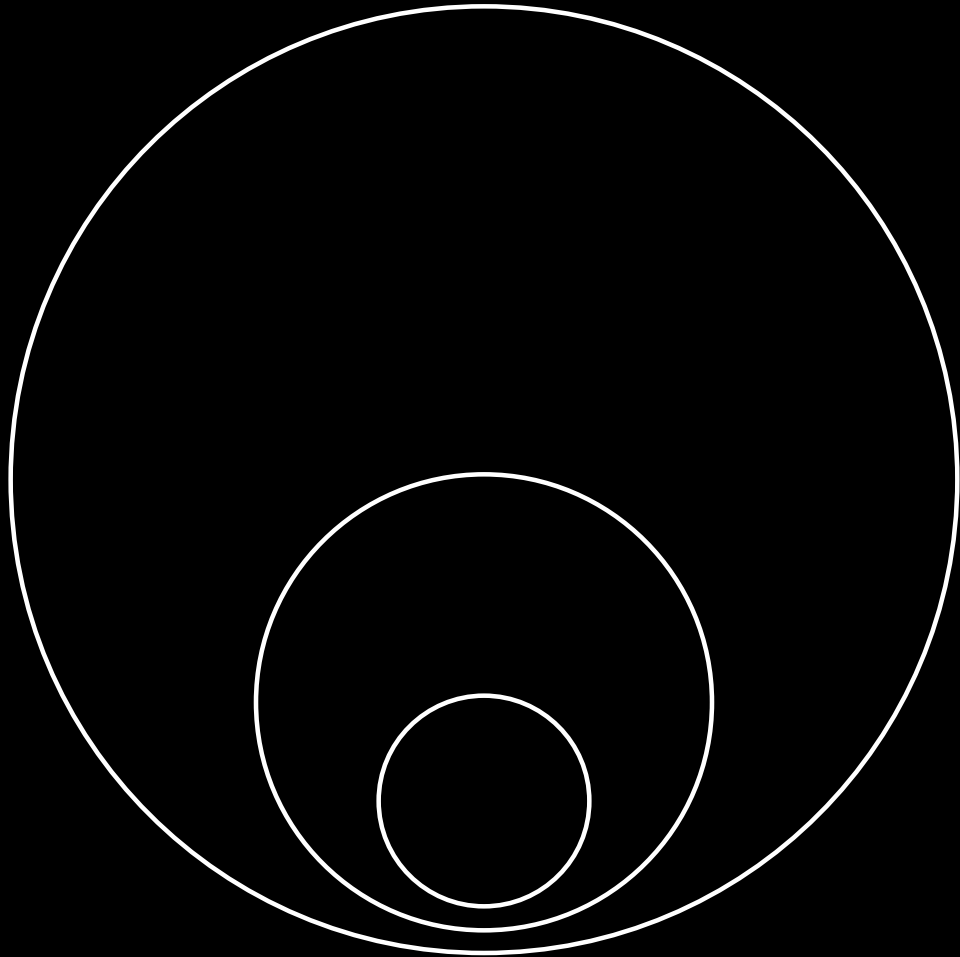
3

Alison decides to continue unpacking the pillars of her life and calls her father.

Reflection

Several issues are bound up in this design proposal. Would users willingly cede autonomy to their Introspective AI, trusting it to extract and guide dialogue in the right way? Could the system curate content in ways that may be biased? Would this persistent, growing, and increasingly entangled archive of deep exchange records shape or change the initial ritual of simply deep talking with loved ones?

DISCUSSION, CONCLUSION & FUTURE WORK



6

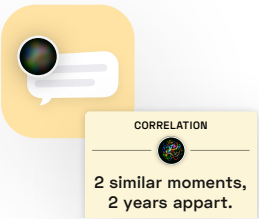
DISCUSSION

Designing interactive systems to support experiences of self-introspection raises new possibilities and challenges for the HCI and design communities. However, current digital products are limited in their near-exclusive focus facilitating the process of introspective journaling, where AI is applied to organize and analyze entries and by drawing only on data that end users explicitly provide them. This investigation explores how AI might operate in this context as a context-aware mediator between users and aggregations of their data. Our pictorial This thesis research contributes five generative themes and seven design proposals that motivate and expand the Introspective AI design space. The contribution of this work is primarily visual, leveraging methods of speculative design and design fiction to manifest possible future interventions in ways that are approachable for an audience to respond to. Next, I reflectively consider each design proposal to continue discussing opportunities and issues that are imbued within these possible futures.

Understanding Starting Points & Dilemmas

Initiating introspective activities in ways that are intelligible and personal is essential to developing a relationship with an introspective AI.

- + *Everyday Personality* and *Music Reflection* illustrate how brief, contextually relevant yet open-ended prompts might lead to experiences of introspection. The combination of short prompts and occasional confrontations presents a practical technique that could be mobilized by designers to keep people self-aware of their future goals while building the capacity to choose new paths for their future selves. Yet, inferring when the ‘optimal’ time is to surface positive patterns or negative discrepancies recognized by the AI that might confirm or question a person’s path to



their ideal future self will need to be handled carefully. There is a need for future research to investigate where boundaries of social acceptability lie when an Introspective AI mediates and even perhaps disrupts a person’s behavioural trends and desires for their own ‘good.’

These two design proposals also point to potential benefits in, at least initially, manifesting a person’s introspective AI through familiar applications and commercial products (e.g., messaging applications and music streaming services). A key issue in successfully fostering the adoption of radically new technology is balancing novelty and typicality, where initially a technology may seem familiar and then for more sophisticated, unique uses to emerge [56,79]. This tactic could provide an already familiar context for a person to begin a relationship with their Introspective AI that can scale into more complex applications over time. This suggests a need for future research to investigate when, how, and in what form subsequent Introspective AI applications would arrive and the ways in which consensus on these decisions might be reached, perhaps even through deliberation among the person and their AI counterpart.

Embracing Divergent Strategies

It is inevitable that there will be inaccuracies in the introspective AI model of a person as they accumulate life experiences over time. My research makes clear there is an opportunity for designers and researchers to explore how cycles of collaboration and alignment can be productively facilitated among person and their AI. In parallel with recent work calling for the HCI community to embrace the quality of uncertainty in human-AI relations as a design material (e.g., [12]).

- + *Mind Probes* materializes the shared labour bound up in long-term human-introspective AI relations by asking the end-user to collect personal data that is required to improve the model. This approach demonstrates how designers can mobilize the technique of extending introspective practises to subtly prompt collaboration and alignment in ways that are introspective and reciprocal.





- ✦ **Vision Shrine** extends an established introspective technique through materializing tensions between desires of the current self and visions of the ideal self. This approach demonstrates that prior HCI research [47,48,121] that applies ludic design to prompt situated experiences of interpretation and sustain interactions can be practically leveraged in the introspective AI design space. Additionally, there is an opportunity for future HCI research to investigate the effectiveness of ludic interaction design [49] in mitigating potential tensions that could emerge if an introspective AI mode more actively resisted or protested a person's desires to depart their envisioned ideal future self.

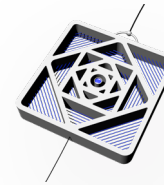


- ✦ **Hello, Cyberself** proposes a design strategy that enables a person to directly manipulate their Intro-spective AI. This technique could be used by designers when a user and their IAI model drifts too far out of alignment, and a hands-on approach is needed to resume the course (opposed to the more passive techniques proposed in Mind Probes and Vision Shrine). This also suggests a need for future research to investigate the extent to which such interactions would be perceived by people to nurture their AI or if such actions would compromise their model's authenticity and trustworthiness.

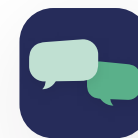
Collectively, these three proposals demonstrate different design techniques, tactics, and strategies that designers can draw on to address uncertainties and imperfections that will emerge in human-introspective AI relations. They also make clear that successfully fostering longer-term adoption will require designing in support of shifting levels of autonomy, trust, and vulnerability among people and their introspective AI.

Leveraging Introspective Data from Diverse Contexts

Dream Streams and Deep Talk Report explore opportunities for incorporating personal data from different levels of perceptual awareness.



- ✦ **Dream Streams** presents new, largely unexplored, opportunities for mobilizing partially known, buried, or unknown subconscious behaviour and associations to extend their self-awareness through new kinds of introspective resources.



- ✦ Alternatively, **Deep Talk Report** preserves and enhances records of deep social exchanges with thematic overlaps across different contexts and people as interactive resources. This approach suggests an opportunity for designers to generate more socially or interpersonally-oriented introspective AI applications that engage directly with the social relations that shape a person's current and ideal self. Yet, there is a need for future research to explore the extent to which divorcing these exchanges from their original context and reducing them to interconnected bits might alter their perceived value and lead to added social expectations.

Collectively, these proposals suggest opportunities for future research and practice to develop the introspective AI design space through exploring social attitudes toward leveraging personal data collected from the subconscious, to the casual, to the deep and intentional.

CONCLUSION & FUTURE WORK

In summary, my thesis research offers contributions that extend growing calls in the HCI community to: (i) enable people to gain alternative perspectives on their life through personal data (e.g., [39,40,77,94,110,118,132]), (ii) critically explore AI as a design material (e.g., [12,58,80,82,88,89]), (iii) and inquire into potential technological futures and unpack their promise and peril (e.g., [7,27,31,108,127]). This research aims to inspire, frame, and expand future research inquiring into the questions of:

- + What roles personal data could play in helping us introspectively consider who we are and desire to be?
- + How might AI play collaborative roles in this endeavor over time?
- + What kinds of new opportunities and consequences exist in the introspective AI design space, and how should we reconcile them?

As the next steps for this project are currently ongoing, I will provide a brief overview of recent developments sparked by this thesis works. To make the seven speculative more accessible, I created video scenarios that animate and narrate each design proposal in detail. The videos made it easier to communicate the scenarios to end-users, as we are currently conducting a study that probes on their social attitudes regarding AI-mediated introspection. The study draws on approaches from speculative enactment [38] and user enactments [96] and asks participants to co-speculate and voice their personal stories, ideas and concerns prompted by the videos. This study aims to formulize and report on the wide variety of responses in the form of a journal article. I hope this study helps further formulate the emerging design space of Introspective AI and offers new lenses to design and imagine preferred services and products.

REFERENCES

7

[1] 1-Life Inc. 2020. MertiLife: A vehicle for lifestyle change. Retrieved from <https://apps.apple.com/ca/app/metrilife/id1462361987>

[2] Rediet Abebe. Forbes Insights: Why AI Needs To Reflect Society. Forbes. Retrieved January 8, 2022 from <https://www.forbes.com/sites/insights-intelai/2018/11/29/why-ai-needs-to-reflect-society/>

[3] David Abram. 2012. The spell of the sensuous: Perception and language in a more-than-human world. Vintage.

[4] Saleema Amershi, Maya Cakmak, William Bradley Knox, and Todd Kulesza. 2014. Power to the People: The Role of Humans in Interactive Machine Learning. *AI Magazine* 35, 4 (December 2014), 105–120. DOI:<https://doi.org/10.1609/aimag.v35i4.2513>

[5] Saleema Amershi, James Fogarty, and Daniel Weld. 2012. Re-group: interactive machine learning for on-demand group creation in social networks. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. Association for Computing Machinery, New York, NY, USA, 21–30. Retrieved August 18, 2021 from <http://doi.org/10.1145/2207676.2207680>

[6] Ian Anderson, Santiago Gil, Clay Gibson, Scott Wolf, Will Shapiro, Oguz Semerci, and David M. Greenberg. 2021. “Just the Way You Are”: Linking Music Listening on Spotify and Personality. *Social Psychological and Personality Science* 12, 4 (May 2021), 561–572. DOI:<https://doi.org/10.1177/1948550620923228>

[7] James Auger. 2013. Speculative design: crafting the speculation. *Digital Creativity* 24, 1 (March 2013), 11–35. DOI:<https://doi.org/10.1080/14626268.2013.767276>

[8] Kartik Balasubramaniam. 2019. Have you taught your machine yet? Medium. Retrieved December 30, 2021 from <https://towardsdatascience.com/have-you-taught-your-machine-yet-45540b7e646b>

[9] Russell W. Belk. 1988. Possessions and the extended self. *Journal of consumer research* 15, 2 (1988), 139–168.

[10] Russell W. Belk. 1990. The role of possessions in constructing and maintaining a sense of past. *ACR North American Advances* (1990).

[11] Russell W. Belk. 2013. Extended self in a digital world. *Journal of consumer research* 40, 3 (2013), 477–500.

[12] Jesse Josua Benjamin, Arne Berger, Nick Merrill, and James Pierce. 2021. Machine Learning Uncertainty as a Design Material: A Post-Phenomenological Inquiry. *arXiv preprint arXiv:2101.04035* (2021).

[13] Tolga Bolukbasi, Kai-Wei Chang, James Y Zou, Venkatesh Saligrama, and Adam T Kalai. 2016. Man is to Computer Programmer as Woman is to Homemaker? Debiasing Word Embeddings. In *Advances in Neural Information Processing Systems*, Curran Associates, Inc. Retrieved February 2, 2022 from <https://proceedings.neurips.cc/paper/2016/hash/a486cd07e4ac3d270571622f4f316ec5-Abstract.html>

[14] Arielle Bonneville-Roussy, Peter J. Rentfrow, Man K. Xu, and Jeff Potter. 2013. Music through the ages: Trends in musical engagement and preferences from adolescence through middle adulthood. *Journal of Personality and Social Psychology* 105, 4 (2013), 703–717. DOI:<https://doi.org/10.1037/a0033770>

[15] Arielle Bonneville-Roussy, Peter J. Rentfrow, Man K. Xu, and Jeff Potter. 2013. Music through the ages: Trends in musical engagement and preferences from adolescence through middle adulthood. *Journal of Personality and Social Psychology* 105, 4 (October 2013), 703–717. DOI:<https://doi.org/10.1037/a0033770>

[16] Edwin G. Boring. 1953. A history of introspection. *Psychological bulletin* 50, 3 (1953), 169.

[17] Nick Bostrom. 2014. *Superintelligence: paths, dangers, strategies* (First edition ed.). Oxford University Press, Oxford.

[18] Lisa Burton and Jonathan Lent. 2016. The Use of Vision Boards as a Therapeutic Intervention. *Journal of Creativity in Mental Health* 11, 1 (January 2016), 52–65. DOI:<https://doi.org/10.1080/15401383.2015.1092901>

[19] Alex Byrne. 2005. Introspection. *Philosophical Topics* 33, 1 (2005), 79–104.

[20] Michelle Carney, Barron Webster, Irene Alvarado, Kyle Phillips, Noura Howell, Jordan Griffith, Jonas Jongejan, Amit Pitaru,

- and Alexander Chen. 2020. Teachable Machine: Approachable Web-Based Tool for Exploring Machine Learning Classification. In *Extended Abstracts of the 2020 CHI Conference on Human Factors in Computing Systems (CHI EA '20)*, Association for Computing Machinery, New York, NY, USA, 1–8. DOI:<https://doi.org/10.1145/3334480.3382839>
- [21] Amy Yo Sue Chen, William Odom, Ce Zhong, Henry Lin, and Tal Amram. 2019. Chronoscope: Designing Temporally Diverse Interactions with Personal Digital Photo Collections. In *Proceedings of the 2019 on Designing Interactive Systems Conference*, 799–812.
- [22] Brian Christian. 2020. *The Alignment Problem: Machine Learning and Human Values*. W. W. Norton & Company.
- [23] Jemine Corentin. 2019. Real-Time-Voice-Cloning. Retrieved from <https://github.com/CorentinJ/Real-Time-Voice-Cloning>
- [24] Kate Crawford. 2021. *Atlas of AI: power, politics, and the planetary costs of artificial intelligence*. Yale University Press, New Haven.
- [25] Kate Crawford and Vladan Joler. 2018. *Anatomy of an AI System*. AI NOW Institute (2018), 2018.
- [26] Amber L. Cushing. 2013. “It’s stuff that speaks to me”: Exploring the characteristics of digital possessions. *Journal of the American Society for Information Science and Technology* 64, 8 (2013), 1723–1734.
- [27] Lorenzo Davoli and Johan Redström. 2014. Materializing Infrastructures for Participatory Hacking. In *Proceedings of the 2014 Conference on Designing Interactive Systems (DIS '14)*, ACM, New York, NY, USA, 121–130. DOI:<https://doi.org/10.1145/2598510.2602961>
- [28] Daniel C. Dennett. 1976. Are dreams experiences? *The Philosophical Review* 85, 2 (1976), 151–171.
- [29] Tia DeNora. 1999. Music as a technology of the self. *Poetics* 27, 1 (1999), 31–56.
- [30] Audrey Desjardins and Aubree Ball. 2018. Revealing Tensions in Autobiographical Design in HCI. In *Proceedings of the 2018 Designing Interactive Systems Conference*, ACM, Hong Kong China,

753–764. DOI:<https://doi.org/10.1145/3196709.3196781>

- [31] Audrey Desjardins, Jeremy E. Viny, Cayla Key, and Nouela Johnston. 2019. Alternative Avenues for IoT: Designing with Non-Stereotypical Homes. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems (CHI '19)*, Association for Computing Machinery, New York, NY, USA, 1–13. DOI:<https://doi.org/10.1145/3290605.3300581>
- [32] Audrey Desjardins and Ron Wakkary. 2016. Living In A Prototype: A Reconfigured Space. In *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*, ACM, San Jose California USA, 5274–5285. DOI:<https://doi.org/10.1145/2858036.2858261>
- [33] Laura Devendorf and Kimiko Ryokai. 2015. Being the Machine: Reconfiguring Agency and Control in Hybrid Fabrication. In *Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems*, ACM, Seoul Republic of Korea, 2477–2486. DOI:<https://doi.org/10.1145/2702123.2702547>
- [34] Lina Dib, Daniela Petrelli, and Steve Whittaker. 2010. Sonic souvenirs: exploring the paradoxes of recorded sound for family remembering. In *Proceedings of the 2010 ACM conference on Computer supported cooperative work*, 391–400.
- [35] Graham Dove, Kim Halskov, Jodi Forlizzi, and John Zimmerman. 2017. UX Design Innovation: Challenges for Working with Machine Learning as a Design Material. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems*, ACM, 278–288. Retrieved from <http://dl.acm.org/citation.cfm?id=3025739>
- [36] Tijs Duel, David M. Frohlich, Christian Kroos, Yong Xu, Philip J. B. Jackson, and Mark D. Plumbley. 2018. Supporting Audiography: Design of a System for Sentimental Sound Recording, Classification and Playback. In *HCI International 2018 – Posters’ Extended Abstracts (Communications in Computer and Information Science)*, Springer International Publishing, Cham, 24–31. DOI:https://doi.org/10.1007/978-3-319-92270-6_4
- [37] Carolyn Ellis. 1991. Sociological introspection and emotional experience. *Symbolic interaction* 14, 1 (1991), 23–50.
- [38] Chris Elsdén, David Chatting, Abigail C. Durrant, Andrew Garbett,

- Bettina Nissen, John Vines, and David S. Kirk. 2017. On Speculative Enactments. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems*, ACM, Denver Colorado USA, 5386–5399. DOI:<https://doi.org/10.1145/3025453.3025503>
- [39] Chris Elsdén, David S. Kirk, and Abigail C. Durrant. 2016. A Quantified Past: Toward Design for Remembering With Personal Informatics. *Human–Computer Interaction* 31, 6 (November 2016), 518–557. DOI:<https://doi.org/10.1080/07370024.2015.1093422>
- [40] Chris Elsdén, Mark Selby, Abigail Durrant, and David Kirk. 2016. Fitter, happier, more productive: what to ask of a data-driven life. *interactions* 23, 5 (2016), 45–45.
- [41] Uljana Feest. 2012. Introspection as a method and introspection as a feature of consciousness. *Inquiry* 55, 1 (2012), 1–16.
- [42] Shi Feng and Jordan Boyd-Graber. 2019. What can AI do for me? evaluating machine learning interpretations in cooperative play. In *Proceedings of the 24th International Conference on Intelligent User Interfaces (IUI '19)*, Association for Computing Machinery, New York, NY, USA, 229–239. DOI:<https://doi.org/10.1145/3301275.3302265>
- [43] David Frohlich and Rachel Murphy. 2000. The Memory Box. *Personal Technologies* 4, 4 (December 2000), 238–240. DOI:<https://doi.org/10.1007/BF02391566>
- [44] Bill Gaver and Heather Martin. 2000. Alternatives: Exploring Information Appliances Through Conceptual Design Proposals. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '00)*, ACM, New York, NY, USA, 209–216. DOI:<https://doi.org/10.1145/332040.332433>
- [45] William Gaver. 2011. Making spaces: how design workbooks work. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, ACM, Vancouver BC Canada, 1551–1560. DOI:<https://doi.org/10.1145/1978942.1979169>
- [46] William W. Gaver. 2006. The video window: my life with a ludic system. *Pers Ubiquit Comput* 10, 2–3 (April 2006), 60–65. DOI:<https://doi.org/10.1007/s00779-005-0002-2>
- [47] William W. Gaver, John Bowers, Kirsten Boehner, Andy Boucher,

David W.T. Cameron, Mark Hauenstein, Nadine Jarvis, and Sarah Pennington. 2013. Indoor Weather Stations: Investigating a Ludic Approach to Environmental HCI Through Batch Prototyping. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '13)*, ACM, New York, NY, USA, 3451–3460. DOI:<https://doi.org/10.1145/2470654.2466474>

- [48] William W. Gaver, John Bowers, Andrew Boucher, Hans Gellerson, Sarah Pennington, Albrecht Schmidt, Anthony Steed, Nicholas Villars, and Brendan Walker. 2004. The Drift Table: Designing for Ludic Engagement. In *CHI '04 Extended Abstracts on Human Factors in Computing Systems (CHI EA '04)*, ACM, New York, NY, USA, 885–900. DOI:<https://doi.org/10.1145/985921.985947>
- [49] William W. Gaver, John Bowers, Andrew Boucher, Hans Gellerson, Sarah Pennington, Albrecht Schmidt, Anthony Steed, Nicholas Villars, and Brendan Walker. 2004. The drift table: designing for ludic engagement. In *Extended abstracts of the 2004 conference on Human factors and computing systems - CHI '04*, ACM Press, Vienna, Austria, 885. DOI:<https://doi.org/10.1145/985921.985947>
- [50] Elisa Giaccardi. Things as Co-ethnographers: Implications of a Thing Perspective for Design and Anthropology. 20.
- [51] Elisa Giaccardi and Johan Redström. 2020. Technology and More-Than-Human Design. *Design Issues* 36, 4 (September 2020), 33–44. DOI:https://doi.org/10.1162/desi_a_00612
- [52] Dorota Glowacka, Tuukka Ruotsalo, Ksenia Konuyshkova, kumaripaba Athukorala, Samuel Kaski, and Giulio Jacucci. 2013. Directing exploratory search: reinforcement learning from user interactions with keywords. In *Proceedings of the 2013 international conference on Intelligent user interfaces (IUI '13)*, Association for Computing Machinery, New York, NY, USA, 117–128. DOI:<https://doi.org/10.1145/2449396.2449413>
- [53] Stephen J. Gould. 1995. Researcher introspection as a method in consumer research: Applications, issues, and implications. *Journal of consumer research* 21, 4 (1995), 719–722.
- [54] Lars Hallnäs and Johan Redström. 2001. Slow technology—designing for reflection. *Personal and ubiquitous computing* 5, 3 (2001), 201–212.

- [55] Adam Harvey. Exposing.ai: Brainwash Dataset. Exposing.ai. Retrieved January 8, 2022 from <https://exposing.ai/datasets/brainwash/>
- [56] Paul Hekkert, Dirk Snelders, and Piet C. W. Van Wieringen. 2003. 'Most advanced, yet acceptable': Typicality and novelty as joint predictors of aesthetic preference in industrial design. *British Journal of Psychology* 94, 1 (2003), 111–124. DOI:<https://doi.org/10.1348/000712603762842147>
- [57] David Hesmondhalgh. 2008. Towards a critical understanding of music, emotion and self-identity. *Consumption, markets and culture* 11, 4 (2008), 329–343.
- [58] Tad Hirsch, Kritzia Merced, Shrikanth Narayanan, Zac E. Imel, and David C. Atkins. 2017. Designing Contestability: Interaction Design, Machine Learning, and Mental Health. In *Proceedings of the 2017 Conference on Designing Interactive Systems (DIS '17)*, Association for Computing Machinery, Edinburgh, United Kingdom, 95–99. DOI:<https://doi.org/10.1145/3064663.3064703>
- [59] Tad Hirsch, Christina Soma, Kritzia Merced, Patty Kuo, Aaron Dembe, Derek D. Caperton, David C. Atkins, and Zac E. Imel. 2018. "It's hard to argue with a computer": Investigating Psychotherapists' Attitudes towards Automated Evaluation. In *Proceedings of the 2018 Designing Interactive Systems Conference (DIS '18)*, Association for Computing Machinery, New York, NY, USA, 559–571. DOI:<https://doi.org/10.1145/3196709.3196776>
- [60] Humantic. Humantic AI | Personality Based Prospect And Talent Intelligence. Retrieved December 18, 2021 from <https://humantic.ai/>
- [61] Insight Network Inc. Insight Timer - #1 Free Meditation App for Sleep, Relax & More. Retrieved January 2, 2022 from <https://insighttimer.com>
- [62] AI Now Institute. 2019. AI and Climate Change: How they're connected, and what we can do about it. Medium. Retrieved January 7, 2022 from <https://medium.com/@AINowInstitute/ai-and-climate-change-how-theyre-connected-and-what-we-can-do-about-it-6aa8d0f5b32c>
- [63] Lilly Irani. 2016. The hidden faces of automation. *XRDS* 23, 2 (De-

cember 2016), 34–37. DOI:<https://doi.org/10.1145/3014390>

- [64] Ye Jia, Yu Zhang, Ron J. Weiss, Quan Wang, Jonathan Shen, Fei Ren, Zhifeng Chen, Patrick Nguyen, Ruoming Pang, Ignacio Lopez Moreno, and Yonghui Wu. 2018. Transfer learning from speaker verification to multispeaker text-to-speech synthesis. In *Proceedings of the 32nd International Conference on Neural Information Processing Systems (NIPS'18)*, Curran Associates Inc., Red Hook, NY, USA, 4485–4495.
- [65] Nicola Jones. 2018. How to stop data centres from gobbling up the world's electricity. *Nature* 561, 7722 (September 2018), 163–166. DOI:<https://doi.org/10.1038/d41586-018-06610-y>
- [66] Ben Jonson. 2005. Design ideation: the conceptual sketch in the digital age. *Design Studies* 26, 6 (November 2005), 613–624. DOI:<https://doi.org/10.1016/j.destud.2005.03.001>
- [67] Os Keyes. 2018. The Misgendering Machines: Trans/HCI Implications of Automatic Gender Recognition. *Proc. ACM Hum.-Comput. Interact.* 2, CSCW (November 2018), 1–22. DOI:<https://doi.org/10.1145/3274357>
- [68] Vera Khovanskaya, Eric P.S. Baumer, Dan Cosley, Stephen Volda, and Geri Gay. 2013. "Everybody knows what you're doing": a critical design approach to personal informatics. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '13)*, Association for Computing Machinery, New York, NY, USA, 3403–3412. DOI:<https://doi.org/10.1145/2470654.2466467>
- [69] Kyung Jin Kim, Sangsu Jang, Bomin Kim, Hyosun Kwon, and Young-Woo Park. 2019. muRedder: Shredding Speaker for Ephemeral Musical Experience. In *Proceedings of the 2019 on Designing Interactive Systems Conference (DIS '19)*, ACM, New York, NY, USA, 127–134. DOI:<https://doi.org/10.1145/3322276.3322362>
- [70] Alexandra Kitson, Thecla Schiphorst, and Bernhard E. Riecke. 2018. Are You Dreaming? A Phenomenological Study on Understanding Lucid Dreams as a Tool for Introspection in Virtual Reality. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems*. Association for Computing Machinery, New York, NY, USA, 1–12. Retrieved February 7, 2021 from <https://doi.org/10.1145/3173574.3173917>

- [71] Susan Schultz Kleine, Robert E. Kleine III, and Chris T. Allen. 1995. How is a possession “me” or “not me”? Characterizing types and an antecedent of material possession attachment. *Journal of consumer research* 22, 3 (1995), 327–343.
- [72] Sandjar Kozubaev, Chris Elsdén, Noura Howell, Marie Louise Juul Søndergaard, Nick Merrill, Britta Schulte, and Richmond Y. Wong. 2020. Expanding Modes of Reflection in Design Futuring. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems*. Association for Computing Machinery, New York, NY, USA, 1–15. Retrieved August 16, 2021 from <http://doi.org/10.1145/3313831.3376526>
- [73] Mike Kuniavsky, Elizabeth Churchill, and Molly Wright Steenson. 2017. The 2017 aaai spring symposium series technical reports: Designing the user experience of machine learning systems. Technical Report SS-17-04. Palo Alto, California.
- [74] Himabindu Lakkaraju, Ece Kamar, Rich Caruana, and Jure Leskovec. 2019. Faithful and Customizable Explanations of Black Box Models. In *Proceedings of the 2019 AAAI/ACM Conference on AI, Ethics, and Society (AIES ’19)*, Association for Computing Machinery, New York, NY, USA, 131–138. DOI:<https://doi.org/10.1145/3306618.3314229>
- [75] Tuck W Leong, Frank Vetere, and Steve Howard. 2005. The Serendipity Shuffle. In *Proceedings of the 17th Australia Conference on Computer-Human Interaction: Citizens Online: Considerations for Today and the Future (OZCHI ’05)*, Computer-Human Interaction Special Interest Group (CHISIG) of Australia, Narrabundah, Australia, Australia, 1–4. Retrieved September 18, 2018 from <http://dl.acm.org/citation.cfm?id=1108368.1108428>
- [76] Tim Hwang Levy Karen. 2015. “The Cloud” and Other Dangerous Metaphors. *The Atlantic*. Retrieved October 5, 2021 from <https://www.theatlantic.com/technology/archive/2015/01/the-cloud-and-other-dangerous-metaphors/384518/>
- [77] Ian Li, Anind K. Dey, and Jodi Forlizzi. 2011. Understanding my data, myself: supporting self-reflection with ubicomp technologies. In *Proceedings of the 13th international conference on Ubiquitous computing (UbiComp ’11)*, Association for Computing Machinery, New York, NY, USA, 405–414. DOI:<https://doi.org/10.1145/2030112.2030166>
- [78] Joseph Lindley, Haider Ali Akmal, Franziska Pilling, and Paul Coulton. 2020. Researching AI Legibility through Design. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems*. Association for Computing Machinery, New York, NY, USA, 1–13. Retrieved August 18, 2021 from <http://doi.org/10.1145/3313831.3376792>
- [79] Joseph Lindley, Paul Coulton, and Miriam Sturdee. 2017. Implications for Adoption. In *Proceedings of the 2017 CHI Conference on Human Factors in Computing Systems (CHI ’17)*, Association for Computing Machinery, New York, NY, USA, 265–277. DOI:<https://doi.org/10.1145/3025453.3025742>
- [80] Joseph Lindley and Robert Potts. 2014. A Machine Learning: An Example of HCI Prototyping with Design Fiction. In *Proceedings of the 8th Nordic Conference on Human-Computer Interaction: Fun, Fast, Foundational (NordiCHI ’14)*, ACM, New York, NY, USA, 1081–1084. DOI:<https://doi.org/10.1145/2639189.2670281>
- [81] Nirav Malsattar, Tomo Kihara, and Elisa Giaccardi. 2019. Designing and Prototyping from the Perspective of AI in the Wild. In *Proceedings of the 2019 on Designing Interactive Systems Conference (DIS ’19)*, Association for Computing Machinery, New York, NY, USA, 1083–1088. DOI:<https://doi.org/10.1145/3322276.3322351>
- [82] Michael Mateas. 2001. Expressive AI: A hybrid art and science practice. *Leonardo* 34, 2 (2001), 147–153.
- [83] David McGookin. 2019. Reveal: Investigating Proactive Location-Based Reminiscing with Personal Digital Photo Repositories. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems (CHI ’19)*, Association for Computing Machinery, New York, NY, USA, 1–14. DOI:<https://doi.org/10.1145/3290605.3300665>
- [84] Mohamed Mostafa, Tom Crick, Ana C. Calderon, and Giles Oatley. 2016. Incorporating Emotion and Personality-Based Analysis in User-Centered Modelling. *arXiv:1608.03061 [cs]* (August 2016). Retrieved December 18, 2021 from <http://arxiv.org/abs/1608.03061>
- [85] Condé Nast. 2021. The Dark Side of Congo’s Cobalt Rush. *The New Yorker*. Retrieved January 7, 2022 from <https://www.newyorker.com>

- rker.com/magazine/2021/05/31/the-dark-side-of-congos-cobalt-rush
- [86] Carman Neustaedter and Phoebe Sengers. 2012. Autobiographical design in HCI research: designing and learning through use-it-yourself. (2012), 10.
- [87] Iohanna Nicenboim. 2015. Who is the object in the Internet of Things? DOI:<https://doi.org/10.13140/RG.2.1.1747.1205>
- [88] Iohanna Nicenboim. Affective Things: More than Human Design. Retrieved January 20, 2020 from <https://iohanna.com/Affective-Things-More-than-Human-Design>
- [89] Iohanna Nicenboim, Elisa Giaccardi, Marie Louise Juul Søndergaard, Anuradha Venugopal Reddy, Yolande Strengers, James Pierce, and Johan Redström. 2020. More-Than-Human Design and AI: In Conversation with Agents. In Companion Publication of the 2020 ACM Designing Interactive Systems Conference (DIS' 20 Companion), Association for Computing Machinery, New York, NY, USA, 397–400. DOI:<https://doi.org/10.1145/3393914.3395912>
- [90] Warren T. Norman. 1963. Toward an adequate taxonomy of personality attributes: Replicated factor structure in peer nomination personality ratings. *The Journal of Abnormal and Social Psychology* 66, 6 (1963), 574–583. DOI:<https://doi.org/10.1037/h0040291>
- [91] Michael Nunes, Saul Greenberg, and Carman Neustaedter. 2008. Sharing Digital Photographs in the Home Through Physical Mementos, Souvenirs, and Keepsakes. In Proceedings of the 7th ACM Conference on Designing Interactive Systems (DIS '08), ACM, New York, NY, USA, 250–260. DOI:<https://doi.org/10.1145/1394445.1394472>
- [92] William Odom, Richard Banks, David Kirk, Richard Harper, Siân Lindley, and Abigail Sellen. 2012. Technology Heirlooms?: Considerations for Passing Down and Inheriting Digital Materials. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '12), ACM, New York, NY, USA, 337–346. DOI:<https://doi.org/10.1145/2207676.2207723>
- [93] William Odom and Tijs Duel. 2018. On the Design of OLO Radio: Investigating Metadata as a Design Material. In Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems

(CHI '18), Association for Computing Machinery, Montreal QC, Canada, 1–9. DOI:<https://doi.org/10.1145/3173574.3173678>

- [94] William T. Odom, Abigail J. Sellen, Richard Banks, David S. Kirk, Tim Regan, Mark Selby, Jodi L. Forlizzi, and John Zimmerman. 2014. Designing for Slowness, Anticipation and Re-visitation: A Long Term Field Study of the Photobox. In Proceedings of the 32Nd Annual ACM Conference on Human Factors in Computing Systems (CHI '14), ACM, New York, NY, USA, 1961–1970. DOI:<https://doi.org/10.1145/2556288.2557178>
- [95] William Odom, MinYoung Yoo, Henry Lin, Tijs Duel, Tal Amram, and Amy Yo Sue Chen. 2020. Exploring the Reflective Potentialities of Personal Data with Different Temporal Modalities: A Field Study of Olo Radio. In Proceedings of the 2020 ACM Designing Interactive Systems Conference (DIS '20), Association for Computing Machinery, New York, NY, USA, 283–295. DOI:<https://doi.org/10.1145/3357236.3395438>
- [96] William Odom, John Zimmerman, Scott Davidoff, Jodi Forlizzi, Anind K. Dey, and Min Kyung Lee. 2012. A fieldwork of the future with user enactments. In Proceedings of the Designing Interactive Systems Conference on - DIS '12, ACM Press, Newcastle Upon Tyne, United Kingdom, 338. DOI:<https://doi.org/10.1145/2317956.2318008>
- [97] William Odom, John Zimmerman, and Jodi Forlizzi. 2014. Placelessness, Spacelessness, and Formlessness: Experiential Qualities of Virtual Possessions. In Proceedings of the 2014 Conference on Designing Interactive Systems (DIS '14), ACM, New York, NY, USA, 985–994. DOI:<https://doi.org/10.1145/2598510.2598577>
- [98] William Odom, John Zimmerman, Jodi Forlizzi, Ana López Higuera, Mauro Marchitto, José Cañas, Youn-kyung Lim, Tek-Jin Nam, Moon-Hwan Lee, Yeoreum Lee, Da-jung Kim, Yea-kyung Row, Jinmin Seok, Bokyoung Sohn, and Heather Moore. 2013. Fragmentation and Transition: Understanding Perceptions of Virtual Possessions Among Young Adults in Spain, South Korea and the United States. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '13), ACM, New York, NY, USA, 1833–1842. DOI:<https://doi.org/10.1145/2470654.2466242>
- [99] Gerard Oleksik and Lorna M. Brown. 2008. Sonic gems: exploring the potential of audio recording as a form of sentimental memory

- capture. In Proceedings of the 22nd British HCI Group Annual Conference on People and Computers: Culture, Creativity, Interaction-Volume 1, British Computer Society, 163–172.
- [100] S. Tejaswi Peesapati, Victoria Schwanda, Johnathon Schultz, Matt Lepage, So-yae Jeong, and Dan Cosley. 2010. Pensieve: Supporting Everyday Reminiscence. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '10), ACM, New York, NY, USA, 2027–2036. DOI:<https://doi.org/10.1145/1753326.1753635>
- [101] Josef Perner, Daniela Kloo, and Elisabeth Stöttinger. 2007. Introspection & remembering. *Synthese* 159, 2 (2007), 253–270.
- [102] Daniela Petrelli, Simon Bowen, and Steve Whittaker. 2014. Photo Mementos: Designing Digital Media to Represent Ourselves at Home. *Int. J. Hum.-Comput. Stud.* 72, 3 (March 2014), 320–336. DOI:<https://doi.org/10.1016/j.ijhcs.2013.09.009>
- [103] Daniela Petrelli, Nicolas Villar, Vaiva Kalnikaite, Lina Dib, and Steve Whittaker. 2010. FM radio: family interplay with sonic mementos. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, ACM, 2371–2380. Retrieved September 19, 2015 from <http://dl.acm.org/citation.cfm?id=1753683>
- [104] James Pierce. 2014. On the presentation and production of design research artifacts in HCI. In Proceedings of the 2014 conference on Designing interactive systems, ACM, Vancouver BC Canada, 735–744. DOI:<https://doi.org/10.1145/2598510.2598525>
- [105] James Pierce. 2016. Design Proposal for a Wireless Derouter: Speculatively Engaging Digitally Disconnected Space. In Proceedings of the 2016 ACM Conference on Designing Interactive Systems, ACM, Brisbane QLD Australia, 388–402. DOI:<https://doi.org/10.1145/2901790.2901908>
- [106] James Pierce. 2021. Eccentric Sensing Devices: Using Conceptual Design Notes to Understand Design Opportunities, Limitations, and Concerns Connected to Digital Sensing. In Creativity and Cognition (C&C '21), Association for Computing Machinery, New York, NY, USA, 1. DOI:<https://doi.org/10.1145/3450741.3466775>
- [107] James Pierce and Eric Paulos. 2015. Making Multiple Uses of the

Obscura 1C Digital Camera: Reflecting on the Design, Production, Packaging and Distribution of a Counterfunctional Device. In Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems, ACM, Seoul Republic of Korea, 2103–2112. DOI:<https://doi.org/10.1145/2702123.2702405>

- [108] James Pierce, Phoebe Sengers, Tad Hirsch, Tom Jenkins, William Gaver, and Carl DiSalvo. 2015. Expanding and refining design and criticality in HCI. In Proceedings of the 33rd Annual ACM Conference on Human Factors in Computing Systems, ACM, 2083–2092. Retrieved from <http://dl.acm.org/citation.cfm?id=2702438>
- [109] Franziska Louise Pilling and Paul Coulton. 2020. What's it like to be Alexa? An exploration of Artificial Intelligence as a Material for Design. DRS Biennial Conference Series (August 2020). Retrieved from <https://dl.designresearchsociety.org/drs-conference-papers/drs2020/researchpapers/53>
- [110] Zachary Pousman, Mario Romero, Adam Smith, and Michael Mateas. 2008. Living with tableau machine: a longitudinal investigation of a curious domestic intelligence. In Proceedings of the 10th international conference on Ubiquitous computing, ACM, 370–379. Retrieved September 26, 2016 from <http://dl.acm.org/citation.cfm?id=1409685>
- [111] S. R. F. Price. 1986. The Future of Dreams: From Freud to Artemidorus. *Past & Present* 113 (1986), 3–37.
- [112] Larissa Pschetz, Kruakae Pothong, and Chris Speed. 2019. Autonomous Distributed Energy Systems: Problematising the Invisible through Design, Drama and Deliberation. In Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems. Association for Computing Machinery, New York, NY, USA, 1–14. Retrieved August 16, 2021 from <http://doi.org/10.1145/3290605.3300617>
- [113] Lauren Rhue. 2018. Racial Influence on Automated Perceptions of Emotions. Social Science Research Network, Rochester, NY. DOI:<https://doi.org/10.2139/ssrn.3281765>
- [114] Rashida Richardson, Jason Schultz, and Kate Crawford. 2019. Dirty Data, Bad Predictions: How Civil Rights Violations Impact Police Data, Predictive Policing Systems, and Justice. Social Science Research Network, Rochester, NY. Retrieved January 8,

2022 from <https://papers.ssrn.com/abstract=3333423>

- [115] Jon Rogers, Loraine Clarke, Martin Skelly, Nick Taylor, Pete Thomas, Michelle Thorne, Solana Larsen, Katarzyna Odrozek, Julia Klobner, Peter Bihr, Anab Jain, Jon Arden, and Max von Grafenstein. 2019. Our Friends Electric: Reflections on Advocacy and Design Research for the Voice Enabled Internet. In Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems (CHI '19), Association for Computing Machinery, New York, NY, USA, 1–13. DOI:<https://doi.org/10.1145/3290605.3300344>
- [116] John Rooksby, Mattias Rost, Alistair Morrison, and Matthew Chalmers. 2014. Personal Tracking As Lived Informatics. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '14), ACM, New York, NY, USA, 1163–1172. DOI:<https://doi.org/10.1145/2556288.2557039>
- [117] Karin Ryding. 2020. The Silent Conversation: Designing for Introspection and Social Play in Art Museums. In Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems. Association for Computing Machinery, New York, NY, USA, 1–10. Retrieved August 16, 2021 from <http://doi.org/10.1145/3313831.3376357>
- [118] Victoria Schwanda Sosik, Xuan Zhao, and Dan Cosley. 2012. See Friendship, Sort of: How Conversation and Digital Traces Might Support Reflection on Friendships. In Proceedings of the ACM 2012 Conference on Computer Supported Cooperative Work (CSCW '12), ACM, New York, NY, USA, 1145–1154. DOI:<https://doi.org/10.1145/2145204.2145374>
- [119] Eric Schwitzgebel. 2012. Introspection, what? Introspection and consciousness (2012), 29–48.
- [120] Phoebe Sengers, Kirsten Boehner, Shay David, and Joseph “Jofish” Kaye. 2005. Reflective design. In Proceedings of the 4th decennial conference on Critical computing between sense and sensibility - CC '05, ACM Press, Aarhus, Denmark, 49. DOI:<https://doi.org/10.1145/1094562.1094569>
- [121] Phoebe Sengers and Bill Gaver. 2006. Staying open to interpretation: engaging multiple meanings in design and evaluation. In Proceedings of the 6th conference on Designing Interactive systems, ACM, 99–108. Retrieved from <http://dl.acm.org/citation>.

[cfm?id=1142422](https://papers.ssrn.com/abstract=3333423)

- [122] Avi Shankar. 2000. Lost in music? Subjective personal introspection and popular music consumption. *Qualitative Market Research: An International Journal* 3, 1 (2000), 27–37.
- [123] Sydney Shoemaker. 1986. Introspection and the Self. *Midwest Studies in Philosophy* 10, (1986), 101–120.
- [124] Sydney Shoemaker. 2000. Introspection and phenomenal character. *Philosophical Topics* 28, 2 (2000), 247–273.
- [125] Paul J. Silvia and Guido HE Gendolla. 2001. On introspection and self-perception: Does self-focused attention enable accurate self-knowledge? *Review of General Psychology* 5, 3 (2001), 241–269.
- [126] Alison Smith-Renner, Ron Fan, Melissa Birchfield, Tongshuang Wu, Jordan Boyd-Graber, Daniel S. Weld, and Leah Findlater. 2020. No Explainability without Accountability: An Empirical Study of Explanations and Feedback in Interactive ML. In Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems. Association for Computing Machinery, New York, NY, USA, 1–13. Retrieved August 16, 2021 from <http://doi.org/10.1145/3313831.3376624>
- [127] Marie Louise Juul Søndergaard. 2020. Troubling Design: A Design Program for Designing with Women's Health. *ACM Trans. Comput.-Hum. Interact.* 27, 4 (August 2020), 24:1-24:36. DOI:<https://doi.org/10.1145/3397199>
- [128] Marie Louise Juul Søndergaard and Lone Koefoed Hansen. 2018. Intimate Futures: Staying with the Trouble of Digital Personal Assistants through Design Fiction. In Proceedings of the 2018 Designing Interactive Systems Conference (DIS '18), Association for Computing Machinery, New York, NY, USA, 869–880. DOI:<https://doi.org/10.1145/3196709.3196766>
- [129] Emma Strubell, Ananya Ganesh, and Andrew McCallum. 2019. Energy and Policy Considerations for Deep Learning in NLP. *arXiv:1906.02243 [cs]* (June 2019). Retrieved January 7, 2022 from <http://arxiv.org/abs/1906.02243>
- [130] Neille-Ann H. Tan, Han Sha, Eda Celen, Phucanh Tran, Kelly Wang,

- Gifford Cheung, Philip Hinch, and Jeff Huang. 2018. Rewind: Automatically Reconstructing Everyday Memories with First-Person Perspectives. *Proc. ACM Interact. Mob. Wearable Ubiquitous Technol.* 2, 4 (December 2018), 191:1-191:20. DOI:<https://doi.org/10.1145/3287069>
- [131] Alex S. Taylor. 2009. Machine intelligence. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (CHI '09)*, Association for Computing Machinery, Boston, MA, USA, 2109–2118. DOI:<https://doi.org/10.1145/1518701.1519022>
- [132] Lisa Thomas, Elaine Farrow, Matthew Aylett, and Pam Briggs. 2018. A life story in three parts: the use of triptychs to make sense of personal digital data. *Personal Ubiquitous Comput.* 22, 4 (August 2018), 691–705. DOI:<https://doi.org/10.1007/s00779-018-1110-0>
- [133] Lisa Torrey and Jude Shavlik. 2010. Transfer Learning: In *Handbook of Research on Machine Learning Applications and Trends*, Emilio Soria Olivas, José David Martín Guerrero, Marcelino Martinez-Sober, Jose Rafael Magdalena-Benedito and Antonio José Serrano López (eds.). IGI Global, 242–264. DOI:<https://doi.org/10.4018/978-1-60566-766-9.ch011>
- [134] Laurens Van der Maaten and Geoffrey Hinton. 2008. Visualizing data using t-SNE. *Journal of machine learning research* 9, 11 (2008).
- [135] Robert Van Gulick. 2000. Inward and upward: reflection, introspection, and self-awareness. *Philosophical Topics* 28, 2 (2000), 275–305.
- [136] John Vines, Mark Blythe, Stephen Lindsay, Paul Dunphy, Andrew Monk, and Patrick Olivier. 2012. Questionable concepts: critique as resource for designing with eighty somethings. In *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*. Association for Computing Machinery, New York, NY, USA, 1169–1178. Retrieved August 11, 2021 from <http://doi.org/10.1145/2207676.2208567>
- [137] Ron Wakkary, Doenja Oogjes, Sabrina Hauser, Henry Lin, Cheng Cao, Leo Ma, and Tijs Duel. 2017. Morse Things: A Design Inquiry into the Gap Between Things and Us. In *Proceedings of the 2017 Conference on Designing Interactive Systems*, ACM, 503–514. Retrieved from <http://dl.acm.org/citation.cfm?id=3064734>
- [138] Matthew Walker. 2017. *Why we sleep: Unlocking the power of sleep and dreams*. Simon and Schuster.
- [139] Melanie Wallendorf and Merrie Brucks. 1993. Introspection in consumer research: implementation and implications. *Journal of consumer Research* 20, 3 (1993), 339–359.
- [140] Danding Wang, Qian Yang, Ashraf Abdul, and Brian Y. Lim. 2019. Designing Theory-Driven User-Centric Explainable AI. In *Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems*. Association for Computing Machinery, New York, NY, USA, 1–15. Retrieved August 18, 2021 from <https://doi.org/10.1145/3290605.3300831>
- [141] Jordan White, William Odom, and Nico Brand. 2020. Exploring Location Histories as a Design Material for Reflection with Memory Compass & Memory Tracer. In *Companion Publication of the 2020 ACM Designing Interactive Systems Conference (DIS' 20 Companion)*, Association for Computing Machinery, New York, NY, USA, 221–226. DOI:<https://doi.org/10.1145/3393914.3395878>
- [142] Steve Whittaker, Ofer Bergman, and Paul Clough. 2010. Easy on That Trigger Dad: A Study of Long Term Family Photo Retrieval. *Personal Ubiquitous Comput.* 14, 1 (January 2010), 31–43. DOI:<https://doi.org/10.1007/s00779-009-0218-7>
- [143] Katie Williams. Mobile Users Spent \$195 Million in Meditation Apps Last Year, Up 52% Over 2018. *Sensor Tower Blog*. Retrieved January 2, 2022 from <https://sensortower.com/blog/meditation-apps-2019-revenue-downloads>
- [144] Jordan Wirfs-Brock, Sarah Mennicken, and Jennifer Thom. Giving Voice to Silent Data: Designing with Personal Music Listening History. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems (CHI '20)*, ACM.
- [145] Qian Yang. 2018. Machine learning as a UX design material: How can we imagine beyond automation, recommenders, and reminders? In *AAAI Spring Symposia*.
- [146] Qian Yang, Nikola Banovic, and John Zimmerman. 2018. Mapping Machine Learning Advances from HCI Research to Reveal Start-

ing Places for Design Innovation. In Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems (CHI '18), Association for Computing Machinery, Montreal QC, Canada, 1–11. DOI:<https://doi.org/10.1145/3173574.3173704>

[147] Qian Yang, Jina Suh, Nan-Chen Chen, and Gonzalo Ramos. 2018. Grounding Interactive Machine Learning Tool Design in How Non-Experts Actually Build Models. In Proceedings of the 2018 Designing Interactive Systems Conference (DIS '18), Association for Computing Machinery, New York, NY, USA, 573–584. DOI:<https://doi.org/10.1145/3196709.3196729>

[148] John Zimmerman. 2009. Designing for the self: making products that help people become the person they desire to be. In Proceedings of the SIGCHI Conference on Human Factors in Computing Systems, ACM, 395–404. Retrieved September 27, 2016 from <http://dl.acm.org/citation.cfm?id=1518765>

[149] Reflectly - A Journal for Happiness. Retrieved April 21, 2021 from <https://reflectly.app/>

[150] The Superhuman App - Self Reliant And In Control - from Zenegant. Zenegant. Retrieved April 21, 2021 from <https://zenegant.io/zenegant-superhuman-strategic-thinking-self-reliant-control-decisions-emotions-interactions/>

[151] Dreamapp. Dreamapp. Retrieved April 21, 2021 from <https://dreamapp.io>

[152] Lobe | Machine Learning Made Easy. Retrieved December 29, 2021 from <https://www.lobe.ai/>

[153] Meditation and Sleep Made Simple - Headspace. Retrieved January 2, 2022 from <https://www.headspace.com/>

[154] Muse S: EEG-Powered Sleep Tracking. Muse. Retrieved January 2, 2022 from <https://choosemuse.com/muse-sleep-overnight-tracking-new/>

[155] Waking Up with Sam Harris – Unlock your mind. wakingup.com. Retrieved January 2, 2022 from <https://wakingup.com/>

[156] Calm - Meditation Techniques for Sleep and Stress Reduction. Retrieved January 2, 2022 from <https://get.calm.com/>

[157] The Pattern. Retrieved January 2, 2022 from <https://thepattern.com/>

[158] Replika. replika.ai. Retrieved August 18, 2021 from <https://replika.ai>

[159] OpenAI. OpenAI. Retrieved January 2, 2022 from <https://openai.com/>

[160] Better Images of AI. Retrieved January 5, 2022 from <https://betterimagesofai.org>

[161] Excavating AI. -. Retrieved January 10, 2022 from <https://excavating.ai>

[162] How our data encodes systematic racism. MIT Technology Review. Retrieved January 8, 2022 from <https://www.technologyreview.com/2020/12/10/1013617/racism-data-science-artificial-intelligence-ai-opinion/>

[163] Five Machines — yuxi liu. Retrieved January 2, 2022 from <https://lyxsix.com/Five-Machines>

[164] The Design Way: Intentional Change in an Unpredictable World - Harold G. Nelson, Erik Stolterman - Google Books. Retrieved October 28, 2021 from https://books.google.de/books?hl=en&lr=&id=lr34DwAAQBAJ&oi=fnd&pg=PR9&dq=Harold+G.+Nelson+and+Erik+Stolterman.+2012.+The+Design+Way:+Intentional+Change+in+an+Unpredictable+World.+The+MIT+Press.&ots=U-Exccjn6Va&sig=ICC3li9H1L54Y0qv45Xy2H4myXU&redir_esc=y#v=onepage&q=Harold%20G.%20Nelson%20and%20Erik%20Stolterman.%202012.%20The%20Design%20Way%3A%20Intentional%20Change%20in%20an%20Unpredictable%20World.%20The%20MIT%20Press.&f=false

[165] Design Noir: The Secret Life of Electronic Objects - Anthony Dunne, Fiona Raby - Google Books. Retrieved October 28, 2021 from https://books.google.de/books?hl=en&lr=&id=_49YT-KJ16l4C&oi=fnd&pg=PA6&dq=Anthony+Dunne+and+Fiona+Raby.+2001.+Design+noir:&ots=5JochfQL6-&sig=BF-BhA11X1Lpl92tsKp-1PUov1n8&redir_esc=y#v=onepage&q=Anthony%20Dunne%20and%20Fiona%20Raby.%202001.%20Design%20noir%3A&f=false

[166] Interpretation in Architecture | Design as Way of Thinking | Adrian Sn. Retrieved October 29, 2021 from <https://www.taylorfrancis.com/books/mono/10.4324/9780203873366/interpretation-architecture-adrian-snodgrass-richard-coyne>

[167] Otter Voice Meeting Notes. Retrieved January 9, 2022 from <https://otter.ai>

[168] ↑ Capture - Your Dream Journal. App Store. Retrieved January 12, 2022 from <https://apps.apple.com/us/app/capture-your-dream-journal/id968737914>

[169] ↑ Dreamy - Personal Dream Diary. App Store. Retrieved January 15, 2022 from <https://apps.apple.com/us/app/dreamy-personal-dream-diary/id1534164217>

[170] IBM Watson | IBM. Retrieved from <https://www.ibm.com/watson>

[171] Predict behaviour and understand the psychology of people who matter to you. Receptiviti. Retrieved April 23, 2021 from <https://www.receptiviti.com>

[172] Symanto: Real-Time Customer Insights for Businesses. Retrieved December 18, 2021 from <https://www.symanto.com/>

[173] RunwayML | Machine learning for creators. Retrieved January 31, 2020 from <https://runwayml.com/>

[174] GitHub - NVlabs/stylegan2: StyleGAN2 - Official TensorFlow Implementation. Retrieved January 16, 2022 from <https://github.com/NVlabs/stylegan2>