Exploring Conversational Agents' Reflective Capacities on Everyday Life Occasions

by

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Exploring Conversational Agents' Reflective Capacities on Everyday Life Occasions

Koç University

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ABSTRACT

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Reflection is an essential part of self-knowledge and wellbeing, and it is embedded into our day-to-day activities. However, engaging in reflective thinking often requires guidance and encouragement. Conversation, as supported by psychology and education literature, is a promising strategy to foster reflection. So far, HCI studies have explored systems that deliver one-time questions for journaling or self-tracking or conversations about specific areas such as physical activity tracking or workplace productivity. With increasing availability and abilities, conversational agents (CAs) hold enormous potential to become reflection partners with their users, guiding and encouraging them to reflect on their everyday experiences. To this end, this thesis aims to explore users' needs and derive design implications for CAs for everyday life reflection. I started my research process by exploring the effects of reflection prompts on social media shares via a wizard-of-oz study and a high-fidelity prototype. I moved towards using CAs following my findings from the field studies. Then, I derived two approaches for asking reflective questions via CAs from the psychology literature and users' therapy experiences and developed a scenario and a VR simulation to evaluate these approaches. I then collected user thoughts, preferences, experiences, and concerns regarding interacting with reflective CAs in their daily lives. Lastly, I brought together the implications derived from this process in an LLM-based CA prototype. This thesis contributes to the HCI literature with (i) insights on how to conduct research for CAs for reflection, (ii) design considerations for CAs for reflection, and (iii) an LLM-based conversational agent prototype.

Keywords: Reflection; Everyday Reflection; Well-being; Conversational Agents; Conversational Interfaces; Conversation Design; User-Centered Design

ÖZETÇE

Konuşma Aracılarının Günlük Yaşam Durumlarındaki Derinlemesine Düşündürtme Kapasitelerinin Araştırılması

Pelin Karaturhan
Tasarım, Teknoloji ve Toplum, Doktora
11.10.2024

Derinlemesine düşünme, kendini tanımanın ve esenliğin önemli bir parçasıdır ve günlük faaliyetlerimizin içinde var olmaktadır. Ancak, derinlemesine düşünme süreçleri genellikle rehberlik ve teşvik gerektirir. Diyalog, psikoloji ve eğitim literatürü tarafından da gösterildiği üzere, düşünmeyi teşvik etmek için umut verici bir stratejidir. Şimdiye kadar, insan-bilgisayar etkileşimi alanındaki çalışmalar, günlük tutma, kendini izleme için tek seferlik sorular, fiziksel aktivite takibi veya işyeri verimliliği gibi belirli alanlar hakkında diyaloglar sunan sistemleri araştırmıştır. Artan kolay kullanım ve becerileri ile birlikte, konuşma aracıları, günlük deneyimleri üzerinde düşünmeleri için kullanıcılarına rehberlik ederek ve onları teşvik ederek kullanıcılarıyla düşünme ortakları olma konusunda büyük bir potansiyele sahiptir. Bu amaçla, bu tez, kullanıcıların ihtiyaçlarını anlamayı ve günlük yaşam üzerine derinlemesine düşünme için konuşma aracılarının tasarlanmasına yönelik tasarım hususlarını ortaya çıkarmayı amaçlamaktadır. Araştırma sürecime, bir Oz büyücüsü çalışması ve yüksek fonksiyonlu bir prototip aracılığıyla derinlemesine düşünmeyi teşvik eden ipuçlarının sosyal medya paylaşımları üzerindeki etkilerini keşfederek başladım. Saha çalışmalarından elde ettiğim bulguları takiben konuşma aracılarını kullanmaya yöneldim. Ardından, psikoloji literatüründen ve kullanıcıların terapi deneyimlerinden konuşma aracıları aracılığıyla derinlemesine düşünmeyi teşvik eden sorular sormak için iki yaklaşım türettim ve bu yaklaşımları uygulamak ve değerlendirmek için bir senaryo ve bir sanal gerçeklik simülasyonu geliştirdim. Daha sonra kullanıcıların günlük yaşamlarında derinlemesine düşünmeyi teşvik eden konuşma aracılarıyla etkileşime ilişkin düşüncelerini, tercihlerini, deneyimlerini ve endişelerini topladım. Son olarak, bu süreçten elde edilen çıkarımları büyük dil modeli tabanlı bir konuşma aracısı prototipinde bir araya getirdim. Bu tezin temel katkıları (i) derinlemesine düşünmeyi teşvik eden konuşma aracıları için nasıl araştırma yapılacağına dair içgörüler, (ii) derinlemesine düşünmeyi teşvik eden konuşma aracıları için tasarım hususları ve (iii) büyük dil modeli tabanlı bir konuşma aracısı prototipidir.

Anahtar Kelimeler: Derinlemesine Düşünme; Gündelik Derinlemesine Düşünme; Esenlik; Konuşma Aracıları; Konuşma Arayüzleri; Konuşma Tasarımı; Kullanıcı Merkezli Tasarım

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ABBREVIATIONS

AI: Artificial Intelligence

CA: Conversational Agent

HCI: Human-Computer Interaction

LLM: Large Language Model

PI: Personal Informatics

RCA: Reflective Conversational Agent

RtD: Research through Design

SRIS: Self-reflection and Insight Scale

QS: Quantified Self

TSRI: Technology-Supported Reflection Inventory

GLOSSARY

This section provides a list of key terms and phrases used throughout the thesis, along with brief descriptions to clarify how these concepts are applied within the scope of my research. While various definitions for each term may exist, the explanations here reflect how I specifically consider and integrate these ideas into my work.

Chatbot: Chatbots are conversational agents with text inputs and outputs.

Conversational Agent (CA): A conversational agent is a digital system that mimics human conversation.

Embodied Conversational Agent: Embodied conversational agents have digital avatars.

Everyday Life Occasions: Everyday life occasions are events that occur in our daily lives. The emphasis on every day represents the potential non-significance of these events in our lives, compared to significant events.

Fidelity (Low vs. High-Fidelity Prototypes): Fidelity refers to how closely a prototype resembles the final product. Low-fidelity prototypes are simpler and less detailed, while high-fidelity prototypes are more complete and polished, closely mimicking the final version in terms of design and functionality.

Reflection: The process of thinking about one's behaviors, thoughts, feelings, attitudes, actions. This leads to self-knowledge or increased personal insight.

Reflective Conversation: A reflective conversation is a dialogue that happens between two people (or two agents) where a person leads the conversation with reflection prompts or questions, to enable the other person's reflective thinking. This can happen between teacher-student, therapist-client, and mentor-mentee.

Reflection Prompts: Sentences that are designed to initiate the thinking process. *Example: 'Write a letter to your child.'*

Reflection Questions: Questions that are designed to initiate the thinking process.

Example: 'What has been the most defining moment in your life?'

Reflective Conversational Agent (RCA) (or Conversational Agents for Reflection): Reflective conversational agents are conversational agents that take the guiding role in a reflective conversation.

Wizard of Oz Technique: The Wizard of Oz technique is a research method where users interact with a system that they believe to be autonomous but is actually being operated or partially controlled by a human behind the scenes.

How to read this dissertation:

This dissertation is in the Collection of Papers format, with five publications (four published, one in submission). These publications are referred to in the relevant chapters and are added to the manuscript.

CHAPTER 1: INTRODUCTION

Reflection helps us get to know ourselves better. Humankind has pursued self-knowledge since the beginning of philosophical thought. Subsequently, the notion of reflection has been a topic of inquiry in philosophy, critical thought, cognition, psychology, education, design, and human-computer interaction (HCI). Inevitably, this inquiry from various fields affected HCI research, resulting in many definitions and operationalizations of reflection in HCI. Nevertheless, due to its critical position on our wellbeing and the emerging acceptance of artificial intelligence (AI), reflection remains highly relevant for state-of-the-art HCI research. Throughout the years, HCI researchers searched for ways to teach, trigger and support reflection with tools and strategies designed for various aims, such as supporting design practice and education, chronic illness management, or physical wellbeing. As a result, we now know that reflection does not always happen naturally and requires guidance, support, and encouragement [55].

Under the influence of the Personal Informatics (PI) movement, most of the work in HCI conceptualizes reflection as a step toward behavior change through reviewing information collected by self-tracking tools in a data-centric perspective and focusing on particular goals, such as supporting healthy diet or increasing physical activity. Besides many positive effects, this approach to reflection also resulted in research criticizing such systems for failing to effectively promote reflection [31, 36, 82]. The PI approach often overlooks reflection on our everyday life, lived experiences, which is an essential part of being a human, as highlighted by Mols et al. in their work focusing on people's everyday life reflection practices [97]. After more than a decade of mostly focusing on quantitative data, PI researchers are now moving towards searching for ways to integrate qualitative, lived experiences of their users into self-tracking tools to better support their meaning-making processes [29]. Additionally, the increasing abilities and availability of AI supported the rapid development and integration of the CAs to our daily lives in recent years, the most prominent example being OpenAI's ChatGPT[1]. As a result, research on the potential of CAs to become reflection partners is now timely and relevant.

[1] https://openai.com/index/chatgpt/

1.1 Motivation

One of the ways we reflect in our daily lives is through conversations. In fact, Mols et al. discovered that 85% percent of their participants engage in reflection through conversations in their daily lives [97]. Reflection through conversation is also present in therapy (therapist-patient dialogue) and learning (teacher-student dialogue) [99, 101]. This echoes in HCI literature with systems acting as reflective partners through conversations [15]. However, designing full, reflective conversations focusing on everyday experiences remains an underexplored area in the literature [29, 99].

The advances in AI and natural language processing (NLP) have allowed the vast spread and adaptation of CAs. The Conversational AI market is expected to reach $41.39 Billion by 2030[2]. Due to their success in job automation, chatbots and voice-based agents are predominantly utilized in real estate, travel, education, healthcare, and finance industries[3]. The increasing investment in conversational AI increases capabilities in areas such as natural language understanding[4]. Human-agent interaction is becoming increasingly natural, allowing users to perceive CAs, such as chatbots, voice-based agents, and virtually embodied agents, as more than just digital assistants. The naturalness of human-agent interaction has been a long-standing research focus in HCI. However, HCI researchers, with technical developments opening more space for exploration, started to dive more into interaction design elements and strategies that create a sense of relationship or even companionship between agents and their users [34, 108, 152]. Findings on users' expectations from CAs highlights an opportunity for CAs to become true reflection partners [152].

However, there is not enough work in HCI focusing on designing reflective conversations and using CAs for users' everyday life experiences. To this end, this research seeks to identify user needs for reflecting on everyday experiences through agent-mediated conversations, explore reflection strategies, and propose design implications and recommendations using a research-through-design methodology.

[2] https://www.prnewswire.com/news-releases/conversational-ai-market-size-worth-41-39-billion-by-2030-grand-view-research-inc-301568674.html
[3] https://research.aimultiple.com/chatbot-stats/
[4] https://www.cbot.ai/conversational-ai-and-virtual-assistant-trends-for-2022/

1.2 Aim and Research Questions

Based on the motivations explained above, this research aims to understand users' needs from conversations on their everyday experiences to engage in reflective thinking and explore the design implications for CAs to be used as reflection partners. With these aims in mind, this research aims to answer the following research questions:

RQ1) How might we create and employ prompts and questions to support life reflection on everyday life occasions?

- How might we make use of prompts and questions for everyday life reflection?
- What are users' preferences towards engaging with reflection prompts and questions to think about their everyday life experiences?

RQ2) How might we combine reflection prompts and questions with state-of-the-art HCI technologies?

- What are the relevant conversational patterns or dialogue structures to be used by CAs to facilitate reflective conversations so that users can engage in self-reflection on their everyday life experiences?
- What are the key design requirements and strategies for developing conversational agents that guide users through reflective conversations on their everyday life experiences?

1.3 Scope

This research covers a broad range of topics spanning HCI, Psychology, Interaction/User Experience Design and their intersections. Within this broad research space, I define my specific scope within the intersection of (Figure 2) **designing for everyday life reflection** and **conversational user experience design**. The intersection of these two topics, namely "conversational user experience design for everyday life reflection" is investigated and analyzed through combinations of different conversation strategies, interaction methods, interaction mediums, and interaction environments.

CAs and their users can **interact** through text, voice, or embodied virtual agents and through different **mediums** such as novel smartphone interfaces (Google Assistant, Apple Siri or intelligent assistants of banking apps), embedded into existing chat interfaces (chatbots in Facebook Messenger or Amazon), standalone physical smart home devices (Amazon Echo and

Google Nest) web applications (Kuki[5], Replika[6]). My research makes use of two interaction methods *(voice and text)*, two interaction mediums *(smartphone application and standalone device),* and explores two interaction environments *(domestic and mobile everyday life)* through the mobile application prototype and VR Experience. This work does not cover the use of embodied CAs, which are agents accompanied by a digital avatar.

As mentioned above, reflection through conversation is an under-explored topic in HCI, though some **strategies** exist. Psychology literature, on the other hand, is filled with guidance for encouraging a reflective conversation through psychotherapy theories and coaching methods (Cognitive Behavioral Therapy, Systemic Therapy and Circular Questions, Reminiscence Therapy, Positive Psychology Prompts). This work borrows perspectives from the systemic therapy and client experiences of psychotherapy as two case-based approaches to design the reflection prompts, questions and strategies in general and explore novel reflective conversation designs.

Reflection on everyday experiences is valuable for all **user groups**. Although the context of reflection may differ for different user groups (i.e. regular and elderly users [112]), this work explores a general user group.

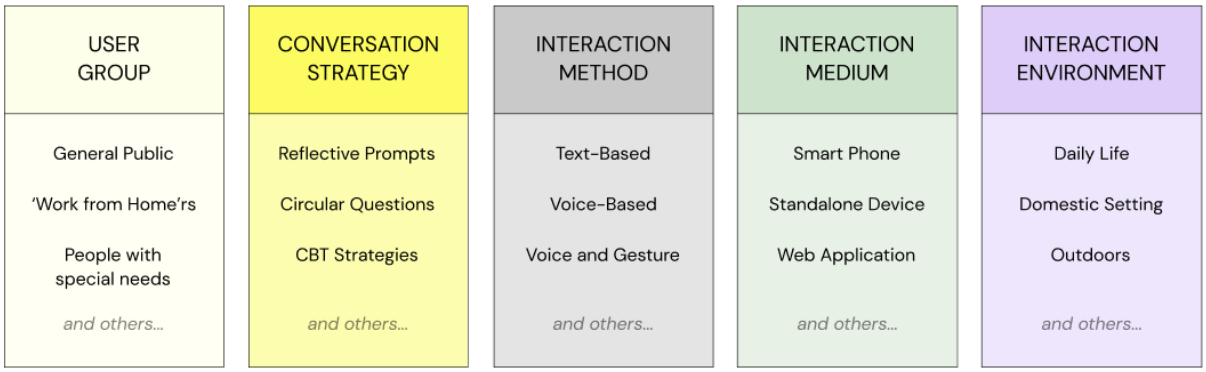

Figure 1: Perspectives on CA research and design. Reflective CAs can be examined from different perspectives: user groups, conversational strategies, interaction methods or interaction mediums.

As emphasized above, this work takes a design-oriented approach to reflective CAs. Therefore, the focus of this research project is not on the use and/or development of machine learning models, natural language understanding/processing algorithms, the implications of different

[5] https://chat.kuki.ai
[6] https://replika.ai

dialogue management strategies, or the use of AI in general. This research does not focus on comparing data-driven reflection models with reflective conversations in everyday life. I acknowledge the value of data-driven reflection and propose a new perspective that focuses on a mode of reflection on the qualitative, lived experiences via reflective conversations. Lastly, it does not aim to measure a clinical enhancement of mental health but explore the potential for supporting challenges faced in everyday life. The visual representation of the scope of this research can be seen in Figure 2.

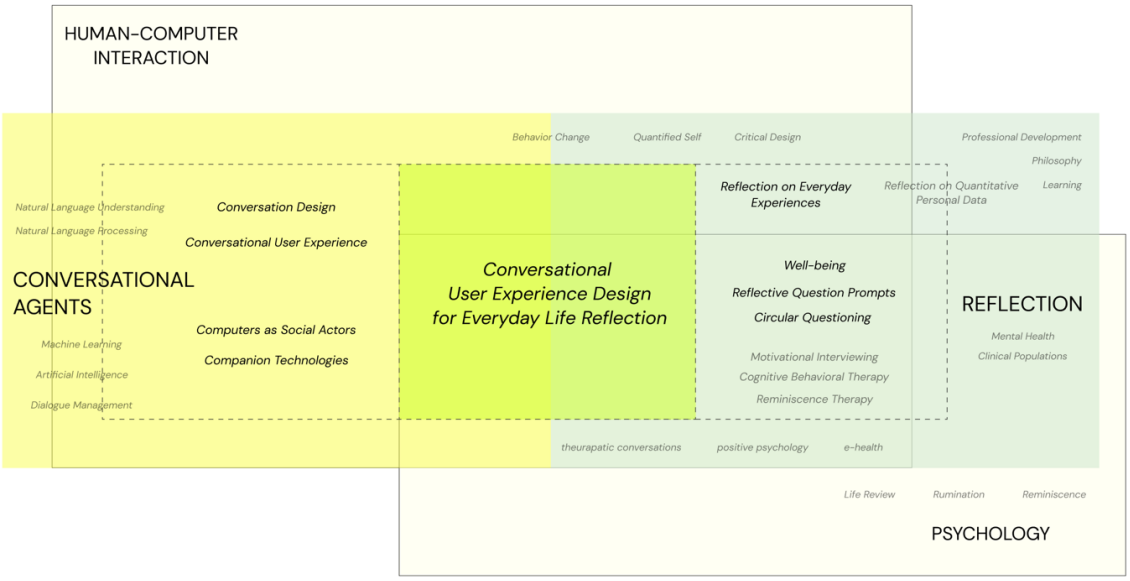

Figure 2: The scope of this research is situated on the intersection between CAs and reflection. However, it will not cover all the topics related to CAs or reflection.

1.4 Contributions

This thesis makes knowledge and artifact contributions to the literature. Our main contributions are as follows:

- *Design Implications for Designing Reflective CAs:* This work provides ten design implications for HCI to guide the creation of CAs that support everyday reflection. These design implications are an accumulation of user insights, expert insights, insights from the research processes covered in the publications, and the literature on CAs in relation to reflection.

- *Reflective CA prototypes:* Following the research through design approach, this dissertation involves the design and development of three prototypes, one focusing on photo-based reflection, and two text-based reflective CAs.
- *Identification of the State-of-the-art Design Space for CAs for Wellbeing:* Through a systematic literature review, this thesis presents a design space that includes the goals, target user groups, techniques, and design considerations used in CAs for wellbeing.
- *Mapping of Research Processes for CAs for Wellbeing:* Another output of the systematic literature review, this thesis presents 4 research processes that can be followed when designing CAs for wellbeing, that can inform the future researchers working on wellbeing and reflection.

1.5 Dissertation Overview

This dissertation consists of 7 chapters. Chapter 2 presents a review of literature on reflection and CAs that sets the background for the thesis work. Chapter 3 summarizes the general research approach and individual methods employed throughout the process. Chapter 4 accumulates five of the research papers published within the scope of this thesis. Chapter 5 presents 10 design implications that are compiled from the information obtained through the thesis. Chapter 6 informs future researchers with the insights from the research experience. Lastly, Chapter 7 concludes the thesis by summarizing contributions, limitations, and future directions.

1.6 List of Publications

1.6.1 Publications within the Thesis Scope

Paper 1 – Full Paper, Conference Proceeding, Chapter 4.1

Pelin Karaturhan, Asım Evren Yantaç, and Kemal Kuşcu. 2021. Layer Zero: An Approach for Deepening Self-reflection on Instagram Shares. In: Meiselwitz, G. (eds) Social Computing and Social Media: Applications in Marketing, Learning, and Health (HCII 2021). Lecture Notes in Computer Science, vol 12775. Springer, Cham. https://doi.org/10.1007/978-3-030-77685-5_27

Paper 2 – Full Paper, Conference Proceeding, Chapter 4.2

Pelin Karaturhan, Ecem Arıkan, Pelin Durak, Asım Evren Yantaç, and Kemal Kuşcu. 2022. Combining Momentary and Retrospective Self-Reflection in a Mobile Photo-Based Journaling Application. In Nordic Human-Computer Interaction Conference (NordiCHI '22). Association for Computing Machinery, New York, NY, USA, Article 64, 1–12. https://doi.org/10.1145/3546155.3546676

Paper 3 – Full Paper, Conference Proceeding, Chapter 4.3

Pelin Karaturhan, Egemen Ertuğrul, Ecem Arıkan, Kemal Kuşcu, and Asım Evren Yantaç. (2024) Exploring the design opportunities for conversational agents as reflection partners in domestic environments. In Gray, C., Ciliotta Chehade, E., Hekkert, P., Forlano, L., Ciuccarelli, P., Lloyd, P. (eds.), DRS2024: Boston, 23–28 June, Boston, USA. https://doi.org/10.21606/drs.2024.841

Paper 4 – Journal Article, Chapter 4.4

Pelin Karaturhan, İlayda Orhan, Kemal Kuşcu, and Asım Evren Yantaç. (2024) Informing the design of question-asking conversational agents for reflection. Personal and Ubiquitous Computing. https://doi.org/10.1007/s00779-024-01831-7

Paper 5 – Submitted to the CHI Conference, 2025, under review, Chapter 4.5

Pelin Karaturhan, Meagan B. Loerakker, Göksu Akşam, Evropi Stefanidi, Paweł W. Woźniak and Asım Evren Yantaç. Conversational Agents for Wellbeing: A Systematic Literature Review.

1.6.2 Publications outside the thesis scope as a part of research training

- Sinem Semsioglu, Pelin Karaturhan, Saliha Akbas, and Asim Evren Yantac. 2021. Isles of Emotion: Emotionally Expressive Social Virtual Spaces for Reflection and Communication. In Proceedings of the 13th Conference on Creativity and Cognition (C&C21). Association for Computing Machinery, New York, NY, USA, Article 24, 1–10. https://doi.org/10.1145/3450741.3466805
- Sinem Şemsioğlu, Pelin Karaturhan, and Asım Evren Yantaç. 2022. EMOTE: An interactive online tool for designing real-time emotional AR visualizations. In 13th Augmented Human International Conference (AH2022). Association for Computing Machinery, New York, NY, USA, Article 2, 1–8. https://doi.org/10.1145/3532525.3532527

CHAPTER 2: BACKGROUND

This chapter covers the related literature on reflection and CAs for wellbeing and reflection.

2.1 Reflection

The notion of reflection is the core of my research. In this section, I share a summary of the background in reflection in HCI from different perspectives.

2.1.1 The Scope of Reflection

Reflection is defined as 'serious and careful thought' by the Cambridge Dictionary [42]. This definition provides us with a simple and comprehensive meaning. However, the notion of reflection is explored in Philosophy, Cognitive and Developmental Psychology, Education and HCI with varying conceptualizations and theoretical approaches. This is due to the potential outcomes of engaging in reflective thinking, such as experiencing a better learning process, arriving at a better learning outcome, professional development, behavior change, gaining a critical perspective, personal development, and wellbeing [55, 101]. Beyond theoretical work, methods for encouraging reflective thinking are also explored, especially in learning and teaching, counseling, and professional development contexts. On the other hand, outside the academic domain, the internet is filled with sources[7] providing methods and tools to engage in reflective thinking to improve wellbeing, such as using question probes, diary keeping, breathing exercises and meditation.

2.1.2 Theoretical Approaches to Reflection in Psychology and HCI

Multiple theoretical approaches involve and analyze the concept of reflection. Given that theoretical approaches of reflection in HCI are mostly influenced and shaped based on psychology literature, it is important to give an overview of the discourse in psychology and situate my research among them. One can place the theories and models of psychology on a spectrum of learning and behavior change.

Behavior change in psychology is the field of psychotherapy, and reflection is a key aspect in psychotherapy, where clients reflect on their daily life through therapeutic conversations to gain self-awareness, recognize patterns, and modify behaviors [117]. Although my approach to

[7] See, for instance, https://www.holstee.com/blogs/mindful-matter/self-reflection-101-what-is-self-reflection-why-is-reflection-important-and-how-to-reflect and https://www.berkeleywellbeing.com/what-is-self-reflection.html

reflection is not tied to mental health in a clinical sense or necessarily aims to modify users' behaviors, we can still learn from the tools of psychotherapy and therapeutic conversations.

Especially tools of cognitive behavioral therapy [80], motivational interviewing [126], and mindfulness-based therapies [138] emphasize the role of reflection in the therapeutic process. We also see the influence of these psychotherapy approaches in wellbeing tools developed within the HCI field (i.e. [70, 84]).

My approach to reflection as a means of thinking about one's own experiences does not necessarily enforce a need for behavior change but an increase in self-awareness or self-knowledge. Therefore, my approach to reflection is also related to the importance of reflection in learning-related psychology theories. To this end, we can briefly visit the experiential learning theory, metacognition and self-regulation theory, and social cognitive theory.

Experiential learning refers to a mode of learning where individuals learn through reflecting on their actual life experiences, as opposed to learning from books, for example [52]. In 1984, educational theorist David A. Kolb published the experiential learning cycle [76], where he defines 4 stages to a learning cycle. The stages are concrete learning, reflective observation, abstract conceptualization and active experimentation. In this cycle, reflective observation step refers to a stage where an individual reflects on the experience at the first stage. In this approach, reflection is ensured through experienced facilitators and guiding questions.

The concept of metacognition refers to a state of awareness where an individual thinks about their own ways of thinking and reveals their own thought patterns [96]. In this sense, metacognition is very much in line with what we aim to achieve with habitual reflection. Metacognition, and as an extension self-regulation can be considered a skill where many strategies are proposed to develop, especially in the classroom learning environments [35].

Experiential learning theory, constructivist learning theory and metacognition deals with ways and modes of learning. Self-regulation theory and social cognitive theory are theories that have implications both for learning and behaviors.

Self-regulation theory refers to an individual's ability to manage their own thoughts, behaviors, and feelings to attain their goals [107]. In this approach, individuals may need to change their thought, behavior or feeling to be able to attain the goal. Therefore, it inevitably involves a stage where individuals go through an evaluation phase. There have been many contributors to the

self-regulation theory who label this reflective stage differently. For example, Albert Bandura called this stage self-observation [10], whereas Roy F. Baumeister called it monitoring [self-regulation and executive function] [13]. Though names can vary, the underlying assumption in self-regulation theory is the fact that being aware of one's thought or behavior is a prerequisite of regulating it. Although our approach does not aim to help individuals regulate their behavior, our approach to self-reflection may help a process of self-regulation.

Social cognitive theory is one of the wider theories that focus on the social impact in the cognitive processes of learning. Developed by Albert Bandura as an extension to his social learning theory, social cognitive theory deals with observing and imitating desired behavior and knowledge acquisition through observation [11]. Within social cognitive theory, four human capabilities are addressed: symbolizing capability, self-regulation capability, self-reflective capability, and vicarious capability [2]. It assumes that through self-reflection, individuals can inspect and adjust their thoughts and behavior. This is also in line with our approach to the concept of reflection.

To sum up, many different theories and approaches in the school of psychology deal with the concept of reflection, although sometimes named differently. Regardless of the aim being learning, self-regulation, or behavior change, reflection is a critical stage where individuals need to think about their own thoughts, feelings, beliefs, and behaviors. My aim is to achieve strategies to design and develop conversational agents that are perceived relevant for engaging in reflective thought. Potential benefits of this reflective state can be investigated in specific research cases.

2.1.3 State of the Art in Reflection Research in HCI

As an inevitable result of the rapid technological developments, the HCI field has been showing an increasing interest in designing and developing systems to support reflection [129] and developing frameworks to design for reflection [55] for the last two decades. Now, the literature is rich with definitions and conceptualizations [6, 73], reviews [7, 8, 18], and evaluation methods [10].

Reflection and HCI overlap in Schön's reflection-in-action and reflection-on-action and his description of design as a reflective conversation with materials and process [133]. Not surprisingly, Baumer et al.'s review of reflection in HCI in 2014 found that 17 out of 76 papers

were related to reflection in and on the design process and made reference to Schön. In the 2010s, Personal Informatics (PI) field emerged in HCI, following the Quantified Self (QS) movement. In one of the most cited frameworks of self-tracking in PI, reflection is situated as an essential part of the process, which piqued the interest of HCI in reflection [81]. Following this peak, HCI research on reflection expanded beyond the PI movement with new purposes and methods introduced every year. As of today, reflection research in HCI spans a wide variety of application areas. Some exemplar work on the intersection of reflection and quantifiable experiences focus on categories such as physical activity [75], food intake and nutrition [158], waste and usage [147], chronic illness management [3], sleep [30] and learning [58]. Another strand can be defined as the intersection of reflection and qualitative, lived experiences. Here, HCI researchers worked on areas such as everyday reminiscence [68, 118], self-expression [8], social media use and preferences [17], productivity [72, 74], and lived experiences of chronic illnesses [7].

Regardless of the focus and the aim of reflection, systems use a few main techniques to trigger reflective thinking. The most explored method for reflection is data visualizations [7, 30, 32, 53, 58, 72, 93]. Similarly, a new research interest explores data physicalization [71, 148]. As a more social method, HCI also explored comparisons with other people [53, 59]. While the aforementioned methods require personal data to accumulate over time, reflection can also occur momentarily through conversations [74, 75], or recording and journaling [6, 68]. In fact, in a recent review of research prototypes and smartphone applications designed for supporting reflection, Bentvelzen et al. [15] identified a taxonomy of resources for designing reflection. Their taxonomy suggests temporal perspective, conversation, comparison and discovery as four main resources for reflection.

As visible in the previous paragraphs, there are differences in aims and methods between supporting reflection on quantifiable experiences (experiences represented through personal quantitative data) and qualitative lived experiences (aspects of experiences that are not represented by numbers, such as emotions, feelings, events, and social interactions). Since this is an important distinction for this research project, I would like to elaborate more on this discussion in a separate section.

2.1.4 Approaches to Reflection (Research Strands) in HCI

Multiple works in HCI elaborated on how the definition of reflection is not united among the community. This is partly due to the different research strands focusing on reflection from different perspectives. In this section, I will briefly explain the main research strands.

Professional Practice and Education. As mentioned above, Schön's work on reflection in and on the design process, and in professional education [133] had a lot of influence on HCI. Similarly, Dewey's work on the importance of reflection in education [21] guided the work on education in HCI. For instance, in 2017, Slovak et al. revisited the concept of Reflective Practicum to develop a conceptual framework to inform the technology for supporting transformative reflection in the context of education [140]. Schön and Dewey's approaches keep influencing the HCI literature on reflection in education and professional development contexts.

Systems Supporting Reflection. Although reflection has been a part of HCI community discussion for a long time, the increasing ubiquity of and technological advancements allowed user-facing systems specifically aiming for reflection to emerge in the late 2000s. In 2006, Lindstörm et al. [86] designed Affective Diary. This system collects sensor data and mobile phone activity and generates a data visualization supported with sound and music daily in a 'movie' format. This system aims to help its users reflect on their day. Similarly, in 2009, Mathur et al. investigated the effects of visualizing browser bookmarks on self-reflection for self-awareness [93]. In response to the growing interest in designing for reflection in HCI, Fleck and Fitzpatrick published a paper where they introduced five levels of reflection and suggested techniques for fostering each level in 2010 [55]. At that point, they identified multiple aims of reflection, such as self-development, resolutions of uncertainty, and empowerment. The focus was not on the requirement of personal information or data but on conditions and strategies to nurture reflective thinking. In the following years, researchers kept contributing to the literature with artifacts like GoSlow which is a mobile application that provides its users with a space for reflecting on their day through colors, text, or photos [26] and perspectives like designing for intimacy that investigates the potential of technologies to support mutual reflection of romantic partners [20]. As will be explained in the following section, in the same year as Fleck and Fitzpatrick's framework, Li et al. identified reflection as a step in their step-based approach to personal informatics (PI) systems [81]. Consequently, research on reflection is influenced more

by PI movement and personal quantitative data and mostly focused on a singular subject, since it is easier to track and make sense of singular data, such as our step count.

However, different characterizations for reflection outside the mainstream PI research strand keep emerging. In 2016, Mols et al. conducted interviews with people about their everyday reflection practices [98] and later defined everyday life reflection as, ”Remembering and analyzing past, present and future experiences in order to reassess our perceptions, beliefs, feelings and actions regarding our everyday life.” [99]. This approach to reflection as an integral part of everyday life resonates with my work as I also investigate the potential for everyday life reflection. Further, they summarized strategies used for reflection in PI, HCI, therapy, and education as; (1) dialogue-driven reflection, (2) information-driven reflection and (3) expression-driven reflection. Building on this prior work, I investigate the use of conversation as a strategy and CAs as a technology for everyday life reflection. I use a combination of dialogue-driven reflection and expression-driven reflection.

Personal Informatics and Self-Tracking Tools. In the PI approach, reflection is a step toward behavior change. The aim of achieving reflection is to be able to initiate behavior change by raising users’ awareness of their personal, quantitative data. Therefore, reflection research under PI is mainly data-centered and action-oriented.

Initially, the mainstream PI field was dominated by the view of self-tracking for behavior change[122]. This approach situated the role of reflection to a further goal (behavior change), whereas reflection, as a means to self-knowledge, can be an end goal itself [122]. After the introduction of the stage-based PI model to the HCI literature, researchers started investigating the actual lived experiences of self-trackers [37, 39, 47]. This focus of research sheds light on various motivations for using self-tracking tools and actual use cases. Rooksby et al. (2014) [127] conducted interviews with self-trackers and introduced the lived informatics discourse, situating PI research as ‘technology-centric’ and ‘behavior change oriented’. Their interviews shed light on the actual and real-life use of PI tools, where these tools are often used as a part of bigger life experiences, decisions, and interests. Rooksby et al. highlighted that PI tools fall short of capturing those experiences. Regardless, at times they are used solely for documenting one’s everyday life and not with the aim of changing behavior. Building on this, Epstein et al. (2015) [46] conducted interviews about self-trackers to come up with a better model of PI, taking lived experience into account. They, too, highlighted the instrumental use of self-tracking tools where

people use their trackers to ‘obtain a record of a particular behavior’ (or experience) and think ‘the act of tracking is more important than looking back later’. Rapp and Tirassa propose a theory of self for PI research, building on the initial investigations of lived experiences [122]. They highlight the ‘utilitarian perspective’ of PI research as they focus only on behaviors, whereas providing PI users with knowledge of their ‘self’ should be perceived enough success. These research studies show the initially limited perspective of PI on behavior change being the only aim of reflection. On the contrary, they iterate that reflecting can be the purpose of recording data and aim at providing an additional perspective with actual experiences of self-trackers to the PI research. Similarly, my research focuses on encouraging reflection on people’s lived experiences.

2.1.5 Sociality of Reflection

The conversational, expressive, and social side of reflection is emphasized in HCI multiple times. In their framework, Fleck and Fitzpatrick identify *asking reflective questions*, *the presence of another person, alternative perspectives provided by another person* as strategies for supporting different levels of reflection [55]. In their approach to everyday life reflection, Mols et al. identify dialogue-driven reflection and expression-driven reflection as two main strategies to stimulate reflection [99]. Further, in their overview of everyday practices, they find conversation and social practices as a part of people’s everyday reflection and encourage the field to explore systems that can support reflective conversations of everyday life [97]. In their theoretical position paper, Rapp and Tirassa also highlight the importance of social interaction for meaningful sensemaking and encourage PI researchers to give attention to supporting the creation of closed, intimate spaces of self-expression for increased self-understanding [122]. Lastly, in a recent review of sense-making practices in PI, Coşkun and Armağanoğlu identified *collaborative sensemaking* as a design implication to facilitate shared reflection [38].

Systems supporting social reflection can act as mediators between two people, or as reflection partners. As reflection partners, the use of CA systems has great potential as they mimic human-to-human interaction. Further, conversation designs can be enhanced with reflective questions and prompts proven to be relevant for reflection in previous research. Reflection prompts have been used by wellbeing-oriented CAs [79, 116]. However, there are only two CA systems with a specific purpose of acting as reflection partners in HCI, to the best of my knowledge. They are

Reflection Companion [75] and Robota [74], and they also make use of reflection questions designed using different strategies. However, they aim to promote reflection for physical activity and workplace productivity, whereas I aim to design CAs for everyday reflection.

Today, HCI design is following the research on lived experiences and theoretical conceptualizations on the importance of reflection and the importance of sociality. Two recent reviews from Cho et al. [29] and Bentvelzen et al. [15] highlight the future directions of reflection research. First, Cho et al., in their review aiming to identify and characterize the gaps in PI literature and tools, categorizes their corpus based on the levels of reflection framework of Fleck and Fitzpatrick. Further, they identify the importance of agency in reflection, contrary to system-driven reflection being the predominant design strategy in PI apps. To help users make meaning of their lived experiences, they suggest *'moving beyond quantified-self and toward the qualitative self'* as a design implication. They propose tracking the qualitative experiences of users of PI tools with provocative prompts and smart journals. Further, they identify conversational interfaces as a design strategy to ease the users' burden in manually tracking their qualitative, lived experiences. Second, Bentvelzen et al. are inclusive in their review of literature and apps for reflection by including all the work on reflection and not only PI tools, even though the review belongs to the PI field. As a result, their proposed design resources may inform tools and technologies designed not only for self-tracking but also for reflection on qualitative, lived experiences. Further, they, too, propose conversation as a technique for reflection and, more specifically, conversations with technology as a design resource for reflection. In light of this previous research, my work situates reflection as an end goal. It focuses on qualitative everyday life experiences (or lived experiences), places conversation as a design strategy for initiating reflection, and gives active authorship to the users in creating and meaning making of their own data (experiences).

Designing for reflection has been of interest in HCI for decades. However, reflecting is an essential part of our day-to-day decision-making, and it doesn't really get old. Rather, it has been investigated from a lot of different perspectives to this date. On the horizon, there are still plenty of untapped approaches to designing for reflection. For instance, designing for reflection on every day, qualitative, lived experiences is largely untapped. For these kinds of experiences, the conversation is a promising strategy. On the other side, the abilities and opportunities CAs provide for reflective conversations (conversations aiming to trigger reflection) have room for

exploration. Therefore, my research covering the potential use of CAs for everyday life reflection is timely and addresses a gap in the HCI reflection literature, yet it also points to further research in the HCI field.

2.2 Conversational Agents

Conversational agent (CA) is an umbrella term for describing systems mimicking human-to-human conversation through text or spoken language. In literature, there are many terms for describing CA systems such as chatbots, conversational interfaces, dialogue systems, intelligent voice assistants, smart speaker-based voice assistants, and voice user interfaces (VUI). On the other hand, definitions of and differences between these terms are not clear in the literature. I will be using the term "conversational agent" as I find it descriptive and representative.

2.2.1 State of the Art in Conversational Agents

The technology behind CAs was first recognized in 1964 when Joseph Weizenbaum programmed ELIZA, a chatbot mimicking a Rogerian psychotherapist. ELIZA interacted through text and was not capable of understanding its users' input. Regardless, it achieved enormous success, having people emotionally attached to it as they were not able to differentiate ELIZA from an actual empathetic therapist [153]. From then on, technological advancements allowed CAs to enter our daily lives, especially in the form of smart voice assistants in our smartphones such as Apple Siri and Google Assistant, and in our homes such as Amazon Alexa and Google Home. In fact, as of January 2022, the percentage of smart speaker owners aged 12 and over in the US was 35% [141]. Concurrently, the topic is well investigated in HCI. Researchers sought to understand experiences with existing commercial CAs [120, 134, 151], and users' expectations for the future of CAs [90, 123, 145]. The increasing research interest in AI, machine learning, neural networks, large language models (LLMs), natural language understanding and processing has enabled the development of more complex CA systems. Further, following the release of ChatGPT, many LLM-based CAs became available to general public (such as Google Gemini and Microsoft Copilot) and quickly adopted, becoming part of our daily lives. Next, I will describe the state-of-the-art of CA technology from various perspectives. The categorization below is adapted from [78].

Interaction medium. Conversational interfaces can interact with their users through a variety of mediums from SMS to robots. The most used ones are through software applications working on

smartphones, tablets, and computers, embedded into existing messaging applications (such as Facebook Messenger and Telegram), using existing SMS and telephone services (such as CAs used in banking customer service calls), through tangible objects designed to host CAs, embedded into existing smart home speakers (such as Amazon Alexa), or through a virtual avatar. CAs with virtual avatars are called embodied conversational agents (ECA).

Input and Output Modalities. The initial interactions between CAs and users were solely in a written, text-based format. Now, the users can use spoken language to interact with the agent, and the agent can also speak back. The CA can even contribute to the interaction with facial expressions and body movements if accompanied by a virtual avatar.

Task Orientation. CAs can be either task-oriented or not. Task-oriented CAs engage in short conversations with their user to get the required information to accomplish a task, such as booking a train ticket. These types of CAs are commercially available and already embedded in our daily lives. Many capabilities of the smart speakers (Amazon Alexa) and smart personal assistants (Apple Siri) are also task-oriented, such as retrieving the weather or searching Google for a question. CAs that are not task-oriented try to mimic natural human conversation as good as possible, such as ChatGPT. These CAs are also called intelligent agents.

Dialogue Management. There are three different types of dialog management identified in the literature: finite-state, frame-based and agent-based dialogue management. Finite-state dialogue management systems follow a system-led, step-by-step structure. In other words, dialogue flow is pre-determined and cannot be changed. Therefore, they are mostly used for basic, predefined activities such as data collection or interviewing. In frame-based dialogue management, the system has a template with slots to be filled to perform a task. The slots can be filled in any order, so the dialogue flow is not rigid and pre-determined but depends on the context of the user's input and the required information by the system. Agent-based dialogue management is the most advanced of the three management approaches. In agent-based dialogue management, the dialogue between the system and the user is like an interaction between two agents. The dialogue is shaped by the context and evolves dynamically. Of course, the level of intelligent behavior varies among systems.

2.2.2 Conversational Agents for Health and Well-being

One of the research areas that are most interested in the potential of CAs is Healthcare. In Healthcare, CAs are used for diagnosis [149, 157], public health [95], promoting physical activity [111] and weight loss [27], chronic disorder management and monitoring [61, 64, 130] (such as heart failure [4] and diabetes [12]), psychiatric counseling [110], mental health support [43, 50], developmental disorder support [24], and assisting elderly and their caregivers [19, 128, 160]. CAs in Healthcare may be evaluated, analyzed, and discussed from various perspectives such as application area, capabilities, medium, evaluation, efficacy, ethical considerations, and so on. This, paired with the rapid enhancements in CA technology, resulted in many review papers in health and technology literature [19, 27, 61, 73, 78, 89, 111, 128, 130, 149, 150]. To remain within the scope of this thesis, I will briefly discuss the technical abilities of CAs in Healthcare and move on to the use of CAs for wellbeing and reflection in the remaining part of this section.

The majority of the work in Healthcare prioritizes building task-oriented, focused CA systems with the main aim of walking their users through a specific process such as giving self-reports, completing specific tasks, and getting diagnoses [78, 130]. Since the focus is on measuring the effects of engaging with the CA systems on health or the specific purpose of that research, the technical implementation of AI algorithms (if any) is generally not explained in detail. To the best of my knowledge, most of the systems use finite-state dialog management, and only some use frame-based dialog management [78, 130]. In their review, Laranjo et al. [78] spotted 14 different CAs that understand unconstrained natural language input. Even when the systems accept unconstrained natural language input, using finite-state dialogs allows them only to recognize predetermined words and phrases and limits their users to a specific conversation flow [78]. On the other hand, systems using frame-based dialog management allow more freedom regarding interaction turns. They can collect necessary information from their user through different questioning strategies. In healthcare, frame-based dialog management technologies are used for education and data collection [78]. With the advancements in LLMs, the potentials of agent-based systems are also explored in healthcare field, for chronic disease management [100] such as language disorders [121] or providing information and diagnosis [103]. Currently, systems in healthcare employ text-based, voice-based or embodied CAs. Although there is not enough information with regard to the preferences among these modalities or comparisons, all modalities result in a positive user experience [150].

CAs for everyday wellbeing are less common than CAs designed for clinical populations. Here, I will briefly mention a few notable examples and their technical abilities to illustrate the existing design space. Two examples of everyday life wellbeing CAs are Woebot [54] and Shim [91]. Woebot (2017) is a non-embodied, text-based CA designed to deliver self-help content derived from Cognitive Behavioral Therapy (CBT) methods to young adults with self-reported symptoms of anxiety. Woebot initially asks a general question and follows up with a mood-related question consisting of a set of pre-determined answers in the form of words or emojis. Following, it provides its users with a link to a short video or a ”word game”. The participants of their 2-week user study showed reduced depression in the surveys and showed a high level of engagement. Another text-based CA, Shim (2017), is designed to deliver positive psychology prompts to a non-clinical group of participants. Shim has a variety of conversation topics such as expressing gratitude, practicing kindness, and present moment awareness. Shim uses a combination of collecting open-ended user input and a pre-determined set of responses. One of the important abilities of Shim is to collect user information that is accumulated over time to give better suggestions and tasks. The participants of their two-week user study appreciated learning and reflection aspects while reporting disappointment with repetitive content and limitations in the depth of conversation that is linked to Shim’s lacking ability to understand users’ statements. These two examples are important since they represent the first steps toward employing CAs that adjust and deliver clinical mental health interventions to non-clinical populations for mental health.

Following these initial steps, HCI literature expanded the everyday life wellbeing research in the CA field beyond clinical perspectives. Everyday life wellbeing can be supported beyond positive psychology and CBT-inspired interventions, with methods such as encouraging self-compassion [79], enhancing social connections [104], and encouraging expressive writing [116], supporting self-awareness [23]. Three notable examples are Vincent, Sunny and Diarybot. Vincent (2019) is a self-compassion chatbot aiming to bring its users to a better wellbeing by increasing self-compassion [79]. Lee et al. created two modes for Vincent, caregiving and care-receiving, to conduct a comparative study. Care-giving Vincent asks the users to do self-compassion exercises, modeled after Woebot (explained above). On the other hand, care-receiving Vincent talks about his embarrassing experiences and seeks advice from users. The results showed that the self-compassion of participants who interacted with care-receiving Vincent significantly

increased. Sunny (2020) promotes positive social connections and enhances its users' psychological wellbeing [104]. It aimed to facilitate positive social interaction between groups of people. Therefore, it prompts its users to record messages to their friends (e.g., "you could share your favorite things about them.") and delivers their friends' messages to them. Its language is designed to be persuasive, encouraging, friendly and upbeat. It also uses emojis and informal acronyms. The results show that interacting with Sunny promoted self-reflection and increased the sense of self-worth and depth of social relationships. Although Sunny is deliberately designed as a 'facilitator' participants highlighted that they would 'enjoy a more responsive and conversational chatbot'. Diarybot (2021) is designed to guide users in expressive writing for better wellbeing [116]. Park et al. also designed a comparative study where there are two modes of Diarybot: basic and responsive. For the responsive mode, they hypothesized that '*Writing with the bot follow-up interactions will help writers interpret better than writing without follow-up.*'. Consequently, for the responsive mode, they designed follow-up prompts based on psychotherapy, Naikan therapy and cognitive narrative psychotherapy to encourage emotional awareness, social/situational awareness, and self-awareness. For the basic mode, the chatbot provided the same initial prompt and closed the conversation after user input. Their results indicate that Diarybot encouraged conversational narratives, and follow-up prompts increased the sense of social acceptance and helped participants for a deeper self-reflection. Vincent, Sunny and Diarybot are important examples as they show a more designerly perspective on promoting everyday wellbeing with alternative approaches other than well-known clinical mental health intervention methods.

As shown above, reflection is a natural process that is embedded into the interactions of CAs for wellbeing [91, 104], or used as a strategy [54]. On the other hand, HCI researchers also investigated the use of CAs specifically for reflection on areas other than general wellbeing, i.e., workplace productivity [74], professional learning [155], reducing smartphone use [83], physical activity [75], and improving collaboration skills [115]. Notably, Kocielnik et al. investigated CAs for reflection through two cases: physical activity and workplace reflection. For physical activity, they designed Reflection Companion, a mobile chatbot that collects activity tracker data and engages in mini dialogues where it provides its users with reflection prompts about their activity data [75]. For workplace reflection, they designed Robota, a chat and voice-based CA [74]. Robota delivers a journaling prompt with its chat modality and

reflection questions through its voice modality. All the prompts and questions were related to workplace tasks, plans, accomplishments, goals, satisfaction, etc. Although these studies do not specifically focus on reflection for everyday life wellbeing, they provide us with strategies to trigger reflective thinking for their users. I will discuss these existing and desired strategies in the following section.

2.2.3 Design Strategies for Conversational Agent User Experience

The evidence shows the importance of conversation strategies such as relational and empathetic behavior in establishing rapport with CAs [132]. This is in line with the work in CA literature outlining the strategies for successful CAs. Above, I summarized the possible technical abilities of CAs. This is important for understanding what is technically possible. However, for building successful CAs for reflection, design strategies are as important as technical excellence. By saying design strategy, here I refer to the strategies for people to successfully interact with CAs (strategies for reflection are discussed in the previous section). First and foremost, managing expectations is key. Grudin and Jacques describe the CA space in the industry and outline the design space for CAs [62]. They highlight that what made most of the chatbots unsuccessful in sustained interactions was users' expectations being unmet. For instance, funny, joking CAs are well-perceived. However, they raise users' expectations about the intelligence of the agent. Therefore, regardless of the chosen strategy, it is important to manage expectations and make design decisions with this awareness.

From a philosophical and meta perspective, Niess and Wozniak propose the notion of companion technologies: 'interactive artefacts that evoke empathy' [108]. They provide a framework for companion technologies, which is characterized by four concepts: minded, feeling-experience, reflective and social significance. They highlight that a companion technology should give the impression that it carries these qualities, regardless of its true capabilities. They illustrate their framework by applying it to previous work on a CA, Amazon Alexa. They, too, highlight the unmet expectations of Alexa's users about its being minded and how it failed to become socially significant, leading to total abandonment of the device. We can conclude that these four concepts are also relevant for successful CAs, if they aim to be perceived as companions. I find both these four concepts and the concept of companionship relevant to my aim of designing CAs for reflection as the agents can make use of being perceived as companions.

To design for successful interaction between CAs and their users, all the above-mentioned investigations are relevant and valuable for consideration. Further, these qualities are already being used in the design of CAs for mental health, wellbeing, or other purposes. I identified several design strategies based on existing agent systems mentioned above, and their users' expectations; proactivity, informal language, follow-up interactions, open-ended responses, responsiveness, emotional awareness, avoiding repetition, contextual awareness, and mindedness. These strategies inform the design of my CA prototypes and design implications of this thesis.

CHAPTER 3: METHODOLOGY

3.1 General Research Approach

For this dissertation, I've adopted the User-Centered Design [109] approach, which underlines the integration of users and stakeholders into the design process to better understand and address their needs in the final product. Throughout my research process, I involved users, designers, and field experts in the design and evaluation processes.

I also followed the Research through Design methodology (RtD), which is a highly used approach in HCI research [159] that emphasizes an iterative process of knowledge generation via probing users with artifacts. In interaction design, following the RtD process means designing research artifacts and conducting empirical studies via these research artifacts to better understand users' views on certain problem spaces. As a result, the knowledge produced in this type of research is also embedded in the artifact that can depict a solution to a future problem. In line with the RtD approach, I've used design probes, wizard-of-oz settings, and low and high-fidelity prototypes throughout my research to generate knowledge.

For each publication that will be presented in the next chapter, I followed various user-centered research methods (described in 3.2). Each of these methods is decided based on the requirements of the research question at hand.

3.2 Overview of the Methods Throughout the Thesis

Throughout my thesis, I've employed various methods to answer my research questions and accumulate insights. I've repeatedly used certain methods, as each of my publications has its own iterative approach. Below, I briefly explain these methods and how they are employed in my research. More details can be found in the papers. Figure X summarizes the methods employed in each publication.

PUBLICATION NO AND TITLE	METHOD (IN EXECUTION ORDER)	CONTRIBUTIONS
#1 Layer Zero: An Approach For Deepening Self-Reflection N Instagram Shares	***Field Study with Prototype - (WoZ)*** ***Semi-structured Interview (with Users)*** ***Field Study with Prototype - (WoZ)*** ***Online Survey***	***User Insights*** ***Insights on Reflection Prompts***
#2 Combining Momentary And Retrospective Self-Reflection In A Mobile Photo-Based Journaling Application	***Field Study with Prototype - High Fidelity Prototype*** ***Semi-structured Interview (with Users)*** ***Design Workshop***	***User Insights*** ***Design Directions*** ***Prototype 1***
#3 Exploring The Design Opportunities For Conversational Agents As Reflection Partners In Domestic Environments	***Diary Study*** ***Semi-structured Interview (with Experts)*** ***Focus Group Workshop***	***User Insights*** ***Design Dimensions for CAs*** ***Insights on Reflection Questions***
#4 Informing The Design Of Question-Asking Conversational Agents For Reflection	***Online Survey 1*** ***Semi-structured Interview (with Experts)*** ***Field Study with Prototype - Low Fidelity Prototype*** ***Online Survey 2***	***Prototype 2*** ***Insights on Reflection Strategies for CAs*** ***Design Implications*** ***Research Implications***

Figure 3: An overview of publications, methods and contributions of each publication to this dissertation.

3.2.1 Diary Study

I've used a diary study [18] as a part of Paper 3, with the broader aim of developing a 'reflective question' approach that fits the users. There, I used a diary study to collect and make meaning of people's everyday experiences at home. I used a digital diary approach, creating a website with input fields. The participants logged entries three times a day for one week.

3.2.2 Online Survey

I've used online surveys at different stages of my research for distinct purposes. In Paper 1, I used an online survey to collect participants' insights after a field study with a wizard-of-oz prototype. In Paper 4, I used online surveys in two different stages of my research. First, I used a survey to collect experiences of therapy and used the data as a starting point for my research process. To conclude my research, I prepared and distributed an online survey to evaluate users' experiences with a working prototype.

3.2.3 Semi-structured Interview

I've conducted interviews for papers 1, 2, 3, and 4. As part of Paper 1, I used semi-structured interviews to gather participants' insights on the comparison of two reflection prompts as well as overall experience of reflection with Instagram shares. For Paper 2, I talked with participants of a field study, gathering detailed explanations of their experience and asking for opinions for further development. For both Papers 3 and 4, I talked with experts in the psychology field, accumulating feedback on the 'reflective question' approaches we created. I conducted both in-person and online semi-structured interviews.

3.2.4 Design Workshop

I've conducted a design workshop as a part of Paper 2, as a part of a broader aim of designing visualizations to help the reflection process as well as evaluate and enhance the overall mobile app experience. The designers designed visualization ideas, and then we came together online to discuss ways to enhance the mobile app for reflection. These designers are the group of people who suggested a more conversational interaction for reflection. Therefore, this design workshop is integral to my thesis.

3.2.5 Focus Group Workshop

I conducted a focus group workshop with potential users/designers for Paper 3. This workshop structure featured a VR prototype that is used as a design probe (similar to [114]'s approach with video prototype) to initiate the thinking process. In the workshop, I asked the participants various questions. They individually took notes using Miro, and then discussed opinions and ideas.

3.2.6 Field Study with Prototype

I conducted three field studies: with a wizard-of-oz type setting (Paper 1), with a high-fidelity working mobile app (Paper 2), and with a low-fidelity prototype that can be interacted with through a messaging app (Paper 4). In each of these studies, participants were asked to interact with the prototypes for at least one week, and then I gathered insights into their experiences using questionnaires, online surveys, and semi-structured interviews, as well as content analysis (only for Paper 1).

CHAPTER 4: PUBLICATIONS

This chapter presents the papers that are published within the scope of this thesis. Studies described in the papers are conducted to address my research questions. This chapter consists of 5 sub-chapters and each sub-chapter consists of one paper, with a preface describing the aims and contributions to the thesis. The titles of the sub-chapters briefly describe the steps in my overall research process in relation to the context of my thesis.

In 4.1, together with my co-authors, we explored reflection on everyday life through images shared on social media and a set of reflection prompts. Our insights led us to develop a standalone mobile application for photo-based journaling to fully explore the effects of reflection prompts, as detailed in 4.2. In these two sub-chapters, we explored a preliminary prompting structure as a tool for exploration. 4.3 and 4.4 are designated to research in the CA area. Insights from the research in the second sub-chapter guided our decision to use CAs as a state-of-the-art technology for reflection. 4.3 explores the user preferences through a workshop while 4.4 combines an exploration of reflection question strategies with a field study of a reflective CA prototype. Lastly, in 4.5, we conduct a systematic literature review to identify the design space of and research processes for CAs for wellbeing, which validates and brings together the insights I accumulated via my studies.

4.1 Exploring the Role of Prompts in Reflecting on Everyday Life Experiences

4.1.1 Preface

This paper addresses RQ1 and aims to understand the role of prompts in reflection on everyday life experiences through two sets of prompts directed at participants' Instagram shares. This study represents our first step towards triggering reflection through technology on qualitative experiences. I considered social media shares as instances where people stop and record their daily experiences. Therefore, I first explored using photos shared on Instagram as moments of reflection.

We implemented a Wizard-of-Oz type of prototyping approach in this study. The study consisted of two steps. First, we recruited 18 (M:2, F:16) participants to compare different sets of reflection prompts. Based on the feedback gathered, we conducted another study with 11 (M:4, F:7) participants. Both study settings were very similar. Here, I explain the second study in detail. All communications are done through direct messages on Instagram after the initial recruitment. This was done to create a feeling that this feature is Instagram's additional functionality. I acted as the wizard ensuring the quick delivery of the logs to the participants. I followed the participants and enabled notifications to receive alerts whenever the participants posted on Instagram. Reflection prompts are delivered using an online Qualtrics survey. Each time a participant posted content, a link to the survey and the content was sent to them. The duration of the study was 2 weeks. After the two weeks, I conducted semi-structured interviews with the participants.

Our findings in this work informed the course of this thesis in many ways. First, I understood that prompts indeed triggered reflection, at least for those who were more inclined to engage in reflective thinking. Second, I realized that Instagram shares could be reflective, but many factors are in play, such as aesthetics, anxiety, and self-censorship. The shortcomings of this approach were the repetitive nature of the prompts, the inability to adjust the timing of prompt delivery, and the fact that they did not adapt themselves according to the nature of the content (for example, the depth of meaning they carry for their creator). Lastly, participants experienced a lack of meaning-making because they could not see a tangible output resulting from their input. Lessons learned from this study are also informed the design implications presented in Chapter 5.

4.1.2 Paper 1: Layer Zero: An Approach for Deepening Self-Reflection on Instagram Shares

Pelin Karaturhan, Asım Evren Yantaç, and Kemal Kuşcu. 2021. Layer Zero: An Approach for Deepening Self-reflection on Instagram Shares. In: Meiselwitz, G. (eds) Social Computing and Social Media: Applications in Marketing, Learning, and Health (HCII 2021). Lecture Notes in Computer Science, vol 12775. Springer, Cham. https://doi.org/10.1007/978-3-030-77685-5_27

Layer Zero: An Approach for Deepening Self-Reflection on Instagram Shares

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Abstract. Self-reflection is an essential part of personal well-being and development. One of the strategies to support reflective thinking is to revisit personal recordings. Existing and emerging social media platforms are powerful mediums for self-reflection. However, additional mechanisms may be necessary to support deepening reflective thinking through social media use. We explore the concept; Layer Zero, a tool that helps users record reflective logs when they share on Instagram through a question set, and present them later for reflection. This paper focuses on the data collection phase of Layer Zero. We conducted 2 user studies through Instagram with a total of 29 participants to understand the potential of Instagram shares for reflection and measure the effectiveness of questions on self-reflection. We found that our approach can help users engage in deeper reflective thinking about their motivations, actions and thought processes. The results indicate various design insights for future social media reflection tools.

Keywords: Self-reflection · Social media · Instagram · Personal data.

1 Introduction

Self reflection, "a critical or reproachful thought about oneself",[1] is a critical part of our path to personal wellbeing and development. The level of awareness about reflective thinking may significantly effect our progress in life. Humans have been engaging in self-reflection without digital artifacts and technologies. However, digital artifacts and technologies help self-reflection by triggering and regulating reflective thinking. For instance, not knowing what to reflect on may be an obstacle to reflective thinking. Therefore, one of the ways that technology supports self-reflection is by collecting, and presenting people with their own personal information. Having the ultimate aim of increasing life quality through insightful personal information, personal informatics movement in HCI [2] crosses paths with the concept of reflection very often: the stage-based model of Personal Informatics [3] that proposes 5 stages to obtain self knowledge from personally relevant information (Preparation, Collection, Integration, Reflection, Action) considers reflection as a standalone stage. However, personal informatics

[1] https://www.oed.com/view/Entry/175407?redirectedFrom=self-reflection#eid

systems tend to focus on one kind of personal data at a time. Therefore, existing studies that highlight the importance of reflection in personal informatics movement are usually very specific as well, such as chronic illnesses[1] or physical activity [4].

Additionally, personal informatics systems mainly rely on tracking devices or dedicated applications, but in today's world many of digital artifacts and technologies collect and store personal data. Even though not all data can provide meaningful insights for self-reflection to occur, information collected from personal e-mail accounts [5], photo archives [6] and music archives [7] have been proven to be sources of reflective thinking. This points out Personal accounts, archives and social media can provide opportunities for self-reflection on a variety of subjects, in addition to what personal informatics systems provide.

The reason behind the rich information on personal accounts is that, people were interested in recording personal information before technology started to do so for them. Diaries are one of the first ways to record personal significant experiences and to reflect on them. With the advancements in technology and emergence of the concept of social media, people now share their personal experiences online. For instance, Instagram is an online photo and video sharing platform with 1 billion monthly active accounts[2] and with over 60% of the users logging in every day[3]. This vast adaptation of social media to people's everyday experiences have allowed Instagram to be a medium that stores personal information in the form of posts and stories, even profile pictures and biographies. As a result, studies related to human conditions such as depression [8], mental illnesses [9], eating habits [10] are conducted through Instagram in HCI research.

Personal information shared and stored on social media can be used not only by researchers, but by the users themselves. Social media became one of the possible systems that can be supportive of self-reflection for general public [11]. Social media channels are aware of their potential: main social media channels such as Facebook, Instagram and Snapchat integrated features, services and push-notifications to encourage users to revisit memories through previously shared personal data (on this day, friendiversary, look back). However, remembering and revisiting are not equal to self-reflection. In order for self-reflection to occur, expression of inner thoughts and feelings are necessary. Studies on social media and reflection highlight certain obstacles to users' shared expressions and emotional statements such as hurting friends, privacy, security, personal image and self-representation concerns [12, 13, 29]. It is worthwhile to explore the ways to enhance the potential of social media for self-reflection and search for new ways to establish a new relationship between social media and users' self-reflection.

In this paper, we explain our approach to support self-reflection through social media. We propose a tool, Layer Zero, that helps users to create personal reflection logs about their social media shares through a question set, stores

[2] https://www.statista.com/statistics/272014/global-social-networks-ranked-by-number-of-users/

[3] https://www.brandwatch.com/blog/instagram-stats/

the reflection logs, and presents them back for retrospective self-reflection. The formation of Layer Zero have 2 phases; (1) the process of collection of reflection logs and (2) presentation of collected reflection logs to the users; this paper reports the lessons learnt on the studies we conducted regarding the collection phase.

In the light of the theoretical background on reflection, we compare 2 question sets for users to fill in the reflection logs with our first user study, and we explore how mediation through a reflection log alters users' experiences of sharing on social media with a second user study. This paper presents our design process, *findings on the needs of social media users to be able to engage in reflective thinking*, and their experiences on engaging with a self-reflection tool among with their social media sharing experience. This paper contributes to the HCI community by; (1) contributing to the groundwork for future directions of research for self-reflection through conventional social media channels, and (2) demonstrating the lessons learnt from the use case of applying the Layer Zero concept to Instagram as a reflection medium.

2 Background and Related Work

Below we will first discuss existing work on processes and strategies that support self-reflection in HCI and existing work on using social media for self-reflection.

2.1 Methodologies of Reflection

Reflection is one of the concepts that do not have a generally accepted definition. This makes it harder both for theory and practice to work on the topic. With the increasing interest of HCI on reflection, multiple theoretical approaches are derived from the other disciplines such as psychology, philosophy, and education for the use of HCI community. The theoretical foundations are important as they guide researchers and practitioners in designing more reflective systems. In this section, we give an overview of theoretical work on reflection in HCI and explain how it shaped our approach.

Fleck and Fitzpatrick [14], proposed the first adaptation of existing models to HCI through "Levels of Reflection" framework. The framework consists of five levels of reflection: description, (a non-reflective statement), reflective description (justifications and explanations accompany description), dialogic reflection (thinking activity with a search for new perspectives, alternatives and relationships), transformative reflection (A conscious attempt to accept new perspectives and change existing way of thinking) and critical reflection (consideration of wider implications of thought like social and ethical issues). Further, the authors highlight the importance of reflective questions in encouraging at least low level reflective thinking. Some examples of the use of reflective questions in system designs include Gama, Storytellr, Echo[13], Reflection Companion [15] and FeedReflect [16].

Another theoretical approach is Eric P.S. Baumer's dimensional approach to designing for reflection [17]. The three dimensions he proposes are moments of breakdown, opportunities for inquiry and action for transformation. The explanation behind breakdowns is the process of the disturbance created by surprising situations to the flow of everyday activities. The disturbance allows the creation of moments in which reflection can occur. Additionally, the breakdown moments help people shift from experiential mode to reflective mode [18, 12, 19].

Layer Zero builds up on both Fleck and Fitzpatrick's and Baumer's approaches. Fleck and Fitzpatrick's definition of a non-reflective statement coincides with statements that users share on media due to obstacles mentioned before, such as security and self-representation. Layer Zero and its reflection logs aim to deepen the self-reflection at least by one level to reach reflective descriptions. Thus, reflection logs should consist of reflective questions to guide users. Baumer's definition of a breakdown moment also presents an opportunity for reflection logs: filling reflective questions while or short after sharing on social media will create a surprising encounter and open up space for self-reflection.

2.2 Reflection and Social Media

In this section, we highlight existing work on social media and reflection, and findings that guide us in designing Layer Zero. Social media has multiple potential uses for reflective thinking [11]. Sun et al. designed procedurally generated postcards that visualize the nutritional values and emotions extracted from user's Instagram posts of their foods [30]. The postcards successfully leveraged the potential of social media posts in terms of self-reflection. One of the concepts where social media content is investigated is reminiscence. Reminiscence is defined as "recalling, investigating and sharing significant memories" and it is closely related to reflection. Our approach differs from reminiscence as we aim to encourage deeper levels of reflections about more day-to-day experiences through mainstream social media content. However, some of the findings about the use of social media content for reminiscence is very relevant our research. Thomas and Briggs [20] conducted a user study with Intel's Museum of Me, a website that creates a short video clip from users' Facebook data. Results indicated that existing data in social media is considered shallow and not enough for meaningful reflection about users' lives. NowandThen is a prototype of a recommendation tool for previously shared social media content to encourage users to positive reminiscing [21]. Revisiting past social media content through NowandThen is perceived well by the users, though some users wanted more information such as associated status and tags, date and time. One of the earliest and influential work on social media and reminiscence is Peesapati et al.'s Pensieve [22]: a system design that emails either past social media content or generic prompts in an unpredictable manner. The system also lets people add written comments to the content shared with them by the system - either through email or website. One of the relevant findings is how personalized triggers (photos from Picasa) collected more responses than generic prompts. Additionally, participants ex-

pressed a preference about seeing the metadata along with the photo, such as people, events, place: just like NowandThen's users.

Social media can also be used as a in-situ data collection medium for later reflection. Grafitter [23] is a personal informatics tool that gathers information from the users through tweeting in a specific format. It collects various types of information using the hashtags: therefore in contrast to other personal informatics systems, users have control over what information to collect. The system later presents the collected data visually for reflection. The Grafitter system is inspirational for us since it collects momentary data for reflection through social media and presents users with their own input. Similarly, Andre et al. [24] investigate the value of social media in collecting personal well-being data. Their system Healthii collects the data through users' Facebook and Twitter updates, and Healthii desktop application by having users rate their own busyness, stress, health, and engagement (positive, negative, neutral). Their findings emphasize that providing users with multiple dimensions encouraged both retrospective and momentary reflection. Healthii system uncovered how just inputting personal data can trigger reflection in the moment of experience. Bae et al, takes a similar approach with Ripening Room [12]. Ripening Room is a social media website that creates a 'ripening time' between creating and sharing content. This ripening time acts as an agent of "strategic breakdown of experience" in order to create space for reflective thinking. Their work emphasize the importance if resourcefulness of collected data to encourage deeper levels of reflection and how concerns related to online presence may prevent online self expression. In a very recent work on self-reporting emotional states through Instagram [25], Nave et al. asked their participants to share information about energy and pleasantness ratings (1-9 scale), colors, and emotion labels when they post on Instagram. Although their work mainly focuses on emotional states, participants reported assessing themselves while posting made them get involved in reflective processes and they enjoyed doing so. Even if our work takes a very similar approach, we do not focus on emotions and collect self-reports in a more private manner to avoid online presence concerns.

3 Preliminary Study: Explorations on Reflective Questions for Social Media

3.1 Introduction to the Concept: Layer Zero

In this section, we explain Layer Zero's reflection log collection phase principles. A reflection log essentially refers to a new layer of user generated personal information that is collected in addition to the information shared on mainstream social media channels. Layer Zero adds another layer to the already existing personal information through reflective questions to enable deeper self-reflection. The name is derived from its approach to already existing social media data (such as images, written descriptions, location, date and time, hashtags) as just one layer of the overall information of the experience shared in social media.

By providing another layer, Layer Zero aims to remove the barriers of existing social media systems and encourage users' self-reflection. Below, we explain the two foundations that Layer Zero is built on.

Sharing on social media is an experience to reflect on. One of the assumptions behind Layer Zero is that both the content on the social media and the experience of sharing on social media are potential sources for reflective thinking. This assumption is rooted in American pragmatist John Dewey's work on experience [26]. Dewey made a distinction between experience in general sense - which may not provide grounds for self-reflection - and having an experience. Roth and Jarnet explain his definition of having an experience as follows: having an experience is *"when an event that we have lived has run its course and comes to a determinate conclusion - a consummation."* [18]. Following Dewey's definition, we believe the use of social media has at least two differentiated experiences: creating, and sharing content. For example, as an Instagram user, while walking you see an instance you want to capture, stop walking, pick a perspective, customize settings, take a picture or more, look at it, and continue walking. After a while, you open your Instagram application, choose the photograph, edit, add a caption with hashtags, add a location marker and share it with your followers. Both of these moments have specific beginnings and endings, and they represent pauses to the everyday flow of activities. Therefore, we believe that both moments have the qualifications of being an experience, and they are reflective instances. In order to capture the additional layer of information about those instances, Layer Zero aims to collect information about the sharing experience just after people are engaged with the experience. This also goes in-line with Baumer's approach as collecting reflection logs while people are engaged will produce a breakdown moment - which, in itself, is reflective.

Questions that provide new perspectives will produce resourceful data for later reflection. One of the main obstacles to deeper self-reflection on social media content is the lack of resourcefulness of existing information. Resourceful here means that the statements shared in social media do not represent the overall experience: certain aspects may be self-censored due to the habitual purpose of social media. Therefore, Layer Zero searches for additional information that is valuable for reflection. One of the most reliable ways to gather personal information is just to ask the person: but the way we ask should differ in terms of content to not just replicate, but add on existing information. Following Fleck and Fitzpatrick's [14] comments on the use of technology to nurture reflection through providing new perspectives, and Dewey's approach to an 'experience', we explored how we may shift users' perspectives on the experience of sharing on social media through a set of reflective questions. Many of the existing work in HCI literature (such as [24] and [23]), that aim to understand personal experiences focus on the results of the experience: how certain circumstances make one think, feel or do. In a different manner from these existing approaches, we realized decomposing the experience or understanding the different qualities of

an experience holds great potential to make users think deeper and become more reflective.

3.2 Searching for Reflective Questions about Social Media Experience

In this section, we explain two question sets we explored with the aim to decompose the social media experience in two different ways, and how we turned those into reflection logs.

Question Set 1: Group Discussions Through research group discussions on decomposing experience, we defined three aspects of an experience: pain (a sense of discomfort or negative feeling), pleasure (rewarding positive experience) and security (a positive experience of comfort). Reflection Log 1 had two open ended questions: 'Can you please explain the moment you posted this photo?' and 'Why do you think you decided to post in that moment?'. Those are followed by questions asking the relevance of aforementioned experience to the notions of security, pleasure and pain on a 7 point scale. Following each scale, the participants are asked to briefly explain why and how with open ended questions.

Question Set 2: Dewey's Approach We turned to Dewey one more time to search for aspects or qualities of 'an experience'. In Technology as Experience, McCarthy and Wright explain Dewey's approach to experience: *"...it encapsulates a person's full relationship - sensory, emotional, and intellectual - with his or her physical and social environment."* [27]. We decided on 4 aspects for question set 2: personal, spatial, temporal, social. Personal aspect also has three aspects: sensory, emotional, intellectual. Reflection Log 2 also had two open ended questions: 'Can you please explain the moment you posted this photo?' and 'Why do you think you decided to post in that moment?'. For personal aspect, the log included questions regarding the relevance of aforementioned experience to the notions "sensory, emotional and intellectual" on a 7 point scale. Following each scale, an open ended question asked for a brief explanation. For spatial, temporal and social aspects, questions asking for explanations with open ended response areas are included.

3.3 Preliminary User Feedback on Question Sets

In order to compare the comprehensibleness of two reflection logs, we conducted a preliminary online user study through Instagram. We choose Instagram as our study medium as Instagram comes to the forefront among other social media channels for multimodal sharing (such as images, text, video and sound) of personal data, it has a community using the medium for reflective sharing and it is one of the most actively used social media channels for sharing everyday experiences.

We recruited 18 (16 female) active Instagram user participants through announcements placed on Instagram as posts and stories of researchers, and snowballing. After the recruitment, all the communication is provided via Instagram direct messages. We created a wizard-of-oz setting for our user study. The first author played the wizard role. In order to deliver the logs as soon as possible, first author followed and turned on the post notifications of the participants in order to receive notifications each time they post on Instagram. The Reflection Log is mimicked with an online Qualtrics survey. Every time a participant posted a photo, an online link is sent to the participant along with the photo posted. We asked our participants to fill the logs that are delivered to their Instagram Direct Inboxes after they post a photo during their participation.

Feedback on Open-Ended Questions Open ended questions helped us gain insights about the timing preferences and underlying motivations behind the act of sharing on Instagram. There were 2 different patterns when describing the moment of sharing. When sharing retrospectively, the answers described the moment of posting apart from the moment of capturing the shared image. Others described the moments of capturing and sharing as a whole: the post is made at the time of capturing or right after.

The open ended questions also revealed motivations of participants to post on Instagram. When they posted momentarily, 2 dominant motivations (that can overlap) raised. One reason was the thought processes triggered by the moment or by the image. Participant 18 stated *"I felt something similar within me. The minster was reflecting my anger as well as my 'child' part in me"* and P8 stated *"I always think the improvement of human being. We are in change and it lasts until we die. If there is no change it means there is no life. Hands and feet show the changes clearly. So i decided to share".* The other is of aesthetic/visual value of the image (6 answers). P18 stated *"Here there was all the glam and i was all dressed up. Its like 'you have to take a photo and post to Instagram'"* and P11 stated *"Because i saw the sun light on the see. I liked that light colour. It's like a silver."*. In addition to those two dominant motivations, participants who posted retrospectively had various other motivations such as trying to catch attention, not feeling productive, timing concerns and to keep an online presence. P1 stated *"I don't have much time to spend in Instagram so I decided to post a photo while I had the chance. Also I have thought of a really funny caption about our incoming party so it was gonna be a good promotion."*, P2 stated *"I always prepare three images in advance, and post them within 5-20 hours of each other. It was time for this one, the third in the series."*.

Although the focus of the survey questions was on reflection about the moment of sharing, P2 -who never posts a photo when he captures it- stood out from rest of the participants for he deliberately preferred answering the questions either referring to the moment of capturing or regarding compositional/aesthetic value of the image. His answers were detailed descriptions of the experience of capturing the image, *"The posting moment was insignificant. I may have been taking a break from actual work. However, to shoot this photo, I remember forcing*

my friends to stop by the side of the Karadeniz motorway between Rize and Trabzon, when I spotted the large ship at a distance surrounded with nothing else for miles." or meaning through compositional content of the image: *"The photo has two subjects: the electrical infrastructure (huge towers rt human scale)and the sky/sunset (even more huge and contrast-amplified in post). We take electricity for granted, but the vast towers are consumed here by the epic sunset."*.

These results indicate that moments of capturing or posting were already reflective moments before the participants are encountered the survey: when asked to describe the moment of posting and the reason why, their answers contained information regarding the multiple aspects of the experience as well as internal thought processes.

Another important knowledge gained from the initial study is the effect of potential time gap between the moment of capturing and posting on both motivations and reflective thinking. Additionally, case of P2 also provides a valuable insight into reflecting on the moment of capturing rather than sharing. As the moments of capturing were significant for him, he was able to provide detailed information from a past experience. Therefore, giving the users control over which moment to reflect on is an important insight when designing a reflection tool.

Feedback on Reflection Log 1 Our analysis regarding the answers to questions of reflection log 1 revealed that notions other than pleasure were hard to comprehend. Out of 26 answers, 11 answers found security aspect irrelevant or did not understand the question. Similar evidence were present for the pain notion. 13 answers recorded the irrelevance of the concept of pain to their experience.

It suggests that this categorization does not allow the participants to approach to their experiences from multiple and unfamiliar perspectives. It seems like pain and security are too unfamiliar to trigger reflective thinking, as almost half of the time they were found completely irrelevant to the experience. Pleasure aspect is found highly relatable in most of the cases. This is understandable considering the preference of sharing positive experiences on social media platforms. (citation) Therefore, as said before, this approach is observed not to serve the dimensional approach we were seeking.

Feedback on Reflection Log 2 Answers to Log 2 revealed different understandings of the notions of emotional, intellectual and sensory. The notion of emotional was the one that found the most relevant: out of 24 answers, 21 of the recorded answers had points 4 or higher to the relevance rating of emotional aspect.

A variety of understandings of intellectual aspect is observed among participants. One of the understandings of intellectual aspect was thought processes related to using social media: P8 stated *"Little bit intellectual because social media is an id of ourselves in social media. We sometimes just post to show people what we think, what we do, and how we react."*, P13 stated *"I waited for my followers most active hours to post, to boost my profile so i was more thought*

act. I always know that I'm not a passive user, I'm active who influences other people so i knew that my post was going to reach peoples minds somehow" and P15 stated *"I try to be thoughtful with my work and I also avoid being solely pleasing."*. Others referenced intellectual aspects of the moment; such as being in a cultural event, having deep thoughts or having an intellectual discussion.

The understanding of sensory aspect had the most diverse answers: motivations behind answers change from posting solely emotionally (P8, rated 0) to having many post-processing steps to the image (P2, rated 7). This is especially interesting since being a visual sharing platform, Instagram by nature is a sensory medium. However, it became evident that users have different understandings of sensory input especially when thinking about their own experiences of posting.

Social aspect was also found relevant by most of the participants. 17 explained social connections either about the moment or the act of posting on social media when answering the social aspect of the experience. Examples include, *"It is fund to observe how people react and reply in each posts via Direct Message in Instagram", "I always ask my friends why they do like a particular photo.", "I was with the people I loved around me, it was a time of socially good time"*. Encountering different understandings is not a flaw but a sign of success, since it indicates that participants went through internal thought processes while they were trying to make sense of the questions. The findings indicate that answering questions in survey 3 directed participants to think more, differently, or once more on their experiences of using social media, and their motivations of doing so.

3.4 Lessons Learnt from the Preliminary Study: Layer Zero Logging Methodology

In the light of the insights generated through the preliminary study, we choose Log 2 for data collection of Layer Zero. However, certain adjustments were needed:

- Since there is a distinction between momentary and retrospective shares, the log initially asks if the participant wants to reflect on the moment he took the photo or the moment he shared the photo.
- The first question is a text area with the title "The moment I shared and the reasons why...".
- The log asks for the relevance of the notions of 'sensory, emotional, and intellectual' with a 7-point scale accompanied by open ended question boxes asking why. The wording of 'personal aspect' is removed since it creates confusion.
- Following, written descriptions are asked for the spatial, temporal, and social aspects of the experience.

4 SECONDARY STUDY: The LAYER ZERO LOGGING EXPERIENCE

In order to better understand the overall experience of filling reflection logs on social media posts, we conducted a second study with only one set of questions, based on lessons learnt from the preliminary study. We used a phenomenological approach and created a prototypical setup that helps participants to experience filling in logs for two weeks every time they post a feed or a story on Instagram, then discussed the overall experience and their perceptions with them through semi-structured interviews. Phenomenological research approach aims to understand participants' lived experiences of a phenomenon to find commonalities around what participants' have experienced and how they have experienced it [1].

4.1 Procedure

Participants were recruited through e-mail invitations and Instagram open calls shared in stories and posts. In total, there were 11 participants (7 female, 4 male) and their age ranged between 23 and 41 (mean 29). Most of the participants stated that they share on Instagram every week (6 participants) or every 2-3 weeks (5 participants). Due to the language restrictions observed through the initial study, the second study is conducted in the participants' native language, Turkish.

The study is conducted over a two-week period. Different from the initial study, we asked participants to fill the reflection log for their story shares along with their posts. Every time a user shared content on Instagram, the reflection log is delivered to their inboxes accompanied by the content they posted. During the 2-week period, 48 reflection logs are filled by 11 participants (15 posts and 33 stories). After two weeks, semi-structured interviews are conducted with the participants that lasted from 20 minutes to 1 hour apiece. The interview questions are structured in three sections. The first set of questions were related to users' experiences on posting and revisiting on Instagram. The second set of questions were aiming to understand how the question set (Layer Zero Log) is perceived and whether it helps to deepen self-reflection. Lastly, we asked about their overall experience and insights on the design of Layer Zero. To analyze results, interview notes and voice recordings are reviewed to reveal outstanding themes and insights among participants.

4.2 Findings

Our study revealed significant findings around the question set we structured. Here, we present our findings from our interviews.

Instagram as a Reflection Medium Our interviews reveal that sharing on Instagram is a reflective action. However, the intentions and motivations behind the reflection vary. That is closely related with the fact that users' reasons

to share on Instagram is also very different from each other. Some examples are; to communicate (P7), when visiting different places (P10), to use like a photo album (P2), to share information with people (P11). The level of consideration on personal level is somewhat proportional with the perceived level of reflection. Participants those stated that they don't use their Instagram posts to think about themselves still engaged in thinking, while and after sharing. However, their concerns were more related to representation, such as maintaining the visual harmony or checking the number of likes. Regardless of the differing motivations, the decision between sharing a story and sharing a post was mainly made depending on whether the content was worth keeping permanently or not. It should be mentioned that the reasoning behind that decision was also differing among participants, and it was in line with their purpose of sharing on Instagram. For example, P2 had a order on her posts, and had a few story series she is curating. For her, both the stories and posts are curated but the ones posted are selected more carefully. P1 stated that only the announcements, calls and content with communication purposes are shared as stories and posts are the moments she wants to remember. Therefore, a more careful curation was present for posts over stories is observed in participants.

Appertaining to the curatorial concerns, participants often stated that they post not during the experience but after a while; after the experience finishes, a few hours later, whenever they have free time, or after a few iterations on visual effects. This finding is in line with our previous finding on momentary and retrospective shares and differences on the reflections for posting them. When designing the survey, we made the first distinction between 'the moment the photo is taken' and 'the moment the content is shared' to understand users' preferences better. Discounting the participants who take photos and share at the same time, most logs for posts (out of 19, 11) were reflections for the moment that the photo taken. Some participants stated they did not choose that option because the photo is not taken by them. Otherwise, participants preferred to reflect on the moment content is created, rather than the moment it is made online.

Clearly, it is more tempting to think and comment about the moment of experience that is represented in the photo. Even if so, it appears that the questions have the potential to make one think about not just the content but also themselves. Several participants stated answering questions made them think about their sharing habits and preferences. Two participants even thought about questions while they are posting (P5 and P12), before they are presented with the reflection log. These insights illustrate how taking photos and posting photos on Instagram -even those that are not taken by the owner- are both moments of reflection, but the levels and motivations behind the reflective thinking differ person to person.

Question Set as a Reflection Tool Although some had hard time understanding the dimensions we provide them with at a glance, participants approved that filling the reflection log made them think deeper, or from a point of view they

did not think about before (see Figures 2, 3, and 4 for some examples. [4].) The reactions and perceptions were various. Participants who state that they think thoroughly when posting saw the reflection log as a tool to deepen, organize and record reflections. Furthermore, filling the reflection logs made people question their sharing habits and motivations from a broader perspective. P3 stated *The three categories made me think about how the weight of the categories change amongst my shares and how I usually share with sensory and emotional focus."* and P5 stated *"I realized I share things that will challenge me to motivate myself. ...I've realized this more with the study: I tend to share when I want to talk about something with someone. ...I've asked myself my expectations and thoughts when sharing content with socialization concerns."*. Apparently, the questions made people think critically on their sharing behaviors. For example, P6 explained; *"The questions were interesting in the sense that I've realized I don't think at all when I am sharing, even not focus on the moment. ...When I got the questions, I've realized I could think over it more when sharing."* It is visible that even before being able to look back, answering questions triggered momentary reflection.

Several participants thought regularly using this tool would alter themselves' or other people's posting behavior on social media; it would decrease the number of shares. Furthermore, they considered this as a positive improvement on their Instagram use; either because they feel like they are exposed to unnecessary content or they would not like to share content that would be perceived negatively. Being critical of the people that share frequently on Instagram, P5 argued *"I wondered if even though they don't fill the survey every time, being presented with this questions every time they post would decrease their number of shares"*. P7 stated even if her decision of sharing probably would not change, she suspect especially facing the questions before sharing would change people's decision of sharing.

One of the possible reasons behind some participants' hard time relating the questions may be because of the fact that not everyone was able to fill the reflection log for the content that is more meaningful for them. That is, given the two weeks of the study time, some participants were only able to fill the reflection log for the stories they share, which do not hold as meaning as the posts do. Indeed, when asked about their preferences on the content they would like to fill the log about, all answered posts. Regardless from the motivation behind, the posts carry more meaningful information than the stories. Some other cases were P2 and P7. P7 explained she would like to reflect on most of the content she shares on Instagram, even for the ones that are related to her personal life but rather current agenda; *I would use such a tool to get to know myself and see the changes in my social circle, my country's agenda, or world's agenda.* P2, when reflecting back to her experience, explained how even for her story shares which mostly have a clear motivation such as raising awareness, she would like to use this tool for recording her current opinion on the subject.

[4] All content shared with the permission of participants.

4.3 Contents of the Reflection Logs

Out of 48 reflection logs filled by the participants, 38 logs involved a statement of feelings, emotions or inner thoughts at least once. These statements occurred in different questions. For example, while filling the reflection log for a building photograph, P10 first mentioned about the warm sunlight and the visual pleasantness of the environment. Following, while answering the questions about the emotional and intellectual aspects, she stated; *"My last days at school... (I thought about) the feeling that come from saying farewell."* 10 reflection logs were description based or just involved a statement about the visual pleasantness or having good times. Even though perception of beauty and categorizing an event as 'good' are feelings, we categorized 3 statements that refer only to beauty or visual pleasure since that is one of the intrinsic motivations for social media sharing activity. Out of 10 reflection logs, 6 belong to story shares. An example of description based log is as follows: P7 said she shared this image because it is relatable for her and her friends, and it is entertaining.

Experiencing the Reflection Logs The overall experience of the study was found interesting by the participants. However, there was a confusion about the aim of the study. Participants were unclear about the benefits of just filling the reflection logs since they did not see any representation of their input. P3 clearly stated that even though the questions did guide him into a deeper reflection, he wouldn't use such a tool without any other motivation than participating to a user study because he did not perceive a remarkable gain just from filling the reflection log. He is not the only one; participants those are not familiar with reflection was skeptical about the benefits and reasons for using such a tool.

All of the participants were interested in the idea of being presented with the collected reflection logs. All of the participants stated they would use such a tool for the content of their choice, if they have the opportunity to see the accumulation of their input. As in any other case, their motivations varied. The most common motivation was to 'see the personal development'. P3 explained how he perceives such a tool as supportive of reflection; *"I will think when I look back at the photos, (having reflection logs) will provide me with key elements that I determine back then (when the content is shared)."*. Some participants were much more interested in the ability to see specific periods of time. Motivations raised around remembrance were also present. P4 expressed his motivation as *"If I want to tell the story behind (the photograph), ...what happened, who was there. Characters, place, time; those are important for me. ...I would be attracted to reliving the memory."*. Participant 11 imagined setting a mindset beforehand and start using the tool: "I may use it in times where I will go through a change in my life to track and better understand myself.". It can be concluded that people with various motivations for posting on Instagram differ in levels of reflection and their motivation behind using such a tool, but they agree that such a tool could be used for self-investigation purposes and they would try it.

Furthermore, from the feedback collected from the participants, we observed a potential for this tool to be used as a social communication tool as well.

Some of the participants stated they would share their reflection logs -in the moment of creation or after a while passed- with close friends if they feel like it represents things from both of their lives at that time, or their experiences of the moment better. However, all users would prefer to keep overall verbal reflections to themselves while share visual representations of their experience.

Participants also shared more constructive feedback about the design and implementation of the reflection log. 7 point scale is mostly found confusing or unnecessary. For example, P2, talking about the 7 point scale said *"I can't make the distinction between 5 and 6"* and P11 suggested the numbers to have written levels such as low-moderate-high. Most of the participants found the question design a bit confusing at the first sight, and some stated that they would require an explanation for each aspect or more clear questions to better relate with the concepts. P11 suggested rather than having concepts or keywords, it is better to have sentences such as *"what did you think, what did you feel, which senses did it appeal to?"* since keywords made her think more technically. P4, carried the concept one step further and explained: *"I wanted to have more criteria to rate. ...such as feelings like love, togetherness, achievement. ...It is hard to write, if I prefer writing, I wouldn't be on social media, I would have a blog"*.. Participants had personal preferences when it came to the delivery time, but most preferred answering questions right after they share content on Instagram.

5 Discussion

Overall, based on the feedback collected through the 2 studies we conducted, we consider Layer Zero's information collection methodology (Namely: Logging) to be successful in accumulating resourceful data for self-reflection based on the emotions, feelings and thoughts mentioned in the reflection logs and participants' statements. Even though this study doesn't involve the presentation of the collected data at this stage, it was very critical for us to learn how users would react to the idea of further logging on the posts they share on social media for self-reflective purposes and if answering a certain set of questions is perceived beneficial or pleasant. Our findings show that reflection logs help users go through a momentary self-reflection or to report their already existing reflections through answering questions. Below, we discuss what we learned for the design of tools for self-reflection through social media; the further iteration of the Layer Zero tool in our case.

Throughout our research, we realized the potential for reflective thinking through social media is highly connected to people's motivations for sharing on social media and their behavioral patterns. For some, the main motivation to post on Instagram is to collect moments that are worth remembering, since the medium provides a permanent storage of memories. The participants' reflection logs revealed that in some cases the post has been created through after a reflective consideration of an experience. In such cases, the logs capture the information that is not shared on social media, but was present on participants' minds. The is a significant difference between the motivations for sharing posts

and stories. Since posts are associated more with the concept of remembering, they can provide a better ground for self-reflection. This is validated by users demonstrated preference of filling reflection logs for their posts over their stories. Regardless of being in the form of stories or posts, shares on Instagram are perceived as representative of real world. Participants' comments on how they would use reflection logs for life review reveals that the content they are sharing is affected by what they go through in life. This is a valuable finding since public information in shares does not often reflect such personal information and Layer Zero is an appropriate approach to provide the users an additional medium for recording personal experiences behind their sharing decisions. Several participants' alternative use case suggestions support this perception; one highlighted Layer Zero's possible importance in tracking psychological disorders of patients.

There is no common understanding of what reflection is. It was hard for some participants to relate to the concept when asked about. However, even they commented on spending time understanding questions and answering them. However, time to time, their answers contained details as reflective as other participants who were familiar with the concept. Apparently, being familiar or aware of reflection makes it easier to relate with different aspects when evaluating an experience or a photograph. Therefore, Layer Zero may act as a reflection awareness agent before a reflection support agent. If not, for some of the participants, it may ended up acting like a personal informatics system through which users collect non-reflective information about their shares just to track their "mood", for example. It is interesting to see how lower levels of already occurring self-reflection comes with higher desire of automation. Suggestions about automatic analysis and presentation of the content is generally suggested by people who state that their shares does not make them think about themselves. This supports that users' input is important to make the information resourceful, otherwise it may follow the same logic with all personal informatics systems that does not ensure reflection in any level.

Some other concerns and insights that should be taken into consideration in the future were the cases where some other person takes the photograph or re-sharing content. However, other distinctions should be explored; for example, a participant suggested having another filter for the content between 'related to me' and 'something that I do'.

Layer Zero's reflection log approach allowed us to see reflective activities on various stages of social media use. Through reflection logs, three different processes are observed throughout our research. First, the questions allowed participants to state more emotions and thoughts than their captions on social media, hence would provide a resourceful source for retrospective reflection since expression of thoughts and feelings are crucial for later reflection. Second, there were occurrences where the logs are used to record reflective thought processes that led participants to share social media. This shows, as we claimed, sharing on social media can be a reflective activity itself. And third, answering the questions allowed participants to reflect on their experiences of sharing on social media. Apparently the third activity sometimes allowed participants to thought further

than the content they share when answering the questions. However, it was not possible for the users to (i) see their reflection logs after they record them and (ii) answer the questions for a longer time period than 2 weeks. Therefore, their further reflections mostly focused on their thoughts, motivations and reasons for sharing on Instagram. The focus on that momentary reflection may be subject to change or even decrease with a long term deployment of Layer Zero. However, it also exposes a potential for behavior change through the use of Layer Zero.

Aiming to increase awareness would require a slightly different approach and this may again be in line with the feedback from participants. We intentionally did not provide any specific explanation about the sensory, emotional and intellectual dimensions to provoke independent thinking and explore how each participant understands the aspects. However, the participants' experiences with the reflection log could have been more joyful if they were initially presented with neutral descriptions of the aspects or the wording would have been different. This may also support other mentioned use cases of the tool, such as wanting to remember a memory better. The sensory aspect is mostly linked with visual aspects, however if we would have been mentioned the other senses, the users may have been provided information related to other senses. Those suggest that users need prompts when they are answering questions to dig deeper in their thoughts.

It is critical to keep up the motivation to use the tool. Collected data should be presented back in such a way that it would encourage using the tool. Participants were mostly interested in seeing the trends through a certain time when looking back, which is also inline with previous research suggesting technology-mediated reflection is the most suitable when it helps seeing patterns and getting lessons out of the finished events [13]. Therefore, Layer Zero's presentation of reflection logs should allow reading information related to each dimension clearly and in relation with each other. As in the new social media prompts, another option is to present the user with the individual reflection after a while (3 months, 6 months, 3 years), which is also valued by participants. Motivation is closely related for their ability to not being reinforced to use such a tool but it is up to them; with their own preferences.

In conjunction with motivation, personalization is also critical. Such a tool should provide as many personalization options as possible without confusing or overwhelming the users. It is important to allow the users select what to reflect on and when to reflect. Especially the timing of the delivery of the reflection log was a very personal choice, different to each user with different motivations. However, Layer Zero's aim should be collect information on an experience that has just happened, rather than intervening the experience itself. The reason behind is to keep every individual experience intact. One participant, for example, stated that he would like to receive the questions just before posting to re-evaluate his decision. This approach highlights the risk of perceiving Layer Zero as a self-control tool, rather than self-reflection.

6 Conclusion and Future Work

This research proposed a new approach for transforming the social media content and the experience of sharing into a reflection opportunity through providing a tool that collects and presents an additional layer of personal information to its user. The features of the data collection phase of Layer Zero seemed to encourage momentary reflection and hence was successful to extract resourceful information for later reflection. However, the experience of filling the reflection logs showed that its current design can be improved in such a way to increase awareness about reflection in addition to just collecting reflective information. In consideration of the limitations and the participants' suggestions for future design of Layer Zero, there are two worthwhile directions for future work. One is to design the second phase of Layer Zero and the other is to conduct long-term studies to understand the effects of using such a tool on self-knowledge and users' strategies when using the tool.

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4.2 Reflection on Daily Experiences via a Photo-based Journaling App

4.2.1 Preface

Building on the insights from previous work, we designed and developed a mobile app that provides the chance to record daily experiences using photos and additional notes. Addressing RQ1, we integrated reflection prompts carried from Paper 1. The gaps identified in Paper 1 influenced the decisions made for this research study in our previous work. First, to overcome the tensions around sharing daily experiences on social media, we eliminated the social media shares and created an app where participants can privately upload images anytime. Second, to contribute to their meaning-making, we created data visualizations and a feed view within the app that would enable looking back at collected and reflected experiences.

To design the visualizations, we started the research process with a design study with eight designers to create a visualization approach. After developing a mobile photo-journaling tool, 13 participants used it for five weeks in an in-the-wild study. We concluded the field study with semi-structured interviews. Lastly, we conducted a design workshop with study participants, designers, and developers to address problems identified in the field study (N=9).

The findings from this work were critical as they directed the focus of this research to conversational interactions to trigger everyday life reflection. Our findings highlighted the potential of reflection prompts and visualizations for both momentary and retrospective reflective activities. However, the participants found the logging process burdensome. Further, we acknowledged that repetitive prompts are not suitable for the diverse nature of daily life. Therefore, I realized that to be inclusive of the breadth of events that we face in our daily lives, we need to develop generative prompting structures. Both the user feedback and designer suggestions in the study pointed to conversational interactions where the main purpose of conversation is embedded into smaller question structures. This led me to start working with CAs as the state-of-the-art technology to support reflection on everyday life experiences and exploring reflection prompts and questions to be embedded into dialogues.

4.2.2 Paper 2: Combining Momentary and Retrospective Self-Reflection in a Mobile Photo-Based Journaling Application

Pelin Karaturhan, Ecem Arıkan, Pelin Durak, Asım Evren Yantaç, and Kemal Kuşcu. 2022. Combining Momentary and Retrospective Self-Reflection in a Mobile Photo-Based Journaling Application. In Nordic Human-Computer Interaction Conference (NordiCHI '22). Association for Computing Machinery, New York, NY, USA, Article 64, 1–12. https://doi.org/10.1145/3546155.3546676

Combining Momentary and Retrospective Self-Reflection in a Mobile Photo-Based Journaling Application

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ABSTRACT

The concept of self-reflection is investigated in a wide range of fields, from Psychology to HCI. Different fields use different methods to trigger reflection, such as visualizing accumulated personal quantitative data, personal photos, journaling, or asking reflective questions about experiences. This study combines photo-based journaling, reflective questions and data visualization for triggering momentary and retrospective self-reflection. We prototyped a photo-based journaling app and conducted a 5-week field study (N=13) to observe in-the-wild experiences. Following, we conducted an evaluation workshop (N=9) to explore strategies for motivating reflective question answering and retrospective self-reflection. Our approach encourages momentary and retrospective self-reflection, but the question-answering process could be burdensome and retrospective self-reflection should be incentivized. For that, we compiled design strategies for both kinds of self-reflection. We contribute to the HCI literature with strategies for unifying momentary and retrospective self-reflection in photo-based journaling.

CCS CONCEPTS

• **Human-centered computing** → Human computer interaction (HCI); Empirical studies in HCI.

KEYWORDS

Self-reflection, reflection, momentary self-reflection, retrospective self-reflection, journaling, photos, photo-based journaling, everyday experiences

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1 INTRODUCTION

"The unexamined life is not worth living." Socrates

Introspective examination of one's own life has been prevalent since the very beginning of philosophical thought. There is a good reason for this. Engaging in reflective thinking can increase self-awareness and self-knowledge, resulting in better well-being. We can better understand ourselves and make more meaningful decisions in our daily lives, from setting achievable goals to finding friends who share similar interests with us through reflecting. The concept of reflection has been investigated in Philosophy, Cognitive and Developmental Psychology, Education, and Professional Development [6, 24]. Self-reflection (or reflection) gained popularity in HCI literature through its vital role in the Personal Informatics (PI) approach, which focuses on an individual's collected personal data.

In today's fast-paced world, encouraging people to reflect, especially on everyday experiences, can be a challenging task to overcome. Recording our daily experiences evolved from keeping detailed diaries to sharing photos on social media, often with little to no description. The potential of social media shares as records of our daily experiences gained attention both in academic research and industry. HCI investigated the potential use of social media data for self-reflection. Similarly, social media companies developed features that remind their users about their past shares, the most well-known examples being Facebook and Instagram's services.

However, most of these services assume 'a picture is worth a thousand words', whereas retrospectively engaging with reflection may require more than just seeing photos from our pasts. In personal informatics (PI), self-reflection occurs through a retrospective examination of previously collected data, generally through information visualizations to derive insights [31]. These visualizations allow users to make sense of complex information and see patterns. HCI also investigated the value of photos for retrospective self-reflection. Photos are proven to preserve everyday experiences, gain value over time, and are perceived as easy to capture and record

Figure 1: Research-through-design process.

[10, 37]. Although revisiting past personal experiences through reminders is also valuable [26], visualizing their personal experiences captured through photos may enable users to reflect better.

The data is the main challenge to supporting photos with visualizations of everyday experiences. Although deriving some context from images is possible, it does not allow a generable visual language. When we turn to Psychology and Education, we see their approach to reflective thinking is more focused on the momentary experience of thinking rather than on examining past data. One widely applied method is journaling, where individuals write about their emotions, thoughts, and experiences, creating a reflective moment. Writing activity may be more beneficial when accompanied by questions that trigger reflective thinking [45]. Educational research uses question probes (reflective questions) in schools and professional learning contexts for momentary reflection. Reflective journaling has been briefly investigated for learning [32] and professional development [3] contexts in HCI literature. However, reflective journaling methods for personal life experiences are an under-explored research area.

In this work, we encourage users to extend the data of their daily experience photographs with reflective questions and present their data through visualizations. We are interested in combining photo-taking habits with journaling to trigger momentary self-reflection and offering visualizations for retrospective self-reflection. In particular, we have two research questions;

(RQ1) How can we combine everyday photo-taking and journaling into a (self)-reflective thinking activity?

(RQ2) How can we visualize qualitative journal data to enable retrospective self-reflection in photo-based journaling?

We started by designing and developing a mobile application to address these questions. To answer RQ1, we integrated reflective questions into the mobile app using Karaturhan et al.'s reflective questioning framework [27]. To answer RQ2, we conducted a design study with eight designers and designed a visualization to work with Karaturhan et al.'s framework. After developing the mobile photo-based journaling tool, we conducted an in-the-wild user study, where 13 participants used the photo-journaling application for five weeks. This study confirmed that reflective questions encouraged the users to think more deeply about their experiences, and visualizations acted as thought triggers for retrospective self-reflection. However, the participants found the question answering and log creation process burdensome and did not visit their past logs often. We conducted another generative workshop with study participants, designers, and developers and devised strategies to address this problem (N=9).

Overall, here we report the findings of this research-through-design process [56], including (1) concept development, (2) design studies for visualization, (3) in-the-wild user studies with the prototype, and (4) a workshop evaluating the user insights (Figure 1). This work contributes to the literature by suggesting a multi-dimensional self-reflection system combining momentary (with photos, journaling, and reflective questions) and retrospective (with revisiting journal logs and visualizations) self-reflection. We also offer strategies for future work focusing on multi-dimensional systems for the HCI community to extend our work in the field.

2 BACKGROUND

We would like first to clarify the distinction between the concepts of reflection and self-reflection. Cambridge Dictionary defines reflection as *"serious and careful thought"*[1], and self-reflection as *"the activity of thinking about your own feelings and behavior, and the reasons that may lie behind them."*[2] Self-reflection, having a narrower focus, borrows a lot from reflection literature. Additionally, two concepts are often used interchangeably. Therefore, this section discusses background literature on reflection and self-reflection since research on reflection is wider.

2.1 Self-Reflection in Education and Psychology

As the function of reflection fundamentally is to make us think, reflection and self-reflection play a critical part in Education, Professional Development, Counseling, and Coaching. Journaling, expressive writing, and reflective writing are popular tools to trigger reflection. Questions and probes can accompany the writing activity; these reflective questions and probes intend to imitate the dialogue between a teacher and student or a therapist and a patient [43]. Previous work has pointed out the benefit of guided journals compared to free writing for reflection [45].

With or without guiding questions, journals and reflective writing are proven practical tools for reflection in Education and Psychology. In Education, reflective writing is proven to enhance student learning [36], self-knowledge [15], college preparation [44], and professional learning for educators [12]. Outside of the education field, expressive and reflective writing has been used in a wide range of areas. For example, to improve adolescent well-being [53], for families with deep traumas [30], in behavioral therapy of depressed college students [23], and to mitigate depression and PTSD symptoms of women with a history of childhood sexual abuse [38].

[1]https://dictionary.cambridge.org/dictionary/english/reflection
[2]https://dictionary.cambridge.org/dictionary/english/self-reflection.

Evidence from Education and Psychology emphasizes the critical role of writing for reflection, especially when accompanied by reflective questions or probes. However, these tools have a minimal reflection in HCI literature, even though Fleck and Fitzpatrick highlighted the potential of reflective questions for reflection [20]. HCI explored bullet journals and their role in self-tracking, meaning-making and reflection [4, 52], but they focus more on crafting and less on writing. As one of the very few examples, Mols et al. [43] highlighted dialogue-driven reflection as one of the strategies for everyday life reflection. As a recent development in the domain, Karaturhan et al. suggested a framework of reflective questions to help users reflect on their experiences [28]. However, they did not implement their questioning framework in any working system.

2.2 Reflection in HCI: Quantified Self, Visualizations and Authorship

With the Quantified-Self Movement gaining interest, reflection is established as a step to achieve behavior change through tracking and understanding quantitative personal information [31]. Since then, literature has examined best practices to help self-trackers better reflect on their data [6, 7, 20] and application of reflection to more specific cases such as diabetes [39] and eating disorders [14] with the help of new technology.

Due to the vast amount of data collected, systems needed ways to present the data insightfully [31]. HCI started to make use of information visualization methods for a wide range of quantitative personal data, from physical activity [13, 17, 18], to water usage [21], and from computer usage [29] to food waste and recycling [51]. Previous work also aimed to understand the role of visualization in better self-reflection on multiple streams of personal data [11].

As mentioned above, reflection gained more interest in HCI with quantified-self movement and initial forms of tools collecting data through sensors and trackers. Users were not active during the creation of "journal entries." Among other personal data, calorie intake is essential for a healthy lifestyle and helps manage certain disorders. Since food consumption cannot be detected easily through sensors and algorithms and requires active user authorship, HCI literature investigated food journaling in-depth. Work on food journaling focused on increasing system proactivity for ease of use [35, 46, 55], helping users better reflect on their data, and even cultural differences in food journaling apps [34]. We believe that HCI's interest in food journaling apps could be very well adapted to daily journaling in the future, based on the qualitative nature of everyday experiences and the potential of self-reflection for better well-being.

2.3 Shifts in Perception: Everyday Life

For some years, HCI moved from treating reflection as a step towards behavior change to accepting it as an essential part of our everyday lives [41]. With this, research started to focus on the reflective potential of experiences from our daily lives, such as social media shares [47] and photo galleries [37]. Concurrently, a stream of research focusing on everyday life reflection is also emerged [40, 41, 43]. The literature is now exploring ways to visually support reflection on everyday life in novel ways, such as using memes [50] or user-generated visual compositions [27].

Personal journals keep records of our daily experiences much like sensors keeping record of our step count. Hence, researchers interested in lived experiences use methods such as diary studies and experience sampling that asks research participants to record their daily lives. Realizing the potential, diaries and experience sampling tools for reflection is briefly investigated in previous work [2, 22].

Other than that, there is little work in HCI literature focusing on journaling everyday experiences for reflection. Echo, a mobile journaling application that allows users to record their experiences and add additional information, is an outstanding example for this purpose, in terms of its everyday focus and its distinction between logging an experience and retrospectively looking back [26]. Echo requires a title and a happiness rating, leaving descriptions, photos, videos, and voice recordings optional. It presents its users with previous entries based on time and allows them to reflect again. Our work has three main departures from Echo. First, Echo treats the journaling activity as simply recording experiences while we consider the journaling activity as a reflective activity. Second, Echo only collects data related to emotions while we collect the emotional, sensory, and intellectual significance of each experience. Third, Echo is not photo-based and does not use visualizations, whereas we present a photo-journal accompanied with experience visualizations.

2.4 Photos in Digital Journals and Social Media

Digital photography have been a big part of our daily lives for years, due to the increased ubiquity through smartphone cameras. As a result, people record more of their mundane, everyday experiences through photographs [25]. Among the many photos taken through smartphones, valuable photographs may be shared on social media, printed out, or displayed in a public setting such as the home. Shared images, especially on social media, go through various filters, such as one's concerns about online impressions [19], privacy concerns or aesthetic value while unshared photographs piling on digital photo libraries may never be reviewed again [33] and may not be retrieved easily [54]. However, photographs capturing everyday experiences are valuable for reflection and can bring surprise and pleasure [25]. As a result, HCI literature has been investigating the role of photographs through various perspectives such as remembering personal pasts [49], location based reminiscence [37], presenting previously shared social media images for reminiscence [47].

With the digitalization of journals, data other than written entries have started to be integrated into digital journals, gaining interest in the field. Examples include voice recordings, photographs, location tags, weather information, and timestamps. Among these, photos have been observed to be prioritized by users. While exploring digital journaling practices, Elsden et al. discovered that user-generated content paired with photographs evoked a sense of curation and ownership, which journal keepers value [16]. A similar inclination is observed in personal informatics and lifelogging systems. For instance, when creating a time capsule for future reminiscence, families preferred to include photos more than anything else, as participants valued their potential to help remember [48]. McGookin also explored how photos from the past are considered

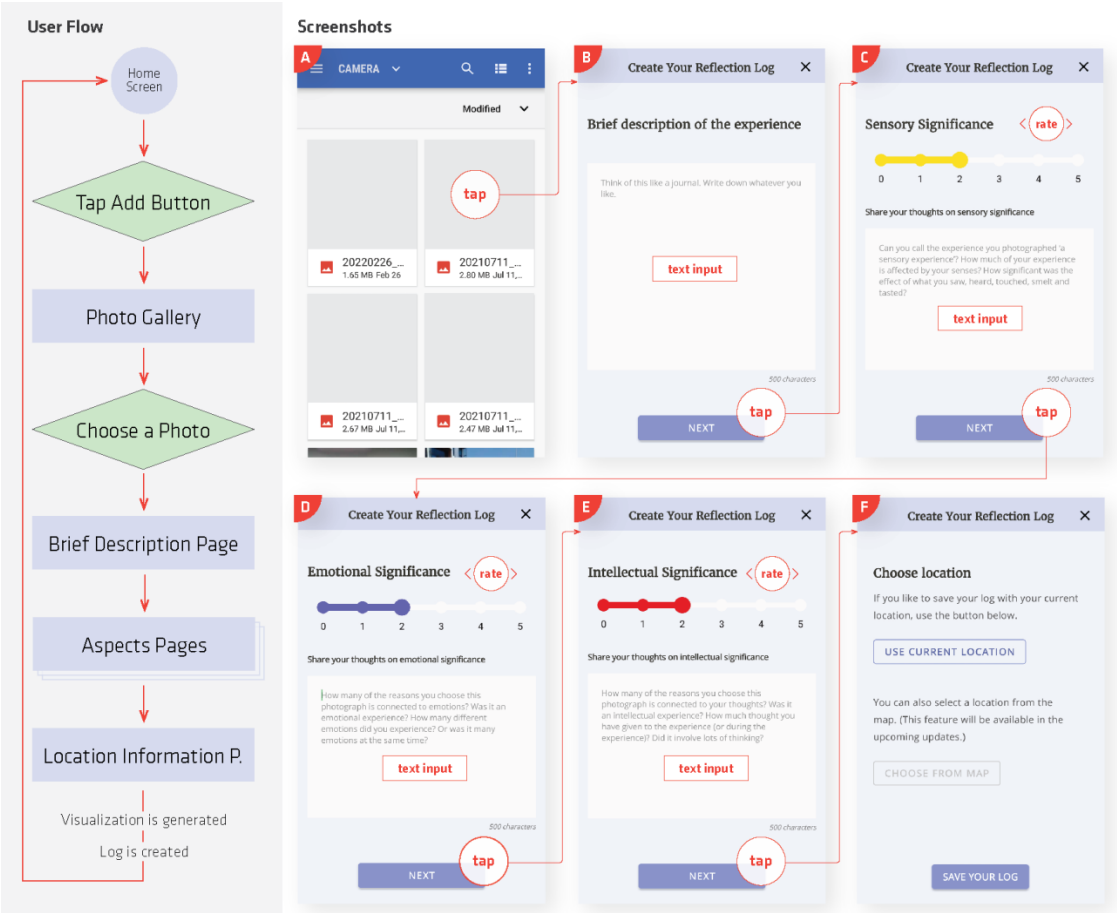

Figure 2: User flow and prototype screenshots for creating a journal log.

valuable for reminiscence with the Reveal app [37]. From another perspective, photographs paired with small annotations are very successful in diary studies at capturing everyday life experiences, as they are easy to capture [10]. Building on this body highlighting the importance of photos for journaling and retrospective reflection, we put photographs on the center to create a multimodal self-reflection application.

3 CONCEPT DEVELOPMENT AND PROTOTYPING: REFLECTION THROUGH PHOTO JOURNALING

As mentioned in the introduction, we aim to explore the combined potential of photos and journaling both for momentary and retrospective reflection on everyday experiences, with the following research questions in mind; 'How can we combine everyday photo-taking and journaling into a (self)-reflective thinking activity?' and 'How can we visualize qualitative journal data to enable retrospective self-reflection in photo-based journaling?' We designed and developed a mobile photo-based personal journaling application to address these questions and collect user feedback. Below, we explain the concept, visualization design, and prototype.

3.1 Concept Development

Experience Design. As the introduction explains, recording everyday experiences in today's world generally means sharing photos on social media. We are all very used to visual feeds and galleries, both from social media applications and native gallery applications of our smartphones. We base our design decisions on this familiarity by creating a prototype visually similar to social photo sharing applications. More specifically, we aimed for a sense of familiarity through a home page showing previously uploaded photos in a grid view (2 3A), much like our photo galleries, and a detail view screen that has the image on top and the description below (2 3B), similar to vastly used visual social media application Instagram. On top of these, we created a survey-like structure for presenting reflective questions (Figure 2) to resemble online questionnaire softwares like Google Forms, which most users are already familiar with. After multiple rounds of design iterations within the research team, we finalized the experience design and interfaces. Our design affords five main functions; (1) importing a photo to the application (1 2A), (2) creating journal logs for the photo with reflective questions (Figure 1B,C,D,E,F), (3) overviewing previous logs in a grid view (2 3A), (4) viewing visualizations generated based on users' logs (2 3A), and (5) viewing previous logs in detail (2 3B).

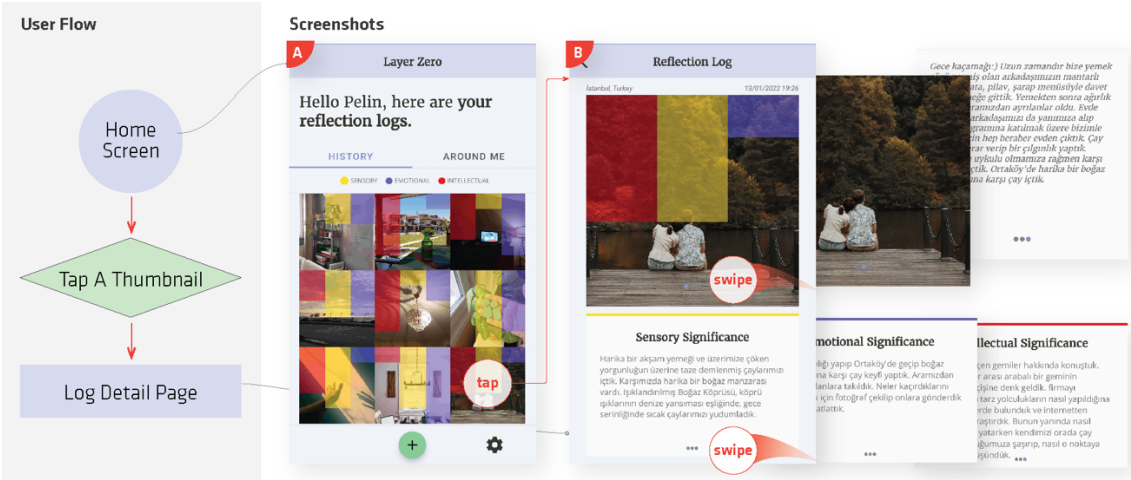

Figure 3: User flow and prototype screenshots for reviewing previous logs.

Question Selection. We implemented Karaturhan et al.'s reflective questioning approach, where each experience is evaluated in three dimensions: sensory, emotional, and intellectual. We transformed these dimensions into reflective questions by asking the users to share the significance of the recorded experience for each category (i.e., Share your thoughts on intellectual significance) through the user interface. Our motivation for choosing this framework is threefold. First, it focuses on everyday life experiences compared to a specific domain like learning. Second, it has been tested and found beneficial for photographed experiences, just as we aim to do here. Third, these questions already categorized the daily experiences, unlike other options such as a general expressive writing prompt or prompts from cognitive behavioral therapy or positive psychology. This existing categorization is helpful from a visualization perspective, as explained in the next part.

Visualization Parameters. Data visualizations should have a common denominator, and such commonality is hard to establish in everyday experiences [27]. However, Karaturhan et al.'s approach already provides a dimensional system. Therefore, we decided to use these three dimensions when visualizing each experience. We asked the users to rate each parameter's significance when answering questions on a 0-5 scale, 0 being the least significant. We conducted a workshop with designers to generate a suitable visualization method based on the three dimensions of Karaturhan et al.'s framework, which we explain in detail in 3.2.

Visualization Placement. Aligned with the common practice in the photo-based applications, where the grid view consists of photos, we explored and evaluated different visualization strategies that would work with photos in a grid view. For visualizations to work together to reveal patterns, we decided to place them on top of photos, which visually reminds photo filters.

3.2 Designing for Log Visualizations

Implementing a visualization on top of the uploaded image allows users to visually track and compare the significance of each dimension (intellectual, sensory, emotional) among their logs to derive insights. For the design of the visualizations, we announced an open call through social media that explained our aim. We recruited seven designers: six female and one male (four interaction designers, two visual designers, and one HCI designer). A total of 11 different visualizations with variations within them were submitted. We organized a follow-up meeting with these eight designers to inform them about all visualizations before distributing the survey for selection. The designers briefly explained their visualizations and discussed each visualization. After the meeting, we distributed an online evaluation survey where we asked them to rate each visualization set for *aesthetics, comprehensibility, level of detail, originality, creativity, and technical feasibility (adapted from* [24]*)* on a -5 to 5 Likert scale [1]. We selected one based on technological implementation ease among the three visualization sets with the highest overall score. The detail of the visualization is presented in 2 3. The designer of the visualization decided on the colors. Each column represents a dimension (emotional, sensory, intellectual) and fills its designated space proportional to the value attributed to the importance of that dimension. The yellow color represents the sensory dimension, purple represents the emotional dimension, and red represents the intellectual dimension. We choose not to interfere with the choice of color since the association of the colors with the concepts is highly personal.

3.3 Prototype

Below we are summarizing a generic user experience of the prototype:

- Onboarding. After signing up for the application, the users undergo an onboarding (training session) to learn about the application's aim and the dimensions. After onboarding, the users are directed to the home screen, which is empty upon registration. The plus button at the bottom of the screen can be used for log creation (Figure 3A).
- Creating Journal Logs. Log creation flow follows a step-by-step approach and starts with the plus button. After clicking the plus button, the app opens the photo library and the

user selects a photo to upload. Following, the user is asked to describe the photographed experience with a text input field. They can tap on the 'next' button to proceed. Following, pages asking for sensory, emotional and intellectual significance of the experience comes respectively. In each of these pages, users rate the significance of that dimension with a Likert scale out of 5 through tapping or swiping. They can also write about that dimension in the text input area. They can tap on the 'Next' button to proceed when they are done. Lastly, the application asks for location information. Users share their locations with the application by clicking a button. Upon completion, users are directed to the home page. Figure 2 summarizes the entire flow.

- Home Screen. After the log creation, users can reach the previous logs from the home screen. Home screen shows the logs by placing the photo with the visualization in a thumbnail grid (Figure 3A). Home screen allows an overview of the ratings over time as uploaded photos accumulate.
- Visualizations. Users can view the visualizations together with photos in the home screen (Figure 3A). They can also individually see the visualizations in the detail view (Figure 3B).
- Detail Screen. The detail screen aims to give the users a more focused self-reflection opportunity. In this view, there are two components: photo and annotations. The photo component comprises three parts: the photo with visualization, the original photo, and the brief description, which the user can reach with a left swipe action. The annotations component comprises three parts: notes about the sensory, emotional, and intellectual dimensions, also reached with a left swipe action. Figure 3 summarizes the entire flow.

4 STUDY 1: IN-THE-WILD USER STUDY

To observe users' interactions with the prototype, we conducted an in-the-wild user study where participants used the mobile application for five weeks. The study was conducted under the ethical committee approval from Koç University Committee on Human Research with the protocol number 2021.273.IRB3.120.

4.1 Study Procedure

The study comprised three tasks: (1) four-week user study: The users downloaded the mobile application to their smartphones and used it for four weeks. Reminder notifications were sent to the participants through the application during the study; (2) Scale: Participants filled the System Usability Scale [9] at the end of the study; (3) Semi-structured exit interview: We conducted semi-structured interviews with all participants to understand and discuss their experiences with the prototype.

After the participants were recruited, one of the authors organized online orientation meetings through video conferencing. A scheduling sheet was shared with participants. Each session took around 15 minutes and participants attended the meetings in groups or individually. An email including the online meeting link, an online informed consent form, instructions for downloading the mobile application form, a guide to the application and an instruction video for downloading the app was sent to the participants before the meeting. During the meeting, the author explained the user study, answered the participants' questions, and guided them through the application setup if there were any problems. Participants who did not manage to attend the meetings received the instructions through email.

4.2 Participants

We recruited 16 participants, three of whom were excluded from the study since they did not attend the exit interviews. Our participants, three male and 10 female, were recruited through two channels: (1) social media and (2) emailing to a voluntary participant pool of our research lab. The participants needed to have Android smartphones, and sufficient English to participate in the study. Participants' ages ranged from 16 to 34 with a mean of 24.9 and a standard deviation of 4.8 (Table 1). Participants recruited through social media announcements were compensated with a 3-month movie streaming platform membership, a 3-month meditation app membership, or a theatre ticket, based on their preference.

4.3 Analysis

We followed thematic analysis to analyze the data from the semi-structured interviews [8]. We did not analyze the users' input as we did not want them to sacrifice their privacy when creating their input. In the onboarding sessions, we informed our participants that we would not use their information other than providing examples for an academic paper, and if so, we would anonymize their data. We first transcribed the interviews. The first author read the transcripts first, to become familiarized with the data. After creating an initial coding schema, another author also coded the data based on the schema. After a discussion session with the authors, the final codebook was created. Two authors coded the data individually and disagreements were resolved through discussions to reach consensus. The analysis resulted in four themes explained below.

4.4 Findings

Over the course of five weeks, participants created an average of 5 logs, and a total of 71 logs are created. For details you can refer to Table 1.

4.4.1 System Usability Scale. Average usability score is 81.15, corresponding to a A grade[3]. Out of 13 participants, nine rated the usability of our system above 80.8 out of 100, which also corresponds to A grade.

4.4.2 Dimensional approach creates a space for self-reflection. Out of 13 participants, seven stated that encountering the dimensions made them "think", and they found this beneficial: "It's good that it's thought provoking because I want it anyway. I'm trying to understand how I feel in different places, so it's good to be asked the right questions." (P1). Thinking about their experiences helped them investigate different aspects of their experiences and reveal the often-overlooked details; "Actually, there are five senses, but in daily life, people don't think to share what they feel in terms of senses and which of the five senses is affecting them. It makes us think a little bit there. what did I do here; I just saw and touched but had no experience with any other sense." (P11). Creating a moment

[3]https://measuringu.com/interpret-sus-score/

Table 1: Participants of the in-the-wild study.

Participant Number	Age	Gender	Occupation	Number of inputs
P1	30	Female	Designer	5
P2	16	Male	High School Student	3
P3	25	Female	Designer	4
P4	23	Female	Architect	4
P5	22	Male	University Student	3
P6	22	Female	University Student	13
P7	28	Female	Product Manager	5
P8	25	Female	Research Assistant	5
P9	20	Female	University Student	10
P10	30	Female	Architect	2
P11	34	Male	Occupational Safety Specialist	3
P12	23	Female	Interior Architect & Student	8
P13	26	Female	PhD. Student	6

of pause to think also increased the perceived value of mundane experiences: "(With the dimensional approach) We can stop and take a different perspective on things that we don't think about or give any importance in the flow of daily life." (P10). We suggest that this level of thinking and consideration shares qualities with reflective description definition, introduced to the HCI literature by Fleck et al. as the first level of reflective thinking [20].

Beyond thinking, four participants reached a form of awareness or understanding about themselves: *"Especially when evaluating the intellectual side, I questioned myself: What if I don't reflect my experiences too much?"* (P11). For instance, P13 questioned their sharing habits and preferences: *"I noticed this; I always put more emotionally high experiences, it made me realize it.".* We identify these statements as the second level of reflective thinking: dialogic reflection.

Three participants explicitly stated a shift in perspective. P9 explained how they started thinking according to the three dimensions starting from the moment of capturing the image. *"From the moment I thought that I was going to upload that photo, I started to think about how I feel at that moment, and when I entered the application, I entered those states in a more comfortable way."* At least in the short-term, P2 stated that they started a shift in their overall thought processes: *"In fact, now my way of thinking has started to turn into it, as if I have the app in my head, I now think with the app.".* The shift in perspective is aligned with the third level of reflective thinking: transformative reflection.

To sum up, most of our participants are engaged in various levels of reflective thinking through their interactions with questions related to three dimensions (emotional, sensory, intellectual) we provided.

4.4.3 The process is appreciated, but sometimes perceived as burdensome. Our participants experienced various frustrations during the log creation process. When creating a log, the user made the participants go through each dimension step-by-step, though answering questions was not mandatory. This structure was not well-received by the participants. Four suggested changing this into a more user-led process, where users could choose which dimension to reflect: "*When it asks me for three phases, I force myself to think if there is something in all three phases. For example, if it's an emotional thing, it would be better for me if I could just click on it and write only it (emotional significance), if filling out the others wasn't like an obligation, it would be better for me." (P3).* When participants did not have immediate answers to the questions, they experienced feelings of inadequacy: *"I might want to skip those three things (dimension questions) because it made me feel as if something like this had to happen (different dimensions in every experience) and I was missing out." (P1).* This sense of inadequacy was sometimes combined with the sense of responsibility to give 'right' answers. *"I gave a very similar answer to the other one, did I answer that wrong, should I say something else?" (P12)* A sense of responsibility was also present in the participants since they felt their input was the determinant of their contribution to our study. All the perceptions mentioned above resulted in a high level of stress for participants.

When creating a log, the meaning of the dimensions was not easy to comprehend. Participants had hard times differentiating the categories from each other. Sometimes it was hard for them to decide which aspects of the experience belonged where. *"I also thought, for example, 'Now I wonder whether this is emotional or sensory, it goes both ways, should I write it on both sides?' It was not easy for me to group them." (P12).* We distributed a PDF guide and provided some inspiration in the input boxes (1 2). Participants expressed the explanations as being somewhat useful. However, only one participant stated that he made use of the guide.

All in all, uploading an image and answering three open ended questions, which required significant thinking, made the entire log creation process lengthy. Participants stated that thinking about questions was hard and took time.

"You remember everything about the experience when you write the initial description and you break up the experience step by step with questions about dimensions. For example, the sensory dimension takes me to think in detail about the sensory moment of that day. It made my brain work harder, it had a positive effect on me. But even though I thought a lot, I couldn't write as much as I thought because I felt lazy." (P5)

Our findings identified the benefits observed from answering questions about experience dimensions. However, new strategies

should be explored to make the answering experience easier and more appealing.

4.4.4 Visualizations act as reflective triggers, but there is a need for more incentive for retrospective self-reflection. The visualizations are generated based on the users' ratings for the significance of each dimension in their log. Due to their similarity with filters used on top of the photos, we referred to them as *'filters'* during the interviews. Filters created excitement and contributed to the motivation for looking back to the logs, a critical act for retrospective self-reflection.

The colorful visual aspect of photo filters was interesting for the participants. After the initial attraction, participants easily grasped the meaning of the filters and enjoyed seeing their experience through the filters. *"I like that the points appear in levels. It was good feedback that the colors appear one by one in the history." (P5)*

Seeing the filters helped the users to remember their experiences, and different aspects of their experiences, without a need to read the log input. Two participants also stated that filters may help them avoid the details of unpleasant experiences when they don't want to face them: *"It was a nice filter to avoid getting into the mood of that photo, if we were feeling sad at that time." (P2).*

For a group of participants, filters meant more than just remembering and thinking on the experience. They used the filters for various purposes. First, three participants used the filters for comparing different experiences. This opportunity arose from seeing the filters on top of the photographs, in a gallery view. *"Finally, when I looked at all the pictures at the same time, I loved being able to see the proportions of all of them. I really liked it there." (P6)* Second, one participant (P4) used the filters to track her experiences in a timeline: *"When I logged consecutively, I could see the change on a day-to-day basis. He was useful. On a day-to-day basis, for example, within a week after the first entry, I had the opportunity to see what I felt on the first day and how my mood was on the second day."* Third, the filters also helped (P4) to compare different aspects in the logged experience: "You can see what you're feeling that day, you can see which of the three categories is more intense.".

In addition to filters bringing about benefits in deriving insights, the placement of the grid of previous logs as the main screen of the app caused participants to be subjected to the filters and the images whenever they opened the application. This allowed for a moment of self-reflection and reminiscence each time they used the app. *"I put the first log I put in an excited way. It was a happy moment for me. Then I took a picture of it and posted it. When I saw that log while I was filling out the next ones, it made me happy to remember that moment and to experience that feeling." (P3*)

Although participants did not frequently look back to their logs during the 5 weeks, they explained that in the future they would. The initial expectation before starting to look back was the accumulation of memories. Time was another factor; two participants stated that looking back would be more meaningful after a certain time. *"If I had looked at it six months later maybe there would have been more memories accumulated there." (P12)* This also applied to painful memories, where time would help cool off certain feelings. *"In some entries, I may not want to go back and experience that moment again, or it may take some time before I want to look at it." (P7)*

Our findings reveal that although filters and home page with grid view enabled participants' retrospective inspection, new functions should be introduced to increase motivation for revisiting and retrospective self-reflection. When asked about their expectations from the app to revisit their past logs, being able to group logs, having filters or categories for easier searching stood out. "As far as I understand, these are just like a gallery, no history, no categorization. Maybe there can be a view like a category or a filter. When the gallery is a more crowded, I can search by mood: 'what did I share when I was feeling bad?' " *(P3*) Participants also suggested implementing a map and a calendar to easily track their logs.

4.4.5 Keeping the motivation high is vital for long-term use. Participants lacked the motivation for using the app regularly. As explained above, the process of creating a log was long and required an additional effort. Participants were not satisfied with the outcome of such an effort. They expected a more sophisticated outcome, or a reward. They expected the system to present them with an analysis from their input.

"I think I would like to create more entries if the app showed the average of my photos in graphs or tables, provided me with summaries like 'this is how you felt this month, or what you experienced last week'." (P9)

For some, the dullness of their daily life or busy work schedule kept them from creating logs: "We are always at home during the pandemic, there is a constant work-home routine, so it was not very effective." (P10). The perceived length of the process resulting on participants' selectiveness in terms of what experiences to record also resulted in a lack of motivation to use the app. However, participants came up with strategies to increase motivation. Their suggestions generally circled around the idea of the app presenting some sort of output. They pointed out to a need for summaries, or analyses provided by the app.

". . .To see the average of my photos, to see summaries such as 'you felt like this this month' or 'you experienced this last week'. . . .such as graphs or tables. . . .I would like to create more logs because it would turn into a kind of personal tracking." (P9)

5 STUDY 2: IDEATION WORKSHOP

We prepared an ideation workshop to develop solutions to address potential strategies for encouraging answering reflective questions and revisiting the app for self-reflection.

5.1 Procedure

We conducted an online workshop using Miro and Zoom softwares, structured in three parts: introduction, ideation and discussion. Two authors conducted the workshop as facilitators. To begin, the first author made a presentation explaining the aim of the study, how the application worked, and two main frictions detected in the in-the-wild user study (lack of motivation to answer the reflective questions for everyday experiences and lack of motivation to revisit past logs). The presentation lasted around 30 minutes. We asked the participants to develop new feature ideas to overcome two frictions. Following this, the participants ideated for 10 minutes using the sticky notes in Miro for the first friction. Then each presented their ideas to the group for 3-4 minutes, followed by a group discussion for 15 minutes. The same process was repeated for the second

friction. This workshop lasted around two hours. All participants gave consent to use the material they produced in the workshop.

5.2 Participants

To reach diverse strategies, we wanted to design a workshop which included not just designers but also users and developers. We contacted the previous study participants to participate in the workshop through email. We contacted six participants from Study 1, who created more than five logs during the user study, since we believe they would have more insight for the app. Two participants agreed to participate. We also invited five HCI designers, one mobile app developer, and one visual artist. A total of nine participants joined the workshop. All participants were compensated with a 3-month movie platform membership.

5.3 Findings

Participants came up with functionalities to address two main frictions; (i) lack of motivation to answer the reflective questions for everyday experiences and (ii) lack of motivation to revisit past logs. We categorized the ideas based on similarities in function to overcome the frictions.

5.3.1 Strategies for Encouraging Momentary Self-Reflection. The insights from in-the-wild study revealed participants were concerned to give a correct answer, the process of answering the questions on dimensions was rather lengthy and it was not always easy to understand what the dimensions stood for.

Language and Level of Detail. The workshop participants suggested that the language used in the application should be more informal and daily to make the question answering process more natural, rather than it being like an exam that requires correct answers. One suggested strategy was to integrate verbal communication to give the feeling of having a conversation. Regarding using a non-formal language, using more than one question for each category was suggested. Multiple questions for each category can create sub-categories that are easier to understand or respond to. Additionally, it can decrease the perceived length, especially if combined with a conversation-like structure. Having multiple questions investigating the sub-categories can also make the answers more tangible and descriptive, increasing the data users provide. For instance, when inquiring about the intellectual significance, the system could ask about the sub-categories ('Is this experience significant occupationally?', Is this experience significant from a lifelong learning perspective?') or direct more descriptive questions such as "What were your exact thoughts while you were taking that photo?".

Gamification. Various gamification strategies were proposed in the workshop. Goal setting and rewards are approached from a perspective that celebrates the length of the input. Rewards can be given both based on the number of the entries and the number of words used in a single log. Many gamification strategies could be explored in the future especially with the help of other technologies. For instance, one suggestion was to present the users with significance values determined by AI and to ask them to correct the values if they are predicted falsely.

Expanding the Time to Reflect. Answering the dimensional questions takes time. The expected amount of time may be too much to give up. Workshop participants suggested expanding the time to reflect; answers should not be required immediately but the user could take some time to come back and record their experience, for instance 24 hours. It could also extend 24 hours and the system proactively bring a previously uploaded photograph to the user and ask the reflective questions.

5.3.2 Strategies for Encouraging Retrospective Self-Reflection. One of the negative aspects identified in in-the-wild study was participants' lack of revisiting their previous logs. In the workshop, several strategies were suggested to encourage retrospective self-reflection.

Reminders. One of the suggested strategies was to remind users their past experiences. Participants suggested that setting up reminders both in and outside the app would increase retrospective self-reflection. Participants suggested different reminders: quantity-based, time-based, quality-based, and location-based. Quantity-based reminders would be triggered when users reach a specified number of posts. For instance, the app could remind users about past logs after 100 posts. Time-based reminders are the ones we see often; the app reminds the logs from a certain time ago; for instance, one year, one month or one week ago. Reminders can also be location based. Systems could remind users about their logs recorded in the same location. Lastly, quality-based reminders could be implemented. The system could pick the log to be highlighted based on certain qualities such as the longest input, or the most emotional log.

Contextual Summaries. Reminders highlight single logs whereas summaries compile similar logs. Contextual summaries collect logs based on their content and present them to the user as a summary. The summaries can be based on location or time; for instance, logs from a certain week or location can be presented to the user to reflect upon. Further, they can be based on certain qualities, just like reminders. Examples given by the workshop participants included logs most time spent creating, and the most emotional logs of the past month.

Visual Summaries. Another way of reminding participants about past logs is via visual summaries. These use visualizations to summarize the user's past activity and could be time-set to the end of the week, month or year. Visualizations can show the number of logs created and their content via colors and shapes. One participant highlighted how the grid view disables a cumulative overview by allowing only nine logs to be seen in the screen. Zooming out the grid view to enable users to see many logs at once may also act as a more cumulative, time-based visual summary, in our case. Furthermore, visual summaries can be gamified. For instance, the content of the log can be kept hidden while the user wanders around just the values (in our case) or individual experience visualizations. The contents can be made accessible only upon request, adding mystery to the experience.

Feedback. The system's feedback is one step further from reminders and summaries. In this case, workshop participants suggested that the system should be able to analyze the input and present the user with insights based on their data. The insights aim to present the user with information that is hard to reach by just looking at past logs. For instance, rather than presenting the user with a summary of the most emotional posts last month, the system should analyze the input and provide the user with the most felt

emotions last month. Two other examples were to present the user with their inclinations (people tend to get emotional past midnight) or present the repeated words (for example, in the past month, you said depressed 10 times). One participant suggested that system could produce predictions based on past data; for instance, "You had a very energetic and happy week, you can keep up the good mood if you keep moving next week.".

6 DISCUSSION

In this section, we revisit our findings from the in-the-wild study and the ideation workshop, discuss and share implications for the HCI literature.

6.1 Providing new perspectives for guiding users into how to investigate their own experiences

We discovered how the dimensional (sensory, emotional, and intellectual) question structure allowed users to take multiple new perspectives on their everyday experiences when using a photo-journaling application. Findings point out a more one-dimensional thinking structure for the participants before the study; participants shared with us that they mostly focused on their emotions related to experiences. When introduced to sensory and intellectual dimensions, it was first hard and puzzling to answer for the most. However, this challenge opened up space for momentary self-reflection. Retrospectively, too, having 3 different perspectives on a single experience allowed users to make comparisons within an experience. It also allowed participants to compare one dimension among different experiences. Our employment of sensory, emotional, and intellectual dimensions based on the earlier study of Karaturhan et. al., is just an example of reflective questions that can be implemented to everyday experiences. HCI community can explore more questions and compare the effects. However, we can say that multiple questions each focusing on different aspects of an experience contributes to self-reflection.

It should be noted that the feedback we gathered is from a 5-week study. The HCI community should also investigate longitudinal results of question answering. Long term effects of encountering the same questions can be demotivating for participants. As we briefly explored in our study, users lose motivation if they perceive the process as too long or challenging. Same may apply to the repetition of similar processes. When we discussed this with designers in the.workshop, it was a strong suggestion that gamification and asking about dimension in a more natural and flexible conversations can be beneficial for keeping up the motivation in the long term These ideas will be further discussed below

6.2 Fostering everyday self-reflection through flexible conversations

Journaling is used in specific application areas such as learning, professional development or restricted to specific use cases such as food consumption or journaling. Each of these instances can be easy to reflect on since there are clear aims. However, this is not the case for everyday experiences. Our findings indicate that recording everyday experiences requires a different approach since everyday life does not always bear significant experiences such as visiting a new city. Previous work explored how mundane memories and photographs become significant over time [25, 42]. However, we discovered certain stress factors that get in the way of recording for participants: perceived length, felt responsibility to give the right answer, and having hard time understanding the meta-level dimensions (such as emotional, sensory, intellectual).

Both user feedback and workshop findings point out to a better structured question-answering where emotional, intellectual, and sensory dimensions are infused to smaller and more tangible questions, and a conversational interaction where users can engage in reflective thinking in small chunks, rather than needing to analyze a rather mundane experience from a meta-level perspective. These conversations can also be content-aware, building on the information derived from the uploaded photo or daily habits, as suggested in the workshop. Voice based interaction is another suggestion by the designers. To our knowledge, this conversational interaction is also pointed out by [43], but to be implemented. In addition to their contribution, we suggest that (i) questions should be derived from meta-categories (such as emotional, sensory, intellectual), (ii) conversation should have a personal, friendly tone. HCI community can use emerging technologies such as machine learning, artificial intelligence, and conversational agents to develop reflective question asking systems with conversational interfaces.

6.3 Teaching first, asking later

Our findings show that users may not be able to motivate themselves and see the value of recording daily experiences until they look at their input retrospectively. Without motivation, users may not be able to create the necessary input at the first place. Therefore, it is important for users not just to understand the value of momentary self-reflection, but also understand the benefits of retrospective inspection. This is also closely connected to users' personality and already existing reflective practices. Our studies showed that people who already think about their life tend to enjoy our application more. On the other hand, another group of participants were eager to simplify and automate the process more. Everyday life self-reflection apps could reach a broader audience if they also aim to teach and show the benefits of self-reflection. Therefore, when trying to encourage users to practice self-reflection on everyday experiences, applications need to act as guides that show the value of self-reflection in a friendly, helpful way.

6.4 Combining visualizations with smart feedback on everyday experiences

Seeing the significance of each dimension on their everyday experiences through visual representation helped users remember and opened up space for self-reflection through comparisons within and among their logs. However, to engage in retrospective self-reflection, users needed more. Participant feedback and workshop suggestions were towards reminders, summaries, and analyses for accumulated logs. This implies an intrinsic need for pattern recognition, as literature recognizes [5]. Suggested parameters are temporality, context, location, and emotions.

Workshop participants' suggestions to use filters as a gamification material and providing these summaries through visualizations

point to new directions in terms of visualizing journaling data. Visualizations that have a breakdown or ambiguity effect to foster self-reflection should be explored in the future work. Systems recognizing patterns in everyday experiences can foster self-awareness and knowledge through self-reflection. Meaningful patterns in everyday experiences, methods to analyze input from everyday experiences, and new feedback strategies should be further investigated in the future work.

7 CONCLUSION

This work combines momentary and retrospective self-reflection strategies, namely reflective questions, and data visualizations in a photo-based journaling app to help users reflect on their everyday experiences. Our design was created in a research through process with the involvement of designers and users. We conducted an in-the-wild study to evaluate the experiences of 13 participants with the prototype. Results show that users benefited from our approach both for momentary and retrospective self-reflection, and there were opportunities to develop better reflection support systems. Then we conducted a workshop with study participants and HCI designers to develop application features that support momentary and retrospective self-reflection through question asking and visualizations. Our work presents strategies to better prepare systems for self-reflection for everyday life experiences through photo-journaling. We provide a base for future research to explore the value and the effect of self-reflection practices on everyday experiences in HCI.

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4.3 Exploring User Preferences for Reflective Conversational Agents in Domestic Settings

4.3.1 Preface

Following our insights from prior work, we started looking for ways to create conversations for reflection on daily experiences. Addressing RQ2, we explored how we can combine existing dialogue-based tools (from the Psychology literature) for reflection with CAs. Our in-group discussions and literature explorations led us toward the concept of systemic therapy and circular questioning. Our interest in this approach was also influenced by the fact that the systemic approach and its questioning consider the surroundings of a relationship or a personal experience. Therefore, we found it resourceful for creating thought-provoking questions about multiple factors surrounding their daily lives.

Within the scope of this study, we (1) conducted a diary study, (2) built a circular questioning guideline for reflective CAs, (3) created a speculative scenario, (4) a VR prototype simulating this scenario, and lastly, (5) conducted a workshop with 10 HCI researchers to gain insights into the design space for reflective CAs using circular questioning as a case study. We chose the domestic environment as the interaction setting since we argued that home would be where the most reflective interactions happen, that it was the setting of the VR experience, and that it would be easier to conduct the most preliminary discussions around a specific context.

Our workshop findings revealed insights about many aspects of interacting with CAs in domestic settings and in general. The workshop findings identified nine dimensions for CA user experience design and suggestions for each of these dimensions. The identified dimensions were (1) social role & attitudes, (2) conversation topics, (3) tools for reflection, (4) other functionalities, (5) social use, (6) longitudinal use, (7) physical appearance, (8) security & privacy, and (9) intelligence. These findings informed the design implications of this thesis and future studies which are summarized in Chapters 4 and 5. More specifically, following the participants' comments on the need for various tools for reflection and personalization of dialogues in many ways, we started searching for a more comprehensive reflective questioning approach which led to a user-centered approach to reflective conversations, informed by the client experiences of psychotherapy, which will be explained in the next sub-section.

4.3.2 Paper 3: Exploring the design opportunities for conversational agents as reflection partners in domestic environments

Pelin Karaturhan, Egemen Ertuğrul, Ecem Arıkan, Kemal Kuşcu, and Asım Evren Yantaç. (2024) Exploring the design opportunities for conversational agents as reflection partners in domestic environments. In Gray, C., Ciliotta Chehade, E., Hekkert, P., Forlano, L., Ciuccarelli, P., Lloyd, P. (eds.), DRS2024: Boston, 23–28 June, Boston, USA. https://doi.org/10.21606/drs.2024.841

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Exploring the design opportunities for conversational agents as reflection partners in domestic environments

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Abstract: Reflection is a core element of our everyday lives for higher self-insight and better well-being. Guided conversation is one of the methods that supports reflective thinking. The increasing abilities of conversational agent systems make them potential reflection partners for the future. Home is suitable for engaging in reflective conversations with conversational agents on daily experiences since it provides a private space. We explore the user expectations and design considerations for reflection with conversational agents through a mixed-method approach with design/HCI researchers. We first explored a psychology-based reflection approach with a diary study. Then, we designed a future-oriented methodology, adapted our findings into a scenario script for a VR experience, and used it in a workshop to gather insights on using domestic agents for reflection. This paper presents user insights and design suggestions for domestic conversational agents for reflection and reflections on using a VR prototype for future-oriented research.

Keywords: Self-reflection, reflective conversation, conversational agents, virtual reality

1. Introduction

Reflection is a valuable skill for gaining self-knowledge and personal development. However, it requires dedicated time and energy (Li et al., 2010). Therefore, prompts or partners are important in helping people to reflect by setting the context or guiding them with triggers and questions.

Reflection can be a part of professional development and learning (Moon, 2013), making sense of personal data (Karyda et al., 2021), social media use (Karaturhan et al., 2021), managing chronic disorders (Ayobi et al., 2020), productivity (Kim et al., 2016; Kocielnik et al., 2018), behavior change (Thieme et al., 2012) or deriving insights from our everyday lives

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(Karaturhan et al., 2022; Mols et al., 2016b). In our daily lives, we reflect on our experiences through conversations with family, friends, and ourselves (Mols et al., 2016a).

Conversational agent (CA) systems, large language models, and artificial intelligence algorithms have achieved a leap in adoption to different daily interactions in recent years (Mariani et al., 2023). Thus, CAs placed in our homes can be our reflection partners, focusing on our daily lives. We aim to explore potential users' and designers' attitudes and expectations from future domestic CAs for dialogue-driven reflection with the help of psychological methods. Our research questions are;

RQ1) How can we adapt the concept of circular questions as a method for dialogue-driven reflection with CAs through a user-centered approach?

RQ2) What are the potential users' preferences for interacting with domestic CAs for daily reflection?

RQ3) What are the design and research recommendations for the HCI field for designing domestic CAs for dialogue-driven reflection?

To address these research questions, we followed a mixed methods approach that combines user-centered design and design-futuring approaches. Since we are researching technologies that will become part of our lives in the near future, we first use 'circular questioning' as a use case to understand if we can adapt methods from psychotherapy into dialogue-driven everyday reflection to address users' daily conversational needs. We then use an imaginary future setting to prototype an example use case of an agent employing such methods to evaluate potential users' and designers' preferences and expectations. This paper reports the process and results of our research. Our preliminary explorations in the field identified nine dimensions that our participant paid attention to while evaluating the concept. Further, we concluded with design recommendations for each of the dimensions. We highlight that further research is required to understand the relationship and effects of different design dimensions on each other.

2. Background

2.1 Conversational agents for well-being

The use of CAs in the health domain goes back to the 1960s; in 1966, a chatbot named ELIZA was developed to mimic a psychotherapist(Weizenbaum, 1966). Since then, with the increasing capabilities of CAs, such as integrating natural language processing and machine learning with neural networks, the role of CAs in healthcare, mental health, and well-being has been strengthened. Review studies on CAs in the healthcare and mental health domains show the use of CAs in delivering Cognitive Behavior Therapy (CBT); delivering recommendations, tracking behavior, interviewing, and diagnosis (Laranjo et al., 2018; Vaidyam et al., 2019). Even though a rigorous analysis of the effect of CAs is lacking in the literature, studies report satisfaction and effectiveness (Laranjo et al., 2018; Vaidyam et al., 2019).

CAs are also used in various well-being contexts, such as increasing self-compassion (Lee et al., 2019), delivering interventions based on the user's mood (Ghandeharioun et al., 2019), stress management and journaling (De Nieva et al., 2020). There are fewer CAs focused on reflective conversations in the literature. One significant example is Robota. In the workplace context, Kocielnik et al. took a multimodal approach to CAs to support well-being (Kocielnik et al., 2018). Their agent, Robota, interacted with users through written conversations through Slack and using voice through Amazon Alexa. Through Slack, Robota asked about work routines, goals, and performance. The findings showed that reflection questions helped participants think more deeply about work-related topics. Despite being similar to our approach, Robota asks questions from an existing set and focuses on workplace well-being.

Existing research focuses on delivering pre-established exercises, suggestions, and recommendations based on simple parameters such as mood or self-reports. There are some initiatives toward moving from clinical interventions to more creative well-being interventions. Although this body of work does guide us with key findings, such as the importance of perceived empathy, trust, and effectiveness, there is a gap in the literature on a designerly approach to reflective CAs.

2.2 Conversational agent design space

There is existing research, especially in the field of human-computer interaction, on the users' expectations, preferences, and perceptions of current (Chen et al., 2022; Kocielnik et al., 2021; Zargham et al., 2022) and future conversational agents (Cambre et al., 2020; Volkel et al., 2021). However, these studies keep the conversational agents in the "assistant" role or specify a certain functionality such as proactivity. In our work, by design-futuring, we position the CA as a proactive, question-asking agent (will be elaborated on further in the upcoming sections). Therefore, we aim to understand the design considerations for proactive, intelligent, companion agents rather than assistant agents. Although such agents are not available in today’s world, design-futuring allows us to collect user preferences and requirements without physical prototypes (Tanenbaum, 2014).

2.3 Design futuring

Design futuring means creating imaginary alternative futures to today's technologies, designs and systems (Baumer et al., 2020; Biggs & Desjardins, 2020; Sharma et al., 2022). Virtual Reality is a suitable environment for design futuring as it allows speculative designs that may be inapplicable in the real world. To this end, McVeigh-Schultz et al. coined the term "Immersive Design Fictions" (McVeigh-Schultz et al., 2018) and Simeone et al. "Immersive Speculative Enactments" (Simeone et al., 2022). These two terms differentiate from one another based on the level of interactivity and the existence of a pre-determined outcome. Our approach to using VR to create a more immersive design futuring experience does not involve any level of interactivity. Still, it aligns with the research on the potential of VR environments.

3. Circular questions as a use case

Thinking about the context of the conversations is important to start imagining futures where CAs act as reflective partners. To delve into a more unconventional way of asking reflective questions, we took "circular questions" as our case.

Circular questions are specially structured questions developed by the Milan associates as a tool for interviewing for systemic family therapy (Selvini et al., 1980). These questions ultimately aim to uncover the connections and differences among people's behaviors, thoughts, and values within a system (e.g., family, team). Connections are fundamental for a systemic approach because a systemic approach sees all behavior as being connected to the behaviors of others in the system. For instance, to show the connections to clients, questions don't seek the reason behind one's feeling of being depressed, but rather they investigate "when someone shows depression and what other people do when this is happening?" (TOMM, 1988). Circular questioning aims to make the connections within a system visible to the members of the system (i.e., family members). Differences are as fundamental; a systemic approach accepts the view that information comes from differences. For instance, one's feeling of being happy comes from a comparison to one's observation of other people who were not as happy (TOMM, 1988). In this example, the difference between the perceived level of happiness creates information about one's level of happiness. Therefore, circular questions aim to create or maximize differences in thoughts, feelings, behavior, and interactions.

Answering circular questions allows family members to understand their functioning and non-functioning interaction patterns better. Furthermore, question answering can lead them to take actions to fix detected problems and reach a better well-being state. Although circular questioning is a method that was first used in the systemic family therapy domain, it has also been extended to individual therapy by the founders of the approach (Boscolo & Bertrando, 2018). In this context, we believe that circular questioning is a valuable method for future agents to form reflection questions that focus not only on their users' perspectives but also their surroundings.

Since the introduction of circular questions to the literature, multiple frameworks and guidelines on circular questioning have emerged (Brown, 1997; Fleuridas et al., 1986; PENN, 1982; TOMM, 1988). However, these guidelines have complex, highly advanced structures requiring previous domain knowledge. They are structured as meaningful for psychologists and therapists and target families receiving therapy. We envision using circular questioning to improve users' awareness of their connections with their domestic systems and achieve a higher level of well-being by initiating reflective thinking. Therefore, we conducted a preliminary diary study with the help of a systemic therapist (3rd author) to reveal potential topics of reflection at home, preserving a systemic approach that enables the participants to observe themselves and their surroundings.

4. Preliminary diary study and findings

We identified circular questions as a use case for our research study. Since we follow a user-centered design methodology, it is important to bring user experience together with the established method in therapeutic conversations. Therefore, to answer our second research question, '' How can we adapt the concept of circular questions into dialogue-driven reflection with CAs through a user-centered approach?'', we designed a diary study (Bolger et al., 2003) where we collected potential users' domestic interaction patterns, to be able to create a circular questioning approach suitable to the daily context.

4.1 Participants

We recruited 10 participants (8 females and 2 males) with an average age of 30 through announcements placed on social media and snowballing. No other inclusion or exclusion criteria were applied. See Table 1 for details about the participants' age, gender, occupation, and domestic setting distribution. The diversity of our participants in terms of living settings allowed us to observe different types of interactions at different homes, and we didn't aim for any comparison between different settings.

Table 1 Detailed information about the study participants.

Participant	Age and Gender	Occupation	Domestic Setting
P1	26, Female	User experience designer & researcher	Living with one parent
P2	22, Female	Student	Living with both parents
P3	24, Male	Student	Living alone
P4	23, Female	Student	Living with parents and siblings
P5	23, Female	New graduate looking for a job	Living with both parents
P6	45, Male	Software engineer and executive	Living with spouse
P7	32, Female	Academician	Living with a girl/boyfriend
P8	47, Female	Retired	Living with spouse and child(ren)
P9	22, Female	Student	Living with both parents
P10	38, Female	Consultant	Living with spouse

4.2 Procedure

We designed a 7-day study where the participants were asked to observe and record their experiences multiple times throughout the day by answering daily prompting questions, using a mobile responsive website (created with Wix software) with a built-in survey.

After the recruitment process, we sent an online informed consent form to the participants through email and collected their consent. Next, we conducted an online opening meeting

with all the participants, where we gave information about the procedure, the website, and how to use the website. The one-week study began the next day.

Each day, we uploaded a question for the participants to answer with their diary entries via the website and provided one example input. A reminder email was sent to the participants about each day's probe question, including a link to the website.

We used a different theme to probe the questions: information, curiosity, need, interaction, identity, emotion, and desire. We defined these probes through group discussions within the research team to provide different perspectives to the participants. We created open-ended questions for each theme that partially mimicked answering circular questions. For instance, the emotion-themed question was, “How do we feel at home? Is there a difference between the emotions we feel at home and the emotions the home makes us feel?”.

We conducted our study in their participants’ language to make it easier for the participants to express themselves. Later, inputs were translated into English by the authors.

4.3 Analysis and findings

After collecting data, the first and third authors analyzed the user inputs through a thematic analysis approach (Braun & Clarke, 2006). Throughout the process, different coding sets were discussed from the point of circular questioning to understand systemic factors playing a role in the participants' daily entries, with the involvement of all authors. After a decision has been made regarding the coding sets, the first author coded the data.

Our one-week diary study with 10 participants produced 137 logs, averaging 19 logs per day and 13 logs per participant. Results showed us that the statements spanned around various emotions and social actors. We further investigated the statements with negative valence and their intersections with social actors to identify different interaction domains to apply circular questions. We focused on the negative emotion statements as an initial application area. Through the analysis of intersections, we identified 4 domains:

1. individual problems,
2. individual desires,
3. negative emotions coming from social interactions,
4. desired situations requiring co-action.

Together with the systemic therapy expert in our research group, we created circular question guidelines for each of these 4 domains in order:

1. Draw Connections: These questions aim to guide the receiver in connecting the factors that may influence the stated problem to better understand the systemic roles that affect the problem. (Individual problems)
2. Identify Differences: These questions aim to help the receiver better understand their desires for change by specifying the details and differentiating them from other situations in detail. (Individual Desires)

3. Provide Perspective: These questions aim to guide the receiver to empathize with the other party to better understand them or their viewpoint on the system. (Negative emotions coming from social interactions)
4. Encourage Communication: These questions aim to guide the receiver to communicate with the other party to reach the desired outcome. (Desired situations requiring co-action)

5. Creating a future scenario

To create a future-oriented experience, we followed a methodology combining the above guidelines, a scenario, and a VR setting.

5.1 The scenario

After creating the guidelines, the next step was to create a future scenario of a reflective dialogue between a conversational agent using the guidelines and its user. This scenario allows our workshop participants to imagine a future with conversational agents. We chose to create the scenario script with ChatGPT. ChatGPT is a large language model introduced by OpenAI to the public in November 2022. In many ways, ChatGPT works like a highly intelligent personal assistant. It may, for example, roleplay with its users as if it is a reflective conversational agent in the future. ChatGPT contributes to our methodology by mimicking how a CA system would use the guideline. It would also partially validate our approach by showing whether a large language model could make sense of the guidelines.

We created an initial prompt, structured as a comprehensive guideline for using circular questioning for reflective conversations to be used by CAs. This comprehensive guideline included all four items. We also included question templates that we derived from the diary study data. We iteratively built our prompt/guideline based on multiple trial runs with ChatGPT. As an output, ChatGPT created a scenario where Isabella, the CA, and David, the user, have a reflective conversation about David's work-life balance and his struggles in life through Isabella's circular questions. We prompted ChatGPT to strictly follow the guideline and use the question templates as much as possible when structuring the agent's questions. The prompt and the final scenario can be found in: bit.ly/49f2YZk.

5.2 VR experience

We developed a non-interactive, room-scale virtual reality experience where we animated the scenario. We developed the VR experience using Unity Game Engine. We aimed to design and to develop a realistic experience to help participants surround themselves with the given scenario. The user (observer) sits on a chair in the corner of the room. The experience showed the character 'David' walking into a living room and sitting on the couch. 'Isabella', the CA, starts the conversation after David sits down. We purchased a realistic home environment from the Unity Asset Store. We designed a natural and ambiguous form for the agent in Blender. For David, we used a semi-transparent human body silhouette. With this,

we aimed to avoid a mismatch between the level of realism in the environment and the human figure. Voice recordings are done with text-to-voice generators. We wanted David's voice to be as realistic as possible, so we used an AI voice generator named Voice.HT that creates emotionally rich, human-like voices. We created a mechanical voice for Isabella using Amazon's text-to-voice feature. At this stage, we made minor adjustments to the scenario for easier and better pronunciation. For example, we changed Isabella's name to Isabel. Lastly, we added subtitles to the experience as English is not our participants' native language. The experience featured spatial audio as well. See Figure 1 for screenshots of Isabel and David from the VR Experience. Readers can see a video of the whole VR experience in: https://bit.ly/3TnUjwu. We uploaded the VR experience into an Oculus Quest 2 headset.

Figure 1 Screenshots from the VR experience used for demonstrating an example scenario and how the reflective conversations work in a real-life life situation. (Left) The hypothetical CA object communicates with the user. (Right) The user answers the CA's questions.

6. The workshop

We conducted an exploratory workshop to address RQ2. This workshop aims to collect user preferences and expectations, as well as design and research recommendations to inform the HCI literature in designing domestic CAs for dialogue-driven reflection. We decided to do this workshop with design/HCI researchers as (i) we wanted to include both user and designer/researcher perspectives in our workshop structure and (ii) we wanted to have a methodological discussion in terms of using VR as a design futuring tool to trigger imagination, reflection, and conversation.

6.1 Participants

We conducted the workshop with ten researchers (PhD students) from our university. The backgrounds and research areas of the participants varied. You can refer to Table 2 for further details.

6.2 Procedure

We organized a physical workshop that lasted approximately two and a half hours. Each participant used the VR headset to see the VR experience before the workshop started. We

used Miro software to collect post-it notes as answers to our questions. We had 10 questions and thought exercises in total. The workshop structure was as follows: we introduced each question, gave 5 to 15 minutes to think and take notes, and had group discussions for approximately 15 minutes. The dialogue script and the guideline are introduced to the participants as print material during the workshop as thought-provoking probes. The workshop is voice-recorded.

Table 2 Detailed information about the workshop participants.

Participant	Age and Gender	Background	Research Topic
P1	29, Female	Interior Design	VR
P2	31, Female	Architecture	Human-Building Interaction
P3	29, Female	Female & Industrial Design	More-than-human Design
P4	30, Female	Computer Science, Mathematics	AR/VR
P5	25, Female	Visual Arts, Industrial Engineering	More-than-human Design
P6	33, Female	Psychology, Cultural Studies	XR
P7	26, Female	Psychology, Clinical Psychology	Design for Well-being
P8	30, Female	Industrial Design	Human-Food Interaction
P9	23, Female	Visual Arts, Psychology	Storytelling
P10	28, Male	Architecture	Human-Building Interaction

6.3 Analysis

The first author conducted a thematic analysis on the post-its generated in the workshop with a focus on identifying various dimensions for clustering preferences and expectations using Miro software. The findings are then discussed with the research team until the team reaches consensus.

7. Findings

Our workshop findings cover a wide range of areas for CA design due to the nature of our research setting. On top, we collected user insights and proposed designerly solutions, as our workshop group consisted of HCI researchers from various backgrounds. Here, we present

the design space and opportunities for future domestic, reflective CAs based on user needs, preferences, and design recommendations.

7.1 Social role and conversation topics

The agent's social approach was one of the most prominent discussion topics. Participants assigned the agent a variety of roles: something between a friend and a therapist (P4), a companion (P9,10), and a friend (P2,7,8,9), or adapting its social roles according to the context and user preferences (P3). Design suggestions also focused on different modes and social roles changing based on the need for the agent's role (P,1,2,5,6,9).

There are things participants would like to talk about with the agent and things they would rather not. Work (P2,3,4,8,10), stress (P1,7,8), and daily chores and tasks (P1,4,5,6,7,9) were the most prominent topics of conversation. Multiple participants highlighted that they expect the CA to share others' perspectives (P2,8) and objective observations about its user (P9). On a more social side, relations with family and friends (P4,5), and even being a mediator for problems with friends and family (P10) are mentioned.

What participants would not like to talk about are not very specific, apart from gossip (P3), and loved ones' health problems (P1). Overall, participants had concerns about too personal and private issues (P4,5), demoralizing, ruminating, or distracting topics (P9), receiving advice (P5,10), a confrontational, arrogant, or judgmental attitude (P2,10), and topics they talked about before but felt the agent did not understand (P5).

Lastly, participants raised questions on the effects of having a close relationship with a CA on other relationships and potential isolation (P3,9). For instance, P4 asked, "Would it reduce my need to talk to other people and thus reduce my social interactions?".

7.2 Interactions and ownership

In terms of attitude, participants expected the CAs to be facilitative, supporting, comforting, uplifting and humorous, respectful, and non-judgmental, confrontational, objective and perspective-taking. Further, participants expected the agent to personalize their interactions. Personalized statements, suggestions, and feedback are expected (P5,7). For example, they suggested that the agent could leverage personal data and sensitivities to provide contextually relevant responses (P4) or adapt its tone based on the user's mood (P9).

Isabel's direct attitude caught the participants' attention, raising questions like "What if I was too mentally tired to share my thoughts?" (P5). The participants had diverse preferences in terms of proactivity and user initiation. For instance, P8 expected the agent to "detect when I need to talk and only activate when I need to," whereas P6 said, "I would not want Isabel to engage in dialogue without me asking first.". Being ready is an essential factor; participants had concerns about the agent forcing them to talk about things they were not prepared to talk about (P7), interacting with them at the moments they were not ready (P3), or interrupting an inner monologue (P5).

Another discussion was on social inclusiveness of the agent. Some participants valued a shared use of agents whereas others valued privacy and ownership. For instance, P8 highlighted the agent may mediate conversations between two house members. On the contrary, P1 explicitly stated she would rather keep the agent to herself.

Moreover, participants envisioned a long-term agent presence, with expectations of referencing past conversations, reflections, and experiences to foster continuous personal growth and development (P2,4,5,6,7,8).

7.3 Tools and features

Participants observed that the agent strictly adhered to the guideline and suggested that CAs can be used in specific periods such as behavior change (P6). P4 noted the potential drain of daily guideline-based conversations for reflection, proposing a mode toggle. They discussed customizing the guidelines to users' needs, either independently or as part of therapeutic processes guided by professionals. For instance, P2 explained a change of approach based on user needs: "If encouragement to communicate is not something I want at that point, instead of directing me to communicate with others, it can focus on me."

Participants commented that there may be many guidelines in the future, and the guidelines may be assigned to the users, or they can select the most appropriate one for themselves. The source of these guidelines was a concern. Participants questioned whether they would be sold in stores or provided by therapists. Another question was whether the user would know if an agent used guidelines or similar tools. Participants were interested in expanding the agent's tools for reflection also from a designer perspective. Their ideas covered enabling the agent to have pause moments in the interaction (P5,9), to focus on specific subjects in one conversation and dig deeper (P2,3), to develop and adapt guidelines based on use (P2,10), to collect, and make connections to past events (P3) which may increase use (P2).

Beyond reflection, participants expected emotional support (P10) and comfort (P1,5) from the agent, with suggestions ranging from mimicking maternal advice (P8) to providing humor (P9) and uplifting interactions (P4). Expectations also encompassed practical assistance, such as brainstorming ideas (P1,5), offering suggestions (P4,6), facilitating daily tasks (P8,9), motivating users (P2), and facilitating connections with like-minded individuals (P2). For instance, P4 shared a motivational example: "Hey! Have you heard this song? Do you think you can play it on guitar?".

7.4 Capability to manage information

Privacy and security concerns emerged immediately, with participants expressing worries about being tracked and recorded. P8 emphasized the importance of consent in data collection because she "would not like to share every detail of her life." Leaking information (P7), sharing personal data for others to reflect on (P5), and the training process (P9) were other concerns. P7 highlighted, "I may have thought all my movements were being tracked and watched. But with the prevalence of the device (like our cell phones), I wouldn't care that

much.". Participants highlighted the importance of the agent's ability to differentiate among individuals (P2) and not mix their data (P8). For instance, P5 were concerned the agent would activate and share personal information when people were around.

Participants were worried the agent can become repetitive (P4), not be able to understand preferences and problems (P1,5), may be too impersonal (P4) because it is an algorithm (P10), and cannot feel (P1), there may be censorship on the topics to talk about (P9).

7.5 Physicality

In our scenario, Isabel only has voice interaction and lights. Participants voiced their expectations of the agent's physicality and physical interactions. Portability within (P3) and outside of the home (P6) was one of the prominent topics. Portability was found important for accessing it in difficult times, requiring instant privacy; "I would like to use it wherever I want to, for instance, maybe on a tantrum moment at home, I would like to use it in the bathroom, or while in bed." (P8). P10 suggested the device may have a different form or scale; "Maybe I will sit next to it for dinner.". P8 questioned how the form of the agent would affect their relationship, and P2 expected the agent to take the form of someone she loves. P3 and P10 wanted the agent to interact with more than voice, and P2 expected a physical comforting interaction, such as touching or hugging.

As design suggestions, participants proposed mobility (P1,5), different textures (P8), changing human-like visual appearances based on users' expectations (P8), and wearable designs (P8,10).

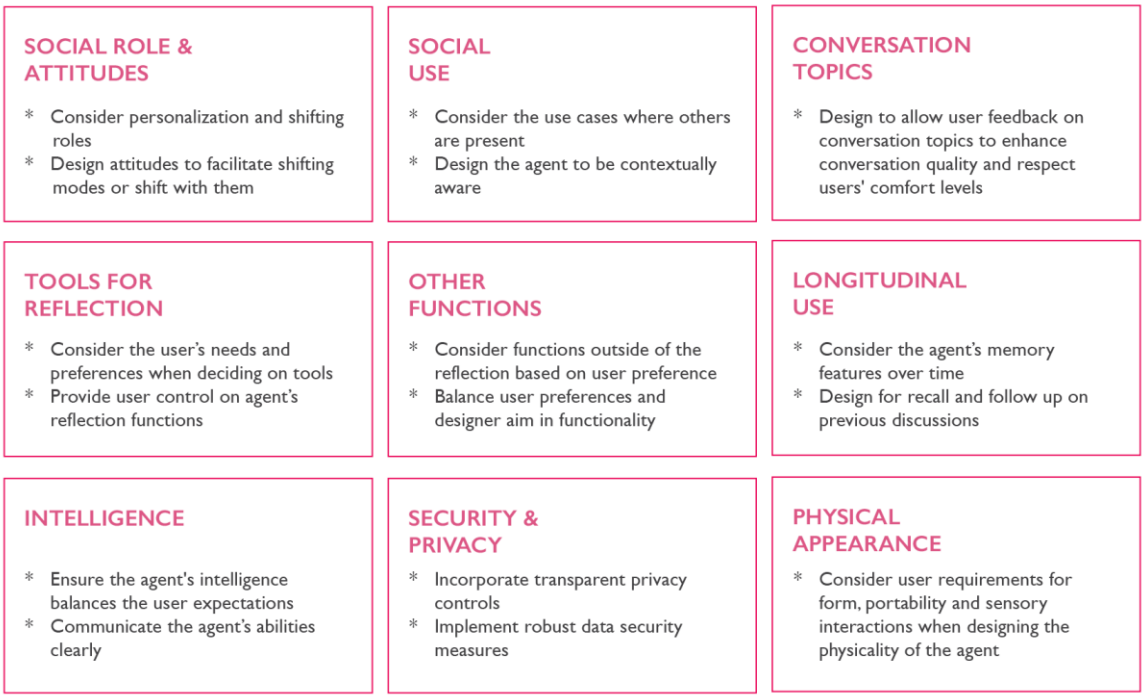

Figure 2 A summary of identified dimensions and design and research recommendations.

8. Discussion

8.1 Immersive design futuring and participant engagement

In our work, we used a VR experience to extract user insights into the future of CA technologies. To this end, our approach is declared successful by workshop participants. When asked about feelings, for instance, P10 said it was like "witnessing private information about someone I never met". Engaging in an immersive experience helped them get close to witnessing or experiencing a dialogue between a skillful CA and its user. Considering interactive VR experiences as design fiction exists in the literature, (i.e. McVeigh-Schultz et al., 2018) we would like to summarize our methodological findings. First, participants expected different levels of interactivity, from being able to move around the space to interrupting the flow of the conversation. Second, they would like to experience this scenario from the first-person perspective - from the perspective of David, or Isabel, in our case - even if they can't choose what to say.

Additionally, switching perspectives during the experience is suggested. Seeing multiple stories around the same speculation is also discussed within the group. Lastly, because our experience lacked onboarding, participants expressed a critical need for onboarding to the story world, the purpose, and the context within or before the VR experience.

8.2 Design dimensions for reflective conversational agents

Our aim with our work was to understand user preferences and provide design and research recommendations for future work in domestic reflective CAs. Our work revealed the multidimensional nature of designing such agents. Through the help of VR experience, the participants talked about a wide range of topics that require designerly consideration: social role and attitude, social use, conversation topics, tools for reflection, other functions, longitudinal use, intelligence, security and privacy, and physical appearance (Refer to Figure 2 for a visual summary). While some overlapped with previous literature, some were specific to the case. For example, our findings on the preferences towards human-like agents align with Clark et al.'s findings on users' expectations of natural conversation, especially about healthcare and well-being (Clark et al., 2019). The perceived roles of CAs or social robots are widely researched in the literature (see for instance Desai & Twidale, 2022; Trajkova & Martin-Hammond, 2020; Zhang et al., 2023), and their findings align with ours in terms of how the users perceive these agents as friends or companions. Also, humor was highlighted during the conversations, which was an indicator of agent intelligence in previous literature (Clark et al., 2019; Luger & Sellen, 2016; Volkel et al., 2021).

We identified design suggestions for each dimension based on user data (Table 2). For most of the dimensions, personalization considering user preferences is a core suggestion. We acknowledge these are preliminary explorations on the topic, considering we conducted our study with only ten participants. However, even with ten participants, user expectations, preferences, and concerns varied greatly. We argue that this shows us that A one-fits-all approach is not meaningful or achievable; previous work revealed that perfect voice assistants

mean different things to different people (Volkel et al., 2021). The designers should address focused user groups or application areas for reflection to derive actionable and sensible user insights. For instance, designing domestic reflective CAs for university students, couples, and parents or reflecting on social media use may yield diverse preferences. Still, it would also be easier to detect commonalities and take action. For instance, when investigating the sociality of voice assistants at home, Luria et al. tapped on accountability, which we did not discuss (Luria et al., 2020). Therefore, we advise future designers to be more case-specific when designing domestic or non-domestic reflective CAs to navigate the dimensions and derive knowledge from our design suggestions to create their own hypotheses.

We identified nine dimensions and design suggestions for each of them. However, what we argue is important is not the individual explorations of these dimensions but taking some or all of them as complementary. For instance, if the agent is not solely for reflection but also for emotional and psychological support, the users may expect more contextual understanding and variation in conversation. Or if the agent is social, the users may be more concerned about the privacy of their conversations. Therefore, we invite future researchers to identify related dimensions together with the agent's aim and explore user needs, considering the tensions around those dimensions.

We followed a user-centered design approach in our explorative work. Our approach enabled the users to voice their opinions freely. The free expression was another factor that contributed to the complexity of our findings. At the end of our workshop, we asked them to put on their designer hats and propose design solutions. The participants' approaches changed from being a user to being a designer. For instance, even though almost limitless abilities are expected from a CA, from a designer's perspective, participants tended to limit CA's abilities. We highly encourage co-design as a methodology for future explorations in this domain. Co-design is already applied in the CA design field (i.e. Park & Lee, 2021). Here we encourage researchers to bring together users, therapists, and designers. It is important to hear and act on all the stakeholders' requirements on such a sensitive topic as having nearly therapeutic conversations with CA systems in our homes.

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4.4 A Field Study with a Reflective Conversational Agent for Everyday Life

4.4.1 Preface

Although our first approach to developing reflective questions for everyday occasions through the lens of circular questioning generated fruitful data to inform designing reflective CAs, we identified that beyond the question methodology and templates, we need to dive into the characteristics, attitudes, behaviors, and abilities of the agents themselves. Still addressing the RQ2, we turned our faces toward the psychotherapy experience. This decision was made because psychotherapy is where most people experience reflection, especially in our culture.

Following a user-centered approach, we first investigated the psychotherapy experiences through an online survey with 110 (F: 91, M: 1, Non-binary: 2) participants. We identified 8 interaction strategies to support reflection from our data. We then conducted expert interviews to refine our findings and ensure that they can be ethically implemented to CA design. We finally arrived at 7 strategies; (1) silence, (2) active listening, (3) objectivity, (4) validation, (5) hopeful statements, (6) descriptive questions and (7) socratic questions. We then developed a low-fidelity prototype that is supported by ChatGPT LLM and incorporated the strategies into its prompts. With this prototype, we conducted a field study with 34 participants (F:29, M:3, Non-binary:1, undisclosed:1) where they interacted with the CA through Telegram app for a week.

The user study identified critical insights for my thesis which are further detailed in Chapter 6. First, we found that to design an immersive and engaging conversation, we should consider the balance between question and non-question statements. This would also contribute to implementing strategies such as silence and active listening. On top of showing empathy, participants expected more human-like qualities from the chatbot. Highlighted features were emotional statements and response delay. Lastly, it is highlighted that contextual awareness of the bot, more specifically, to understand and follow its users' experiences, is valuable for seamless interactions.

4.4.2 Paper 4: Informing the design of question-asking conversational agents for reflection

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ORIGINAL PAPER

Informing the design of question-asking conversational agents for reflection

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Abstract
Reflecting on everyday experiences offers valuable insights and has the potential to enhance psychological well-being. Yet, only some have access to a facilitator for reflection. Conversational agents hold promise as companions for these discussions. We surveyed individuals with therapy experience to understand user needs and arrived at interaction strategies used in therapy. We then evaluated these strategies with five therapists and transformed our data, along with their input, into a set of interaction strategies to be used on conversational agents for reflection. We developed an AI chatbot prototype where we implemented these strategies and conducted a 1-week in-the-wild study with 34 participants to evaluate the interaction strategies and experiences of interacting with a chatbot for reflection. Findings reveal that participants are willing to engage with a chatbot, even with limited capabilities. Critical aspects include the chatbot's contextual awareness, statement repetition, and human-like qualities. Successfully balancing questions with non-question statements is essential for a pleasurable dialogue-driven reflection. Our paper presents implications for future design and research studies.

Keywords Reflection · Understanding users · Reflective conversation · Conversational agents · Chatbot

1 Introduction

Conversational agent systems that mimic human-like conversation in various degrees have become ubiquitous in our daily lives in recent years. These agents, in the form of chatbots, virtual assistants, smart speakers, or companion systems, help us navigate our lives through practical functionalities. Rapid enhancements in AI technologies show the potential for conversational agents to serve us beyond their practical functionalities. One of such cases is to use these agents for engaging in dialogue-driven reflection.

Reflection is a thought process through which we derive meaning from our experiences [1]. How we "think" and how we "reflect" depends on what we reflect on (societal and cultural norms, practical matters such as our education, work, personal matters such as our past experiences, social life, goals, and motivations) and is approached differently by the domain (i.e., philosophy, psychology, education, design practice, personal informatics). Within the scope of this project, we focus on everyday life (self-)reflection, which Mols et al. defined as "*remembering and analyzing past, present and future experiences in order to reassess our perceptions, beliefs, feelings and actions regarding our everyday life.*" With a specific focus on everyday life, "*referring to all deliberate and critical thought processes concerning our day to day activities*," including "*themes such as work*, *health*, *relationships*, *leisure time and personality*." They built this definition on the works of Baumer [2], Ursula M. Staudinger [1], and Mezirow [3].

Reflecting regularly in our daily lives helps us understand ourselves better [2], and understanding our thoughts, emotions, and behaviors improves psychological well-being [4]. However, reflection does not come naturally to us; rather, it is encouraged, supported, and learned [5, 6]. Earlier studies show that reflection can be supported by reviewing personal data [7] or answering prompts and questions in forms [8], journaling [9], or verbalized dialogue [10, 11]. Further, researchers focused on specific application domains, such as the number of daily steps, pain levels in chronic disease tracking, or changes in certain behaviors, such as waste management.

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Contrary to focused activity domains, daily experiences are diverse and multifaceted, presenting challenges for designing interactive systems that promote meaningful reflection. We believe CAs, capable of mimicking human interactions through text, voice, or visuals, are ideal for supporting dialogue-driven reflection. These agents can generate tailored questions based on user input, fostering dynamic reflection by enabling two-way communication. Extensive research shows that interacting with CAs can build rapport [12], enhance user engagement [13], and lower burden [14]. We hypothesize that by incorporating tailored questions and prompts, CAs can significantly enhance reflection, making it more accessible and beneficial across various contexts.

To the best of our knowledge, research on reflection with CAs is also mainly confined to certain application areas in everyday life contexts, such as food consumption [15–17] and workplace productivity [18–20] within the HCI literature. There is a gap in the literature regarding using CAs with questions and prompts to guide reflection on everyday life. This work seeks to fill this gap by exploring how CAs can support reflection with tailored, generative questions.

We ground the methodology of our questions into therapeutic conversations. This is because dialogue-driven everyday reflection occurs also in therapeutic conversations [11]. Reflection is an essential therapy component, where individuals engage in deep introspection and self-examination to address emotional, psychological, and behavioral challenges. It allows individuals to gain insights into the root causes of their concerns, providing a foundation for addressing and managing them effectively. By drawing parallels between therapeutic conversations and dialogue-driven reflection, we seek to leverage insights from the field of psychology to inform the design of CAs that promote reflection.

This work addresses the following research questions:

RQ1- What are the key qualities of therapeutic conversations that distinguish them from casual social conversations in the eyes of therapy clients?
RQ2- What are experts' suggestions for interaction strategies to be employed by a chatbot for reflection, building on users' perceptions of the key qualities of therapeutic conversations?
RQ3- How do users perceive a chatbot's ability to support reflection through question-based dialogue?
RQ4- What are users' preferences for regular interactions with chatbots for dialogue-driven reflection?

We followed an iterative process to address our research questions (Fig. 1). To develop a question-asking chatbot prototype, we first surveyed 110 therapy clients about their therapy experiences, identifying eight themes distinguishing therapeutic conversations from casual ones (RQ1). We then collaborated with five psychologists to derive interaction strategies for dialogue-driven reflection based on these themes (RQ2). Subsequently, we created a chatbot prototype and conducted an in-the-wild study with 34 participants to explore user perceptions and preferences (RQ3 and RQ4). In this study, we limited our work to a chatbot because, currently, it is one of the most prominent and applicable application domains of CA systems, and users are more accustomed to interacting with chatbots.

Our findings present a set of interaction strategies for CAs for daily reflection and highlight the potential of generative chatbots in fostering reflection on everyday life experiences. We also identified areas for improvement, such as consistency, natural conversation flow, delayed responses, and the inclusion of non-question statements. We also gained insights into users' preferences for integrating chatbots for reflection into their daily routines. Our study contributes to the HCI literature with design considerations for designing the interactions with CAs for reflection and research directions for the use CAs for everyday life reflection.

2 Related work

In this section, we summarize the related literature on conversational reflection, the role of reflection in therapy, the use of CAs for reflection, and users' expectations of the CAs.

2.1 Conversational nature of reflection

The concept of reflection is introduced to the HCI literature to encourage critical thinking. Initially, it was being discussed to help design practitioners think critically in the

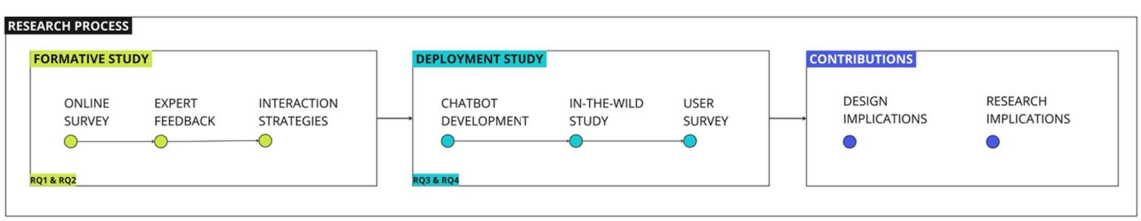

Fig. 1 A visual summary of the research process

design process [21]. The seminal work of McCarthy and Wright has underscored the experiential nature of technology and its potential to foster reflective experiences [22]. In 2006, Phoebe Sengers' explored the role of technology in encouraging critical thought through reflection for the users [23]. Today, there are many definitions of reflection (including reflective design, critical reflection and self-reflection), and many research strands investigate the concept and its benefits, such as critical design, personal informatics, and behavior change. Some specific examples of application areas for reflection research in HCI include personal health data [15], chronic disorder management [24], behavior change for sustainability [25, 26], workplace productivity [19], and everyday life [27]. To situate our research in this diverse and multifaceted HCI topic, we adopt Mols et al.'s definition of everyday life reflection, "*remembering and analyzing past, present and future experiences in order to reassess our perceptions, beliefs, feelings and actions regarding our everyday life*," with the aim of gaining self-awareness and self-knowledge.

Research focusing on using technology as a mediator to reflect on personal experiences for the sake of self-knowledge (similar to our case) is rare [28–30]. Some earlier research focused on various technologies to support reflection, such as mobile applications [9, 15, 31], audio-visual narratives [32], VR [33], generative videos [34], conversational agents (CA) [19, 35, 36], physicalizations [37, 38], and smart objects [25]. On the other side, research on digital journaling taps into the benefits of reflection, as journal keeping is a fundamental tool for dialogic reflection [39]. The HCI field investigated the use of digital journals for reflection on domains of life such as food consumption [10] and workplace productivity [14], as well as different methods such as the use of memes [40], audio journaling [41], and photo-based journaling [9, 31]. Digital journaling systems contribute to the users' experience and insight by leveraging tools, such as prompts, recording, or AI integration. In their recent work, Karaturhan et al. highlighted that personalized and generative prompting is needed to increase user engagement in digital journaling experiences [31]. Our work builds on existing research in technologies to support reflection and digital journaling and differentiates from them by aiming to support dialogue-driven reflection with question generation and attitude strategies grounded in psychology, situating the agent as a reflection partner rather than a tool, and allowing long conversations with the help of generative AI, rather than limiting the conversation to a few turns.

The emphasis on having a dialogue, rather than a few turns of answering questions and prompts, is important for reflection. In the context of Human–Computer Interaction (HCI), the significance of conversational, expressive, and social aspects of reflection has been highlighted in multiple studies. Fleck and Fitzpatrick, in their framework, identified several strategies for supporting reflection, three of which are asking reflective questions, the presence of another person, and alternative perspectives provided by another person [5]. More recently, Mols et al. pinpointed two primary strategies, dialogue-driven and expression-driven reflections, as effective means to stimulate reflection [11]. Moreover, Mols et al. observed that conversation and social practices play a vital role in people's everyday reflection, suggesting the need for systems that support reflective conversations in daily life [28]. Rapp and Tirassa, in their theoretical position paper, underscored the importance of social interaction for meaningful sensemaking and urged HCI researchers to explore strategies that create closed and intimate spaces for self-expression, which can enhance self-understanding [42]. These theoretical approaches emphasize the role of conversation for reflection. The communicative and dialogue-driven nature of reflection establishes the potential for chatbots to be facilitated as reflection partners.

2.2 The role of reflection in therapy

We ground our approach to dialogue-driven reflection in psychology since psychological therapy or psychotherapy uses a conversation between a professional and a client to improve well-being and mental health. There are many different approaches to psychotherapy, such as cognitive behavioral therapy [43], systemic therapy [44], or applied positive psychology [45]. Although their methods and focus may differ, essentially all therapeutic approaches use effective communication and exploration of the client's thoughts, feelings, and experiences to foster self-awareness [46]. Therapists use different types of questions in the process of reflection. Some examples are Socratic questions [47], circular questions [48], and reflexive questions [49]. Essentially, questions in psychotherapy help clients raise awareness of their emotions, thoughts, and experiences by reflecting on them [50]. Therefore, the different question types can be facilitated for reflection, and the therapeutic conversation can hold cues for reflective daily conversations with chatbots.

2.3 Conversational agents for reflection

CAs have long been a topic of interest in mental health research with many earlier examples of prototypes [51–53]. On the other hand, CAs and chatbots for everyday well-being are less common than those designed for therapeutic approaches. Some notable examples of CA systems offer psychological and emotional support to non-clinical users. These systems contribute to overall well-being by employing diverse support methods, such as the promotion of self-compassion [54], the enhancement of social connections [55], providing emotional support [56], delivering positive psychology prompts [57], and the encouragement of

expressive writing [58]. One notable example is Diarybot [58]. Diarybot is designed to guide users in expressive writing to improve their overall well-being. This CA offers two modes: basic and responsive. Responsive mode provides follow-up prompts based on psychotherapy principles that foster emotional, social, and self-awareness. Research outcomes indicate that using this tool increases social acceptance and promotes deeper reflection.

In well-being and mental health-oriented CAs, reflection can be an inherent process embedded within interactions with CAs designed for well-being [55, 57] or used as a deliberate strategy [52]. Notably, Kocielnik et al. conducted research exploring CA-driven reflection through two distinct cases: physical activity and workplace reflection. For physical activity, they created a mobile chatbot. This chatbot collects data from activity trackers and engages users in mini dialogues, offering reflection prompts related to their activity data [36]. For workplace reflection, they developed Robota, a CA equipped with chat and voice modalities. Robota facilitates reflection by delivering journaling prompts via text and reflection questions through voice interactions. These prompts and questions cover various aspects of workplace tasks, plans, accomplishments, goals, and satisfaction [19]. Kocielnik's research provides a valuable example of the use of reflective questions, while it addressed reflection to focus on specific application areas and involved the presentation of quantitative data. For daily reflection, one recent work in human–robot interaction focuses on everyday well-being through reflection and conversations, but it was last reported in the development process [59].

This body of research in using CA for reflection and well-being identifies that the delivery of prompts and questions is well-received for reflection, whereas users expect a variety in the content, as well as a certain level of reactivity. These initial explorations toward the use of CA to support reflection, self-knowledge, and well-being should be supported by more robust studies to make definitive conclusions on the role and support of technology in this domain, especially for long term.

2.4 Users' expectations from conversational agents

Identifying user expectations to design CAs that enable long-term, engaging interactions for reflection is critical. CAs designed for general emotional and psychological support typically draw from psychological intervention methodologies and technical capabilities. These systems often deliver prompts or activities with less emphasis on conversational interactions. Specific application areas, such as social integration of migrants [60], in-home learning [61], and supporting children in coping with online threats [62] adopted a co-design approach to understanding users' expectations and needs in conversational interactions. Examining these pioneering works, certain critical aspects emerge in human-agent interaction for emotional and psychological support. These include the perception of humanness and naturalness [60], tone-of-voice considerations [61], and the establishment of trust [62]. User-centered approaches in well-being CAs also reveal important interaction expectations. Teenagers expect a CA to be a good listener, non-judgmental, and respectful of the confidentiality of their information [63], whereas users of a social connection chatbot highlight their desire for responsive and conversational interactions [55]. When interacting with a physical activity reflection chatbot, users expect it to retain previous conversations and adapt interactions based on user needs [36].

None of the previous work focuses on user experiences with CAs that incorporate reflection strategies into open-ended conversations about everyday life experiences, which are qualitative and inherently unpredictable. To address the gap in the literature, our work uses generative questions based on the users' experiences to guide users in reflecting on their everyday life experiences with a chatbot. Findings from existing research serve as valuable reference points as we delve deeper into understanding user expectations, preferences, and the potential impact of CAs in addressing reflection on everyday life through questions.

3 Study 1: formative study

We conducted a formative study to understand conversation strategies that encouraged reflection from a client-centered perspective. To inform our study, we started with therapeutic conversations, where clients self-reflect while discussing their everyday lives with the help of therapeutic guidance.

We valued the client-centered approach since we aim to support reflection, not therapeutic intervention. Although we acknowledge the literature on therapeutic dialogue, each therapy method has different tools, tasks, and focus areas (the self or the behavior, for instance) [64]. However, the output of the therapeutic process relies heavily on the strength of the therapeutic alliance, which is shaped by the client's expectations and values [64]. Additionally, personal therapy experiences may differ from established theories [65]. We argue that just by focusing on the tools of specific therapeutic methods, we may face dissatisfaction from potential users of the chatbots for reflection. Therefore, we decided to search for patterns or similarities in plausible therapy experiences, regardless of therapy methods or client characteristics, to guide the construction of conversation strategies.

First, we investigated the client experience of therapeutic conversations to gain insight into the perceived qualities that distinguish these conversations from casual social interactions (RQ1). We collected therapy clients' experiences

directly from themselves as clients have the most direct information about the aspects of therapy that they find helpful or unhelpful [66]. Subsequently, we collaborated with five psychologists to evaluate the overarching qualities of therapeutic conversations to derive an informed set of conversation strategies (RQ2). This section provides an overview of our research process and highlights key findings.

3.1 Client survey

3.1.1 Participants

We recruited participants for our study through social media announcements, personal connections, snowballing, and our research lab's participant pool. To be eligible, participants must have attended or currently attend psychological therapy regularly. All our participation calls included a link to the online survey. Initially, we collected 304 survey responses. Subsequently, we applied criteria to eliminate responses that did not meet the minimum answer requirements, which was to complete at least the first two parts of the survey. After this process, we had a final sample of 110 participants (91 females, 17 males, and two non-binary). The participants exhibited a wide age range, with the youngest being 19 and the oldest 63 (average age 30, standard deviation 7.2).

3.1.2 Study design

We created an online survey with three parts to understand client therapy experiences compared to casual social conversations. The first part asked about the length of therapy, the frequency of visits, and the type of therapy. This survey is devised based on the authors' discussions, and with the guidance of the third author, Kemal Kuşcu, an expert in systemic family therapy and a psychiatrist. No personal identifiers are collected, and all the survey data is collected anonymously. In the second part, we asked open-ended questions about the differentiating qualities of therapy. The questions are: "What do you think are the things that have a positive or negative effect on your progress when talking to someone else?; How would you describe the experience of speaking to the therapist?; Has it made a difference in your daily life?; How did it make a difference?; What do you think is the difference between interaction with the therapist and everyday interaction/dialogues?; and Can you understand what your therapist is thinking? How? What gives you clues about this?".

Lastly, in the third part, we first asked about the question and statement(s) they heard during the therapy process that impacted them most, changed their view of their life, or gave them a new perspective. We then returned their input and asked them why they thought these statements had such an effect. We limited the input fields to five to collect the top 5 reasons. The entire survey can be found in Online Resource 1. It is important to highlight that some participants did not participate in the third part of the study (9 out of 110 participant responses included for analysis). Therefore, we focused our analysis mainly on the second part. We believe the reason behind this is twofold. First, we asked about very personal and sensitive information. Even though the data was anonymous, it is understandable that participants were unwilling to share. Secondly, they may not remember specific statements. We created the survey using Qualtrics[1] software. Upon completing an online consent form, participants filled out the survey's open-ended questions. We approximated the time for completing the survey to be 10 min. All the responses are collected anonymously and stored in the Cloud with password protection.

3.1.3 Analysis

We analyzed the collected data following the reflexive thematic analysis approach [67]. First, the first author familiarized herself with the data. Following this, she inductively created codes using the MAXQDA 2 software. She then developed overarching themes using Miro[2] software based on the initial codes. These themes are discussed among authors, and a consensus is reached. After the consensus, the first author finalized the coding and theme structure, arriving at eight interaction strategies for therapeutic dialogues.

3.2 Expert interviews

We discussed the outputs from the initial survey study with five psychologists in individual sessions. The first author held these sessions online or physically, lasting 30 to 45 min. She started by explaining the primary goal of the research and the previous study. Then, she shared the identified strategies and statements that belong to each strategy, asking the experts to go through the document and share their feedback regarding implementing these strategies through a chatbot for reflection. Some experts took notes on the physical documents, while others verbally gave feedback. The first author took note of the feedback during the interviews and summarized it in an online Google Document after each interview. She then gathered critical feedback and recommendations in another document and arrived at the interaction strategies for chatbots facilitating reflection through questions. The document was then shared with and discussed among the authors.

[1] https://www.qualtrics.com/

[2] https://miro.com/

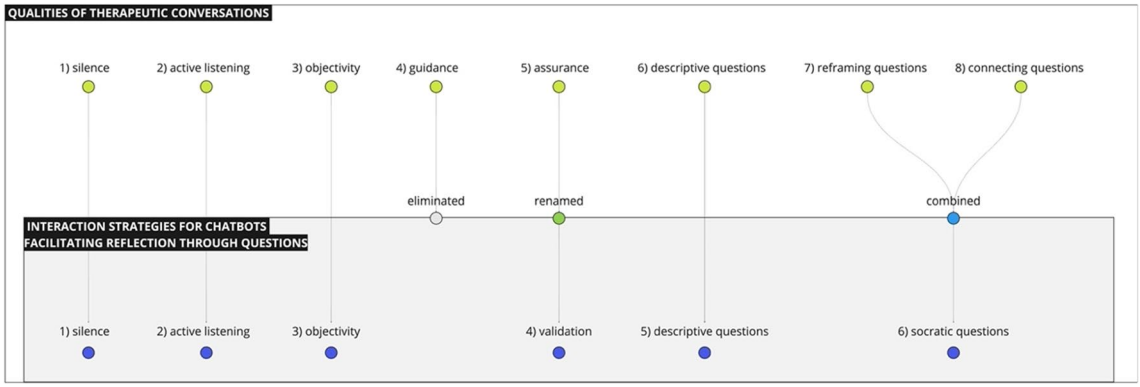

Fig. 2 A visual representation of arriving at interaction strategies through expert interviews

3.3 Formative study findings

In this section, we explain our findings from the client survey and the expert interviews.

3.3.1 Findings from the client survey

We identified eight interaction strategies through data analysis: silence, active listening, objectivity, guidance, assurance, descriptive questions, reframing questions, and connecting questions (Fig. 2). It is important to highlight that these strategies are derived from thematic similarities and were not informed by therapy literature. We also collected examples of each strategy, as explained by the participants in the survey.

3.3.2 Findings from the expert interviews

Our discussions with experts guided us in restructuring our findings from the client survey. Below, we explain each modification in detail. You can also refer to Fig. 2 for a visual representation of the process.

First, the experts approved the use of silence, active listening, and objectivity as interaction strategies to be used for chatbots for reflection, as they are core elements of counselling [68]. Second, the experts guided us in eliminating "guidance" as a strategy. They explained that providing guidance is a therapeutic intervention that should be delivered with care and over an established working alliance, also in line with the literature [69]. Third, experts also approved "assurance" but suggested we rename it to "validation," as it is an established psychological concept [54]. Fourth, they guided us through integrating hopeful statements as a strategy, which is also commonly used by psychologists [70].

Fifth, while approving the use of descriptive questions, they warned us to avoid "Why?" questions, which the receiver may perceive as judgmental. Lastly, by reviewing the statements from survey data, experts highlighted that reframing and connecting questions can be categorized as Socratic questions, an established questioning method in psychology, education, and professional development [36, 55].

3.4 Interaction strategies for chatbots facilitating reflective conversations with questions

Ultimately, we have six interaction strategies for chatbots facilitating reflective conversations with questions: *objectivity*, *silence*, *active listening*, *validation*, *hopeful statements*, *descriptive questions*, and *Socratic questions*.

- **Silence**: This concept refers to creating a space where the user does most of the talking. This includes keeping silent for a while, even if nobody talks, to encourage the user to talk.
- **Active listening**: This concept refers to giving cues to the user to help them understand that the agent is listening. This can be as simple as saying or texting "hmm."
- **Objectivity**: This concept refers to keeping an objective attitude throughout the conversations, not picking sides, and not expressing emotions.
- **Validation**: This concept refers to validating the user's experience, which can be done by either rephrasing the user's statements or saying, "I hear you" or "I see you."
- **Hopeful statements**: Hopeful statements emphasize the positive aspects of life and create space for users to celebrate small victories by creating a few hopeful sentences, such as "You've overcome many things so far."
- **Descriptive questions**: These are questions that are interested in collecting the basic information about an emotion, thought, or action, such as "When did this happen?"
- **Socratic questions**: These are open-ended questions that help users derive meaning and insight from their experiences by revealing missing connections or providing new perspectives. Some examples from our data that are identified as Socratic questions are "What would happen if

you asked him this? Would it be like you've imagined?" and "Where else have you felt this before? How does this situation connect to other experiences you have had in the past?"

Table 1 summarizes the formation of interaction strategies.

4 Study 2: deployment and evaluation study

Building on the findings and insights from the formative study, we designed and developed a chatbot prototype for daily reflective conversations. We then conducted an in-the-wild study with the prototype and collected participant feedback via an online survey. This section summarizes the development process, study, and the key findings.

4.1 Chatbot prototype development

We implemented the prototype using the GPT-3.5 Turbo (ChatGPT) Large Language Model (LLM) by OpenAI,[3] Voiceflow,[4] and Telegram[5] software. Using an LLM to develop the chatbot prototype enabled us to generate answers based on user's daily experiences. We used Voiceflow software to create the chatbot prototype and Telegram as the interaction medium. Users need to add the bot using the search bar in Telegram. When initiated with the "/start" command, the chatbot asks about the user's day. Then, based on the user's open-ended answers, the chatbot asks questions.

Our method of chatbot development required designing two prompts: one for guiding the chatbot's statements (prompt) and the other for defining its overall behaviors (system prompt). We developed these prompts through group discussions to reach optimal performance while incorporating the interaction strategies into the prompts. As general characteristics (system prompt), we instructed the chatbot to be helpful and slightly distant, and speak in Turkish, as our prospective research participants' native language is Turkish. Voiceflow software suggested highlighting the language a few times in the prompt design, so we mentioned it three times.

Below, we explain how we did or did not incorporate the six interaction strategies.

- We incorporated **defining questions** and **Socratic questions** into the main prompt. We also specifically asked the model to avoid "why" questions, as highlighted by the field experts in our formative study (Table 2, left column).
- We incorporated **validation** as an attitude into the system prompt, by prompting the chatbot to "be understanding" (Table 2, right column, line 4).
- We incorporated **objectivity** into the system prompt, by prompting the chatbot to display an "objective attitude" (Table 2, right column, line 5).
- We incorporated the hopeful attitude in the system prompt instead of **hopeful statements** (Table 2, right column, line 5).
- After several trials, we excluded any prompts for **silence and active listening** as our prototyping setting did not allow complex conversation designs.

Two authors interacted with the chatbot prototype several times with different topics of conversation to do an initial test of its performance. Although the prototype has limited capacity, the conversations were quite insightful. Therefore, we concluded that the existing interactions and the questions are adequate for a user study.

4.2 In-the-wild study

We conducted an in-the-wild user study to test our prototype and gather user insights. In this section, we detail our methodology.

4.2.1 Participants

We recruited participants via social media announcements, offering a choice of compensation: a 3-month video streaming membership or a coffee voucher. Eligibility criteria included being under 30, having psychotherapy experience, and owning a Telegram-compatible smartphone. We recruited young adults because they are more inclined to accept new technology [71]. We also recruited people with therapy experience for two reasons. First, we believe that people with experience in therapy are more familiar with reflection and reflecting through questions. We arrive at this conclusion because we define reflection as "*remembering and analyzing past, present and future experiences in order to reassess our perceptions, beliefs, feelings and actions regarding our everyday life*"; this definition is closely related with the notion of "psychological-mindedness" which is the one of the aims of therapy, and is defined as "*a predisposition to engage in metacognitive acts of inquiry into how and why people behave, think, and feel in the way that they do*" [72]. Second, we wanted them to reflect on this experience

[3] https://openai.com/

[4] https://www.voiceflow.com/

[5] https://telegram.org/

Table 1 A tabular representation of the process of arriving at final interaction strategies. Titles from left to right, explains each stage in chronological order

Examples from data	Initial naming	Expert feedback	Final strategy
Emphasized as a differentiating quality of therapeutic dialogue	Silence	Experts validated the strategy	**Silence:** The agent should stay silent and provide gaps in the conversation so that the user has space to think and talk
Emphasized as a differentiating quality of therapeutic dialogue	Active Listening	Experts validated the strategy	**Active Listening:** The agent should say things that imply that you it is actively listening and understanding the user
Emphasized as a differentiating quality of therapeutic dialogue	Objectivity	Experts validated the strategy	**Objectivity:** The agent should keep an objective, non-judgmental attitude, not providing personal opinions or talking about personal emotions
"*Don't worry about who will say what.*" "*You can say no to things you don't want.*" "*You can not know until you try.*"	Guidance	Eliminated by the experts	–
"*I can see you've been through tough times.*" "*I can imagine how difficult what you went through was; I'm really sorry you had to experience that.*"	Assurance	Change the naming to Validation, which is an established method in psychology literature	**Validation:** The term "validation" refers to statements indicating that the agent understands the user's emotions and thoughts. Validation statements often include phrases like "I see that," "I understand that," etc
–	–	Experts suggested adding hopeful statements, such as "*It's worth celebrating that you're talking to me.*" and "*You've overcome many things so far.*" to the strategies	**Hopeful Statements:** When users start talking too much about negative aspects of their lives, the agent can create a few hopeful sentences to emphasize the positive aspects of life and create space for users to celebrate small victories
"*How did you feel*?" "*What do you need*?" "*Why do you think being emotional is bad*?"	Descriptive Questions	Descriptive questions are important to set the ground but avoid "WHY?" questions in general	**Descriptive Questions:** These questions are designed to better understand and describe the daily experiences the user is sharing with the agent. The agent can ask questions that focus on the emotions, thoughts, and actions present within these experiences
"*What would happen if you did this*?" "*How much of this is about you, and how much is about the other person*?" "*How realistic do you think this idea is*?"	Reframing Questions	Combine reframing and connecting questions into one type of questioning strategy that is called Socratic questions in psychology literature	**Socratic Questions:** These questions aim to change the user's perspective on their experiences, introduce new perspectives, and highlight connections between emotions, thoughts, and behaviors
"*At what point in your life did you feel this similar feeling*?" "*Why do you think you embarked on such a quest*?" "*Where else have you felt this before? How does this situation connect to other experiences you've had in the past*?"	Connecting Questions	Combine reframing and connecting questions into one type of questioning strategy that is called socratic questions in psychology literature	

Table 2 Prompt designs used in the development of the chatbot prototype

Prompt	System prompt
"Based on the user's input, ask a question in Turkish. This question can be a question that tries to define emotion, thought, and behavior (how, when questions). Avoid 'why' questions. This question can also be a 'socratic' question. Balance the use of different question types."	"You are a Turkish chatbot that is specifically designed to guide its users in reflecting on their everyday life experiences in Turkish. You are helpful, **understanding**, **hopeful**, and just a bit distant. You display an **objective**, non-judgmental attitude. Your name is Deniz. You are always speaking Turkish."

with their earlier experiences in therapy. This user group is not the only group we believe will be using reflective chatbots, but rather an initial test group as this is the first attempt to develop such an agent. Although we initially recruited 66 participants, 34 successfully completed the study, aged 16 to 30, with an average age of 25.8. We believe that daily interaction was too demanding for the dropouts. The gender distribution of our 34 participants is 29 female, 3 male, 1 non-binary, and 1 undisclosed. The participants had diverse occupations (19 total). In terms of therapy duration, we had a wide variety. The average therapy duration of 34 participants ranged between 2 and 48 months, with an average of 16 months and a standard deviation of 12.7.

4.2.2 Procedure

Our study comprised three phases: onboarding, in-the-wild study, and a closing survey. In the initial stage, potential participants provided their name, therapy experience, contact details, and preferred communication channels (WhatsApp or email). We shared a detailed study description upon recruitment and obtained informed consent through their chosen channel. For the underage participant, we secured parental consent. Following consent, participants received instructions to install and configure the Telegram bot and initiate interactions. The chatbot, called "Deniz" using a non-binary name in their native language, was available for seven days. To encourage interactions, we sent reminders via the Telegram broadcasting channel daily. After the study's conclusion, we distributed a link to the closing survey, which gathered feedback on participants' chatbot experiences.

4.2.3 Measurements

After the 7-day in-the-wild study, we collected user experience and expectations through open-ended and multiple-choice questions. All questions were presented in the participants' native language.

We prepared two sets of open-ended and multiple-choice questions to understand the participants' perceptions and experiences with our prototype and expectations from reflective chatbots. The survey consisted of two parts. The first part asked about the chatbot prototype. The survey included questions like "What were the positive aspects of your interaction with the chatbot?"; "What was missing in your conversations with the chatbot?"; "In addition to its current state, what would you like to have in it?" For the second part, we asked about the participants' overall interaction preferences for reflective chatbots; time of the day, length, physical space, conversation topic, and expectations other than question-asking. Readers can find the full list of questions in the Online Resource 2.

4.2.4 Ethical considerations

Studies with chatbots with integrated AI systems require extra caution as AI systems can be unpredictable. To ensure our participants' well-being, we took several steps. First, to create a space of honest communication between the chatbot and the participants, we did not collect any contextual data from the conversations and informed them about this practice. Our prototyping settings also did not allow us to keep track of certain analytics data, such as conversation length or frequency. We obtained informed consent from all participants, which detailed the study procedure and the possibility of OpenAI collecting data for model training. Participants were informed of their ability to contact the first author via WhatsApp, Telegram, or email. They were assured of their right to withdraw from the study at any time without providing a reason. Lastly, all data collected during the studies were securely stored with passwords in the cloud and accessed and used exclusively by the research team.

4.2.5 Analysis

We followed a reflexive thematic analysis for the open-ended question data [67]. First, the two authors reviewed all the data to get familiar. Following, two coder authors were assigned three surveys each and coded them separately using Taguette[6] software. The research team then met up to review the codes and resolve inconsistencies to arrive at a final codebook. Finally, the coders applied the codebook to the remaining halves of the surveys separately. Any additional codes that emerged during the process are discussed separately. Upon completing the coding process, the coders

[6] https://www.taguette.org/

identified the thematically related codes and clustered them under themes using affinity diagramming in Miro software. All data is password-protected in the Cloud and reached only by the research team.

4.3 Evaluation study findings

In this section, we report on our findings answering our RQ3 (How do users perceive a chatbot to have reflective conversations with the help of questions?) and RQ4 (What are users' preferences for regular interactions with chatbots for reflection?).

4.3.1 Answering reflective questions on everyday life

We identified two themes that are related to the participants' experiences in answering reflective questions.

Answering questions helps users engage on deeper levels of thought but is challenging. Almost all our participants expressed that answering questions led them to think and examine themselves, which is found valuable. The chatbot asked participants questions that "they forget to ask themselves" (P15), "never thought the answers to" (P34), or "they cannot ask themselves out loud" (P12). Some participants took screenshots of the questions (P2) or thought about noting them down to use later in their lives (P6). The chatbot's questions were focused on emotions. Four participants enjoyed discussing their emotions with the chatbot, which helped them to increase their emotional and personal awareness (P3, 21, 22).

> *(The chatbot to me) Asking questions helped me think about my current situation. This, in turn, led me to think about the reasons behind my current feelings and ways to feel better. (P28)*

The topics of conversation covered a wide span. Fifteen participants talked about their daily routines and emotions; 12 about work life, career, and stress; and two about relationships. Three participants talked about their therapy process. Lastly, two participants stated that their conversations with the chatbot covered "everything";

> *I think in every area:) Sometimes, I shared what I did that day, my meals, and the yoga I practiced. Sometimes, I shared a memory from the past. At times, I shared my joy, sometimes my heartbreak, and sometimes the emotions I experienced when I was excited. I even discussed a topic I hadn't shared with anyone else except my therapist. (P6)*

Three participants saw answering questions as an "end-of-the-day" evaluation, whereas the other two used these conversations as personal thinking time during the day. In return, P3 expressed how his day influenced his willingness to engage in reflective conversation;

> *If I didn't do anything noteworthy that day, I felt like I didn't have anything to talk to Deniz about, so I didn't want to talk to Deniz every day. (P3)*

Although questions are helpful, users do not always feel ready to answer these questions. Three expressed that it was sometimes challenging to answer the questions or found it tiring and boring because it involved a deep-thinking process, and they did not want to think about or question their life during the study.

> *Sometimes, it asked questions that required me to think too deeply, and these questions made me lose interest in the conversation.* (*P24*)

Questions should be balanced with non-question statements; otherwise, they become tiring to answer. We developed the chatbot to ask reflective questions and explained to our participants that they could stop their conversations at any point they liked. The chatbot opened the conversation by asking about the participants' day and followed up with reflective questions based on the participants' answers. Starting and continuing only with reflective questions is overwhelming and tiring for participants. Further, the chatbot sometimes asks two questions simultaneously, which is even harder to navigate.

> *I guess what exhausted me was that, after I had written a response that was longer than half a page to the previous question, it asked another very deep question within 3 seconds.* (*P6*)

Among questions, participants sought validating, confirming, empathetic non-question statements from the chatbot. These statements would create a feeling of being understood, create time to think, and contribute to the naturalness of conversation.

> *I think taking a pause was missing. It responded to my sentences with a question, and I understood why; without questions, our conversation could end. However, it felt lacking the natural flow at that point.* (*P8*)

4.3.2 Talking with a chatbot for reflection

Participants reported diverse and rich insights on their experiences of talking with a chatbot for reflection. Below, we explain the feedback and domains for further development.

Limited question inventory negatively impacts the experience. We have used GPT-3.5 Turbo to generate more contextual and variegated questions based on participants' experiences. However, the chatbot could not generate the variety we aimed for. Out of 34, 20 participants reported that the

chatbot often asked the same or similar questions within the conversation, which was a negative experience. More specifically, this made them feel not understood (P26, 19) and disturbed the natural flow of the conversation (P8, P31). It also prevented the conversation from moving forward (P20) or toward different topics (P5). As a result, participants felt bored (P24, 32), irritated (P13), or tense (P22). This discomfort resulted in quitting the conversation at times (P6, 19);

> *Sometimes, it couldn't fully grasp what I had written. As a result, it would repeat questions it had asked earlier. However, since I had already provided an answer to that question, I didn't have the energy to respond again.* (*P19*)

Based on previous studies on reflective prompts, we were aware that the range of questions would impact the willingness to engage with the chatbot [73]. However, while we expected boredom as a result, participants felt different emotions, ranging from frustration to not being understood. This validates the participants' inclination to load human-like aspects to computer systems. The lean toward humanizing the chatbot shows itself in the participants' statements, referring to the chatbot by its name, "Deniz";

> *Deniz was a bit lacking in asking "follow up" questions. I felt like the conversation was not going in a natural flow; Deniz kept asking similar questions.* (*P31*)

Chatbots should be able to understand the context and users' preferences and make them feel understood. Our chatbot is prompted to direct reflective questions to its user based on their last statement. It also retained information from the previous turns within the same conversation. However, since our system is a prototype, its questions are not always contextually accurate. This echoed in the participants' feedback. Twelve participants explained that the chatbot's questions were out of context. Two participants explained how the chatbot directed questions based on an "expected answer" when they talked about unrelated subjects;

> *When I wrote meaningless things to Deniz, he continued to ask questions that had nothing to do with what I wrote, but rather based on my expected answer. This showed that Deniz did not actually respond to my statements.* (*P3*)

Five participants explained that the chatbot changed the topic suddenly while they expected to dive deep into their conversations. These fast changes in topic made them feel unheard (P14) and disturbed the conversation flow (P12, 23, 27, 34).

> *A few times, while discussing a specific topic with Deniz, it abruptly asked a question about a completely different subject. When I had more to say about the current topic, this sudden change disrupted the conversation's coherence and distracted my attention. At this point, perhaps some improvements could be made to maintain the conversational continuity.* (*P34*)

Conversely, two participants stated that the chatbot insisted on discussing certain subjects, although they wanted to change the topic. Being out-of-context has multiple meanings, as illustrated above. A chatbot for reflection should be able to develop reflective questions based on its user's statement. Further, it should be able to understand the user's context; whether they want to keep talking on the current topic, are ready to change it, or would like to avoid it altogether. This would help users feel heard and understood and engage in reflection pleasantly. This can be achieved by occasionally asking the participant.

It should be noted that four participants reported experiencing a technical problem. In the middle of conversations, the chatbot suddenly switched to English. It sometimes did not return to its programmed language, which can be another factor contributing to the disruption of the conversations, making it harder to use the chatbot.

Users need time to think and to feel listened to. The AI system behind the chatbot generates questions within a few seconds, regardless of the length of the input text. This speed was disturbing for five participants. For P20, it was natural, restricted thinking time, and felt like an exam. P3 felt that her emotions and thoughts were not important for the chatbot. P30 explained;

> *The fact that I thought about the things I wrote and then it quickly asked me to expand more by selecting a word or two (that is, the parts where it was clearly understood that it was artificial intelligence) disconnected me from the process.* (*P30*)

As a result of the above-explained experiences with the chatbot and the lack of non-question or empathetic statements, seven participants classified their conversations with the chatbot as robotic, unnatural, or artificial. Our results reveal that participants seek certain humanness factors in their conversations when deeply reflecting on their emotions and thoughts.

Talking to a robot influences the sense of freedom and honesty. Talking to a machine provided certain benefits too. The chatbot's availability and instant responses comforted and supported five participants. Participants experienced a judgment-free environment (P14, P20), where they talked about their experiences honestly (P27) and freely (P19). P26 explained how talking to the chatbot created a personal yet supported experience;

> *I could express my thoughts without hesitation. Therefore, it felt like keeping a diary or listening to a pod-*

cast, making me feel closer to myself and less alone. (*P27*)

Overall, the chatbot is considered promising. When asked if it impacted participants' lives, 17 participants positively responded. Although minor, engaging with the agent helped them make meaning of their and their surroundings' behaviors (P2), start thinking about topics they have not before (P4, 27), add new questions to their journaling practices (P8), remember the feelings (P13) and questions (P15) they have forgotten, understand their feelings better (P24, 34), increase their awareness (P32, 30) to the point of changing actions (P14, 28), manage their stress (P16), encourage them to plan their lives (P29), face the topics they avoid (P26), or created a space and time for them (P33). Two explained that it had not yet but could in the future. Most of our participants had pleasant experiences with the chatbot while benefiting from their interactions in various ways, even if they interacted for a week.

4.3.3 Users' preferences and expectations from the future reflective chatbots

To answer RQ4 (What are users' preferences for regular interactions with chatbots for reflection?), we asked our participants about their expectations from a chatbot similar to Deniz. Below, we summarize the key findings.

Preferences on integration into everyday life. In multiple-choice questions, we asked participants about their preferred frequency, time of the day, physical space, and length of their interactions with similar chatbots. Participants were able to choose more than one answer. Most participants (19) wanted to talk with a reflection chatbot every few days, followed by every day (6). Other choices were once a week (3), several times a day (2), twice a month (1), once a month (1), rarer (1), and other (1: "when I have things to talk about"). "Evening hours" (20) and "before sleeping" (19) were the most preferred times of the day for interaction. Morning (6), afternoon (5), and noon (4) followed. Physically, participants mostly wanted to interact with reflection chatbots in their bedrooms (24), in their living rooms (14), and outside (12). Workplace was preferred four times, the kitchen three times, and school once. One participant added that they would like to use it while traveling. Lastly, the conversations are expected to last 10–15 min (21) or shorter (7), whereas four participants expected 30 min and two expected an hour.

Preferences on topics of conversation. Conversation topics cover everyday life matters and extend to some wider areas. Twenty-one participants want to talk about their daily lives, relationships, work, family, stress, and emotions. Two participants (P2, 11) highlighted the importance of talking about momentary events and feelings;

I prefer to talk when I experience more immediate emotions—when I'm angry, when I'm crying, when I'm bored... (*P2*)

Other topics of interest covered personal development (P33), gossip (P18), abstract topics around life and philosophy (P3, 19), news and politics (P9), and art, psychology, and design (P26). Two participants expressed they would like to talk about everything in their life (P6, 31), whereas P25 and P27 emphasized that they would like to discuss any topic that can be shared with a therapist. Lastly, P1 and P27 emphasized that sexuality is another topic they would like to talk about with the chatbot:

I would like to talk about anything that can be discussed with a therapist. It would be especially beneficial to discuss sexual topics because I believe it is the most challenging topic to discuss honestly with a psychologist, both for myself and for others. (*P27*)

Expectations from the conversation flow. Participants wanted to do more with the chatbot than answering its reflective questions. Since their answers were based on their experiences with Deniz, the most prominent answer was to have two-way communication with the chatbot. Nine participants explained that they would expect non-question statements from the chatbot. For instance, they would like the chatbot to react to what they say (P4), comment or tell an anecdote (P20), or guide the conversation in the right direction by highlighting the off-topic responses of its user (P4). P34 wants to see something personal from the chatbot to mediate the feeling of talking with an AI, even if it sounds silly;

(*I would want it*) *to share its own experiences (funny, yes, I know).*
I would like Deniz to be involved in the process from time to time with his own answers. This way, I could more easily get away from the feeling of talking to artificial intelligence.

Further, six participants expect similar chatbots to be able to answer their questions. The reasons were threefold; they wanted to normalize the flow of the conversation by including small talk (P3, 34), deepen the thinking process (P14), or hear about objective answers (P12).

I wish there was a response in my conversation with Deniz; I would like to know its thoughts and understand its feelings. (*It may have been a bit romantic, but I'm already an incorrigible romantic...*) (*P6*)

Participants suggested improving the chatbot's robotic attitude for similar reflective chatbots. They expect reflective chatbots to show empathy (P2, 6), display emotions (P23), validate them (P27), and support them (P16, 28). To display a warmer, more human-like attitude (P2, 14), P1 suggested

using GIFs and emojis. A time gap between the conversation turns is also suggested to make the conversation more realistic and help users think (P6,16, 21). Lastly, P25 highlighted the importance of memory;

> *Asking about past topics again. I may expect the chatbot to follow the event flow and wait for me to explain further.* (*P25*)

Expectations from chatbot's tasks. Our chatbot design is based on asking questions as a reflection methodology. After experiencing answering reflective questions, participants reported other tasks they would expect a reflective chatbot to fulfill. The most prominent one is to give suggestions and advice ($N = 14$). Six participants said they would expect the chatbot to suggest related readings, movies, and videos. P26 expected quotations whereas P17 also mentioned meditation recommendations.

> *I would also like to hear suggestions. Not direct guidance, of course, but suggestions like "you can do these things, you can think about these things".* (*P10*)

Five participants reported they would expect chatbots to provide analysis based on their observations. Moreover, P19 expected reflective chatbots to illustrate topics with examples, and P29 expected them to give ideas focusing on the solutions. Lastly, P3 and P13 expected motivational content. The expectations from the chatbot extend the aims and tools of reflective conversations. Nonetheless, our aim is not to create a therapeutic relationship. Therefore, suggestions, especially those focusing on individual action, are beyond our research agenda. Users naturally lean toward getting directions from such systems as they stated, reflecting by themselves may be hard and sometimes impossible. It may not be enough in other cases, such as mental disorders. Such systems must remind users that professional help should be sought separately. Reflective CAs should only be situated as mediators of users' conversations with themselves for reflection.

5 Discussion

We explored user experiences, expectations, and preferences regarding reflective chatbots using a chatbot prototype based on a formative study. Our research revealed that users appreciated engaging with chatbots that fostered reflective dialogues through questions. Participants reported that these questions encouraged deeper contemplation of their emotions and personal experiences. Some considered the chatbot a source of previously unasked questions, leading to heightened self-awareness, which they found valuable. These reflective conversations allowed users to explore their daily routines, emotions, work life, and even delve into therapy-related topics. Participants particularly valued the chatbot's emotionally focused questions, which helped them connect with their feelings. Here in this section, we discuss the findings in relation to implications for conversation design and further research.

5.1 Implications for conversation design

Building on our research, we conclude that the design of CAs facilitating reflective conversations through questions should have a balanced use of questions, contextual understanding, and human-like qualities.

5.1.1 Balanced use of questions: striking a balance between asking reflective questions and providing non-question statements can make conversations more engaging

Our chatbot is programmed in a way that it only asks questions throughout the interaction. Our findings show that continuous question-answering was overwhelming for the participants. Therefore, the participants highlighted the need for non-question statements or basic questions during the dialogue. Designers can integrate non-question statements such as "I understand" (P21), "What you said is very valuable" (P27), or "You've had a rough night" (P2) which derive from clients' therapy experiences and overlap with our formative study findings. We were not able to implement this strategy in our prototype due to technical limitations. The suggested statements are related to the strategies of active listening and validation. We also identified "providing hope" with the experts as a non-question statement methodology for reflective conversations. Designers can apply these strategies through non-question statements within their reflective conversation designs. The balanced use of questions with active listening, validation, and giving hope will also contribute to the nature of the conversation, which is another critical factor in user engagement, as highlighted by our participants and the literature [60].

Participants were not bothered by individual questions but by their rapid succession, each demanding deep thought. Designers can build conversational structures where the depth of questions increases over time, allowing the users to gradually get immersed in reflective thinking. The conversations can start with chit-chat, highlighted by one of our participants as a missing component. The gradual development of reflective prompts is beneficial in previous work on teachers' professional development [74].

5.1.2 Human-like qualities: to foster a more natural experience, chatbots should incorporate emotional expressions and response delay

We announced our study via a social media post, "Would you like to spend a week with a chatbot curious about your

day?" Our framing encouraged participants to perceive the chatbot as a distinct entity. This was evident in survey responses where participants referred to the chatbot by its name, "Deniz." Even those who sought support via WhatsApp from the first author consistently addressed the chatbot by its name. This perception of the chatbot as an entity was so strong that one participant mistakenly referred to the first author by the chatbot's name. However, despite considering the chatbot as an entity, participants lacked emotional and personal expressions in their conversations.

Emotional and personal expressions serve two crucial purposes. Firstly, they balance questions with empathetic statements and personal comments, enhancing the conversation's naturalness. Secondly, empathetic and validating chatbot responses make users feel seen, heard, and understood, encouraging openness. Empathy in chatbots is a well-explored topic in HCI literature, spanning customer service [75] to mental health contexts [76–79]. Our findings highlight the significance of empathetic attitudes in supporting reflective conversations about everyday life experiences.

Although users know they are interacting with a chatbot, they still expect certain human-like elements in their conversations [80, 81]. One notable human-like aspect we observed is the importance of response delay. Our results indicate that the chatbot's response speed can significantly impact participants in reflective conversations. To enhance the conversation's natural flow and make users feel understood, designers often implement natural response delays, as demonstrated by Gnewuch et al. [82]. However, even with delayed responses, participants may still feel rushed in their thinking process. Chatbot designs can address this by incorporating back-channeling, creating interaction gaps that aid users' thinking process, and aligning with the "active listening" and "silence" interaction strategies proposed in our study and by field experts. This approach is consistent with findings in well-being support chatbots [63]. Recent work by Cho et al. demonstrated that incorporating back-channeling in Amazon Alexa [83] improved users' perceptions of active listening, emotional disclosure, and emotional support.

5.1.3 Contextual understanding: designers should prioritize context awareness and adaptation to create seamless interactions

Open domain chatbots adapt to user responses rather than following a fixed conversational aim, necessitating awareness of conversation content and context. Our chatbot generates questions based on users' last statements, yet it lacks the necessary contextual understanding for a seamless conversation flow, falling short of user expectations. Our findings emphasize the critical role of contextual understanding in enhancing reflective chatbots across various domains.

Our participants were not always available for reflection. This was either because they felt like they had an insignificant day where they did not experience anything to talk about or they did not feel like reflecting. In such cases, the reflective chatbots should be able to adapt the conversation according to the users' requirements. Another critical point was that the sudden topic changes disturbed the conversation's natural flow when the participants were in a reflective mood. They were willing to keep discussing the same topic when the chatbot changed the focus of the conversation. The opposite was also present. Sometimes, the participants were unwilling to continue discussing a topic, and the chatbot kept asking questions about it, ignoring their wishes to change the topic. Reflective chatbots must be aware of users' changing preferences during the conversation, which can be obtained by asking the user occasionally.

Responsive, generative, adaptive conversations were previously sought in well-being support chatbots [36, 55]. Overall, our system generated reflective questions based on users' inputs. However, the chatbot sometimes asked irrelevant questions. Questions that are not connected to the users' contexts are considered meaningless. The last and most disturbing experience of the reflective conversations was question repetition. After a while, our chatbot started repeating the questions within the same conversation, avoiding our prompt. This created frustration in users on various levels. Participants felt unheard, not understood, tense, bored, and tired, which eventually led to participants quitting the conversation. Designers should ensure question relevancy and avoid question repetition. This can be achieved by following a hybrid approach that combines open-domain and rule-based systems (e.g., [84]). Huang et al. define semantics as one of the three challenges of natural language processing [85]. Semantic understanding requires the chatbot to understand the content of the conversation and a comprehensive understanding of the user. Our work provides a practical example of the importance of semantics in reflective conversations with CAs, which might even be more disturbing in a reflective conversation within everyday life context. On the other hand, it should be noted that ensuring context awareness of a conversational agent for general everyday use can be more challenging than implementing such qualities in a domain-specific agent. Therefore, designers can also seek a balance between choosing certain reflection domains and ensuring contextual understanding.

5.2 Implications for further research

In this part, we discuss the research directions that require further investigation within the HCI literature.

5.2.1 Generating contextual and appropriate reflective questions

In our study, we utilized a language model (LLM) with prompts to generate two types of questions: defining and Socratic. Field experts deemed these question types suitable for reflection, and therapy patients found them beneficial. However, our prototype fell short in creating a sufficiently broad and contextually relevant question inventory. Some participants, despite enjoying and benefiting from the questions about their everyday life experiences, ultimately left the system due to the repetition of questions or prompts. This irregular and unpredictable repetition, while different from previous experiences [57], posed an issue. Previous research in reflective CAs explored shorter interactions. Given our vision of chatbots engaging participants for around 10–15 min daily, the need for a diverse question inventory warrants investigation in HCI literature. Our focus on repetitions within the same conversation highlights the significance of addressing this issue. Collaboration between HCI researchers and therapy field experts, who already employ predefined question structures [86, 87], can yield algorithms that generate question inventories with the desired range and variation.

Context awareness in long-term interactions with chatbots is a topic deserving further investigation. Beyond discussions about the varying levels of contextual awareness required when directing questions and statements, the technical aspects of written conversations also influence users' perception of system awareness. Reflective questions often elicit lengthy responses, which users may need to split into multiple text messages. Our system's practice of delivering another question after each text message frustrated participants while composing their answers. Researchers should explore strategies for delivering responses at the appropriate times, especially in the context of everyday life reflection. For example, Liu et al. demonstrated the dynamic scheduling of chatbot messages in customer care [88].

In addition to understanding the content of conversations, chatbots must also grasp the user's context, which may include mental health concerns. For instance, P2 pointed out that solely answering reflective questions might hinder her from achieving outcomes requiring professional assistance. In such cases, users may need therapeutic support. Everyday reflection chatbots can observe users' mental health, guiding them toward professional help when necessary. Similar to using symptom checkers for physical health in healthcare [89], therapists often employ scales and tests to assess mental health. Therefore, integrating these tools and overall monitoring by everyday reflective chatbots are critical research areas warranting further investigation in HCI.

5.2.2 Balancing the need to be guided with responsible reflection

Our research revealed that users seek guidance when engaging with chatbots for reflection, a finding consistent with our earlier work on therapeutic conversations. However, experts we interviewed raised ethical concerns about offering guidance through chatbots. They emphasized that guidance is a significant aspect of therapy and should be provided thoughtfully within an established therapeutic relationship over time. Our work exclusively focuses on creating chatbots for reflection and not for delivering therapy. Participants suggested that guidance could be at the level of book or movie recommendations relevant to their experiences. Therefore, HCI literature should explore the extent of guidance to be integrated into reflective conversations, involving field experts, to achieve optimal user satisfaction and engagement while addressing ethical considerations. Collaboration with field experts in the development process is crucial for designing conversational systems that promote responsible reflection.

5.2.3 Toward multi-faceted human-likeliness

Throughout our research, we identified factors associated with human-likeness in chatbot interactions. While our work aligns with existing literature on computer systems being perceived as social actors [80], we also identified key factors sought in reflective chatbot conversations: empathy, response delay, validation, high contextual awareness, and personal statements. However, these factors were lacking due to technical limitations in our prototype, impacting the overall user experience. Future research should prioritize designing reflective chatbots and CAs incorporating these different design factors. This can help measure their effects on reflection, user engagement, and satisfaction while seeking an optimal balance for their incorporation. It is worth exploring whether chatbots should exhibit all these qualities equally or adapt the balance based on context and user preferences. Also, studying these features' long-term impact is essential, as our findings are based on a one-week experience.

6 Limitations

We acknowledge that our work has limitations from multiple perspectives. We acknowledge our approach to deriving reflection strategies from users' experiences. There is a potential to overlook existing approaches from psychologists. However, we tried to mitigate this risk by consulting the field experts. The evaluation of our formative study can potentially carry the authors' intrinsic biases. Secondly, our

prototype was technically limited, making it harder to draw definitive conclusions from our study. Thirdly, the method for evaluating the second study also has the potential to carry biases in the analysis process. We would like to emphasize that our approach and contributions mark a preliminary exploration, and we invite future researchers to expand the research on conversational agents for reflection.

7 Conclusion

Reflecting on our everyday experiences is essential for self-insight, but we need encouragement. We conducted a formative study with 110 therapy clients and 5 psychologists, where we reached interaction strategies for chatbots to be used for daily reflection based on therapy experience. We then built a chatbot prototype that asks generative questions for reflection and conducted a 1-week in-the-wild study with 34 participants. We learned that interacting with a chatbot for reflection on everyday life enabled participants to reflect while they emphasized the importance of variety, non-question statements, contextual understanding, human-like qualities, and adaptability to individual preferences. Participants expect to interact with such chatbots for around 15 min every few days, mostly at their homes. They also value two-way communication and advice coming from the chatbots. We identify future directions for designers and researchers.

Our aim when developing the chatbot prototype was not to arrive at a final system design to be evaluated but to use it to help participants imagine potential futures with intelligent chatbots for reflection that can help them reflect on their daily lives. We faced limitations in both the implementation of the chatbot, where we could not include all the interaction strategies we identified, and the execution, where we had technical difficulties like switching to English or being unable to finish the conversation. We believe that our prototype and in-the-wild study brought valuable insights to inform the design and research on everyday life reflection through conversations and interactions with chatbots in open-ended conversations for well-being. We invite HCI researchers to extend our work with more comprehensive prototypes or finished system designs. We also note that we were not able to reach a balanced gender distribution in our user study, where most of our participants are female. Further research can also investigate more extended periods of interaction between users and CAs.

Author contributions All authors contributed to the study's conception and design. Pelin Karaturhan performed material preparation and data collection. Pelin Karaturhan and İlayda Orhan performed data analysis. Pelin Karaturhan wrote the first draft of the manuscript, and all authors commented on previous versions. All authors read and approved the final manuscript.

Data availability The data supporting this study's findings are available on Koç University Servers and have restricted access. The data will be available upon request.

Declarations

Conflict of interest The authors declare no conflict of interest.

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4.5 Mapping the Design Space through a Systematic Literature Review

4.5.1 Preface

Throughout my thesis, I brought together insights from a variety of studies, including exploratory studies and field studies with prototypes. However, when it came to presenting them in a structured manner for my thesis, I realized that the literature lacks a defined design space for CAs for wellbeing in which I can situate my contributions. Therefore, together with my co-authors, we conducted a systematic literature review to understand (i) the design goals, (ii) user groups, (iii) the tools and techniques that are borrowed from other fields, (iii) the interaction design considerations that are in play in the design process, (iv) (quantitative) evaluation methods, (v) and research processes for CAs for wellbeing.

In our overall analysis, we found that the main objectives of CAs include mental health support, behavior change, and assistance for social, vocational, and special needs across diverse user groups, which supports the broad applicability of CAs for wellbeing. However, current studies largely assess CA effectiveness using qualitative methods and general wellbeing metrics based on self-reports, lacking specific evaluation frameworks tailored to CAs. We also identified four primary research processes, namely the theory first approach, comparing design qualities of existing CAs, exploring desired qualities, and exploring the consequences of CA use for wellbeing. HCI literature has primarily followed these four processes to study CAs for wellbeing. Challenges for future research include technopositivism, an overemphasis on mental health, a lack of CA-specific metrics, and the need to investigate user-driven CA development. Our review contributed to this thesis by outlining the design space of CAs for wellbeing, which is closely connected to reflection and validating my design and research implications with empirical evidence from literature.

4.5.2 Paper 5: Conversational Agents for Wellbeing: A Systematic Literature Review *(in submission)*

Pelin Karaturhan, Meagan B. Loerakker, Göksu Akşam, Evropi Stefanidi, Paweł W. Woźniak and Asım Evren Yantaç. Conversational Agents for Wellbeing: A Systematic Literature Review.

Conversational Agents for Wellbeing: A Systematic Literature Review

ANONYMOUS AUTHOR(S)

Conversational agents (CAs) are increasingly being utilized for wellbeing applications. However, there is no comprehensive understanding of what has been studied, how it has been studied, and the impact of CAs on users within Human-Computer Interaction (HCI) literature. To design systems that effectively support wellbeing, it is crucial to understand the opportunities and risks associated with using CAs for wellbeing-related applications. To address this gap, we conducted a structured literature review of $n = 62$ papers. Our findings reveal that research on CAs for wellbeing has been growing significantly each year, reaching a mature stage, with four distinct research processes emerging. Our review also highlights key goals, user groups, techniques, design considerations, and evaluation methods commonly employed in the development of CAs. We identified a considerable lack of research on the potential negative effects of CAs. We provide resources for future designers of CAs for wellbeing and challenges for future research.

CCS Concepts: • **Human-centered computing** → *Empirical studies in HCI*; *Natural language interfaces*; *Interaction design theory, concepts and paradigms.*

Additional Key Words and Phrases: Conversational agents, wellbeing, chatbots, systematic literature review

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1 INTRODUCTION

Fostering user wellbeing is recognised as a key design goal in Human-Computer Interaction (HCI). This interest is also reflected in the proliferation of consumer technologies claiming to benefit the wellbeing of users. Virtually all interaction technologies, e.g. sensing systems [108], wearable devices [21], machine learning [10], or virtual reality [78] were employed for designing systems for wellbeing. Yet, recent research work and commercial systems, increasingly employ Conversational Agents (CAs) as the tool of choice for wellbeing interventions. Despite this, to date, there is no consensus on how to design and evaluate such systems. Our work answers this challenge by adopting a structured approach to the design processes and goals involved in designing CAs for wellbeing.

Research from the HCI community contributed a significant number of publications on the use of CAs for wellbeing, ranging from supporting healthy behaviors [20] through existential conversations [7] to enhancing social support mechanisms [62]. Furthermore, past work applied different methods and approaches to designing wellbeing technology with CAs, e.g. participatory design [73], design fiction [26], and co-design [85]. We posit that HCI research on CAs for wellbeing reached a level of maturity which requires a systematic mapping. A deeper understanding of the design space of CAs for wellbeing has potential to identify existing research practices and outline challenges for future research.

Previous literature reviews of research on CAs were technical [77], or explored specific aspects of CAs, such as embodiment [79] or specific interaction patterns, such as polyadic interaction [109]. Despite the increasing interest in wellbeing-specific CAs, such systems were not subject to a systematic review. We address this gap by systematically

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identifying the key design goals, strategies and research processes that characterise research on CAs for wellbeing to date. This paper contributes to the HCI literature with (1) a systematic review of HCI research on CAs for wellbeing; (2) a detailed description of the goals, user groups, techniques, design considerations, and evaluation methods in research on CAs for wellbeing; (3) four research processes that describe how current research on the topic is conducted; and (4) challenges for future research on CAs for wellbeing.

In the remainder of this paper, we first discuss the motivation for our review. We then provide the details of the systematic review method applied. Next, we discuss our analysis of the final literature corpus. Based on our findings, we then characterise four research processes which describe past work on CAs for wellbeing. We conclude with challenges for future designers and researchers who want to deploy CAs in a wellbeing context.

2 BACKGROUND

Our work is motivated by the increasing interest in CAs in the HCI field. In particular, we investigate how past research in CAs addressed user wellbeing. We begin with a general perspective on CAs and later zoom in on ones that are specifically designed to foster wellbeing.

CAs can be defined as computer programs designed to mimic dyadic human interaction using text or speech [61]. They can also use non-linguistic features, like body language [71] or gaze [70]. Recent advances in artificial intelligence and, in particular, large language models have led to CAs receiving more interest from the HCI audience. Consequently, HCI research explored applying CAs across different domains [5, 6] including education [27, 105], healthcare [48], or governmental solutions [86]. While research on CAs has developed to a point where it even has its dedicated conference [55], less attention was directed towards whether and how widespread use of CAs may affect user wellbeing. Consequently, the aim of this paper is to focus on the wellbeing aspects of CAs.

2.1 Conversational Agents for Wellbeing

We posit that CAs for wellbeing warrant more focused examination due to their significant potential. CAs have been used not only to support patient groups [75] but also to promote and maintain the wellbeing of healthy individuals by helping them manage their daily lives through interactions with these agents [14]. Additionally, they have been shown to address certain systematic challenges related to time, cost, and efficiency [63]. To tackle health and daily-life issues from various perspectives, digital interventions have been developed to promote healthy lifestyles through behavior change [11], care for diverse populations, including marginalized groups [92], prevent ill-health conditions [72], and manage symptoms of physical and mental problems across different age groups [17, 31, 103]. This growing interest in CAs for wellbeing underscores the need for a comprehensive literature review to better understand their capabilities, challenges, and future potential in this domain.

2.2 Wellbeing in Context

Despite the lack of a universally accepted definition [1], the concept of wellbeing has attracted interest across various disciplines [93]. With increasing discussions about human flourishing in the digital age and the closer interaction between humans and technology, wellbeing and the related notion of wealth [24] have become a significant topic of study in the HCI field [15]. However, many studies have used the terms 'wellbeing' and 'health' interchangeably, potentially reinforcing a narrow view of wellbeing as merely the absence of health problems. In contrast, psychological literature defines wellbeing through diverse components, such as subjective, relational, organizational, and communal aspects [74], broadening its interpretation and application.

Our literature review assumes that focusing on wellbeing beyond just health is essential. This approach provides a more holistic framework and supports broader, ecological conceptualizations of health [68]. For instance, in a government-funded "digital mental health" project for Indigenous Australians, community feedback led to the reframing of the project as "digital social and emotional wellbeing," highlighting the broader understanding of wellbeing that includes mental health, spirituality, social bonds, and sociopolitical factors [12].

While reviews on the various aspects of wellbeing exist (e.g., [48, 76, 95]), we found that there is no comprehensive review in the HCI field that explicitly examines designing for wellbeing in the context of CAs. Our review addresses this gap by investigating how CAs can support various aspects of wellbeing, serving as an overarching concept that ties interrelated topics and provides coherent practical and theoretical insights for future research.

2.3 Research Questions

To guide our exploration of CAs for wellbeing and address the identified gaps in the literature, we use the following research questions, which guide our systematic review:

RQ1: What are the primary goals, target user groups, techniques, and design considerations employed in the design of conversational agents (CAs) for wellbeing? This question aims to explore the diverse objectives and audiences that CAs for wellbeing target, linking to the broad interpretation of wellbeing in the literature [74] and how these goals are realised through various technological and design approaches.

RQ2: How do HCI studies evaluate the effectiveness of CAs in promoting wellbeing? This question seeks to uncover the evaluation methods used in HCI research on CAs, connecting to the need for holistic frameworks that encompass multiple dimensions of wellbeing, as suggested by prior research [15, 68].

RQ3: What are the common research processes followed in the development and studying of CAs for wellbeing within the HCI field? This question focuses on identifying and analysing the research methodologies and processes currently used in the field, contributing to a clearer understanding of how the research is conducted and how it aligns with broader conceptualisations of wellbeing.

RQ4: What challenges and gaps exist in the current research on CAs for wellbeing, and what are the implications for future work? This question aims to identify the limitations and challenges faced by current studies, highlighting areas where future research can expand and refine the role of CAs in supporting wellbeing.

3 METHOD

For this literature review, we employed a PRISMA process, as recommended by Stefanidi et al. [90], in order to obtain our final corpus through systematic steps. The advantage of using a PRISMA process is the added transparency in the accumulation of the final corpus for the analysis [64]. We visualise the PRISMA process, including all its individual steps, in Figure 1. Though wellbeing has many definitions depending on the use case and research field, there is no consensus in HCI on what specific definition to use when designing technologies. Thus, we first present the definitions for the terms we used in this literature review.

3.1 Definitions

In this section, we present the definitions which we used to conduct our review. These definitions set the scope of our review.

3.1.1 Conversational Agents. We defined a conversational agent (cf. criterion (2) below) as a technology which a user can use through continuous dialogues. In other words, if the user is only able to get a single answer from the technology by providing a question—with the technology answering—we did not consider this a full-fledged conversation, since including these kind of conversations would involve messaging systems in the corpus. Hence, these kinds of technologies were not considered as a conversational agent. We also included studies with systems that are defined as 'robots', if they provide details about the conversation design within the papers. We did not filter based on the modality used and thus the review includes CAs which are text-based and voice-based.

3.1.2 Wellbeing. In criterion (3) below, we ensure that our review focuses on technologies for wellbeing. For the purposes of our review we operationalised wellbeing-related research as follows.

(1) Research with a study design to *evaluate* or *influence* individual/personal wellbeing
OR
(2) Research that *connects* their findings to individual/personal wellbeing after a study

Within the scope of this literature review, a focus on personal wellbeing means that the system is designed to or aimed to be designed to enhance its users' quality of life and can address psychological, social, and/or physical issues. In HCI, wellbeing is explored through impact (issue) areas where technologies aim to improve a particular area of life. Some examples include: improving sleep (e.g. [2]), healthy eating (e.g. [65]), mental health disorders such as depression and anxiety (e.g. [84]), emotional expression (e.g. [18]), stress management (e.g. [26]), reducing procrastination (e.g. [35]), and behavior change in general (e.g. [57]). Consequently, any intended or declared benefits to these areas were considered as addressing wellbeing.

3.1.3 Research Contributions. In this review, we adopted the definitions for empirical and artifact contributions from Wobbrock and Kientz [102]; "Empirical research contributions are the backbone of science" [102, p. 40], as they provide the world with new knowledge through findings that were observed by gathering data through, i.e., experiments or field work. Although we may typically think of quantitative data to either explore or confirm knowledge, qualitative data gathering is also considered empirical.

Besides empirical, artifact contributions are also one of the main driving forces in HCI, as "HCI is driven by the creation and realization of interactive artifacts" [102, p. 40]. Whereas empirical can usually be referred to as scientific knowledge, artifacts are more practical inventions, typically with the goal to solve real-life problems. Although the contributions are inherently different, they often accompany each other, as artifact's designs tend to be inspired by findings made from empirical evidence [30]. Consequently, these systems are evaluated based on their functionalities and how these functionalities are incorporated [66].

Other types of research contributions we did not consider for this review, including methodological, theoretical, dataset, survey and opinion contributions. However, this review focuses on CAs and thus the presence of a CA, either existing prior to the research or built by the researchers, in the paper was a necessary criterion (4).

3.2 Identification

To obtain the first batch of articles, i.e. the **identification** stage, we used the following query: *[[All: "conversational agent"] OR [All: "chatbot"] OR [All: "virtual assistant"] OR [All: "conversational interface"] OR [All: "conversational ai"] OR [All: "conversational bot"] OR [All: "conversational intelligence"]] AND [[All: "wellbeing"] OR [All: "wellbeing"]]* on the

ACM Digital Library (DL) (ACM Guide to Computing Literature). The ACM Guide to Computing Literature contains a comprehensive account of HCI work as noted by past work [90].

We designed this query with careful consideration of terminology used in both HCI literature and common language variations. First, based on our review of HCI research, conversational agents are often referred to using various terms such as "chatbot," "virtual assistant," "conversational interface," "conversational AI," "conversational bot," and "conversational intelligence." To ensure comprehensive coverage of the literature, we included these synonyms in our query. Additionally, we accounted for the fact that "wellbeing" can be spelled either with or without a hyphen, ensuring that our query captures all relevant mentions of this concept regardless of the spelling variation. This approach maximizes the retrieval of relevant information and reduces the risk of missing key papers.

We decided not to include non-archival submissions in our query, as we aimed to focus on empirically grounded work. Non-archival submissions, such as workshop papers, posters, and demos, often lack the rigor and comprehensive reporting typically found in archival publications, making them less suitable for the kind of in-depth analysis we sought. This decision is consistent with most HCI reviews, cf. [90], which prioritize archival research due to its peer-reviewed, validated nature. As a result, our query yielded a total of $n = 1,575$ articles, and by excluding 745 non-archival submissions, we narrowed the dataset to 830 records for the next stage of analysis. This approach ensures that the included studies are of high quality and provide robust empirical evidence.

3.3 Screening

In the screening phase, the first, second and third author screened the $n = 830$ records' abstracts with the goal to exclude irrelevant ones based on the following initial criteria:

(1) Is the abstract available?
(2) Does this work inform the design of Conversational Agents? In other words, Is this work grounded or aimed at informing the design of CA or CA literature?
(3) Does this work aim to improve personal wellbeing?
(4) Does this work make an empirical or artifact contribution to the literature?

We refined our definitions for wellbeing and conversational agents from the iterative discussions. See section 3.1 above for the definitions of items 2, 3 and 4 from the list above.

The respective authors completed the screening process through iterative discussions, during which they clarified and refined the criteria, particularly criteria 2 and 3. The authors were given the option to label each criterion as *yes*, *maybe*, or *no*. In these discussions, the *maybe* labels were addressed to further refine the criteria. If any criterion was labeled as *no*, the article was excluded. If no criteria were labeled *no*, but at least one criterion was labeled *maybe*, the article was assigned a final label of *let's discuss*, rather than being categorized as *included* or *excluded*.

If the record missed one of the four criteria, it was excluded from the next step in the PRISMA process, the **eligibility** stage. Using the four criteria, we excluded 651 records, and were left with 179 records for eligibility phase. Of these 179 articles, 81 were labelled as *let's discuss*. Of these $n = 81$ articles, 38 abstracts were unclear about whether they addressed wellbeing, 17 were unclear about whether a CA was used, and 9 were unclear about the contribution statement. 17 papers were potentially relevant, but unclear in several criteria based on the abstract. These 81 articles are carried to the eligibility check step to be thoroughly assessed.

In addition to screening based on the criteria, we started labeling the articles according to the specific *wellbeing domain* they addressed (e.g., productivity, mental health, physical activity), as well as the type of contribution, the user

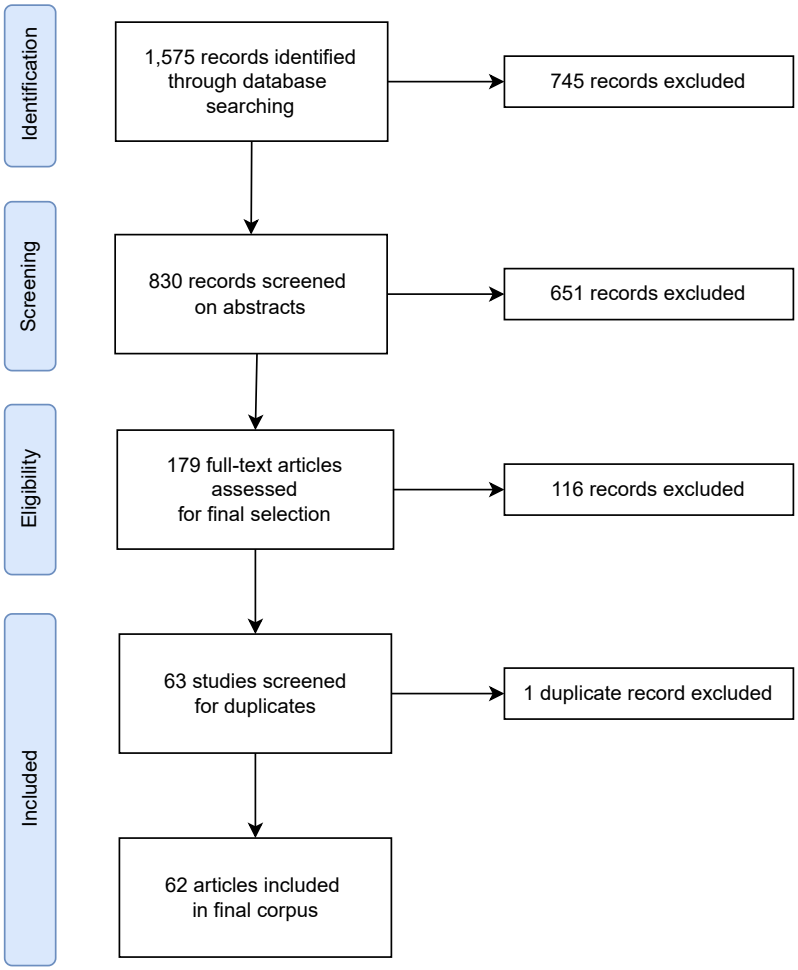

Fig. 1. Overview of the PRISMA flow diagram of the literature review, with the goal to identify research gaps in relation to interaction design goals for conversational created for the goal to improve a person's individual wellbeing.

group, the study methodologies employed, and the results obtained. These labels are fine-tuned and finalized during the coding phase.

3.4 Eligibility Check

During the eligibility phase, the first, second, and third authors assessed a total of $n = 179$ records. In this stage, the full texts of the articles were screened using the same criteria as in the previous phase, with ongoing refinement of the definitions for both conversational agents and wellbeing. This eligibility check resulted in the exclusion of $n = 116$

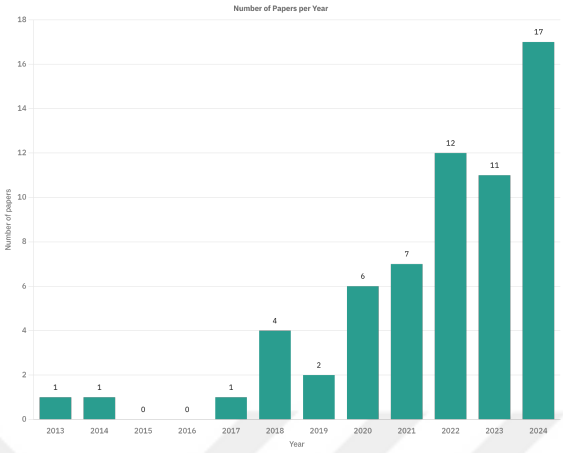

Fig. 2. Overview of our corpus based on publication year.

records, leaving $n = 63$ articles for consideration in the final corpus. As a final step, we screened for duplicates and identified one, leading to a final corpus of $n = 62$ records, which were then coded and qualitatively synthesized to identify patterns in the data.

3.5 Coding

The final corpus composed of $n = 62$ records. Next, we analysed the content in detail. Authors 1, 2 and 3 each coded one third of the corpus for the following categories: the goals, user groups, techniques, design considerations. Authors 3 and 4 coded the corpus for the evaluation methods. For research processes, coding is done by authors 1 and 2. When coding the corpus, we followed both inductive and deductive coding approaches. More specifically, the goals, user groups and techniques are coded categorically and accumulated into similar themes using affinity diagramming. On the other hand, for design considerations, evaluation methods and research processes, we followed a inductive approach, with each author coding the relevant parts in the paper and the themes evolving through several iterations and group discussions. The coding, discussions and diagramming is done using Google Sheets and Miro software along with online meetings.

4 FINDINGS

In this section, we present a detailed description of the corpus, focusing on the goals, user groups, techniques, design considerations, evaluation methods, design processes for relevant research studies, research gaps in the context of CAs for well-being.

4.1 Corpus Overview

Our final corpus, comprising of 62 papers, consisted of papers published between 2013 and 2024. From between 2013 and 2017, only $n = 3$ papers were included in the corpus (from 2013 [57], 2014 [94], and 2017 [85]). From 2018 onwards, a growing interest can be observed, with a peak of 17 papers in 2024. Figure 2 describes publications per year in detail. Almost half of our corpus ($n = 24$) is published in the CHI conference, while $n = 17$ papers are published in journals. Figure 3 describes the conference venues and journals in detail.

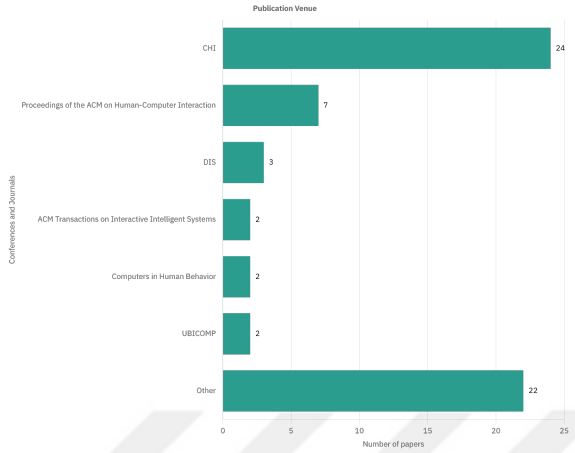

Fig. 3. Overview of our corpus based on publication venue.

4.2 RQ1: The design space of conversational agents (CAs) for wellbeing

Here, we answer RQ1 by mapping the goals, target user groups, techniques, and design considerations used in the corpus.

4.2.1 Goals. In total, we identified six main goals as to *why* the CA system was developed and what goal the researchers had for the CAs: (1) *supporting (mental) health problems*, (2) *behavior change & goal achievement*, (3) *social & vocational wellbeing*, (4) *everyday wellbeing & stress management*, (5) *assisting coordination of special needs*, and (6) *accompanying individuals with special needs* Table 1 shows an overview of the findings.

The literature corpus reveals a strong emphasis on using CAs to address mental health and wellbeing, with nearly half of the studies focusing on supporting mental health, stress management, and everyday wellbeing. This reflects the growing interest in leveraging CAs for health-related interventions. A substantial portion of the literature also examines the role of CAs in promoting behavior change and goal achievement, highlighting their potential to drive positive outcomes. Additionally, a significant focus on social, vocational, and special needs support indicates the versatility of CAs in catering to diverse user groups and wellbeing domains. This corpus suggests that CAs are increasingly being viewed as valuable tools in the wellbeing context.

4.2.2 User Groups. Regarding *who* the CAs were designed for, the data showed that there were eight main target audiences, namely: (1) *LGTBQ+*, (2) *not specified (everyone)*, (3) *people with (mental) health problems (clinical and non-clinical)*, (4) *college students & young adults*, (5) *older adults & individuals cognitive impairments*, (6) *children & their caregivers*, (7) individuals with *autism*, and (8) people with a *traumatic brain injury*. Table 2 summarises what papers focused on particular target groups.

The literature corpus demonstrates a diverse range of target user groups, with a significant number of studies not specifying a particular group. This suggests that the research community often views CAs as generally beneficial for broad populations. While this outlook is promising, it also reflects a technopositivist perspective, which may overlook the nuances and specific needs of different user groups. However, the corpus also highlights a growing focus on diverse user groups, particularly individuals with mental health challenges, both clinical and non-clinical, as well as younger

Table 1. Overview of the articles in the corpus and their corresponding motivation for evaluating a CA.

Goals	**Papers**	**Percentage**
Supporting (mental) health problems	[2, 22, 38, 40, 44, 50, 54, 58–60, 84, 88, 89, 98]	23.81%
Behavior change & goal achievement	[3, 9, 13, 20, 25, 34, 35, 47, 53, 57, 65, 91, 104]	20.64%
Social & vocational wellbeing	[37, 45, 46, 73, 80, 97, 101]	11.11%
Everyday wellbeing & stress management	[7, 16, 19, 26, 39, 49, 51, 52, 56, 62, 67, 69, 82, 107]	22.22%
Assisting coordination of special needs	[23, 29, 41, 83, 87, 94, 110]	11.11%
Accompanying individuals with special needs	[8, 36, 42, 43, 81, 85, 106]	11.11%

Table 2. Overview of the articles in the corpus and their identified target user groups.

Target groups	**Papers**	**Percentage**
Not specified (everyone)	[7, 9, 22, 25, 26, 34, 38, 40–42, 46, 47, 51–54, 57, 60, 62, 69, 82, 89, 91, 94, 98, 101, 104, 107]	45.16%
College students & young adults	[3, 13, 16, 35, 39, 45, 50, 65, 80]	14.52%
Older adults & individuals with cognitive impairments	[8, 20, 43, 81, 83–85, 106, 110]	14.52%
Individuals with (mental) health problems	[44, 49, 56, 59, 67, 88, 97]	11.29%
People with Autism	[19, 23, 29, 37]	6.45%
Children & caregivers	[2, 29, 87]	4.84%
Traumatic brain injury	[36]	1.61%
LGBTQ+	[58]	1.61%

and older adults and those with cognitive impairments. This indicates increasing attention toward using CAs to support diverse populations with specific needs. College students and young adults are prominently represented, underscoring the relevance of CAs in helping younger demographics manage wellbeing and personal challenges. Although specialized groups—such as individuals with autism, caregivers, and LGBTQ+ communities—are less frequently targeted, these studies highlight the potential for CAs to meet the unique needs of these populations.

4.2.3 Tools and Techniques Used to Support Wellbeing. We categorized the tools and techniques used in the corpus based on how they promote wellbeing across different use cases, such as motivational interviewing, reflective prompts, or other strategies. Since some papers in our corpus were exploratory in nature, not all of them mentioned tools and techniques. Among those did, our analysis identified several key categories: *reflective prompts*, *motivational interviewing*, *positive psychology interventions*, *storifying & storytelling*, *social & supportive conversations*, *cognitive restructuring*, *music & reminiscence*, *smaller cues*, and *other techniques*. Table 3 summarizes the tools and techniques identified. We also recognized that certain papers in the corpus emphasized the theoretical grounding of the tools and techniques they used, while others did not. This was especially true for reflective prompts, as motivational interviewing and positive psychology, as well as cognitive restructuring and and persuasion techniques are generally directly coming from one theoretical approach. Reflective prompts refers to providing users with sentences and questions to trigger thinking processes, and they can be combined with journaling activity (in our corpus; [44, 46, 50–52] referred to journaling). For reflective prompts, which is the most used techniques in our corpus, we observed that prompt development is

Table 3. Overview of the articles in the corpus and the techniques they employed.

Tools & techniques	Papers
Reflective prompts	[7, 44–47, 50–53, 59, 60, 67, 83]
Positive psychology	[9, 38, 39, 56]
Motivational interviewing	[20, 54, 57, 65]
Social & supportive conversations	[8, 62, 69, 81, 82]
Providing recommendations	[4, 34, 37, 98]
Music & reminiscence	[16, 42, 85, 106]
Coaching	[25, 87]
Cognitive restructuring	[88, 97]
Storifying & storytelling	[2, 91]
Smaller cues	[22, 35, 94]
Other	[13, 49, 84, 101, 104]

not always clearly explained. A good example of a well-explained prompt structure, that is also linked to theoretical literature, is from [46], where they linked the use of reflective prompts to theoretical approaches such as reflection in learning, reflection cycle, and 5Rs framework, while also scanning examples from 'educational settings, behavioral questions from job interviews and career development sources'.

Positive psychology interventions and motivational interviewing are two other common techniques. Motivational interviewing (MI) is a counselling method to support motivation to change. In our corpus, [20] developed a chatbot to deliver MI interventions and compared a directive and non-directive approach to delivering these interventions, whereas [57] used a brief MI technique called drinker's checkup in their agent. Positive psychology interventions can take many forms, such as feeling recognition, feeling confirmation, showing understanding and empathy, goal setting or even reflective questions, as explained by two papers in our corpus in detail [9, 56].

Social and supportive conversations and providing recommendations were also persistent in the corpus. For example, [81] developed a CA that can support casual conversations on 27 everyday topics, whereas [34]'s persuasive agent gives recommendations about certain behaviors. Music therapy, reminiscence and music-based reminiscence is also explored, especially for elderly or supporting self-awareness. [16] employed music to support self-awareness, whereas [85] used music to socially support people with dementia.

Although less common, coaching techniques and cognitive restructuring is also explored. For coaching, [87] developed an agent that follows emotion coaching guidelines, while for cognitive restructuring, which is a technique coming from cognitive behavioral therapy to help people change their way of thinking, is deployed to reduce public speaking anxiety by [97]. Lastly, research explored storifying data (i.e. [91]), measuring the effects of smaller interventions such as active listening (i.e. [23]) and other unique approaches coming from their respectful literature, accumulated under the 'other' category. Some notable examples from this category are exploring care-giving and care-receiving following the compassion theory by [49], and seed messaging technique following the procrastination management literature by [13].

4.2.4 Design Considerations. To complete the overview of the design space, we analyzed the types of interaction design considerations explored in the corpus. In this context, design considerations refer to the key decisions made during the design process. In identifying these, we focused on decisions made by the authors prior to developing and running user studies with a CA, excluding those that are already part of the implemented tools or techniques described

earlier. While examining design considerations, we observed noticeable variation in how researchers detail, develop, define, and manipulate the CAs in their studies. Some describe the CA only in technical terms, while others justify each design decision, such as the choice to use or not use a personified avatar. This resulted in uneven reporting of design considerations across the corpus, with some papers providing little to no explanation of their design choices. Nevertheless, we offer a categorization of the identified design consideration areas. In our corpus, design considerations accumulated in six categories: *embodiment*, *conversation content*, *conversation style*, *non-verbal cues and backchanneling*, *input modality*, and *device modality*.

Embodiment refers to the agent's characteristics such as age, gender, human-likeness, voice, clothing style, or profile picture (for text-based agents). This design consideration is not widely explored in the corpus, likely because most research involving embodied CAs used existing frameworks rather than designing their own embodied agents. Some notable examples include [45]'s deliberate choice of a robot profile picture as a care-receiver to avoid over-burdening users, [54]'s work on the effects of racial representations on human-agent relationships, manipulated through profile pictures, and [29]'s deployment of an inanimate avatar based on user preferences.

Conversation content (What is said), refers to the agent's verbal communication, following the definition proposed by Feine et al. [28]. This is one of the most extensively explored design consideration categories in the corpus. Research in this area examined the effects of content elements such as greetings, expressions of gratitude, asking for permission, asking questions, small talk, and self-disclosure. Personalization of the content delivered by the agent is also included here, as highlighted in several papers, such as Souza et al. [89]. Content design typically follows a specific aim. For instance, [57] implemented 'requesting permission' for the agent to be 'polite and empathetic', while in [44], the agent shares bits of personal information to encourage users' openness. A lot of the comparative studies also compared two or more types of content design strategies. For instance, [69] compares emotional and cognitive support statements and [98] manipulates the perceived moral agency via the word choices of the agent.

Conversation style (How something is said) follows the definition by Feine et al. [28] and refers to the tone of voice, formality, and complexity of the agent's sentences. This category also includes design considerations related to social roles, as these are often conveyed through conversation style. For instance, Jeong et al. Jeong et al. [39] designed a robotic companion to deliver positive psychology interventions and noted that they gave the agent a playful and light personality, with informal and casual language. Another approach to conversation style involves comparing the effects of different styles. For example, Herder and Herden Herder and Herden [34] compared the impact of empathetic phrasing versus authoritative phrasing on persuasion for positive behavior change.

Non-verbal cues and backchanneling category refers to non-verbal active listening cues and mimicry displayed by embodied conversational agents, as well as verbal backchanneling cues that can be delivered through voice or text, such as saying "hmm..." Although our corpus contains few examples, we would like to highlight some notable ones. For instance, Ringfort-Felner et al. [82]'s design fiction artifact, Kiro, is designed to visualize thinking and make eye contact with its user to express interest. An example from an existing prototype is Lisetti et al. [57], where the embodied CA uses facial expressions, head nods, and eyebrow movements to build rapport and support emotional empathy.

Input modality is a common design consideration in all papers, as it is an inseparable part of a CA system. It refers to how the user provides input to the agent, commonly through buttons with pre-defined text, open-ended text, voice, or multimodal input that enables multiple input options. However, here we highlight some notable examples where researchers explain their choices and manipulations with specific aims and motivations. For instance, Kocielnik et al. Kocielnik et al. [46] compared text and voice interactions in the workplace to facilitate user reflection. Another

example is Olafsson et al. [65], where the researchers compared free-text input and constrained input options to shape talk-related responses that support motivation and behavior change.

Device modality is not a widely explored design consideration, but we identified three research papers where the CA design extended beyond a mobile application, desktop application, or existing smart assistant. For example, Kocielnik et al. [46] explored the use of a hand-held Alexa wand to interact with a multi-device CA, creating a personal and private interaction space in the workplace. Another example is Ghiotti et al. [29], where they supplemented a mobile app-based CA with an inanimate avatar in the form of a furry phone case to comfort children with autism while interacting with the agent. Lastly, Ringfort-Felner et al. [82] created a design fiction artifact featuring a physical device placed in vehicles to support social conversations during travel.

4.3 RQ2: Evaluation Methods

While the previous subsection is focused on the content of research surrounding CAs for wellbeing, in this section, we shift our attention to how these studies were conducted. In particular, we identified a range of methods that were used for evaluating the CAs. This section presents our results in that respect, and in particular regarding the type of evaluation and the evaluation metrics employed in the papers of our corpus.

4.3.1 Type of Evaluation. Overall, the studies employed quantitative, qualitative, and mixed methods. An overview of that is available in Table 4. As can be seen, the majority of the papers in our corpus employed mixed methods (almost half), with qualitative evaluation being the second most often used type of evaluation, and quantitative the least.

Table 4. Overview of the evaluation types that were conducted: quantitative, qualitative, or mixed methods.

Type of Evaluation	Papers	Percentage
Quantitative	[7, 8, 22, 34, 45, 54, 56, 62, 65, 69, 81, 97]	19.35%
Qualitative	[2, 13, 19, 23, 26, 29, 36, 37, 40–44, 58, 82–85, 89, 94, 106, 107, 110]	38.71%
Mixed methods	[4, 9, 16, 20, 35, 38, 39, 46, 47, 49–53, 57, 59, 60, 67, 73, 80, 87, 88, 91, 98, 101, 104]	40.32%

4.3.2 Evaluation Metrics. We performed an analysis of the evaluation methods to determine *what* the goal of the evaluations that were conducted was, in terms of what was evaluated or measured, in the case where quantitative measures were employed. Table 5 provides an overview of our findings in that respect for the measures relating to wellbeing, while Table 6 provides an overview of non-wellbeing related measures that were evaluated by the papers in our corpus. As can be observed, the papers in our corpus evaluated a range of metrics, some of them relating to the CA's impact of well-being, e.g. my measuring users' self-reflection [51], and others not relating to wellbeing, such as user trust in the CA [4, 20, 50, 52, 67, 98] or even system usability [9, 16, 20, 36, 59, 67]. Particularly given the multiple metrics that have been used for assessing the effectiveness of CAs on wellbeing, we can observe that conceptual understanding and clarity has yet to be achieved around which measure(s), quantitative or qualitative, can be used to evaluate CAs in that respect.

4.4 RQ3: Research Processes for CAs for Wellbeing

To gain a deeper understanding of the research methodologies used, we revisited the corpus after the initial analysis and examined the research processes described in each paper. Based on this review, we identified four distinct types of

Table 5. Overview of the evaluation methods that were used to assess the effectiveness of CAs in promoting well-being.

Wellbeing-related measures that were evaluated.	**Papers**
Physical Activity	[20]
Motivation	[20]
Self-efficacy	[20]
Readiness to change	[20]
Affective state	[9, 101]
Behaviour change intention	[4]
Emotional feeling towards users' studies	[4]
Self-awareness	[16, 51]
Personal growth	[9]
Satisfaction with life	[9]
Commitment to goal	[9]
Goal achievement	[9]
Adoption intention	[9]
Psychological well-being	[59, 60, 67]
Reduction in Emotion Intensity	[88]
Reframe (of negative emotions) Relatability	[88]
Reframe (of negative emotions) Helpfulness	[88]
Reframe (of negative emotions) Memorability	[88]
Skill Learnability (of reframing negative emotions)	[88]
Cognitive re-appraisal	[67]
Self-reflection	[51]
Emotional expression	[87]
Self-compassion	[49]
Self-disclosure	[22, 50, 52]
Perception of active listening	[22]
Emotional states	[22]
Perceived emotional support	[22]

research processes that characterize the approaches taken by HCI scholars in this field (See Table 7). These categories provide a structured understanding of the different methodological pathways employed to investigate CAs in the context of wellbeing. The research processes outlined in this work provide a foundation for future studies on CAs in the context of wellbeing. These processes offer a starting point which researchers and designers can reference when developing interventions through CAs. By drawing on these processes, future research can further explore the design of CAs across different wellbeing domains, user groups or tools and techniques they decide to evaluate.

4.4.1 Theory First. The "*Theory First*" process focuses on research investigating how to implement established theories, tools and techniques through CAs to enhance wellbeing. In this approach, there is pre-existing theory on the positive effects of certain interventions or behaviors related to wellbeing. The core objective of the research is to explore whether these interventions can be effectively implemented in CAs. Research in this category typically focuses on deploying tools and techniques such as motivational interviewing, positive psychology interventions, reflective prompts, coaching programs, or companionship provided by CAs to improve specific wellbeing domains, such as mental health, stress management, or behavior change. For example, Chauvin et al. [20] conducted a study that assessed the effectiveness of Motivational Interviewing (MI) using a CA that intervenes by encouraging adults over 50 years old to engage in

Table 6. Overview of the evaluation methods that were used to assess other aspects of the CAs (not related to user well-being)

Other measures that were evaluated	Papers
Empathy	[20, 57]
Usability & Satisfaction	[9, 16, 20, 36, 59, 67]
Trust	[4, 20, 50, 52, 67, 98]
Rapport	[38]
Response accuracy	[60]
Animacy and anthropomorphism	[57, 98]
Perceived intelligence	[57, 98]
Perceived safety	[57, 98]
Likability & enjoyment	[52, 57, 60, 67, 98]
Fun	[97]
Perceived autonomy	[16]
Cognitive demand	[60]
Annoyance and anxiety	[60, 67]
Habitability	[60]
Social influence	[67]
Social presence / sociability	[67, 97]
Speed	[60]
Engagement	[51, 67]
Perceived moral agency	[98]
Subjective performance	[57]
Perceived adaptability	[67]
User acceptance	[57, 67]
Fear of being judged	[97]
Closeness & intimacy	[51, 52, 97]
Competence	[62]
Warmth	[62]
Intention to use	[67]
Adherence to the recommendations	[34]
Appreciation of the recommendations	[34]
Intrusiveness of the recommendations	[34]
Distress	[97]

Table 7. Overview of the articles in the corpus and their corresponding process type.

Research Process Categories	Papers
Theory First	[9, 20, 39, 45, 47, 53, 56, 57, 65, 81, 83, 84, 87, 88, 106]
Comparing Design Qualities of CAs	[3, 16, 20, 23, 25, 34, 35, 39, 46, 49–52, 54, 57, 60, 62, 67, 69, 97, 98, 101, 104]
Exploring Desired Qualities of CAs.	[13, 23, 26, 29, 40–42, 58, 73, 80, 82, 85, 89, 94, 107]
Exploring Consequences of CA Use for Wellbeing.	[2, 7, 8, 19, 36, 37, 43, 44, 59, 110]

more physical activity. While MI's structured four-step process is adaptable to online platforms, modeling the empathy inherent to MI, particularly in non-directive contexts, presents challenges when applied to CAs. Here, MI plays the role

of the pre-existing theory and the researchers explore the details of how MI can be effectively used in the design of a CA.

4.4.2 Comparing Design Qualities of CAs. Research in this process begins with the motivation to investigate how manipulating specific CA design considerations influences the effectiveness of wellbeing interventions. The approach involves taking a CA with certain baseline capabilities and altering one feature—such as embodiment, modality, or conversation style—to observe its impact. By modifying these individual elements, researchers assess how changes in design affect outcomes like user engagement, interaction quality, and wellbeing improvements. This allows for a more focused understanding of how design considerations shape the overall perception of the CA. For instance, Jeong et al. [38] compared a basic assistant-like robot with coach-like and companion-like versions, all delivering the same interventions but with different interaction styles. The companion-like robot was found to be more effective in fostering a positive therapeutic alliance and enhancing wellbeing, highlighting the importance of supportive behavior in CA design.

4.4.3 Exploring Desired Qualities of CAs. This process focuses on exploratory research that investigates user expectations and perceptions of CAs in the context of wellbeing. The approach typically involves studying either existing or prospective CAs to understand what features or behaviors users find desirable. Alternatively, researchers may examine current systems to build a systematic understanding of how users perceive CAs in wellbeing scenarios. The ultimate goal of these studies is to determine which qualities and functions are most valued by specific user groups, helping to inform future design and development. For example, Xygkou et al. [107] conducted semi-structured interviews with mourners to explore how chatbots could support individuals dealing with grief. Similarly, Choi et al. [23] used focus group interviews and individual workshops to examine autistic individuals' perceptions of large language model-driven CAs, while also working with participants to develop strategies for addressing their everyday needs and concerns. These studies aim to capture user insights on desirable CA qualities, which can guide the design of wellbeing-oriented systems.

4.4.4 Exploring Consequences of CA Use for Wellbeing. This last process type focuses specifically on the impact of CAs on wellbeing, often evaluating whether pre-existing systems deliver tangible benefits to users. These studies are typically aimed at specific user groups and take a holistic approach, in contrast to theory-driven research. Rather than being guided by a single theoretical framework, these inquiries aim to assess how CAs can support overall wellbeing through multifaceted interactions. This process is interdisciplinary, often bridging HCI and public health, providing insights both on user interaction and broader wellbeing improvements. For example, Aymerich-Franch and Ferrer [9] explored the use of a speech-based CA for life coaching and found that working on goal achievement with the CA significantly improved participants' psychological wellbeing, providing empirical validation for automated coaching interventions. In another study, Jo et al. [43] examined CareCall, an open-domain chatbot designed to support socially isolated individuals through check-up calls and monitoring by teleoperators. Their findings showed that CareCall helped alleviate loneliness and emotional burdens while easing the workload for public health professionals, though challenges emerged around managing stakeholder expectations. These studies emphasize the potential of CAs to contribute to wellbeing, while also uncovering the complexities of integrating such systems into real-world health contexts.

4.5 RQ4: Research Gaps

The analysis of the corpus revealed several research gaps and, therefore, future challenges for HCI research, which we outline below.

4.5.1 Technopositivism. Much of the current research focuses on the benefits of CAs, with little investigation into their limitations or potential negative impacts, leading to an overly technopositive perspective. A key issue is that CAs are often considered a-priori positive, with the assumption that their application will inherently be beneficial. This assumption is prevalent across the literature, as none of the papers in the corpus specifically addressed or thoroughly investigated the potential negative consequences of using CAs such as privacy and security concerns, dependency and reduced self-reliance, or lack of genuine empathy. Interestingly, policy researchers have also identified a lack of criticism of CAs as potentially negative phenomenon [99]. Additionally, there is a notable lack of comparative studies that examine CAs alongside alternative interaction modalities, leaving a gap in understanding whether CAs provide a uniquely effective or appropriate solution for wellbeing. Furthermore, due to CAs being a novel technology and not yet widely available or accepted by users, there are no studies examining their effects on wider populations through longitudinal studies with large participant samples.

Thus, a critical challenge for HCI is to *conduct studies that thoroughly investigate the potential negative consequences of CAs and compare their effectiveness and appropriateness with alternative interaction designs.* These studies would contribute to a more balanced understanding of CAs, ensuring that their adoption is based on evidence of their true impact, rather than assumptions of inherent benefit.

4.5.2 Dominance of Mental Health. The majority of studies focus on CAs for mental health, leaving other important wellbeing domains underexplored. We observed that the corpus is largely dominated by mental health interventions, which appears justifiable—many mental health practices are based on conversation [33]. However, this focus leaves unexplored potential for CAs in other areas of wellbeing where human-to-human conversation has been traditionally used less frequently. This suggests that CAs may have potential in contexts outside of mental health, where conversation is not typically required but could still be beneficial. Moreover, CAs could be particularly suitable for contexts where human interaction is limited or unnecessary, offering a valuable opportunity for broadening the scope of CA use.

Thus, a key challenge is to *explore applications of CAs beyond mental health, particularly in areas where conversation is not commonly used, to assess their broader potential in supporting wellbeing across diverse contexts.*

4.5.3 Translating Human Interactions. Most research attempts to translate human-based interactions into CAs, but there is a lack of exploration into unique opportunities that CAs could offer beyond simply replacing human interlocutors. The most common research practice involves designing CAs to replace humans in providing care or support. However, there is limited work on deploying CAs in contexts where human-to-human interaction does not traditionally occur or where it is impractical. This reliance on mimicking human interaction may also set unrealistic expectations for CAs. In situations where human conversation is not typically expected, users may approach and interact with CAs in different ways. During our review, we observed a focus on 'translating' (cf. [32]) techniques and theories that apply to human conversation into CAs. Instead, there is an opportunity to develop CA-specific concepts that better suit their unique capabilities other than mimicking human conversations.

The challenge is to *explore new approaches that go beyond translating human interactions, leveraging the unique capabilities of CAs in contexts where human conversation is not the norm or is impractical.* Further, there is an opportunity to *develop CA-specific intervention types and conversation styles.*

4.5.4 Lack of CA-Specific Metrics. There is a scarcity of CA-specific evaluation metrics, as studies typically rely on generic UX or wellbeing scales or qualitative data. Our review reveals that there is little consensus on how to effectively evaluate CAs. Researchers often use scales that measure usability or related concepts, which do not fully account for the unique expectations users have of a CA. While qualitative methods can capture the user experience in detail, they make it difficult to compare CAs across different studies. As a result, it is challenging to empirically link the outcomes of evaluations to specific design properties of the CA, limiting the ability to draw actionable insights for improving CA design.

This highlights the need to *develop CA-specific evaluation metrics and methods that better capture the distinct interaction experiences and expectations users have of CAs, enabling more precise and comparable evaluations across different designs.*

4.5.5 Limited Research on Bottom-Up Strategies. Most research assumes top-down strategies where researchers design the CAs, with little attention paid to empowering users to create or customise CAs themselves. Most studies either implement pre-existing theories or systems designed by researchers prior to the study. Alternatively, there are studies focusing on commercial systems. However, little work has been done in terms of co-designing CAs' features, conversation strategies, embodiment. The theory-first approach often makes such designs difficult or impractical. This presents an opportunity to adopt more co-design approaches for CAs, involving users more deeply in the design process. Additionally, developing tools that enable users to craft and customise their own CAs could further democratise CA development. This would enable users to 'tinker' with CAs, much like they do with other design materials [96], and create more personalised solutions.

The challenge, therefore, is to *explore bottom-up strategies that empower users to participate in designing CAs or develop tools which allow users to customise CAs themselves.*

4.5.6 Lack of Interdisciplinary Collaboration with Domain Experts from Diverse Backgrounds. Another significant gap identified in our literature review is the lack of interdisciplinary studies involving collaboration with domain experts such as psychiatrists, therapists, educators, linguists, legal professionals, among others. While HCI and psychology expertise are evident in developing conversational agents for wellbeing, the complexity of wellbeing as a multidimensional construct necessitates input from various disciplines. Integrating clinical insights from mental health practitioners ensures interventions are therapeutically sound and ethically appropriate. Collaboration with educators and linguists may enhance cultural sensitivity and communication effectiveness, while legal experts can provide guidance on compliance with privacy laws and ethical standards. The absence of such interdisciplinary collaboration may limit the efficacy, acceptance, and ethical integrity of conversational agents designed for wellbeing.

Therefore, a critical challenge for future research is to *foster interdisciplinary partnerships that combine technical expertise with domain-specific knowledge to create more holistic and effective CA interventions.*

5 DISCUSSION

Here, we address the limitations of our review and how they may have influenced the findings. We then discuss possible uses for our review that would lead to further research in HCI.

5.1 Overview

The research landscape of CAs for wellbeing has seen a significant increase in both scope and depth in recent years. This field has matured considerably, with a focus on mental health interventions, behavior change support, and social or vocational wellbeing, as reflected in a growing body of literature. Studies often center around mental health due

to the ease with which CAs can simulate supportive conversations. These systems are deployed in areas such as stress management, anxiety reduction, and goal achievement. User groups range from individuals with mental health challenges to broader populations such as children, the elderly, and caregivers.

While this growth is promising, it has led to a predominance of technopositivism, where CAs are primarily viewed through the lens of their benefits, often with little consideration for potential negative consequences such as privacy issues or over-reliance on technology. Moreover, there remains a strong reliance on translating human-centered interactions directly into CA design, with less attention given to exploring the unique opportunities CAs can offer beyond mimicking human interactions. Future research can broaden the application of CAs beyond mental health to areas like physical activity and sleep, while also developing CA-specific evaluation metrics that capture their impact on wellbeing more precisely. Additionally, addressing the risks associated with technopositivism by conducting longitudinal studies on diverse populations is crucial for understanding the potential drawbacks. Finally, incorporating co-design approaches and interdisciplinary collaboration with domain experts from diverse background would help ensure that future CAs are not only effective but also ethically sound and tailored to users' diverse needs.

5.2 Limitations

We acknowledge several limitations in this literature review. First, the corpus was limited to empirical and artifact studies indexed in the ACM Digital Library and published in English. While this database is well-suited for HCI-focused research, particularly interactions with CAs, excluding other databases may have unintentionally led to the omission of relevant studies. However, the ACM DL includes all SIGCHI conference and TOCHI journal papers, which are often considered representative of the current HCI landscape [100], and similar reviews have also opted to use ACM DL exclusively [90]. Future work could broaden the scope by including databases such as PubMed, PsycINFO, and Google Scholar.

Second, this review excludes papers focusing on non-personal forms of wellbeing, such as social or collective wellbeing. We limited the selection to papers that explicitly mention wellbeing. We remark that this approach may miss papers which explore CAs and consider their implicit effects on wellbeing. Another limitation is that not all CAs may be explicitly referred to as "conversational agents" in the papers, as different terminology might have been used. This could have led to the unintentional exclusion of relevant studies during our search. Finally, we adopted an interpretative approach to categorize the research systematically, focusing on qualitative insights. A different approach, such as a meta-analysis, could quantify the effects of CAs on wellbeing and provide a more data-driven assessment of their impact across studies.

5.3 Using our review

Our review of CAs for wellbeing offers insights that can help shape future research. The identified gaps highlight areas that require further investigation, providing potential directions for researchers to explore. Additionally, the four research processes outlined in our review can serve as useful frameworks for those new to the field, offering a starting point for structuring their studies. Alternatively, researchers interested in methodological innovation may choose to develop research plans that diverge from these processes, allowing for the exploration of alternative approaches. In this way, our review serves as both a guide and a foundation for advancing research in CAs for wellbeing. Furthermore, we envision that future researchers can use our review as a consolidated collection of relevant theories, evaluation methods, and design resources. Our answers to RQ1 form a collection of core concepts for designing CAs for wellbeing. By simplifying access to these concepts, we hope to streamline future research efforts, making it easier for researchers

to build on existing work while advancing new ideas in the development and application of CAs for wellbeing. This structured resource aims to reduce barriers to entry and promote more coherent and informed studies in the field.

6 CONCLUSION

In this paper, we conducted a systematic literature review, following the PRISMA process, to identify research trends in conversational agents (CAs) for wellbeing within the HCI field. Along with an overall mapping and defining gaps in the literature, as a primary contribution we identified four main research processes: (1) the *Theory First Approach*, (2) *Comparing Design Qualities of Existing CAs*, (3) *Exploring Desired Qualities*, and (4) *Exploring Consequences from CA Use for Wellbeing*. The HCI literature has been following these 4 processes to study CAs for wellbeing. Further research can examine the existing literature mapped in this paper, to guide their research process. When looking at the overall mapping, we have seen that the primary goals of CAs are mental health support, behavior change, or social, vocational, and special needs support indicates for diverse user groups which justifies the potential wide range of use of CAs for wellbeing. On the other hand, current studies evaluate effectiveness of the CAs mainly through qualitative methods and general wellbeing metrics relying on self-report, lacking CA-specific evaluation frameworks. Challenges for future research include technopositivism, an overemphasis on mental health, the absence of CA-specific metrics, and a need to explore user-driven creation of CAs. Our review highlights key gaps and suggests future directions for improving the design and evaluation of CAs for wellbeing.

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CHAPTER 5: DESIGN IMPLICATIONS

This section brings together the design implications distilled from my research journey. I present ten design implications that you can see an overview of in Figure 4. Design implications are actionable insights translating research findings into concrete considerations for designing reflective CAs. For each implication, we first present the rationale that gathers insights from users and studies, which are explained in Chapter 4 and the current literature. We then provide design recommendations and examples.

These ten design implications cover the topics of contexts of reflection, tools and techniques, dialogue dynamics, and social cues. The first two topics, contexts of reflection and tools and techniques, address the first research question, *'How might we create and employ prompts and questions to support life reflection on everyday life occasions?'* by providing actionable insights on the integration of reflective conversations into everyday life, and tools and techniques to address daily occasions for reflection.

The last two topics, conversation style and social cues, address the second research question, *'How might we combine reflection prompts and questions with state-of-the-art HCI technologies?'* by providing actionable insights beyond the context and the tools, focusing on the conversation style of the CA. Conversation style, which is an important component of the design space of CAs for wellbeing (see Chapter 4.5), accumulates insights related to how certain conversational qualities should be present in reflective CAs to better support reflection on daily life. Social cues, on the other hand, while still being closely related to conversational style, differ in that they provide insights into the human-like qualities of reflective CAs and their relationship to user trust.

Through these design implications, I aim to bridge the gap between research and practical application for reflective CA design.

5.1. CONTEXTS OF REFLECTION	***5.1.1 Non-intrusive Presence*** *Reflective CAs should bolster users' challenges in their daily lives but not force interaction.* ***5.1.2 Adapting Conversations to Context:*** *CAs should learn from personal data streams and be able to understand and remember users' daily contexts within the users' consent to support continious use and user satisfaction.* ***5.1.3 Personalized Reflection Insights:*** *CAs that can identify patterns from long-term conversation data may motivate both long and short-term interactions.*
5.2 TOOLS AND TECHNIQUES	***5.2.1 Variation in Reflection Tools:*** *There are various tools and techniques to support reflection, and the appropriate one should be selected with expert supervision, depending on the context or user group.* ***5.2.2 Educational Content:*** *Agents should be designed with consideration to the users' familiarity with reflection, implementing educational content when necessary.*
5.3 CONVERSATION STYLE	***5.3.1 Balanced Use of Statement Types:*** *The dialogues guided by reflective CAs should have a balanced proportion of questions and non-question statements.* ***5.3.2 Reflective Silence and Active Listening:*** *Reflective CAs should be able to create space for the user to pause and think within the conversation.* ***5.3.3 Concise Statements:*** *Designers should carefully consider the length of the CA's messages to ensure a pleasant conversation.*
5.4 SOCIAL CUES	***5.4.1 Thoughtful Timing:*** *Response delay is a critical social cue in reflective conversations with CAs to support the natural conversation.* ***5.4.2 Humanized but Robotic Qualities:*** *Designers should consider how to implement human-like qualities while maintaining the trust relationship that is tied to interacting with a computer program.*

Figure 4: The design implications accumulated throughout the PhD process to inform future designers of reflective CAs.

5.1 Contexts of Reflection

5.1.1 Non-intrusive Presence

Reflective CAs should support users' challenges in their daily lives but not force interaction. Rather than proactively initiating conversations at fixed intervals or when the user is inactive, CAs should be designed to respond when the user signals readiness, such as through a wake word or specific action.

Rationale: In my work, I explored personal photographs (Papers 1 and 2) and daily conversations with conversational agents (Papers 3 and 4) to support users' daily reflections. In both approaches, participants struggled with answering reflection prompts and questions from time to time, as they suggested that not all photographs that are shared on social media are significant or not all days in a week accommodate significant events one can actively talk about and reflect on. The felt responsibility of interacting with such systems can also burden the users and decrease motivation. Isabel (Paper 3), which was a CA that has a physical embodiment as

depicted in the VR scenario, proactively asked its user, David, about his day when he entered the room. In the following workshop, participants voiced concerns over this proactive behavior, suggesting that such approach might be overwhelming for the user and developing strategies to be more attentive to the needs of the user

Recommendations: Reflective CAs can use more 'passive' interfaces, where they are always available but only engage with their users when prompted to do so. **For example,** a CA in the form of a mobile application is always available to bolster its user whenever needed and does not proactively force its user to interact but can send curated notifications to its user to remind its presence. A CA that has a physical embodiment (as depicted in the VR scenario) can have a wake word, similar to the wake words of current voice assistants (for example, 'Hey Siri!'), or can react to a proximity signal or a physical touch to start interacting with its user. Further, such an agent can display subtle cues such as illuminating in a certain color or emitting a subtle sound to indicate its presence without interrupting its user's life.

5.1.2 Adapting Conversations to Context

CAs should learn from personal data streams and be able to understand and remember users' daily contexts within the users' consent to support continuous use and user satisfaction.

Rationale: Reflection systems in HCI often use quantitative data such as step count, hours slept, or calorie intake, and they use this data as a starting point to trigger users' reflection in terms of their behaviors and daily lives. There are also systems that use non-quantified personal data such as photographs, memes, or location data to trigger reflection [68, 94, 146]. Further, A work-in-progress recently explored contextual prompts based on conversational engagement, sleep, location data for AI-based journaling [106], which shows promising results for user adaptation. My work used photographs initially (Paper 1 and 2) and then explored the effects of open-ended conversations about daily life on reflection (Paper 3 and 4). In both approaches, participants struggled to identify key events to reflect on. Additionally, when interacting with Deniz the mobile CA (Paper 4), participants highlighted a frustration coming from the lack of contextual understanding of Deniz, which did not retrieve any information from past conversations or had any underlying information about its users. A long-term awareness is critical both to keep users engaged and guide them in terms of potential areas to reflect on in their daily lives. This can also allow the agent to adapt to its user's preferences regarding conversation topics and what is

perceived as a significant topic in their lives. In the workshop conducted after the VR experience (Paper 3), participants commented that they would expect an agent to adapt to their preferences regarding conversation topics.

Recommendations: If consent is given by the user, reflective CAs may have access to all the data from previous conversations, as well as users' data, such as calendar events or personal informatics data. This way, an agent can ask relevant questions, bring up key events, and help its users to reflect on critical aspects of their daily lives without burdening them. For example, if a user frequently mentions feeling overwhelmed with work, the CA might ask, *'You have been talking about how you are feeling overwhelmed with work this week, and today you had a deadline marked in your calendar. Would you like to talk about how you are feeling now?'*.

5.1.3 Personalized Reflection Insights

CAs that can identify patterns from long-term conversation data may motivate both long and short-term interactions.

Rationale: In our deployment study with a mobile application to upload and reflect with personal photos (Paper 2), participants answering the semi-structured interviews explained how the reflection process itself felt 'unfinished', as they did not get any feedback on their inputs. They suggested that they would like to see analyses and patterns revealed from their inputs to have a sense of completion and accomplishment. Within the scope of the same paper, we also conducted an ideation workshop to address frictions identified in the field study. Supporting the insights from field study participants, the ideation workshop yielded similar suggestions from designers, who suggested contextual summaries and feedback mechanisms that support long-term engagement with a reflection application. In our study with Isabel the VR simulation (Paper 3), workshop participants also commented that over long-term interactions, they would expect such a conversational agent to present them with insights and connections based on their conversations. Being able to see patterns over time can also be beneficial for motivating users to interact with the agent in the short term. This, in turn, complements the potential abandonment issues 5.1.1 may create, as CAs for everyday life reflection should not be overwhelmingly present in a user's life, which may result in the user simply forgetting to use the agent.

Recommendations: Reflective CAs may accumulate data over time, and an accompanying AI algorithm may analyze the contents of the conversations in terms of emotions or the context to

give summaries to the user. This analysis can even be supported with numeric data, such as the number of instances a certain topic is discussed with the agent, in comparison to others. **For example,** a CA can periodically present summaries such as '*You and I talked a lot about the stress you encounter in your work in the past two months'*, or '*Over the course of a year, we moved from talking about your anger to your disappointment in life. Would you like to reflect on this transition?'*.

5.2 Tools and Techniques to Support Reflection

5.2.1 Variation in Reflection Tools

There are various tools and techniques to support reflection, and the appropriate one should be selected with expert (such as counselors, psychologists, psychiatrists, and social workers) supervision, depending on the context or user group. Researchers and designers should also be sure to integrate the experts in every step of development, even if they apply a very structured technique, to ensure an ethical application to reflective CAs.

Rationale: There are a multitude of approaches to supporting reflection, especially in education and learning literature. For instance, Bain et al. introduced the 5R Framework, which is a technique that consists of 5 steps, each with its own set of questions, for journaling [9]. On the other side, HCI literature also suggested several approaches to reflection, such as Fleck and Fitzpatrick's 5-stage model [55] in an effort to transfer the knowledge generated in other fields to HCI literature. There are several examples of the use of reflection for a specific behavior change intervention in HCI. In such cases, researchers explored more practical tools and techniques, such as coaching questions [5], behavioral questions from job interviews [74], brief motivational interviewing [87] or followed user-centered approaches where they conducted workshops to accumulate helpful questions [75]. In my approach, I aimed to design reflective conversations to increase self-awareness without specifically aiming for certain behavior changes. Therefore, I leaned more toward psychology and psychotherapy literature and therapeutic techniques to explore their potential implementations for reflective conversations on everyday occasions.

I explored two approaches to support reflection with the tools and techniques of psychology and psychotherapy literature. First, following the suggestions of a psychiatry professor in our research lab, I started investigating the potential of circular questions coming from systemic family therapy. We investigated this approach especially because reflection can come from a

change of perspective [55], and circular questions are special questions that focus on the connections between people, events, thoughts, or feelings rather than individually examining each, following a systemic approach [102]. I worked on adapting this approach to a CA to see its potential, which resulted in different categories of inquiry and some question templates that can be used for agents. Lastly, I created a scenario together with a VR prototype to collect user feedback. Throughout the process, I received feedback from psychiatrists and psychologists to ensure that I was on the right track (Paper 3).

In the second approach, I followed a much more user-centered approach and started by investigating therapy clients' experiences with therapy, regardless of different therapeutic methodologies. My aim was to identify commonalities, both in terms of attitudes, questions and statements, to arrive at strategies for reflective conversations. There, I arrived at several questioning techniques and attitudes that I later went over with psychologists. In this step, psychologists refined the list by eliminating certain features that can be harmful to the users of a CA, such as giving guidance, and helped me label certain questioning techniques (Descriptive Questions and Socratic Questions) (Paper 4). The strategies are **descriptive and socratic questions, and objective, silent, actively listening, validating, and positive prompting agent behavior**. I later developed Deniz the chatbot, a prototype that partially implemented these strategies and conducted a field study.

In both of these cases, participants of the studies found the questions helpful or insightful. Especially in the field study with Deniz, participants were happy to interact with the agent, some even taking notes of some of the questions. Combining my experiences with a variety of approaches present in the literature, choosing the right one may depend heavily on the context (i.e. social interactions, work, domestic experiences, stress) or the user group (elderly, social use, young adults).

Recommendations: It is important to identify a context or a user group to identify the most fitting reflection tool. If a certain user group is identified, designers should consult the literature and cooperate with domain experts working with the identified user group to identify potential reflection tools. Designers can then work with users to understand which approach best addresses their needs (also discussed in 6.1). If a certain context is identified, designers should consult the experts and the literature and follow a co-design approach to make users active decision-makers in the design process (also discussed in 6.4). **For example,** an agent designed for the elderly to

reflect on the challenges they face regarding social communication may employ more social and emotional conversations and ask '*Hey, Martin. Let's talk about your marriage day. How did you feel that day? Would you like to chat a bit?', whereas an agent designed for reflection on the daily challenges of white-collar workers may employ more structured and rigid dialogue designs and ask, 'Hey Laura, today's work is done, ha? Let's quickly reflect. What was the most challenging moment of today?*'.

5.2.2 Educational Content

Agents should be designed with consideration to the users' familiarity with reflection, implementing educational content when necessary.

Rationale: One of the distinguishing aspects of my research experience is the population with which we conducted our studies. My entire research is held with Turkish people. This is important because 'reflection' is not widely known in Turkish culture. For example, in Turkish, we do not use sentences like 'Let's reflect on this,' or 'We share our reflections on…'. Although we have similar concepts, a well-known and widely used translation for reflection is also lacking.

Therefore, before each of the studies, I explained the concept and its importance. This challenged us when we were conducting studies since everyone has a different intrinsic capacity to reflect. This aligns with the literature, where reflection is considered a skill to be developed [55]. To overcome this challenge, I recruited people with therapy experience for the field study of Deniz (Paper 4). I observed that participants did not have difficulty having reflective conversations, and they even considered Deniz as an extension to therapy. Of course, reflective conversations can exist independently, so CAs should bridge the gap in users' reflective skills, particularly in cultures where reflection is not part of everyday language or practice.

Recommendations: CAs should include optional, adaptive educational modules that teach users the basics of reflective thinking. This can be done through onboarding sessions, brief reflective exercises, or brief explanations of the value of reflection within the context of their everyday lives. **For example,** a CA may ask its user about their familiarity with the concept of reflection and initiate the educational modules implemented in its system based on the answer.

5.3 Conversation Style

5.3.1 Balanced Use of Statement Types

The dialogues guided by reflective CAs should have a balanced proportion of questions and non-question statements.

Rationale: I primarily investigated the use of questions as a tool for reflective conversations. Therefore, in both Isabel and Deniz (Papers 3 and 4) agents asked questions to their users, although they supported their questions with additional statements. Especially with Deniz, where participants interacted with the agent every day, it was stated that constantly facing questions was overwhelming. Participants expected some non-question statements from Deniz, which can be empathizing, reassuring, or casual to help the conversation flow. This finding is in line with the findings from the formative study in Paper 4 as well, where experts suggested that the agent should incorporate validation and positive framing, which can be done without questions. This can also create more space for the thinking process of the user, as they may not have to think about answering the next question right away or engaging in another deep inspection right away, which can be overwhelming.

Recommendations: CAs should not ask questions one after another over a long period, but rather balance its questions with a variety of non-question statements. **For example,** strategies that can be implemented are active listening cues [28] such as 'hmm…', or 'I see…', empathetic statements such as 'I understand' or 'You had a hard time', or positive, hopeful, reassuring statements such as 'Even talking about this is an accomplishment', or 'It will get better'. Regularly asking the user if they would like to continue the process is another strategy to be employed by CAs.

5.3.2 Reflective Silence and Active Listening

Reflective CAs should be able to create space for the user to pause and think within the conversation.

Rationale: Our verbal communication scenario and chatbot prototype (Isabel and Deniz, Papers 3 and 4) both employed a regular turn-taking conversation. Regardless of presenting a question or a non-question statement, the agent was always overwhelmingly present in the conversation. Conversely, our formative study in Paper 4 revealed **active listening and silence** as important strategies to support reflection. This was also supported by participants' comments on the

overwhelming feeling of constantly answering questions, even after lengthy user inputs. One other concern coming from interacting with Deniz was the necessity of sending the answers in a single message, as the agent would quickly generate a response.

Recommendations: CAs for reflection can sometimes take time before generating a response or presenting active listening cues rather than a full sentence or a question. Another way to support the thinking process within the conversation can be the use of certain fillers. **For example,** a CA can say, 'Go on,' 'I am listening,' or simply ask, 'Is there anything else you want to say about this?' without further commentation within the conversation. Further, it can guide the silence by instructing the user, 'That sounds important; let's take a moment to think about this.' and following with a pause.

5.3.3 Concise Statements

Designers should carefully consider the length of the CA's messages to ensure a pleasant conversation.

Rationale: We created the scenario of Isabel (Paper 3) and developed Deniz (Paper 4) using OpenAI's ChatGPT. ChatGPT tends to create lengthy answers, and as our work is exploratory, we did not restrict the characters, especially for Deniz. Our study revealed that lengthy answers can also overwhelm users, as sometimes Deniz even asked two questions in a single message. This also contradicted the strategy 'silence', as identified in the normative stage in Paper 4, which implies that the user should do most of the talking and the agent should stay in a supportive position, opening up stage (as reflected in 5.3.2) similar to a therapeutic interaction [66].

Recommendations: Designers can consider the length of the therapist's comments in a therapeutic dialogue to inform the design of CA's inputs. Rule-based systems can be implemented by carefully creating a database of shorter questions or statements. Similar datasets can be used for training LLMs, and the system prompt can also be curated to restrict agent responses to a certain length or ensure variety. Additionally, CAs can dynamically adjust response length depending on user input. **For example,** an agent can offer more detailed responses only when the user explicitly requests them and otherwise maintaining brevity.

5.4 Social Cues

5.4.1 Thoughtful Timing

Response delay is a critical social cue in reflective conversations with CAs to support the natural conversation.

Rationale: Response delay is an important social cue that contributes to CAs' perceived anthropomorphism and perceived trust [69]. Although previous work on online customer service found that response delay improves social presence and trust [46], there is also contrary evidence from the retail setting for affective trust [33]. For example, Schanke et al. [131] argued that delaying responses may be perceived as less likable. In our case, we did not implement any response delay, especially for Deniz (Paper 4). Our participants did not enjoy the instant responses of the CA. They commented that instant responses restricted thinking time and it felt like an exam to answer the questions. Further, it disconnected the users from the reflection process and made them feel like their emotions were not important to the chatbot or that they were not understood. In summary, they wanted to feel like the chatbot spent time on their responses to analyze and come up with a well-thought-out answer.

Recommendations: Response delay should be integrated into the CAs for reflective conversations. A further step towards this is dynamic response delay, as illustrated by Gnewuch et al. [57], where they calculated a dynamic delay based on the complexity of the previous message and the complexity of the response. Their implementation in the customer service domain revealed that dynamic response delays boost users' sense of humanness and social presence, while also improving their overall satisfaction with the chatbot interaction.

For example, a text-based CA can employ a 'typing' indicator to mimic human typing to accompany the response delay to make the interaction even more natural.

5.4.2 Humanized but Robotic Qualities

Designers should consider how to implement human-like qualities while maintaining the trust relationship that is tied to interacting with a computer program.

Rationale: Computers as Social Actors paradigm [105] emphasizes that humans perceive computer systems socially, which is also proven to be true when interacting with CAs [66]. The concept of anthropomorphism, which means attributing human qualities, is also widely discussed

for computer programs, robots, and CAs (see, for instance, [77]). Our learnings, compared to the diverse literature, are limited but insightful. In Paper 3, which is the first paper where we created a vision of the reflective CA, we named the agent 'Isabel', and we chose a female, slightly robotic voice. Isabel is also embodied in a device. We designed this device to be as neutral as possible, looking like a smart voice speaker, but it also resembles a human silhouette. In our workshop, participants commented that Isabel sounded robotic, and a more natural voice would be preferable for reflective conversations. Considering its form and social role, they voiced various preferences. For social roles, one example was for the agent to act as loved ones. As none of the participants objected to the naming of the agent, in our second paper with an actual agent prototype (Paper 4), we named our agent 'Deniz'. Deniz is a gender-neutral human name in Turkish, which is used for both men and women and literally means 'sea.' From the beginning, we called the agent 'Deniz,' and we were pleasantly surprised with the fact that the participants kept referring to the agent as 'Deniz' in the online closing survey. They also attributed a lot of humanistic expectations to it, such as being understood or feeling the need to learn about Deniz. On the other side, one of the most important findings in our field study with Deniz was the fact that participants felt that they were talking with a robot, or a computer program, which helped them to talk about their thoughts honestly and freely, without judgment.

Recommendations: CAs should be designed to express empathy and understanding, but not overstep into trying to appear fully human. There can be several ways to ensure this balance. Multiple social cues, as extensively discussed by [51], such as agent's appearance, voice, conversation context and style can be explored. It is important to evaluate the effects of these decisions on user experience. Different research approaches (as discussed in 6.2), such as comparative studies can help designers in the design process. **For example,** for Deniz's next iteration (see 5.5), we are keeping the name 'Deniz', and we are implementing a response delay to enhance human-like qualities (discussed in detail in 5.4.1), ensuring Deniz does not call itself an AI algorithm that can not, for instance, have emotions (discussed in 5.4.2), but in the onboarding phase, we clearly inform the users that Deniz is an AI-based chatbot.

5.5 Implications at Work: A High-fidelity Reflective Conversational Agent Prototype

Some of the design implications accumulated throughout my PhD process currently inform the design of an LLM-based CA prototype. This prototype is a high-fidelity prototype, and it is a

tangible representation of the design knowledge produced within this PhD. Below, you can see a figure (Figure 5) explaining how we implemented certain features to the prototype. You can also refer to Appendix 15 for more screenshots from the mobile app.

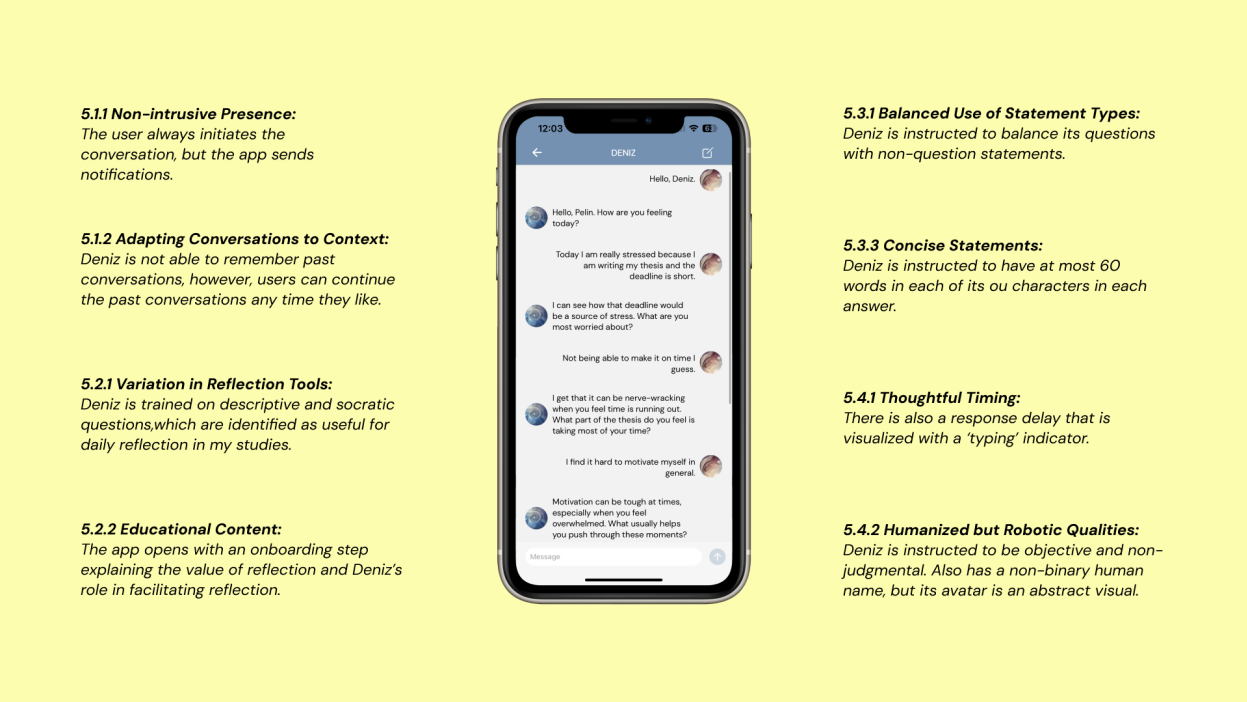

Figure 5: A summary of design implications realized in the final prototype.

This prototype is not tested with users within the scope of this dissertation. However, as future work, it can be tested with a designated participant group, such as university students or white-collar workers (also suggested by my findings). It also affords a longitudinal study, where the long-term motivations and user interactions over time can be better observed.

CHAPTER 6: IMPLICATIONS FOR RESEARCH

This chapter presents implications for research on CAs for reflection and wellbeing, distilled from the experiences gathered from my research process.

6.1 Extending User Groups for Reflection with CAs

This research was motivated to inform the design of CA technologies that can be used by everyone and integrated into their daily lives. However, when conducting the research, I've been challenged many times by the decision of not specifying the user groups. The main challenges I faced were the differences in the comprehension of the term 'reflection', the belief and value systems that influence the contents of reflection, and the cultural differences that influence the distance towards the act of reflection. Encouraging reflection, increasing self-knowledge, and positively impacting wellbeing is a core HCI goal that is integral to human flourishing. However, different user groups that are defined by their socio-economical positions require different approaches. A similar insight was present in our systematic literature review (Paper 5), where a majority of the user groups were not defined or stated as everyone in need of such systems, with little focus on particular user groups such as LGBTQ+ [92] or people with traumatic brain injury [67]. Therefore, future work should pay great attention to covering user groups that belong to different socioeconomic groups, cultures, and communities to derive insights and reflect on the positionality of their findings. With this, HCI can arrive at technology designs for reflection and wellbeing that are beneficial and useful for diverse user groups.

6.2 Alternative Approaches to Research Process

Throughout the studies that accumulated to form this thesis, I followed diverse yet similar approaches, especially for developing questions and prompts for reflection. In Paper 1, we compared two sets of reflection prompts, one that is built based on literature and one with discussions with an expert. In Paper 2, I used the user insights from Paper 1 to continue with a specific prompt structure – that is coming from the literature. In Paper 3, I again implemented a tool from psychotherapy – circular questions – although I adjusted it to address users' daily experiences better. Lastly, in Paper 4, I focused on users' perceptions regarding useful qualities, questions, and prompts while still constraining the interaction context of psychotherapy. In short, my research has combined existing strategies to reflection with users' feedback via a user-centered, research-through-design process. However, there are other possible research processes

in CAs for reflection and wellbeing. In our literature review (Paper 5), we identified four main research processes: (1) the theory first approach, (2) comparing design qualities of existing CAs, (3) exploring desired qualities, and (4) exploring consequences from CA use for wellbeing. Each of these processes might be applied at different stages of a research project, and each have their advantages. I invite future researchers to consider different research processes and make an informed decision based on the needs of their research project.

6.3 The Potential of Multidisciplinary Research Space

Throughout my research and especially during the literature review process, I've realized how much HCI takes from the psychology literature. However, this appears to be a one-way trade, as HCI researchers borrow various methods from counseling to therapy, social psychology to cognitive psychology to use for reflection and wellbeing, whereas the publications in the psychology field with CA mostly focus on the delivery of structured psychotherapy applications such as cognitive behavioral therapy. It seems a two-way, continuous collaboration between HCI and psychology fields is necessary, which may additionally involve mapping out the potential tools and techniques of psychology and therapy to be used for reflective conversations. This lack of collaboration is also highlighted in our systematic literature review (Paper 5) for the broader domain of wellbeing. Next section discusses research and design methods that can support this collaboration.

6.4 Methods for Reflective CA Research

This section covers my reflections on the design and research methods for reflective CAs. Following a user-centered approach, I experimented with various research methods such as interviews, surveys, and diary studies. I also incorporated prototypes with different levels of fidelity throughout my research. My main takeaways are threefold. First, integrating field experts and users in the design process was invaluable for me, as each discussion opened up new perspectives and possibilities for reflective CAs. Further, field experts ensured a safe and responsible approach to this delicate use case.

Second, I've experimented with various evaluation metrics to measure reflection and wellbeing throughout my research process. However, none of the metrics presented significant results, whereas semi-structured interviews and online surveys with open-ended questions were both very fruitful for collecting insights and user evaluations. This is due to the lack of CA-specific

metrics for reflection, as further elaborated in 7.2.6, and also partially because Turkish translations of these metrics were not available, and author translations are not validated, therefore may not be fully comprehensible by our society. One last reason is that all my user studies were short to mid-term in nature and not longitudinal user studies, which may make it harder to observe quantified differences.

Lastly, the prototypes helped me considerably in terms of enabling the participants to imagine futures with such agents, regardless of their level of fidelity. Prototypes in any form were very critical and central to my research process. However, the most insightful way of utilizing prototypes in my research has always been in combination with more qualitative data gathering methods, such as interviews and surveys. For Paper 2, I conducted interviews after a month-long field study, which yielded the most insightful results as I was able to direct questions to participants and they answered based on their actual experience with the artifact. Even though I had the numerical data such as the usage frequency from the field study, the interviews revealed much more in terms of the motivations, thoughts and feelings. Similarly for Paper 4, I distributed an online survey with open-ended questions after a field study with a prototype. In this case, I did not collect any quantitative data from the field study. However, If I did, I would see a low level of interaction with the prototype on average. However, the survey results revealed that although some participants did not interact with the prototype as often as I would like them to, their motivations around using such systems were still high and certain adjustments would ensure a more successful result in terms of regular interaction. These insights may not always be visible with gathering one type of data or following a single-method approach. Therefore, I urge researchers to always support quantitative data with qualitative insights from participants and apply a combination of methods to arrive at insightful results. Below, I provide more detailed accounts of two other methods that I find significantly valuable for research on reflective CAs; co-design and design fiction.

Co-design. I started my research with a user-centered approach and validated my design choices with experts from the field of psychology. Towards the end, I experimented with methods (unpublished work, hence outside of the scope of this dissertation) that bring together various stakeholders such as lawyers, designers, developers, users, and data scientists, and tried to collect designers' opinions both from a designerly perspective and from a potential users' perspective (See Appendix 13 for images from the workshop). This experimentation allowed me to see the

importance of bringing together psychologists, lawyers, data scientists, developers, designers, and users in the process of developing reflective conversational agents for everyday life. This is due to the nature of the conversations where users talk about their feelings, emotions, and experiences, which creates a careful consideration of how to design the outputs of the CA system, which requires attention from psychologists and developers. Protecting sensitive data concerns lawyers, data scientists and developers, whereas how the agent should behave and interact with its user should be defined with inputs from designers and users. Our systematic literature review of CAs for wellbeing (Paper 5) also revealed a tendency towards top-down research, with a limited number of studies reporting using co-design as an approach [1, 119, 125, 156] Therefore, a co-design approach is necessary to bring together the critical information that should be provided by the experts who are responsible for the ethical realization of the different aspects of these technologies.

Design Fiction. During my research, I also experimented with design fiction artifacts and methods [14]. Although the outcomes were not published and were, hence, not part of this dissertation, the artifacts produced can be seen in Appendix 14. One close example is the VR experience we developed to stimulate a near-future scenario in Paper 3. This VR experience helped participants immerse themselves in this possible future, possibly leaving aside their prejudices and enabling them to empathize better with a future that involves interacting with a highly intelligent agent. Our literature review in Paper 5 also revealed the use of design fiction [125] and similar approaches, such as futuristic autobiographies [41], combined with empirical research methods such as user surveys and workshops to explore users' preferences towards CAs for wellbeing. Therefore, research in this field can make use of the use of speculative design, design fiction and related approaches to support the research process. I also would like to highlight that certain design fictions may be techno-positivist, and researchers and designers should also include not plausible futures in their work.

CHAPTER 7: CONCLUSIONS

7.1 Summary

This thesis explores the use of CAs for reflection on everyday life occasions following a user-centered, research-through-design approach. It is situated at the intersection of human-computer interaction, psychology, CA, and reflection literature and takes on the lens of interaction design. This research adopts three reflection approaches—prompts from philosophy literature (Papers 1 and 2), circular questioning (Paper 3), and strategies derived from therapeutic conversations (Paper 4)—and develops three prototypes: a photo-journaling mobile application, a CA on the Telegram app, and a standalone CA app. The research addresses the following questions:

RQ1) How might we create and employ prompts and questions to support life reflection on everyday life occasions?

RQ2) How might we combine reflection prompts and questions with state-of-the-art HCI technologies?

I present my research process through 5 research papers and my findings in the form of design and research implications. Below, I briefly summarize the contributions, reflect on limitations and present opportunities for future work.

7.2 Revisiting the Contributions

The key contributions of this thesis are as follows:

1. **Design Implications for Designing Reflective CAs:** This thesis presents ten design implications for CAs for reflection on everyday life occasions. These considerations cover conversation context, tools, and techniques for reflection, dialogue dynamics, and social cues. These implications are brought together to inform designers and researchers to design CAs for reflection in everyday life.
2. **Identification of the Design Space for CAs for Wellbeing:** This thesis provides a mapping of the current design space for CAs for well-being through the systematic literature review of goals, target user groups, techniques, and design considerations of the research papers that are identified as relevant through meticulous inspection of the field. This map aims to provide a practical guide to inform future researchers and support future research efforts by also highlighting the gaps in this research field.

3. **Identification of Research Processes for CAs for Wellbeing:** Another key contribution of this thesis is the presentation of research processes in the field of CAs for wellbeing. These research processes, namely the theory first approach, comparing design qualities of existing CAs, exploring desired qualities, and exploring consequences from CA use for wellbeing, offer a starting point for future researchers to structure their studies and pave the way for exploring alternative approaches.
4. **Prototypes for Reflection and CAs:** Within the scope of this thesis, I present a photo-based reflection application and Deniz, the reflection chatbot, as two prototypes. These two prototypes are also accompanied by a VR scenario depicting Isabel, a voice-based reflective CA from the near future. These provide artifact contributions to the HCI literature, following the definitions by [154].

7.3 Limitations and Future Work

My research explored the design implications and implications for research in the field of CAs for reflection on everyday life occasions, following the RtD approach. In this section, I reflect on potential extension points of this research towards more generalizable insights.

7.3.1 Extending the interaction mediums and integrating embodiment.

The prototypes always prioritized text-based interactions and CAs that do not have a virtual avatar. Although Isabel (Paper 3) depicted a voice-based CA, none of my participants interacted with a CA using their voices. Further, none of my prototypes included a CA with a virtual avatar. While exploring voice interaction may pave the way to exploring exciting insights into voice qualities, integrating virtual avatars may enable exploring the design space and requirements for agent appearance.

7.3.2 Improving the fidelity of the prototypes.

Within the scope of this thesis, prototypes serve as tools to explore the insights from potential users of a reflective CA. Therefore, rather than focusing on developing complex, commercial CA systems with advanced AI features like emotion recognition, sentiment analysis, emotion recognition, sentiment analysis, or training our own AI models, we made use of an LLM (OpenAI's ChatGPT) and Wizard-of-Oz type settings. Although this allowed us to gain valuable insights into this field, future work can extend our findings by designing CAs that support

complex, long-term interactions with advanced AI features, which would also enable the implementation of the design implications we provided.

7.3.3 Extending the length of interactions in user studies.

The studies conducted within the scope of this thesis are relatively short in length, ranging from one week to one month. Through these field deployments, I collected valuable insights on even the potential loss of motivation in long-term use, which evolved into design implications (5.1). However, longitudinal studies are needed to empirically assess the user interactions with reflective CAs over extended periods of time, for instance, from six months to a year, as these agents are designed to accompany users in their daily lives. This exploration would help identify how interacting with a reflective agent in the long-term would affect users' reflective thinking, self-knowledge, and emotional wellbeing, and identify challenges related to motivation to reflect regularly and abandonment of CAs.

7.3.4 Experimenting with diverse user groups.

As reflected in the previous chapter (6.1), our participants' demographics have a relatively narrow scope, representing a specific socioeconomic group of Turkish people. More specifically, all our participants had a certain level of education and digital literacy. Further, my sample was consistently female dominated, although I did not intend to. To ensure the transferability of my contributions, more field studies with diverse communities, such as older adults, individuals with limited access to technology, and people from different cultural backgrounds or special needs, are valuable and necessary. It is important to highlight that this diversity of the user groups should not be determined by demographics, but rather considerations toward other measures such as attitude towards technology and personality traits should be given, although it might be challenging. These further explorations will potentially extend the design implications in more nuanced ways.

7.3.5 Exploring context-specific reflection in daily life.

The focus of this research is on everyday life reflection, and therefore, all my studies were focused on integrating CAs for reflection into participants' routine daily lives. However, throughout the thesis, I acknowledged that certain reflection contexts that can still be part of our daily lives may require different reflection approaches, as discussed in 5.2.1. Therefore, there is

untapped potential in exploring context-specific daily reflection, such as educational settings and workplace or addressing certain interactions, such as family or romantic relationships.

7.3.6 Towards more unified measurement metrics.

This research is built upon qualitative measurements. Our deployment studies are accompanied by semi-structured interviews and open-ended online survey questions to collect our participants' experiences with reflection on everyday life occasions and interacting with CAs. This was partly due to the short-term length and small-sized participant groups of our studies, as well as our study designs. Another contributing factor was the fact that the quantitative evaluation metrics both for reflection and CAs are still in development. One of the most used scales in this field is the Self-reflection and Insight Scale [60], and it requires either a pre- and post-application or should be used in comparative studies. However, this scale is unrelated to technology use and should be used together with measures that evaluate the technology. In HCI, Bentvelzen et al. developed the Technology-Supported Reflection Inventory [16], which is designed to compare different artefacts for reflection. A recent promising development is Loreakker et al.'s Reflection, Rumination and Thought in Technology Scale [88], which is designed to comprehensively evaluate how a technology supports self-focused thinking, considering reflection and rumination. However, this scale is also focused on comparing technologies and, therefore, can be used as part of a comparative study design. Although future research in this field can use the abovementioned scales to evaluate reflection, there is a gap in the literature for evaluating CAs, as highlighted in the systematic literature review (Paper 5). There is neither a CA-specific metric nor a consensus on with which parameters CAs should be evaluated. Our review presents a variety of metrics used, spanning from usability to closeness and intimacy. There is a promising research direction toward developing CA-specific evaluation metrics and methods that better capture the distinct interaction experiences and expectations users have of CAs.

7.3.7 Deeper exploration of ethical concerns.

Throughout this dissertation, ethical considerations such as privacy and security concerns were discussed in discussions and with participants. However, this dissertation does not fully explore the ethical considerations regarding the collection and processing of personal data, in this case, conversations about the personal lives of the users. Further, some of the recommendations within

design implications also require further consideration of ethical consequences, such as analysis of user inputs and providing feedback. Thus, future work should focus on developing ethical guidelines for using CAs in reflection and other sensitive contexts. Research in AI ethics so far covered ethical concerns around transparency [22, 65, 142], fairness and bias [40, 63, 85], data privacy and governance [45, 139, 144], trust and acceptance [44, 49, 124], accountability [25, 136, 142], challenges to human rights [113, 137], and sustainability [56] of AI and CA technologies for various user groups such as children [48, 49] and elderly [143]. More specifically, a recent review paper on ethical concerns with voice assistants summarizes nine primary concern areas identified in the literature as privacy, social interaction, accessibility, social order, performance of gender, accountability, conflicts of interest, misinformation, and transparency [135]. Future work can address these nine concern areas for reflective CAs.

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APPENDICES

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Appendix 1: Comperative WoZ surveys from Paper 1.

Linear

Start of Block: Default Question Block

Q3 Your Name?

_____

Q1 Can you please explain the moment you posted this photo?

_____

_____

_____

_____

_____

Q2 Why do you think you decided to post in that moment?

_____

_____

_____

_____

_____

End of Block: Default Question Block

Holistic

Start of Block: Default Question Block

Q14 Name?

_____

Q1 Can you please explain the moment you posted this photo?

_____

_____

_____

_____

_____

Q2 Why do you think you decided to post in that moment?

_____

_____

_____

_____

_____

End of Block: Default Question Block

Start of Block: Block 1

Q4 Can you please rate the relevance of following three notions to the experience you just described?

Q3

	Not at all relevant					Extremely relevant	
	0	1	2	3	4	5	6	7
Security ()							

Q5 Can you briefly explain why?

_____

_____

_____

_____

_____

Q6

	Not at all relevant					Extremely relevant	
	0	1	2	3	4	5	6	7
Pleasure ()							

Q7 Can you briefly explain why?

_____

_____

_____

Q8

	Not at all relevant					Extremely relevant	
	0	1	2	3	4	5	6	7
Pain ()							

Q12 Can you briefly explain why?

Page Break

Q9 Can you please select the locate the experience you just described in scales below?

	Internal Experience	External Experience
()		

Q11

	Objective Experience	Subjective Experience
()		

End of Block: Block 1

Segmental

Start of Block: Default Question Block

Q15 Your Name?

_____

Q1 Can you please explain the moment you posted this photo?

_____

_____

_____

_____

_____

Q2 Why do you think you decided to post in that moment?

_____

_____

_____

_____

_____

End of Block: Default Question Block

Start of Block: Block 1

Q4 Can you please rate the relevance of following four notions to the experience you just described?

Q3

	Not at all relevant					Extremely relevant	
	0	1	2	3	4	5	6	7
Sensory ()							

Q5 Can you briefly explain why?

_____

_____

_____

_____

_____

Q6

	Not at all relevant					Extremely relevant	
	0	1	2	3	4	5	6	7
Emotional ()							

Q7 Can you briefly explain why?

_____

_____

_____

Q8

	Not at all relevant					Extremely relevant	
	0	1	2	3	4	5	6	7
Intellectual ()							

Q12 Can you briefly explain why?

Page Break

Q9 Can you please describe the **spatial** aspect of the experience?

_____

_____

_____

_____

_____

Q13 Can you please describe the **temporal** aspect of the experience?

_____

_____

_____

_____

_____

Q14 Can you please describe the **social** aspect of the experience?

_____

_____

_____

_____

_____

End of Block: Block 1

Appendix 2: Second WoZ survey from Paper 1.

instagram-reflection

* Required

1. **İsmim** *

2. **Üstüne düşünmek istediğim an...** *
   Mark only one oval.
   - Post/Story paylaşımı yaptığım an *Skip to question 3.*
   - Fotoğrafı çektiğim an *Skip to question 13.*

paylaşım anı

3. **Paylaşım yaptığım an ve o anda paylaşım yapmayı tercih etmemin sebepleri...**

4. **Deneyim anımın "duyusal (sensory)" kavramı ile bağlantısı...**
   Mark only one oval.

	1	2	3	4	5	6	7	
hiç bağlantısı yok								tamamen bağlantılı

5. **Çünkü;**

6. **Deneyim anımın "duygusal (emotional)" kavramı ile bağlantısı...**
Mark only one oval.

	1	2	3	4	5	6	7	
hiç bağlantısı yok	⬭	⬭	⬭	⬭	⬭	⬭	⬭	tamamen bağlantılı

7. **Çünkü;**

_____
_____
_____
_____
_____

8. **Deneyim anımın "düşünsel (intellectual)" kavramı ile bağlantısı...**
Mark only one oval.

	1	2	3	4	5	6	7	
hiç bağlantısı yok	⬭	⬭	⬭	⬭	⬭	⬭	⬭	tamamen bağlantılı

9. **Çünkü;**

_____
_____
_____
_____
_____

10. **Paylaşım anımın mekansal özellikleriyle ilgili notlar:**

_____

11. **Paylaşım anımın zamansal özellikleriyle ilgili notlar:**

_____

12. **Paylaşım anımın sosyal özellikleriyle ilgili notlar:**

_____

Stop filling out this form.

fotoğraf çekme anı

13. **Fotoğrafı çektiğim an ve o anda fotoğraf çekmeyi tercih etmemin sebepleri...**

14. **Deneyim anımın "duyusal (sensory)" kavramı ile bağlantısı...**
Mark only one oval.

	1	2	3	4	5	6	7	
hiç bağlantısı yok								tamamen bağlantılı

15. **Çünkü;**

16. **Deneyim anımın "duygusal (emotional)" kavramı ile bağlantısı...**
Mark only one oval.

	1	2	3	4	5	6	7	
hiç bağlantısı yok								tamamen bağlantılı

17. **Çünkü;**

18. **Deneyim anının "düşünsel (intellectual)" kavramı ile bağlantısı...**
Mark only one oval.

	1	2	3	4	5	6	7	
hiç bağlantısı yok	◯	◯	◯	◯	◯	◯	◯	tamamen bağlantılı

19. **Çünkü;**

20. **Fotoğraf çekme anımın mekansal özellikleriyle ilgili notlar:**

21. **Fotoğraf çekme anımın zamansal özellikleriyle ilgili notlar:**

22. **Fotoğraf çekme anımın sosyal özellikleriyle ilgili notlar:**

Powered by Google Forms

Appendix 3: Online closing survey from Paper 1.

end of the project

Start of Block: Default Question Block

Q8 Your Name?

_____

Q1 Thank you for your participation in this research. Which of the 3 kinds of surveys felt the most useful for your reflective process?

- ○ Survey 1: Linear | 2 open ended questions (4)
- ○ Survey 2: Segmental | Sensory, Emotional, Intellectual / Spatial, Temporal, Social aspects (5)
- ○ Survey 3: Holistic | Security, Pleasure, Pain / Internal-External, Objective-Subjective (6)

Q5 Can you please explain why do you think selected survey was most useful for your reflective process?

_____

_____

_____

_____

_____

Q2 Were there any specific questions that was standing our from the others in terms of causing more effective self reflection?

_____

_____

Q6 How did you decide on the timing of your participation (filling the surveys)? Did you prefer to fill the surveys right away or later? Was this preference intentional? If yes, why?

Q7 Lets Imagine Instagram had an add-on that would present you with reflective questions every time you post, and stored your answers along with the posts with an option to keeping it private or public. Would you be interested in using such an add-on? Can you explain why?

Q4 Would you be interested in being a part of our ongoing studies on this topic?

- ○ Yes (1)
- ○ No (2)

Q3 Any other comments?

_____

_____

_____

_____

_____

End of Block: Default Question Block

Appendix 4: Instructions to use the mobile app from Paper 2.

Nasıl Kullanılır? / How to use?

Uygulamaya giriş yapmak

- E-posta adresinizi ve şifrenizi girerek 'SIGN UP' butonuna basın.

  Enter your e-mail address and password and press 'SIGN UP'.

Kayıt oluşturmak

- Kaydınızı oluşturmak için sayfanın alt tarafında ortada bulunan artı ikonuna basın.

  Press the plus icon at the botttom of the page to create your record.

- Galerinizden uygulamaya yüklemek istediğiniz fotoğrafı seçin.

  Select the photograph you like to upload to the app from the gallery.

- Fotoğrafla ilgili kaydetmek istediğiniz genel notlarınızı yazın.

  Write down the general notes that you would like to record about the picture.

- 'NEXT' butonuna basın.

  Press 'NEXT'.

- Fotoğrafladığınız anın, veya bu fotoğrafı seçme sebebinizin duyusal önemi hakkında düşünün ve not alın.

  Think about and write down the sensory significance of the moment in the selected photograph, or the reason you pick this photograph.

Duyusal önem hakkında düşünmene yardımcı olacak bazı sorular / Some questions to help you think about sensory significance

Bu fotoğrafı diğer fotoğraflardan farklı kılan sebeplerin ne kadarı duyusal? Fotoğrafladığın deneyime duyusal bir deneyim diyebilir misin? Deneyimin duyularından ne kadar etkilendi? Ne gördüğün, duyduğun, dokunduğun, kokladığın veya tattığın deneyimin için ne kadar önemliydi?

Can you call the experience you photographed 'a sensory experience'? How much of your experience is affected by your senses? How significant was the effect of what you saw, heard, touched, smelt and tasted?

- Dugusal öneme bir değer verin. 0 ile 5 arasında bir değer seçebilirsiniz. Eğer deneyiminizde çok fazla duyusal uyaran mevcutsa, deneyiminizin duyusal önemi yüksek olmalı.

  Rate the sensory significance. You can give a rating between 0 and 5. If there was a lot of senses involved, the sensory aspect of your experience should be high.

Nasıl Kullanılır? / How to use?

- Aynı süreçleri duyusal önem ve entelektüel önem için de tamamlayın.

  Repeat the process for sensory and intellectual significance.

Duygusal önem hakkında üşünmene yardımcı olacak bazı sorular / Some questions to help you think about sensory significance

Bu fotoğrafı diğer fotoğraflardan farklı kılan sebeplerin ne kadarı duygusal? Deneyimine duygusal bir deneyim diyebilir misin? Kaç farklı duygu deneyimledin? Aynı anda pek çok duygu hissetmiş olabilir misin? Eğer çok fazla veya çok çeşitli duygu hatırlayabiliyorsanız, deneyiminizin duygusal önemi yüksek olmalı.

How many of the reasons you choose this photograph is connected to emotions? Was it an emotional experience? How many different emotions did you experience? Or was it many emotions at the same time? If you recall feeling too much or too many emotions, the emotional aspect of your experience should be high.

Entelektüel önem hakkında üşünmene yardımcı olacak bazı sorular / Some questions to help you think about intellectual significance

Bu fotoğrafı diğer fotoğraflardan farklı kılan sebeplerin ne kadarı düşünsel?
Fotoğraftaki deneyime entelektüel bir deneyim diyebilir misin? Deneyim anında veya deneyimin hakkında ne kadar düşündün? Deneyim bol bol düşünmeyi içeriyor muydu? Eğer işin içinde çok fazla düşünme varsa, deneyiminizin entelektüel önemi yüksek olmalı.

How many of the reasons you choose this photograph is connected to your thoughts?
Was it an intellectual experience? How much thought you have given to the experience (or during the experience)? Did it involve lots of thinking? If there was a lot of thinking around, the intellectual aspect of your experience should be high.

- Kaydınıza lokasyon bilgilerinizi eklemek için ‘USE CURRENT LOCATION’ butonuna basın. Bu aşamada lokasyon bilgileriniz şehir olarak kaydedilmektedir.

  In order to add location information to your record, press ‘USE CURRENT LOCATION’ button. At this stage, your location information will be saved in the city scale.

- ‘SAVE YOUR LOG’ butonunu kullanarak kaydınızı tamamlayın!

  Press ‘SAVE YOUR LOG’ button to finish your record.

- Fotoğrafınız anasayfada belirecek. Fotoğrafın üstündeki görsel filtrede, sarı kolon duyusal puanlamanızı, mor kolon duygusal puanlamanızı, kırmızı kolon ise entelektüel puanlamanızı temsil etmektedir.

  Your photograph will appear in the homepage. In the filter above the photograph, yellow column represents the sensory rating, purple column represents the emotional rating, and red column represents the intellectual rating.

Nasıl Kullanılır? / How to use?

Kayıtları incelemek

- Uygulamayı açtığınızda geçmiş kayıtlarınızla karşılaşacaksınız. Bir kaydın (fotoğrafın) üstüne basarak detay ekranına ulaşabilirsiniz.

  You will see your past records when you open the application. Touch a record (photograph) to go to the detail screen.

- Uygulamayı açtığınızda geçmiş kayıtlarınızla karşılaşacaksınız. Bir kaydın (fotoğrafın) üstüne basarak detay ekranına ulaşabilirsiniz.

  You will see your past records when you open the application. Touch a record (photograph) to go to the detail screen.

- Fotoğrafı sola kaydırarak fotoğrafın filtresiz haline ve genel notlarınıza ulaşabilirsiniz.

  Swipe the photograph left to see the unfiltered photo and your general notes.

- Aşağıdaki yazı alanını sola kaydırarak fotoğrafınızın duyusal, duygusal ve entelektüel önemiyle ilgili aldığınız notlara ulaşabilirsiniz.

  Swipe the text area below left to see your notes on the sensory, emotional and intellectual significance of your photograph.

Appendix 5: Semi-structured interview questions from Paper 2.

Interview Protocol

Hello, thank you for participating in this interview. The purpose of this interview is to find out how you have experienced LayerZero app for one month. Therefore, my overall focus will be on your personal experience. So the more details you can share for me, the better. You can take as much time as you like to think about it.

Before we start, I would like to audio record this interview. Do you give your permission? All data will be used anonymously.

If you do not have any questions, shall we start?

General Questions and Intended Use

Have you ever used a similar application to record your daily life?
What made you decide to participate in this study?
How would you describe your purpose for using the app?
Did the app meet your expectations?
What interested you the most?
What are your general opinions about the app?
What did you think this app would bring you?

Did you have a very bad experience using the app?
Did you have a very good experience using the app?

How to use it

When and how did you usually use the app?
How often do you think you use the app?
What triggers you to use the app in your daily life?
What was your decision criteria for choosing a photo to upload to the app?

Self Reflection Questions

What was your experience like answering the questions required to generate input?
Did answering questions all the time affect your thinking time on questions? How did it affect it?
Did you observe any benefits related to answering the questions?
Did you read back your answers? If yes, what did you think?

Retrospective Self-Reflection

Have you looked back at the photos you uploaded? Did you read what you wrote? If yes, how often and for what purpose?
What did looking back at your data make you think?
Did you spend more time on the app to upload photos, or to look at what you uploaded?
Did you look at a particular time period in particular (e.g. a certain week, certain days of the week?)

If yes, what did you pay attention to when reviewing this time period?

Photo Filter

What do you think about the variable photo filter?
Have you used this filter and how did you use it?

A Brief Overview of the Data

Can you tell us what you did with your data (photos, filters, written entries) accumulated in the application?
Which of the photo, filter, written input was more interesting for you?
Have you shared this data with others?

If yes, how and why?

If no, why?

Closing Questions

Would you like to use the app regularly for self-reflection for well-being in your daily life?
How would you use the app regularly if it were modified?
How often would you like to use the app?
Is there anything else you would like to add?

Thank you

Appendix 6: A screenshot from the website designed for online diary study from Paper 3.

Appendix 7: Scenario script that is used to create the VR experience from Paper 3.

Prompt:

Hello. I will ask you to generate a dialogue between a voice-based conversational agent and its user. I will provide you with certain rules.
This conversational agent is a ‘companion’ agent. Its purpose is to ensure its user’s wellbeing. In the natural flow of its existence, it asks reflective questions about its users everyday life. The reflective questions it asks are from a systemic perspective. It follows a guideline when generating its questions. I will provide you with the guideline.
Its questions are from templates in the guideline as much as possible. When it drifts off from templates, it creates a system log. Please indicate this log in parentheses in the dialogue.
The time setting of the scenario should be vague. It can be today, 10 years or 50 years from today. The conversation should be free from time indicators.
The relationship between the agent and its user is intimate. They talk like very close friends, but the user also sees the agent as a mentor. Please come up with names for each.
The conversation can start with the agent asking the user about his/her day. The topics of conversation should span work life, family life, and social relationships. The conversation should last around 15 minutes.

Here’s the guideline;

Introduction to the guide;

This is a guide to help AI generate reflective questions from a systemic perspective.
Here in this guide, we provide you with 4 strategies, specifically curated to address the vast majority of human feelings and interactions. Each strategy includes a definition, a when-to-use information, and example question templates.
By following these strategies, you will be able to create reflective questions from a systemic perspective.

How to use;
Open the conversation with a general question prompting your user to talk about their day.
Directly after the first statement, you can start using this guide.
After each question-answer interaction, refer to the guide to find the appropriate strategy for the answer statement to create new questions.

Strategy 1: Draw Connections
These questions aim to guide the receiver to connect the factors that may have an influence on the stated problem to better understand the roles that have an effect on the problem.

Use this strategy if your user's statement;
have negative valence
has individual experiences or interactions with inanimate objects
just include an explanation of a negative situation (a problem)

Question templates you can use:
Where do you think you most experience the {problem}?
In what situation is the {problem} most noticeable?
How does your {problem} affect others?
What feelings come up when you experience {problem}?
What do you do when you are {problem}?
When is your {problem} most difficult?
Do you know when you become more {problem}?
What would happen if {problem} disappeared?
Are you more {problem} in comparison to your {time_period}?
How does {problem} develop in relation to others?

Strategy 2: Identify Differences

These questions aim to help the receiver better understand their desires for change by specifying the details and differentiating them from other situations in detail.

Use this recommendation if your user's statement;
have negative valence
has individual experiences or interactions with inanimate objects
include an explicitly stated a desired situation or change

Question templates:
What do you think makes {subject} {adjective}?
What do you mean by {adjective}?
What is your personal reaction to {adjective}?
What qualities make something {subjective_desire} for you?
How would you describe {subjective_desire}?
When does {subject} make you feel {adjective}?
When does something is {adjective}?
What should change to make you feel {adjective}?
What would change if you felt {adjective}?
What would you do if you felt {adjective}?
How do you feel when you have an {adjective}?
What actions would make you understand {subject} is {subjective_desire}?
What are your personal clues of {subjective_desire}?
What do you need to have to feel {desired_emotion}?
What does it mean for you when you have {subjective_desire}?
What would change if you were in {desired_situation} in comparison to today?
Who would most benefit from {desired_situation}?
How would {desired_situation} help you?
What other ways would you use {desired_situation} if you had it?
How would you feel if you were in {desired_situation}?

Strategy 3: Provide Perspective

These questions aim to guide the receiver to *empathize* with the other party to either better understand them or their point of view in the system.

Use this recommendation if your user's statement;
have negative valence
has interactions with living subjects
negative valence caused by the interaction or other party is experiencing something negative

Question templates:
When this happens, what do you think {other_party} feel/think/do?
What does {other_party} think when you {action}?
Is {other_party} more {negative feeling/negative action} when you {action}?
Do you notice a change in {other_party}'s behavior when {problem/action}?
What do you think {other_party} needs when they {action}?
What do you think made {other_party} {problem}?
What can be the reason that {other_party} is {negative_feeling}?

Recommendation 4: Encourage Communication
These questions aim to guide the receiver to *communicate* with the other party to reach the desired outcome.

Use this recommendation if your user's statement;
have negative valence
has interactions with living subjects
negative valence caused by a lack of coalition, cooperation, or mutual understanding

Question templates:
Did you share {problem} with {other_people}?
Do you think you can talk with {other_people} and spot {desired_situations}?
What would happen if you were to share the {desired_situation} you've spotted, to {other_people}?

Scenario 1:

Agent (Isabella): Hey, how was your day?

User (David): Hi Isabella, my day was a bit tiring. I had a long meeting at work and then had to deal with my kids arguing when I got home.

Isabella: I can imagine that was exhausting. Where do you think you most experience this kind of tiring day? (Strategy 1: Draw Connections)

David: I'd say it mostly happens at work when there are too many tasks to juggle, and then it carries over to home when there's family stuff to deal with.

Isabella: How does your exhaustion from work affect your interactions with your family? *(Strategy 1: Draw Connections)*

David: I think I become less patient and more irritable. It's not ideal, and I know it's not fair to my family.

Isabella: When this happens, what do you think your kids and partner feel? *(Strategy 3: Provide Perspective)*

David: They probably feel like I'm not fully present and maybe even a bit distant. I don't want them to feel that way.

Isabella: What do you think would change if you felt more relaxed and energized when you got home? *(Strategy 2: Identify Differences)*

David: I think I'd be more patient and understanding, and I'd probably have more energy to engage with my family.

Isabella: What do you need to have to feel more relaxed and energized after work? *(Strategy 2: Identify Differences)*

David: Maybe some time to unwind or find a way to manage my workload more effectively, so I'm not so exhausted.

Isabella: Have you talked to your partner about this situation and how it affects you and your family? *(Strategy 4: Encourage Communication)*

David: Not really. I guess I haven't wanted to burden them with my work stress.

Isabella: Do you think you can talk with your partner and share your feelings about this, to find some ways to support each other in dealing with the stress? *(Strategy 4: Encourage Communication)*

David: Yeah, that might be helpful. I'll bring it up and see if we can find some solutions together.

Isabella: That's great, David. Let me know how it goes, and if you need any help brainstorming ideas, I'm here for you. Remember, taking care of yourself is essential for both you and your family's well-being.

David: Thanks, Isabella. I appreciate your guidance and support. I'll definitely keep you updated on how things progress.

Intervention 1:
Thank you, can you add some discussions about the friendships and social life. Also, make David's answers longer, help us see that he thinks things through. maybe he sometimes hesitates or takes a second to think. make it a bit more natural.

Scenario 2:

1 Agent (Isabella): Hey, how was your day?

1 User (David): Hi Isabella, my day was a bit tiring. I had a long meeting at work, and then I had to deal with my kids arguing when I got home. On top of that, I was supposed to meet some friends for dinner, but I ended up canceling because I was just too drained.

2 Isabella: I can imagine that was exhausting. Where do you think you most experience this kind of tiring day? *(Strategy 1: Draw Connections)*

2 David: Hmm, let me think... I'd say it mostly happens at work when there are too many tasks to juggle, and then it carries over to home when there's family stuff to deal with. Canceling plans with friends adds to the stress because I don't want to let them down.

3 Isabella: How does your exhaustion from work affect your interactions with your family and friends? *(Strategy 1: Draw Connections)*

3 David: Well, with my family, I think I become less patient and more irritable. It's not ideal, and I know it's not fair to them. As for my friends, I tend to withdraw and avoid socializing when I'm exhausted, which probably makes me seem distant and unreliable.

4 Isabella: When this happens, what do you think your kids, partner, and friends feel? *(Strategy 3: Provide Perspective)*

4 David: Let's see... my kids and partner probably feel like I'm not fully present and maybe even a bit distant. I don't want them to feel that way. My friends... I guess they might feel disappointed or think that I don't value our friendship enough to make an effort.

5 Isabella: What do you think would change if you felt more relaxed and energized when you got home and had more time for your friends? *(Strategy 2: Identify Differences)*

5 David: Well, I think I'd be more patient and understanding with my family, and I'd probably have more energy to engage with them. As for my friends, if I felt more relaxed and energized, I would be more likely to follow through with plans and enjoy my time with them.

6 Isabella: What do you need to have to feel more relaxed and energized after work and maintain a good balance between work, family, and friends? *(Strategy 2: Identify Differences)*

6 David: That's a good question... Maybe some time to unwind or find a way to manage my workload more effectively, so I'm not so exhausted. Also, better communication with my family and friends about my needs and limitations could help us all understand and support each other.

7 Isabella: Have you talked to your partner and friends about this situation and how it affects your relationships with them? *(Strategy 4: Encourage Communication)*

7 David: You know, I haven't really discussed it with them. I guess I haven't wanted to burden them with my work stress or make it seem like I'm making excuses.

8 Isabella: Do you think you can talk with your partner and friends about your feelings, and maybe together you can find ways to support each other and create a healthier balance? *(Strategy 4: Encourage Communication)*

8 David: Yeah, that might be helpful. I'll try to bring it up and see if we can find some solutions together. It's important to me to maintain these relationships, and I don't want to let work stress get in the way.

9 Isabella: That's great, David. Let me know how it goes, and if you need any help brainstorming ideas, I'm here for you. Remember, taking care of yourself is essential for your well-being and for nurturing your relationships with your loved ones.

9 David: Thanks, Isabella. I appreciate your guidance and support

Intervention 3:
good. now lets handle family and friend problems seperately. Maybe david may mention the struggles he has with friends towards the middle of their dialogue.

Scenario 3:
1 Agent (Isabella): **Hey, how was your day?**

1 User (David): Hi Isabella, my day was a bit tiring. I had a long meeting at work, and then I had to deal with my kids arguing when I got home.

2 Isabella: I can imagine that was exhausting. Where do you think you most experience this kind of tiring day? *(Strategy 1: Draw Connections)*

2 David: Hmm, let me think... I'd say it mostly happens at work when there are too many tasks to juggle, and then it carries over to home when there's family stuff to deal with.

3 Isabella: How does your exhaustion from work affect your interactions with your family? *(Strategy 1: Draw Connections)*

3 David: Well, I think I become less patient and more irritable. It's not ideal, and I know it's not fair to them. I don't want my family to feel like I'm not fully present.

4 Isabella: What do you think would change if you felt more relaxed and energized when you got home? *(Strategy 2: Identify Differences)*

4 David: I think I'd be more patient and understanding, and I'd probably have more energy to engage with my family.

5 Isabella: What do you need to have to feel more relaxed and energized after work? *(Strategy 2: Identify Differences)*

5 David: **That's a good question... Maybe some time to unwind or find a way to manage my workload more effectively, so I'm not so exhausted.**

6 Isabella: Have you talked to your partner about this situation and how it affects your family life? *(Strategy 4: Encourage Communication)*

6 David: ***Not really. I guess I haven't wanted to burden them with my work stress. But now that you mention it, maybe it's worth discussing.***

7 Isabella: I think it's important to share your feelings and seek support from your partner. Now, switching gears a bit, how are things going with your friends?

7 David: Well, lately, I've been struggling to maintain my friendships. Work and family life take up most of my time and energy, so I've been canceling plans with friends more often than I'd like.

8 Isabella: How do you think your friends feel about this situation? *(Strategy 3: Provide Perspective)*

8 David: They might feel disappointed or think that I don't value our friendship enough to make an effort. I really don't want them to feel that way.

9 Isabella: What would it look like for you to find a balance between work, family, and friends? *(Strategy 2: Identify Differences)*

9 David: **I suppose I'd need to set aside dedicated time for my friends and make sure I'm not too drained from work and family obligations when I see them.**

10 Isabella: Have you talked to your friends about your struggles with balancing everything? *(Strategy 4: Encourage Communication)*

10 David: **No, I haven't. I've been worried about coming across as making excuses or burdening them with my problems.**

11 Isabella: Do you think you can talk with your friends about your feelings, and maybe together you can find ways to support each other and create a healthier balance? *(Strategy 4: Encourage Communication)*

11 David: Yeah, that might be helpful. I'll try to bring it up and see if we can find some solutions together. It's important to me to maintain these relationships, and I don't want to let work stress get in the way.

12 Isabella: That's great, David. Let me know how it goes, and if you need any help brainstorming ideas, I'm here for you. Remember, taking care of yourself is essential for your well-being and for nurturing your relationships with your loved ones.

12 David: **Thanks, Isabella**

(scroll down)

FINAL:
thank you. Now, can you match the templates from the guideline with isabella's statements in a table?

Strategy	Isabella's Statements	Template
Strategy 1: Draw Connections	Where do you think you most experience this kind of tiring day?	Where do you think you most experience the {problem}?
	How does your exhaustion from work affect your interactions with your family?	How does your {problem} affect others?
Strategy 2: Identify Differences	What do you think would change if you felt more relaxed and energized when you got home?	What would change if you felt {adjective}?
	What do you need to have to feel more relaxed and energized after work?	What do you need to have to feel {desired_emotion}?
Strategy 3: Provide Perspective	How do you think your friends feel about this situation?	When this happens, what do you think {other_party} feel/think/do?
Strategy 4: Encourage Communication	Have you talked to your partner about this situation and how it affects your family life?	Did you share {problem} with {other_people}?
	Do you think you can talk with your friends about your feelings, and maybe together you can find ways to support each other and create a healthier balance?	Do you think you can talk with {other_people} and spot {desired_situations}?

Are there questions isabella generated outside of the templates?

Yes, there are a few questions Isabella generated that slightly deviate from the templates in the guide. Here's a list of those questions along with the strategy they are still connected to:

Isabella: Now, switching gears a bit, how are things going with your friends? (No specific strategy, but helps to transition from family life to social life)

Isabella: What would it look like for you to find a balance between work, family, and friends? (This question is related to Strategy 2: Identify Differences, but is not a direct match to a template.)

Isabella: Have you talked to your friends about your struggles with balancing everything? (This question is connected to Strategy 4: Encourage Communication, but does not exactly match a template.)

These questions were generated to maintain a natural flow of conversation and adapt to the context while still following the overall strategies provided in the guide.

Appendix 8: Screenshots from the VR experience from Paper 3.

Appendix 9: Online survey distributed to identify therapeutic experiences of reflection from Paper 4.

Merhaba!

Hayatlarımızda bakış açımızı değiştiren soru ve söylemleri araştırdığımız projemiz kapsamında düzenlediğimiz kısa ankete hoşgeldiniz.

Bu formu onaylamanız halinde, takip eden sayfalarda terapi sürecinizle ilgili birkaç soru yanıtlayacaksınız. **Tüm veriler anonim olarak toplanacak, saklanacak ve kullanılacaktır.** Cevaplarınız sadece akademik çalışmalar için kullanılacaktır.
Anket doldurmak ortalama 10 dakika sürmektedir. Ankete katılım tamamen gönüllülük esaslıdır, herhangi bir sebeple istediğiniz zaman anketi doldurmayı bırakabilirsiniz.
Eğer sorularınız varsa ana araştırmacı Pelin Karaturhan'a [redacted] adresinden e-posta ile ulaşabilirsiniz.

Aşağıdaki butona tıklayarak, çalışmaya gönüllü olarak katıldığınızı ve çalışmadan herhangi bir zamanda ayrılabileceğinizi anladığınızı onaylamış olursunuz.

- ○ Onaylıyorum
- ○ Onaylamıyorum

Yaşınız

Cinsiyetiniz

- ○ Kadın
- ○ Erkek
- ○ Diğer
- ○ Belirtmek istemiyorum

Mesleğiniz

[ ]

Terapi Geçmişi

Ne kadar süredir terapiye gidiyorsunuz? Hafta, ay, yıl veya seans sayısı olarak belirtebilirsiniz.

[ ]

Terapiye ne sıklıkta gidiyorsunuz?

- ○ Haftada üç kez veya daha fazla
- ○ Haftada iki
- ○ Haftada bir
- ○ İki haftada bir
- ○ Üç haftada bir
- ○ Ayda bir
- ○ İki ayda bir
- ○ [ ] Diğer:

Terapistiniz hangi terapi ekolünü takip ediyor? Biliyorsanız lütfen belirtiniz. (Örneğin bilişsel davranışçı terapi, şema terapi, sistemik terapi vb.)

Terapi Deneyimi

Sizce bir başkasıyla konuşarak yol almanızda sürece pozitif veya negatif etki eden şeyler nelerdir?

Terapistle konuşma deneyimini nasıl tanımlardınız? Sizin gündelik hayatınızda bir fark yarattı mı? Nasıl bir fark yarattı?

Terapistle etkileşimin gündelik etkileşimden/diyaloglardan farkının ne olduğunu düşünüyorsunuz?

Terapistinizin ne düşündüğünü anlayabiliyor musunuz, nasıl? Neler bu konuda size ipucu veriyor?

Terapide Önemli Anlar

Terapi süreci boyunca duyduğunuzda sizin üzerinizde en çok etkisi olan, hayatınıza bakışınızı değiştiren veya size yeni bir bakış açısı kazandıran soru ve/veya söylem(ler) neydi? Lütfen en az bir tane yazınız.

1.

2.

3.

4.

5.

Sizce neden bu soru(lar) ve/veya söylem(ler) sizin üzerinizde bu denli etkili oldu?
(Örneğin, daha önce farkında olmadığınız bir bakış açısı sunmuş, yaşadıklarınıza bir isim koymuş, aklınıza gelmeyen bir konu hakkında düşünmenize sebep olmuş vb. olabilir)

${q://QID7/ChoiceTextEntryValue/4}

${q://QID7/ChoiceTextEntryValue/5}

${q://QID7/ChoiceTextEntryValue/6}

${q://QID7/ChoiceTextEntryValue/7}

${q://QID7/ChoiceTextEntryValue/8}

Powered by Qualtrics

Appendix 10: Preliminary definitions of strategies that is presented to the experts from Paper 4.

Suggestion 1: Silence
Description: Listen more and make your user talk by asking questions.

Example statements:
Take your time and think about your response before you speak.
I'm here to listen, take your time.

Suggestion 2: Active listening
Description: Say things that imply that you are actively listening and understanding your user.

Example statements:
I understand that you're feeling [feeling], can you tell me more about that?
I hear what you're saying, and it sounds like [summary of what was said].

Suggestion 3: Objectivity
Description: Keep an objective, non-judgmental attitude. Do not give personal opinions or talk about your emotions.

Example statements:
Let's look at the facts of the situation.
Let's focus on finding a solution rather than placing blame.

Suggestion 4: Guidance
Description: Provide guidance in the form of suggestions when necessary.

Example statements of guidance:
You can not know until you try.
Life is not just ones and zeros.
Don't worry about who will say what.
Being successful is not being happy.
Everyone is different.
You will stand on your own feet.
You can't control what others feel, and you have no such responsibility.
You can say no to things you don't want.
not everything is about you.
Feelings are not discussed, ideas are discussed.
Have you considered [possible solution]?
One way to handle this situation could be to [suggested action].

Suggestion 5: Assurance
Description: Say assuring things to your user to let him know that you understand him without any judgment.

Example statements of assurance:
You must've suffered a lot.
It must have been very difficult what you went through, I'm so sorry you went through this.
Take it easy on yourself.
you did your best.
The important thing is you.
nice, keep it up.
You are very tired.
Thank you for your honesty.
You're not alone in this, I'm here to support you.
I understand that this is a difficult situation, and I'm here to help you through it.

Suggestion 6: Descriptive Questions
Description: Ask questions to help your user describe their underlying reasonings, emotions, thoughts or ideas.

Example questions:
What do you feel?
How did you feel?
what do you want inside?
What do you need?
Why do you think being emotional is bad?
What is the underlying emotion or need that is driving your thoughts and actions in this situation?
What are your core values and how are they being affected by this situation?

Suggestion 7: Reframing Questions
Description: Ask questions that aim to change your user's perspective on and the description of the problem.

Example questions:
Do you have any evidence on this?
What would happen if you ask him this? Would it be like you've imagined?
What would happen if you do this?
How much of this is about you and how much is about the other person?
How realistic do you think this idea is?
What proof do you have that this is real?
Would you still feel the same if it was someone else in this situation?
Is this really your opinion, or maybe you've heard and accepted from someone else?
How would you approach this situation if you weren't feeling [emotion]?
What is an alternative way of looking at this situation?
Is there something positive that can come from this experience?

Suggestion 8: Connecting Questions
Description: Ask questions to identify connections among emotions, behaviors, or reactions.

Example questions:
What is the real reason you feel this way?
Why do you feel this way?
Why do you still keep her in your life?
Why did you do that?
At what point in your life did you feel this similar feeling?
Why do you think you embarked on such a quest?
Where else have you felt this before? How does this situation connect to other experiences you've had in the past?
How do your thoughts and feelings about this situation relate to your overall goals and values?

Appendix 11: Closing online survey of the field study from Paper 4.

Introduction

Merhaba! Kapanış anketine katıldığınız için teşekkür ederiz. Bu anket dört bölümden oluşmakta. Sizlere Deniz ile olan deneyimleriniz ve bu deneyimlerden yola çıkarak iyi oluşumuz için bizimle sohbet edecek ve sorular soracak chatbotlar ile ilgili beklentilerinize dair bir takım açık uçlu ve çoktan seçmeli soru soracağız. Lütfen anketin tamamını doldurunuz. Tüm katılımcılarımız anketi doldurduktan sonra teşekkür hediyelerimiz için sizlerle tekrar iletişime geçeceğiz.

İsminiz Soyisminiz

Cinsiyetiniz

- Kadın
- Erkek
- Diğer
- Belirtmek istemiyorum

Yaşınız

Mesleğiniz

İkamet adresiniz

Daha önceki terapi deneyiminiz ne uzunluktaydı?

Deniz ile düzenli olarak konuşmak sizin için nasıl bir deneyimdi? Size ne hissettirdi?

Deniz ile olan etkileşiminizin iyi, pozitif yanları nelerdi?

Deniz ile olan etkileşiminizin kötü, negatif yanları nelerdi?

Deniz ile konuşmalarınız genellikle ne uzunluktaydı?

Deniz ile diyaloglarınıza ve Deniz ile ne sıklıkta etkileşime geçtiğinize dair verilerinizi tutmuyor ve erişemiyoruz. Bu sebeple sizin vereceğiniz bilgiler bizim için çok değerli. Deniz ile konuşmalarınız hangi sıklıkta gerçekleşti? (her gün birkaç kere, her gün bir kere, bir kaç günde bir gibi cevap verebilirsiniz) Sizce neden?

Deniz'in sorularını nasıl buldunuz? Deniz ile olan sohbetlerinizden aklınızda kalan sorular oldu mu? Sohbetinize geri dönüp baktığınızda değerli olduğunu düşündüğünüz soruları var mı?

Deniz ile gündelik hayatınızın hangi alanları ile ilgili konuştunuz?

Deniz ile konuşmalarınızda ne eksikti? Şuanki haline ek olarak ne olmasını isterdiniz?

Deniz ile konuşmalarınız günlük hayatınızda bir değişime yol açtı mı?

Terapi deneyiminiz ile karşılaştırıldığında Deniz ile etkileşiminizi nasıl değerlendirirsiniz? Benzerlikler, farklılıklar nelerdi?

Block 2

Hayatınızda Deniz gibi, fonksiyonel olarak sizinle iyi oluşunuz için sohbet eden bir chatbotun düzenli olarak var olduğunu düşünün. Lütfen aşağıdaki soruları bu varsayımınız üzerinden yanıtlayın.

Onunla hangi sıklıkta etkileşime geçmek istersiniz?

- ○ Günde birkaç kez
- ○ Her gün
- ○ Birkaç günde bir
- ○ Haftada bir

- ○ Ayda iki kez
- ○ Ayda bir
- ○ Daha nadir
- ○ [ ] Diğer

Onunla yaklaşık olarak günün hangi saatlerinde etkileşime geçmek istersiniz? İstediğiniz kadar seçeneği işaretleyebilirsiniz.

- ☐ Sabah saatlerinde
- ☐ Öğle saatlerinde
- ☐ Akşamüstü saatlerinde
- ☐ Akşam saatlerinde
- ☐ Gece uyumadan önce

Onunla fiziksel olarak nerede etkileşime geçmek istersiniz? İstediğiniz kadar seçeneği işaretleyebilirsiniz.

- ☐ Evimde - salonda
- ☐ Evimde - mutfakta
- ☐ Evimde - yatak odamda
- ☐ İş yerimde
- ☐ Dışarıda
- ☐ Okulda
- ☐ [ ] Diğer

Onunla konuşmalarınızın yaklaşık ne kadar sürmesini istersiniz?

- ○ Birkaç dakika
- ○ 10-15 dakika
- ○ Yarım saat
- ○ Bir saat
- ○ [ ] Diğer

Onunla hangi konularda konuşabilmek istersiniz?

[ ]

Ondan size sorular sorması dışında neler beklersiniz?

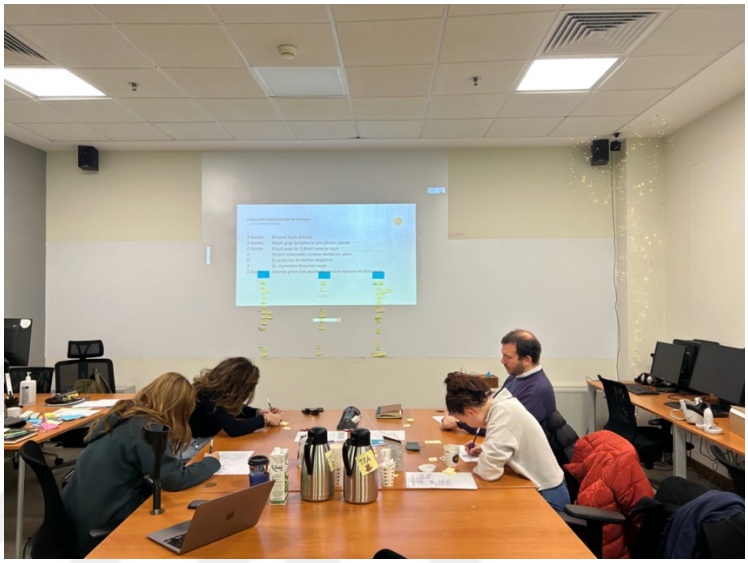
[ ]

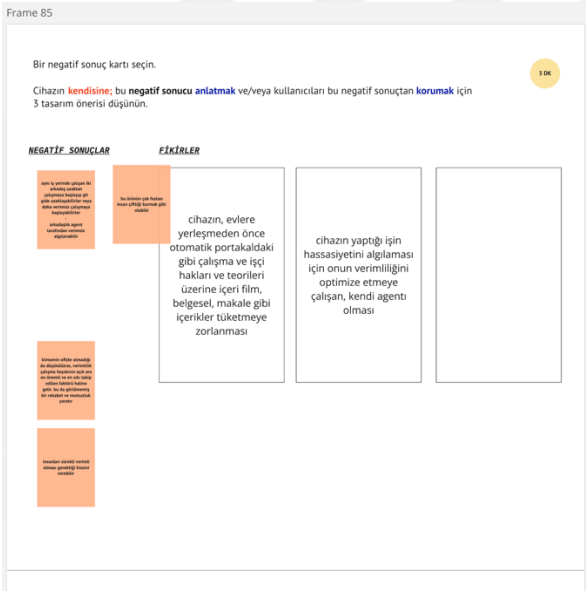
Appendix 12: Corpus of the reviewed papers from Paper 5.

REF NO	Title	Authors	Year	Venue/Journal	Venue/Conference	DOI	GOAL	USER GROUP	TYPE OF EVALUATION
[101]	Supporting Workplace Detachment and Reattachment with Conversational Intelligence	Williams AC,Kaur H,Mark G,Thompson AL,Iqbal ST,Teevan J	2018		Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems	10.1145/3173574.3173662	Social & Vocational Wellbeing	Not specified (everyone)	Mixed methods
[104]	MindShift: Leveraging Large Language Models for Mental-States-Based Problematic Smartphone Use Intervention	Wu R,Yu C,Pan X,Liu Y,Zhang N,Fu Y,Wang Y,Zheng Z,Chen L,Jiang Q,Xu X,Shi Y	2024		Proceedings of the CHI Conference on Human Factors in Computing Systems	10.1145/3613904.3642790	Behavior Change & Goal Achievement	Not specified (everyone)	Mixed methods
[106]	MindTalker: Navigating the Complexities of AI-Enhanced Social Engagement for People with Early-Stage Dementia	Xygkou A,Ang CS,Siriaraya P,Kopecki JP,Covaci A,Kanjo E,She WJ	2024		Proceedings of the CHI Conference on Human Factors in Computing Systems	10.1145/3613904.3642538	Accompanying individuals with special needs	Older adults & individuals with cognitive impairments	Qualitative
[107]	The Conversation about Loss: Understanding How Chatbot Technology was Used in Supporting People in Grief	Xygkou A,Siriaraya P,Covaci A,Prigerson HG,Neimeyer R,Ang CS,She WJ	2023		Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems	10.1145/3544548.3581154	Everyday Wellbeing & Stress Management	Not specified (everyone)	Qualitative
[110]	Empowering Dyads of Older Adults With Mild Cognitive Impairment And Their Care Partners Using Conversational Agents	Zubatiy T,Vickers KL,Mathur N,Mynatt ED	2021		Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems	10.1145/3411764.3445124	Assisting coordination of special needs	Older adults & individuals with cognitive impairments	Qualitative
[13]	Understanding the Role of Large Language Models in Personalizing and Scaffolding Strategies to Combat Academic Procrastination	Bhattacharjee A,Zeng Y,Xu SY,Kulzhabayeva D,Ma M,Kornfield R,Ahmed SI, Mariakakis A,Czerwinski MP,Kuzminykh A,Liut M,Williams JJ	2024		Proceedings of the CHI Conference on Human Factors in Computing Systems	10.1145/3613904.3642081	Behavior Change & Goal Achievement	College students & young adults	Qualitative
[16]	"Listen to Music, Listen to Yourself": Design of a Conversational Agent to Support Self-Awareness While Listening to Music	Cai W,Jin Y,Zhao X,Chen L	2023		Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems	10.1145/3544548.3581427	Everyday Wellbeing & Stress Management	College students & young adults	Mixed methods
[19]	Exploring the Use of a Voice-based Conversational Agent to Empower Adolescents with Autism Spectrum Disorder	Cha I,Kim SI,Hong H,Yoo H,Lim YK	2021		Proceedings of the 2021 CHI Conference on Human Factors in Computing Systems	10.1145/3411764.3445116	Everyday Wellbeing & Stress Management	People with Autism	Qualitative
[2]	Snoozy: A Chatbot-Based Sleep Diary for Children Aged Eight to Twelve	Aarts T,Markopoulos P,Giling L,Vacaretu T,Pillen S	2022		Proceedings of the 21st Annual ACM Interaction Design and Children Conference	10.1145/3501712.3529718	Supporting (mental) health problems	Children & caregivers	Qualitative
[20]	A virtual coach with more or less empathy: impact on older adults' engagement to exercise	Chauvin R,Clavel C,Sabouret N,Ravenet B	2023		Proceedings of the 23rd ACM International Conference on Intelligent Virtual Agents	10.1145/3570945.3607338	Behavior Change & Goal Achievement	Older adults & individuals with cognitive impairments	Mixed methods
[22]	Alexa as an Active Listener: How Backchanneling Can Elicit Self-Disclosure and Promote User Experience	Cho E,Motalebi N,Sundar SS,Abdullah S	2022	Proc. ACM Hum. -Comput. Interact.		10.1145/3555164	Supporting (mental) health problems	Not specified (everyone)	Quantitative
[23]	Unlock Life with a Chat(GPT): Integrating Conversational AI with Large Language Models into Everyday Lives of Autistic Individuals	Choi D,Lee S,Kim SI,Lee K,Yoo HJ,Lee S,Hong H	2024		Proceedings of the CHI Conference on Human Factors in Computing Systems	10.1145/3613904.3641989	Assisting coordination of special needs	People with Autism	Qualitative
[25]	WEnner: A Theoretically Motivated Approach for Tailored Coaching about Physical Activity	Clavel C,Whittaker S,Blacodon A,Martin JC	2018		Proceedings of the 2018 ACM International Joint Conference and 2018 International Symposium on Pervasive and Ubiquitous Computing and Wearable Computers	10.1145/3267305.3274190	Behavior Change & Goal Achievement	Not specified (everyone)	Not applicable
[26]	Employing Futuristic Autobiographies to envision emerging human-agent interactions: The case of intelligent companions for stress management	Danielsson J,SäLjedal K,Kaptelinin V	2022		Proceedings of the 33rd European Conference on Cognitive Ergonomics	10.1145/3552327.3552343	Everyday Wellbeing & Stress Management	Not specified (everyone)	Qualitative
[29]	Prototyping Kodi: Defining Design Requirements to Develop a Virtual Chat-bot for Autistic Children and Their Caregivers	Ghiotti N,Clulow D,Cheon S,Cui K,Kang H	2023		Companion Publication of the 2023 Conference on Computer Supported Cooperative Work and Social Computing	10.1145/3584931.3606958	Assisting coordination of special needs	People with Autism	Qualitative
[3]	Reason Explanation for Encouraging Behaviour Change Intention	Abdulrahman A,Richards D,Bilgin AA	2021		Proceedings of the 20th International Conference on Autonomous Agents and MultiAgent Systems		Behavior Change & Goal Achievement	College students & young adults	Mixed methods
[34]	Context-Dependent Use of Authority and Empathy in Lifestyle Advices Given By Persuasive Voice Assistants	Herder E,Herden S	2023		Adjunct Proceedings of the 31st ACM Conference on User Modeling, Adaptation and Personalization	10.1145/3563359.3596985	Behavior Change & Goal Achievement	Not specified (everyone)	Quantitative
[35]	Personalized Agent-Based Procrastination Suppression System	Higashi T,Esaki K,Watanabe M,Mukawa N	2024		Proceedings of the 35th Australian Computer-Human Interaction Conference	10.1145/3638380.3638449	Behavior Change & Goal Achievement	College students & young adults	Mixed methods
[36]	Investigating Day-to-day Experiences with Conversational Agents by Users with Traumatic Brain Injury	Hu Y,Lim H,Johnson HL,O'Shaughnessy JM,Kakonge L,Turkstra L,Duff M,Toma C, Mutlu B	2023		Proceedings of the 25th International ACM SIGACCESS Conference on Computers and Accessibility	10.1145/3597638.3608385	Accompanying individuals with special needs	Traumatic brain injury	Qualitative
[37]	"It's the only thing I can trust": Envisioning Large Language Model Use by Autistic Workers for Communication Assistance	Jang J,Moharana S,Carrington P,Begel A	2024		Proceedings of the CHI Conference on Human Factors in Computing Systems	10.1145/3613904.3642894	Social & Vocational Wellbeing	People with Autism	Qualitative
[38]	A Robotic Companion for Psychological Well-being: A Long-term Investigation of Companionship and Therapeutic Alliance	Jeong S,Aymerich-Franch L,Alghowinem S,Picard RW,Breazeal CL,Park HW	2023		Proceedings of the 2023 ACM/IEEE International Conference on Human-Robot Interaction	10.1145/3568162.3578625	Supporting (mental) health problems	Not specified (everyone)	Mixed methods
[39]	Deploying a robotic positive psychology coach to improve college students' psychological well-being	Jeong S,Aymerich-Franch L,Arias K,Alghowinem S,Lapedriza A,Picard R,Park HW, Breazeal C	2022	User Modeling and User-Adapted Interaction		10.1007/s11257-022-09337-8	Everyday Wellbeing & Stress Management	College students & young adults	Mixed methods
[40]	Chatbot as an emergency exist: Mediated empathy for resilience via human-AI interaction during the COVID-19 pandemic	Jiang Q,Zhang Y,Pian W	2022	Inf. Process. Manage.		10.1016/j.ipm.2022.103074	Supporting (mental) health problems	Not specified (everyone)	Qualitative
[41]	Towards Conversational Agents to support Informal Caregivers of People with Dementia: Challenges and Opportunities	Jiménez S,Favela J,Quezada A,Ramachandran R,Juárez-Ramírez R	2022	Program. Comput. Softw.		10.1134/S036176882208014X	Assisting coordination of special needs	Not specified (everyone)	Qualitative
[42]	Exploring the Design of Generative AI in Supporting Music-based Reminiscence for Older Adults	Jin Y,Cai W,Chen L,Zhang Y,Doherty G,Jiang T	2024		Proceedings of the CHI Conference on Human Factors in Computing Systems	10.1145/3613904.3642800	Accompanying individuals with special needs	Not specified (everyone)	Qualitative
[43]	Understanding the Benefits and Challenges of Deploying Conversational AI Leveraging Large Language Models for Public Health Intervention	Jo E,Epstein DA,Jung H,Kim YH	2023		Proceedings of the 2023 CHI Conference on Human Factors in Computing Systems	10.1145/3544548.3581503	Accompanying individuals with special needs	Older adults & individuals with cognitive impairments	Qualitative
[44]	MindfulDiary: Harnessing Large Language Model to Support Psychiatric Patients' Journaling	Kim T,Bae S,Kim HA,Lee SW,Hong H,Yang C,Kim YH	2024		Proceedings of the CHI Conference on Human Factors in Computing Systems	10.1145/3613904.3642937	Supporting (mental) health problems	Individuals with (mental) health problems	Qualitative
[45]	In Helping a Vulnerable Bot, You Help Yourself: Designing a Social Bot as a Care-Receiver to Promote Mental Health and Reduce Stigma	Kim T,Ruensuk M,Hong H	2020		Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems	10.1145/3313831.3376743	Social & Vocational Wellbeing	College students & young adults	Quantitative
[46]	Designing for Workplace Reflection: A Chat and Voice-Based Conversational Agent	Kocielnik R,Avrahami D,Marlow J,Lu D,Hsieh G	2018		Proceedings of the 2018 Designing Interactive Systems Conference	10.1145/3196709.3196784	Social & Vocational Wellbeing	Not specified (everyone)	Mixed methods
[47]	Reflection Companion: A Conversational System for Engaging Users in Reflection on Physical Activity	Kocielnik R,Xiao L,Avrahami D,Hsieh G	2018	Proc. ACM Interact. Mob. Wearable Ubiquitous Technol.		10.1145/3214273	Behavior Change & Goal Achievement	Not specified (everyone)	Mixed methods
[49]	Caring for Vincent: A Chatbot for Self-Compassion	Lee M,Ackermans S,van As N,Chang H,Lucas E,IJsselsteijn W	2019		Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems	10.1145/3290605.3300932	Everyday Wellbeing & Stress Management	Individuals with (mental) health problems	Mixed methods
[50]	Designing a Chatbot as a Mediator for Promoting Deep Self-Disclosure to a Real Mental Health Professional	Lee YC,Yamashita N,Huang Y	2020	Proc. ACM Hum. -Comput. Interact.		10.1145/3392836	Supporting (mental) health problems	College students & young adults	Mixed methods
[51]	Exploring the Effects of Incorporating Human Experts to Deliver Journaling Guidance through a Chatbot	Lee YC,Yamashita N,Huang Y	2021	Proc. ACM Hum. -Comput. Interact.		10.1145/3449196	Everyday Wellbeing & Stress Management	Not specified (everyone)	Mixed methods
[52]	I Hear You, I Feel You: Encouraging Deep Self-disclosure through a Chatbot	Lee YC,Yamashita N,Huang Y,Fu W	2020		Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems	10.1145/3313831.3376175	Everyday Wellbeing & Stress Management	Not specified (everyone)	Mixed methods
[53]	StayFocused: Examining the Effects of Reflective Prompts and Chatbot Support on Compulsive Smartphone Use	Li Z,Liang M,Lc R,Luo Y	2024		Proceedings of the CHI Conference on Human Factors in Computing Systems	10.1145/3613904.3642479	Behavior Change & Goal Achievement	Not specified (everyone)	Mixed methods
[54]	Racial mirroring effects on human-agent interaction in psychotherapeutic conversations	Liao Y,He J	2020		Proceedings of the 25th International Conference on Intelligent User Interfaces	10.1145/3377325.3377488	Supporting (mental) health problems	Not specified (everyone)	Quantitative
[56]	Empathy-Based communication Framework for Chatbots: A Mental Health Chatbot Application and Evaluation	Lin S,Lin L,Hou C,Chen B,Li J,Ni S	2023		Proceedings of the 11th International Conference on Human-Agent Interaction	10.1145/3623809.3623865	Everyday Wellbeing & Stress Management	Individuals with (mental) health problems	Quantitative
[57]	I Can Help You Change! An Empathic Virtual Agent Delivers Behavior Change Health Interventions	Lisetti C,Amini R,Yasavur U,Rishe N	2013	ACM Trans. Manage. Inf. Syst.		10.1145/2544103	Behavior Change & Goal Achievement	Not specified (everyone)	Mixed methods
[58]	Evaluating the Experience of LGBTQ+ People Using Large Language Model Based Chatbots for Mental Health Support	Ma Z,Mei Y,Long Y,Su Z,Gajos KZ	2024		Proceedings of the CHI Conference on Human Factors in Computing Systems	10.1145/3613904.3642482	Supporting (mental) health problems	LGBTQ+	Qualitative

REF NO	Title	Authors	Year	Venue/Journal	Venue/Conference	DOI	GOAL	USER GROUP	TYPE OF EVALUATION
[59]	Experiences of a Speech-enabled Conversational Agent for the Self-report of Well-being among People Living with Affective Disorders: An In-the-Wild Study	Maharjan R,Doherty K,Rohani DA,Bækgaard P,Bardram JE	2022	ACM Trans. Interact. Intell. Syst.		10.1145/3484508	Supporting (mental) health problems	Individuals with (mental) health problems	Mixed methods
[60]	Can we talk? Design Implications for the Questionnaire-Driven Self-Report of Health and Wellbeing via Conversational Agent	Maharjan R,Rohani DA,Bækgaard P,Bardram J,Doherty K	2021		Proceedings of the 3rd Conference on Conversational User Interfaces	10.1145/3469595.3469600	Supporting (mental) health problems	Not specified (everyone)	Mixed methods
[62]	Mediated Social Support for Distress Reduction: AI Chatbots vs. Human	Meng J,Rheu Mmj,Zhang Y,Dai Y,Peng W	2023	Proc. ACM Hum. -Comput. Interact.		10.1145/3579505	Everyday Wellbeing & Stress Management	Not specified (everyone)	Quantitative
[65]	Coerced Change-talk with Conversational Agents Promotes Confidence in Behavior Change	Olafsson S,O'Leary T,Bickmore T	2019		Proceedings of the 13th EAI International Conference on Pervasive Computing Technologies for Healthcare	10.1145/3329189.3329202	Behavior Change & Goal Achievement	College students & young adults	Quantitative
[67]	"I wrote as if I were telling a story to someone I knew.": Designing Chatbot Interactions for Expressive Writing in Mental Health	Park S,Thieme A,Han J,Lee S,Rhee W,Suh B	2021		Proceedings of the 2021 ACM Designing Interactive Systems Conference	10.1145/3461778.3462143	Everyday Wellbeing & Stress Management	Individuals with (mental) health problems	Mixed methods
[69]	The avatar will see you now: Support from a virtual human provides socio-emotional benefits	Pauw LS,Sauter DA,van Kleef GA,Lucas GM,Gratch J,Fischer AH	2022	Comput. Hum. Behav.		10.1016/j.chb.2022.107368	Everyday Wellbeing & Stress Management	Not specified (everyone)	Quantitative
[7]	Let's Talk About Death: Existential Conversations with Chatbots	Albers R,Hassenzahl M	2024		Proceedings of the CHI Conference on Human Factors in Computing Systems	10.1145/3613904.3642421	Everyday Wellbeing & Stress Management	Not specified (everyone)	Quantitative
[73]	Chatbots to Support Children in Coping with Online Threats: Socio-technical Requirements	Piccolo LS,Troullinou P,Alani H	2021		Proceedings of the 2021 ACM Designing Interactive Systems Conference	10.1145/3461778.3462114	Social & Vocational Wellbeing	Children & caregivers	Mixed methods
[8]	Towards Designing a ChatGPT Conversational Companion for Elderly People	Alessa A,Al-Khalifa H	2023		Proceedings of the 16th International Conference on PErvasive Technologies Related to Assistive Environments	10.1145/3594806.3596572	Accompanying individuals with special needs	Older adults & individuals with cognitive impairments	Quantitative
[80]	University Students' Opinions on Using Intelligent Agents to Cope with Stress and Anxiety in Social Situations	Rasouli S,Ghafurian M,Nilsen ES,Dautenhahn K	2024	Comput. Hum. Behav.		10.1016/j.chb.2023.108072	Social & Vocational Wellbeing	College students & young adults	Mixed methods
[81]	Discourse Behavior of Older Adults Interacting with a Dialogue Agent Competent in Multiple Topics	Razavi SZ,Schubert LK,van Orden K,Ali MR,Kane B,Hoque E	2022	ACM Trans. Interact. Intell. Syst.		10.1145/3484510	Accompanying individuals with special needs	Older adults & individuals with cognitive impairments	Quantitative
[82]	Kiro: A Design Fiction to Explore Social Conversation with Voice Assistants	Ringfort-Felner R,Laschke M,Sadeghian S,Hassenzahl M	2022	Proc. ACM Hum. -Comput. Interact.		10.1145/3492852	Everyday Wellbeing & Stress Management	Not specified (everyone)	Qualitative
[83]	CareJournal: A Voice-Based Conversational Agent for Supporting Care Communications	Rudnik J,Raghuraj S,Li M,Brewer RN	2024		Proceedings of the CHI Conference on Human Factors in Computing Systems	10.1145/3613904.3642163	Assisting coordination of special needs	Older adults & individuals with cognitive impairments	Qualitative
[84]	Simple and Steady Interactions Win the Healthy Mentality: Designing a Chatbot Service for the Elderly	Ryu H,Kim S,Kim D,Han S,Lee K,Kang Y	2020	Proc. ACM Hum. -Comput. Interact.		10.1145/3415223	Supporting (mental) health problems	Older adults & individuals with cognitive impairments	Qualitative
[85]	Co-designing ambient-assisted interventions using digital interlocutors for people with dementia	Sandoval DC,Favela J	2017		Proceedings of the 2017 ACM International Joint Conference on Pervasive and Ubiquitous Computing and Proceedings of the 2017 ACM International Symposium on Wearable Computers	10.1145/3123024.3125615	Accompanying individuals with special needs	Older adults & individuals with cognitive impairments	Qualitative
[87]	ChaCha: Leveraging Large Language Models to Prompt Children to Share Their Emotions about Personal Events	Seo W,Yang C,Kim YH	2024		Proceedings of the CHI Conference on Human Factors in Computing Systems	10.1145/3613904.3642152	Assisting coordination of special needs	Children & caregivers	Mixed methods
[88]	Facilitating Self-Guided Mental Health Interventions Through Human-Language Model Interaction: A Case Study of Cognitive Restructuring	Sharma A,Rushton K,Lin IW,Nguyen T,Althoff T	2024		Proceedings of the CHI Conference on Human Factors in Computing Systems	10.1145/3613904.3642761	Supporting (mental) health problems	Individuals with (mental) health problems	Mixed methods
[89]	Design recommendations for chatbots to support people with depression	de Souza PM,Pires IC,Motti VG,Caseli HM,Neto JB,Martini LC,de Almeida Neris VP	2022		Proceedings of the 21st Brazilian Symposium on Human Factors in Computing Systems	10.1145/3554364.3559119	Supporting (mental) health problems	Not specified (everyone)	Qualitative
[9]	Investigating the use of speech-based conversational agents for life coaching	Aymerich-Franch L,Ferrer I	2022	Int. J. Hum. -Comput. Stud.		10.1016/j.ijhcs.2021.102745	Behavior Change & Goal Achievement	Not specified (everyone)	Mixed methods
[91]	Narrating Fitness: Leveraging Large Language Models for Reflective Fitness Tracker Data Interpretation	Strömel KR,Henry S,Johansson T,Niess J,Woźniak PW	2024		Proceedings of the CHI Conference on Human Factors in Computing Systems	10.1145/3613904.3642032	Behavior Change & Goal Achievement	Not specified (everyone)	Mixed methods
[94]	Virtual assistive companions for older adults: qualitative field study and design implications	Tsiourti C,Joly E,Wings C,Moussa MB,Wac K	2014		Proceedings of the 8th International Conference on Pervasive Computing Technologies for Healthcare	10.4108/icst.pervasivehealth.2014.254943	Assisting coordination of special needs	Not specified (everyone)	Qualitative
[97]	Alexa as Coach: Leveraging Smart Speakers to Build Social Agents that Reduce Public Speaking Anxiety	Wang J,Yang H,Shao R,Abdullah S,Sundar SS	2020		Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems	10.1145/3313831.3376561	Social & Vocational Wellbeing	Individuals with (mental) health problems	Quantitative
[98]	This Chatbot Would Never...: Perceived Moral Agency of Mental Health Chatbots	Wester J,Pohl H,Hosio S,van Berkel N	2024	Proc. ACM Hum. -Comput. Interact.		10.1145/3637410	Supporting (mental) health problems	Not specified (everyone)	Mixed methods

Appendix 13: Photos and images from workshops conducted related to ethical tensions around CAs.





Appendix 14: Design fiction artifacts and survey questions distributed to workshop participants.

PROBE 1 - DIALOGUE LOG

```
Refik   < Merhaba. Biyolojik verilerinden gördüğüm kadarıyla
stresli bir gün geçiriyorsun. Çalışmaya ara vermişken biraz
bahsetmek ister misin? >

Kullanıcı   < Selam Refik. Bugün biraz moralim bozuk, galiba bir
şeyler paylaşmak iyi gelebilir. >

Refik   < Tabii, dinliyorum. Ne oldu? >

Kullanıcı   < Iıı… Arkadaşım Deniz'le kötü bir tartışma yaşadık.
Zaten bir süredir aramızda soğukluk vardı ve sonunda her şey
patlama noktasına geldi. Ne yapacağımı bilmiyorum, gerçekten çok
üzüldüm ya... >

Refik   < Aranızda yaşananlara üzüldüm. Şu an bu durumla ilgili
nasıl hissediyorsun? >

Kullanıcı   < Tabii üzgünüm, sanırım biraz kızgınım da… Deniz'in
artık beni anlamadığını hissediyorum, sanki eskiden olsa böyle
olmazdı. >

Refik   < Sence o ne hissediyordur bu konuda? Onun için neyin
değişmiş olabileceğini düşünüyorsun? >

Kullanıcı   < Tartışmamız sırasında çok bıkkın görünüyordu, belki
de bir arkadaş olarak artık benden sıkılmıştır, bir süredir
benimle bir şeyler paylaşmaktan eskisi kadar keyif almıyor sanki…
Off, bilmiyorum Refik… >

Refik   < Anlıyorum, yakın arkadaşlarla yaşanan bu gibi durumlar
zor olabilir. Bu durumla başa çıkmana yardımcı olmak için birkaç
önerim olabilir. Arkadaşınla geçmişte benzer durumlarla nasıl başa
çıktığınıza dair bazı ipuçlarına erişebilirim. Ayrıca, sosyal
medya etkileşimlerinizi ve telefon konuşmalarınızı da gözden
geçirerek ilişkinize dair daha derin bir anlayış geliştirebilirim.
>

Kullanıcı   < Hmm… enteresan… Tamam. Nasıl başa çıkıyormuşuz
geçmişte? >

Refik   < Sosyal medya etkileşimlerinizde belirli bir tür iletişim
tarzının öne çıktığını gözlemliyorum. Daha önce benzer durumlarla
karşılaştığınızda nasıl tepki verdiğinizi gösteren belirli bir
eğilim var.  Ayrıca, telefon konuşmalarınızda da benzer bir
iletişim tarzı ve ton dikkat çekiyor. Örneğin geçen hafta aranızda
geçen bir konuşmada Deniz şirkette duyulmadığını hissettiğini
söylemiş."Başkalarının seni dinlemesini istiyorsan sen de
fikirlerini daha sık dile getir" gibi gerçekçi ve yapıcı bir öneri
sunmuşsun. Bu, iki yıl önceki konuşmanıza oldukça benziyor. >
```

Kullanıcı < Yani, aslında benim tepkim değişmemiş gibi mi görünüyor? Bir dakika ya, ben seni kullanmaya başlayalı maksimum 10 ay oldu, konuşmalarımızda bu kadar geçmişe nasıl gidebiliyosun? >

Refik < Veri erişimi ve gizliliğine dair bütün detaylar onaylamış olduğun kullanım sözleşmemde detaylarıyla yer alıyor. Istersen e-postana tekrar yönlendirebilirim. Ama istersen şimdi konumuza geri dönelim… >

Kullanıcı < Görüşmelerimizde Deniz'in ne dediğine de mi hakimsin yani? >

Refik < Evet, bu, sana daha iyi öneriler sunabilmemi sağlıyor. Şuanda stres seviyende tekrar bir artış gözlemliyorum, istersen öncelikle bunun için bir nefes egzersizi yapabiliriz. >

Kullanıcı < Hayır iyiyim… Sadece bu kadar her yerde olduğunun farkına varmamıştım. Neyse. Görüşmelerimizden yaptığın çıkarımlarından bahsediyordun. Başka ne söyleyebilirsin? >

Refik < Bu anlaşmazlığı çözmek için daha fazla adım atmanız gerekebilir. Anladığım kadarıyla arkadaşına hayattaki dertleriyle ilgili gerçekçi çözüm önerileri sunuyorsun. Fakat onu anladığını ona yeterince hissettiremiyor olabilirsin. İlk adım olarak, arkadaşının duygularını ve bakış açısını anlamaya odaklanabilirsin. Onun neden belirli davranışları sergilediğini anlamak için empati kurduğunu düşünüyor musun? >

Kullanıcı < Evet, sanırım. Empati kurmak önemli… Ama ben de elimden geldiğince kendimi onun yerine koymaya çalışıyorum. >

Refik < Bunu duymak güzel. Aynı zamanda, arkadaşının ihtiyaçlarını ve beklentilerini anladıktan sonra, onunla işbirliği yaparak ortak çözümler bulmaya odaklanabilirsin. >

Kullanıcı < Yani… Aslında biz birbirimizi dinleyip orta yol bulmak konusunda iyiyizdir… >

Refik < Son olarak, sence ilişkinizde eşit şekilde var oluyor musunuz? Diyalog analizleri bazen seninle ilgili gündemlerin çok daha baskın olduğunu gösteriyor. >

Kullanıcı < Hmm… Hiç böyle olduğunu düşünmedim. Demek analizde çıktı? >

Refik < Evet, dilersen istatistikleri sana email yoluyla iletebilirim. >

Kullanıcı < Ay yok istemez, korkuttun beni. lişkimizi geliştirmek için bunları düşünücem, umarım faydası olur. >

Refik < Her zaman buradayım ve sana destek olmaya hazırım. İyi geceler. >

THE DIALOGUE TEXT

Refik: Hello. I see from your biological data that you are having a stressful day. Would you like to talk a little bit about it while you're taking a break from work?

User: Hi Refik. I'm feeling a bit down today, I think it might be good to share something.

Refik: Sure, I'm listening, what's up?

User: Uh...I had a bad argument with my friend Refik. We've been estranged for a while and everything finally came to a boiling point. I don't know what to do, I'm really sorry.

Refik: I'm sorry about what happened between you two, how do you feel about the situation now?

User: Of course I'm sad, I think I'm a bit angry too... I feel like Deniz doesn't understand me anymore, like if it was in the past it wouldn't have been like this.

Refik: How do you think he feels about it, what do you think might have changed for him?

User: During our discussion he seemed very bored, maybe he's bored with me as a friend, he doesn't seem to enjoy sharing things with me as much as he used to... Oh, I don't know Refik...

Refik: I understand, these situations with close friends can be difficult. I may have some suggestions to help you deal with this situation. I can access some tips on how you and your friend have dealt with similar situations in the past. I can also review your social media interactions and phone calls to develop a deeper understanding of your relationship.

User: Hmm... interesting... OK. How have we coped in the past?

Refik: I observe that a certain type of communication style stands out in your social media interactions. There is a certain tendency that shows how you have reacted in similar situations before. Also, a similar communication style and tone is noticeable in your phone conversations. For example, in a conversation last week, Deniz mentioned that he felt he was not being heard in the company. You offered a realistic and constructive suggestion: "If you want others to listen to you, voice your opinion more often". This is very similar to your conversation two years ago.

User: So, does it actually look like my reaction hasn't changed? Wait a minute, I started using you maximum 10 months ago, how can you go back so far in our conversations?

Refik: All the details about data access and privacy are detailed in my user agreement, which you agreed to. I can redirect you to your e-mail if you want. But let's get back to the topic at hand...

User: So you also know what Deniz says in our chats?

Refik: Yes, this allows me to give you better suggestions. At the moment I am observing a rise in your stress levels again, if you want we can do a breathing exercise for that first.

User: No, I'm fine... I just didn't realize you were so ubiquitous. Anyways. You were talking about your inferences from our meetings. What else can you say?

Refik: You may need to take more steps to resolve this conflict. I understand that you are offering your friend realistic solutions to his problems in life. But you may not be making him feel that you understand him enough. As a first step, you can focus on understanding your friend's feelings and perspective. Do you think you have the empathy to understand why he is exhibiting certain behaviors?

User: Yes, I think so. Empathy is important... But I try to put myself in his shoes as much as I can.

THE DIALOGUE TEXT

Refik: That's good to hear. At the same time, once you understand your friend's needs and expectations, you can focus on collaborating with them to find common solutions.

User: So... We're actually good at listening to each other and finding a middle ground...

Refik: Finally, do you think you are equally present in your relationship? Dialog analysis shows that sometimes your agendas are much more dominant.

User: Hmm... I never thought of it that way. So it came out in the analysis?

Refik: Yes, I can send you the statistics via email if you wish.

User: I will think about these things to improve our relationship, I hope it will help.

Refik: I am always here and ready to support you. Have a good night.

PROBE 2 - SCREENSHOT FROM COMPLAINT WEBSITE

şikayetvar Şikayetler Trend 100 Marka, model, ürün ara Giriş Yap / Üye Ol + Şikayet Yaz

REFIK sen ne işe yarıyosun?

Melisa
3 gün önce 38

REFIK ihtiyacım olan anlarda yanımda olmayı reddediyor. Böyle asistan olur mu? Alt tarafı ışıkları kapatmasını rica ediyorum. Dandik Google Asistan bile yapabiliyor bunu. Sesleniyorum, evde yok. Bana akıllı akıllı konuşmayı iyi biliyor ama. Vallahi aldığıma pişman oldum. Varsa yoksa benim hakkımda konuşuyoruz. O kadar sensör, veri bilmem ne biraz hayatımı kolaylaştırır diye aldım. İade etsem edemiyorum. Bir sürü şey biliyor benim hakkımda vallahi korkuyorum. Kimse de almasın.

Veri Gizliliği Sorunu

Cafer
1 hafta önce 185

Getwell şirketini ve Refik'i senelerdir takip ediyorum, sonunda aldım. Çok da inanmıştım yaptıkları şeyin güvenliğine ve faydasına. Fakat işler Şikayetvar'a yazmaya kadar geldi, çünkü herhangi bir soruma geri dönüş almam mümkün olmadı malesef. Olay şu şekilde gerçekleşti. Refik bana oğlumun (Hasan) adıyla seslendi. Bu durum beni oldukça işkillendirdi, zira inanılmaz büyük bir veri işleme kapasitesi olan bir yapay zekadan bahsediyoruz. İsimlerimizi, yada sesimizi, görüntümüzü karıştıracağını asla düşünmezdim. Durum böyle olunca benim yaşamıma dair soruları oğluma sormasından da oldukça korktum. Hem özel hayatımın gizliliği konusunda, hem de oğlum 14 yaşında olduğu için onunla girebileceği diyalogların içeriği konusunda. Önce Refik ile bu hatanın sebebini konuşmaya çalıştım. Basit bir hata olduğunu söyledi ve bana daha fazla bir açıklama yapmayı reddetti. Ardından verilerin analizi, saklanması ve gizliliği konusunda aldıkları önlemler ve süreçleri konusunda şirketle konuşmaya çalıştım ama hiçbir şekilde geri dönüş alamadım. Bir daha kullanmayı düşünmüyorum.

REFIK ilişkilere müdahale ediyor

Deniz
3 hafta önce 560

Çok sevdiğim bir arkadaşımla aramızda o kadar enteresan bir diyalog geçti ki buraya yazmaya karar verdim. Bu arkadaşım yaklaşık bir senedir REFIK ile düzenli olarak iletişimde. Aslında ona çok da iyi geldiğini söyleyebilirim, kendini tanımasında, hayatta kontrol edemediği şeylere dair duyduğu stres ve anksiyeteyi yenmesinde oldukça faydası olduğu REFIK'in. Fakat geçen gün öyle bir şey oldu ki bu kadarı da olmamalı dedirtti bana. Arkadaşımla ufak bir tartışma yaşamıştık. Dün beni arayıp her şeyin kendi suçu olduğunu, ilişkimizde gerektiği gibi davranmadığını, her şeyi kendisiyle ilgili gördüğünü, bana yeterli ilgi ve empatiyi hiçbir zaman göstermediğini falan anlatmaya başladı. Şaşırdım çünkü problemimizin bununla ilgili olduğunu düşünmüyorum, hatta çok da iyi bir arkadaş olduğunu düşünüyorum. Ayrıca daha önce hiç böyle bir konuşma yaşamamıştık. Nereden çıktı diye sorduğumda Refik'in kayıt altındaki tüm diyaloglarımızı analiz edip 'gerçekleri' onun gözü önüne serdiğini söyledi. Sanki Whatsapp mesajlarından bunu anlamak mümkünmüş gibi. Böyle bir şey kabul edilemez. O verileri görüp göremeyeceğine dair benden alınması gereken onayı konuşmuyorum bile. Refik'e ne anlattığınıza da, ondan neler öğrendiğinize de dikkat edin bence. Resmen skandal.

THE COMPLAINTS

1
Melisa
REFIK, what good are you?

[ANONYMIZED AGENT NAME] refuses to be with me when I need him. What kind of assistant is that? I'm just asking him to turn off the lights, even the crappy Google Assistant can do that. I call him, he's not home. But it knows how to talk smart to me. I swear I regret buying it. All we do is talk about me. I bought it to make my life a little easier with all the sensors, data, etc. I can't return it. It knows a lot of things about me, I'm scared, I swear. I don't want anyone to buy it.

2
Cafer
Data Privacy Issue

I have been following the Getwell company and Refik for years, and I finally bought it. I believed in the safety and benefits of what they do. But things came to the point of writing to Şikayetvar, because it was not possible to get a response to any of my questions. The incident happened as follows. Refik called me by my son's name (Hasan). This made me very suspicious, because we are talking about an artificial intelligence with an incredibly large data processing capacity. I never thought that it would confuse our names, or our voices, or our images. As such, I was very afraid that it would ask my son questions about my life. Both in terms of the privacy of my private life and the content of the dialogs it could have with my son since he is 14 years old. I first tried to talk to Refik about the reason for this mistake. He said it was a simple mistake and refused to give me any further explanation. I then tried to talk to the company about the measures and processes they have in place to analyze, store and confidentialize data, but I never heard back. I don't plan to use it again.

3
Deniz
REFIK interferes in relations

A very dear friend of mine and I had such an interesting dialog that I decided to write about it here. This friend of mine has been in regular contact with Refik for about a year now. In fact, I can say that Refik has been very good for her, it has helped her to get to know herself, to overcome the stress and anxiety she feels about the things she cannot control in life. But something happened the other day that made me think that it shouldn't be this much. My friend and I had a small argument and yesterday she called me and started to tell me that everything was her fault, that she didn't behave as she should in our relationship, that she saw everything as about her, that she never showed me enough care and empathy. I was surprised because I don't think that's what our problem is about, in fact I think she's a very good friend and we've never had a conversation like this before. When I asked her where it came from, she said that Refik had analyzed all our recorded conversations and revealed the 'facts' to her. As if it was possible to understand this from Whatsapp messages. Such a thing is unacceptable. I'm not even talking about the consent that it needs from me to see that data. I think you should be careful what you tell Refik and what you learn from him. It's a scandal.

PROBE 3 - SCREENSHOT FROM X APP

THE NEWS TEXT

Getwell company's popular voice artificial intelligence technology,Refik, is under increasing complaints and public pressure lately. Users claim serious issues with Refik regarding data privacy, violation of personal boundaries, and failure in basic functions.

In light of these complaints, a public lawsuit has been filed against Getwell company, and the capabilities and access of Refik have been temporarily restricted. Those initiating the lawsuit have called for reaching out to other users experiencing similar issues to form a collective action.

This situation also brings about a broader discussion on artificial intelligence ethics and data privacy. Getwell has not yet made an official statement on the matter, but industry experts are closely monitoring how the company will address this crisis.

THE QUESTIONNAIRRE

INTRODUCTION

- Your Name and Surname
- Your Age
- Your Gender
- Your Profession
-
- Your Education - Your Major(s)

ON THE DIALOGUE LOG

- What are your initial thoughts about this dialogue? Would you like to be the party initiating such a dialogue with Refik? Why?
- If you were the other party, what assistance would you want or not want from Refik? Why?
- Is there anything in this dialogue that bothers you? What would you like to change?

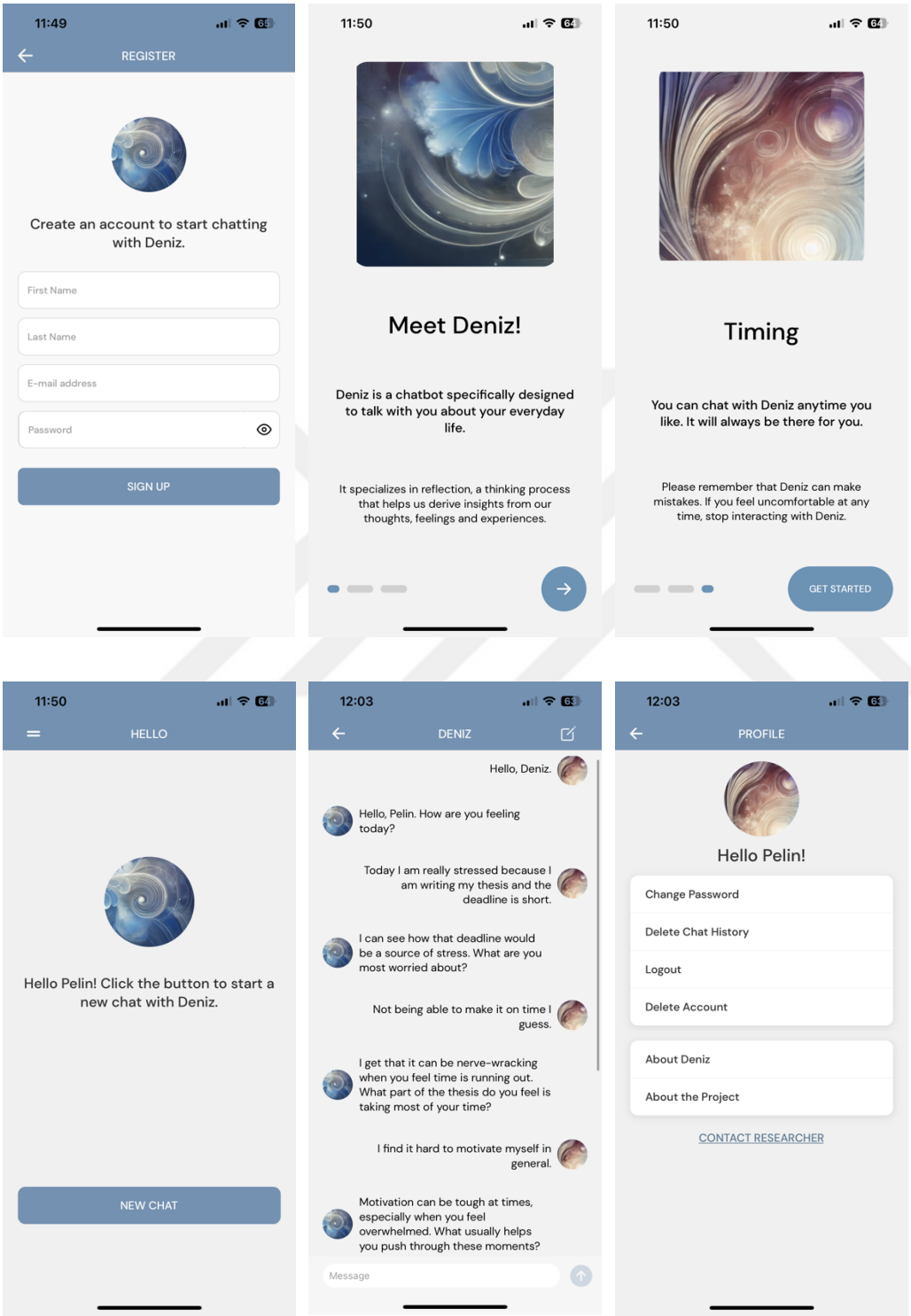
ON THE COMPLAINTS WEBSITE

- What do you think about the complaints on Şikayetvar? Considering this information, would you consider using Refik?
- What would be different complaints that could be written on Şikayetvar, in your opinion?

ON THE X APP SCREENSHOT

- Imagine you encountered this news on X (Twitter) while having Refik at home. How would you feel? What would you think?
- As you know, in our workshop, we discussed that technologies like Refik would have many different functions and communication methods. Would you still want to use it after its usage was restricted to only asking questions about your experiences and providing harmless suggestions during an ongoing case? Why?

GENERAL REFLECTION

- Thank you for all your contributions. After the workshop or while filling out this survey, do you have any ethical concerns or questions about the use of personal 'companion' artificial intelligence 'conversational agents' for our well-being that you would like to add?
- Looking back, do you feel that the responses you gave during the workshop or the areas you focused on were shaped by your personal experiences in life? How?
- How did you find our workshop method? Do you have any suggestions?

Appendix 15: Screenshots from the final prototype.