Conceptualization and Implementation of Eudaimonic Well-Being in HCI

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Dissertation

Conceptualization and Implementation of Eudaimonic Well-Being in HCI

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Abstract

The question of which paradigms, doctrines, or even ethical and legal guidelines should determine the exact form of human-centeredness in computer science remains open in the development of human-centered systems. Especially in the discussion about the use of automated decision-making systems, which increasingly make use of artificial intelligence architectures, there is a continuum of opinions ranging from a dystopian characterization of the future to the study of artificial intelligence (AI) as a cure-all. When attempting to define ethical principles, it must be acknowledged that the interpretation of moral principles of good and evil remains a question of individual reasoning. The separation into the two instances therefore did not seem to make sense in approaching the concept of human-centeredness. Frankly, the hermeneutics of *human-centeredness* is complex to the extent that necessitated a focus on alternative, supposedly more robust doctrines of development: the harmonization of human-centeredness and eudaimonic well-being, or rhetorically: is a system possibly human-centered if it *contributes* to human's well-being *in some way*?

This paradigm forms the core of the entire dissertation. In a narrow sense, this paradigm is a compromise that the *weakness* of ethics prevents us from formalizing, structuring, or even defining a boundary object or a theoretical framework for computer science. Eudaimonia, as a historical school of thought in Aristotelian philosophy, is a virtue ethics that obligates individuals morally to focus on their virtues of action, not the goal of their actions. One might think that it is *too weak*, reusing my own wording, but eudaimonia has been given a psychological research perspective that has manifested itself in emerging patterns of behavior and orientation over the last few decades. Hence, an opportunity arose for computer science and at the same time a research gap to draw the form of human-centered development of systems with the help of the eudaimonic perspective. The eudaimonic perspective of well-being opened up the possibility of avoiding a discussion about good and evil along the observed dimensions of behavior.

The dissertation is intended to provide a comprehensible introduction to the topic, i.e. first of all, the use of the term eudaimonia in human-computer interaction (HCI) was explored. It is supplemented by a further literature study that shows a range of measurement applications specifically in the context of HCI. They serve us to derive a uniform understanding of the term, take into account the perspectives of eudaimonia in HCI, but also to point out contradictions in their interpretation, and formulate suggestions for solutions. Apart from this literature work, which was necessary due to the lack of a boundary object of eudaimonia in HCI, the perception of different systems regarding eudaimonic virtues and experiences was examined in multiple studies. In the context of this

dissertation, a total of five studies will be described chapter by chapter, which should lead to further insights in the context of eudaimonic well-being in HCI. In particular, the use of artificial intelligence and eudaimonic experience of interactive systems was of importance, which can also be found in the dissertation. The four eudaimonic interaction design principles have been derived from the studies and have been incrementally integrated into the theoretical frameworks for the analysis and development of interaction systems, taking into account eudaimonic action and thus eudaimonic well-being. They serve as design guidelines for human-centered systems and address both the analytical and the developmental levels. This dissertation is intended as a foundational work on the methodological approach to the development of eudaimonic-centered systems, but it also includes two concrete architectural examples to emphasize the architectural engineering dimension of this dissertation. These studies have also led to extended insights into the conceptualization of eudaimonia in HCI.

In conclusion, it should be stated that this dissertation, with its use of philosophical-psychological research, has enabled the elaboration of theoretical concepts and the concrete development of systems and thus should also be an inspiration for future ambitions to focus on the topic of eudaimonic well-being and technology use.

Zusammenfassung

In der Entwicklung menschenzentrierter Systeme verbleibt oftmals die unbeantwortete Frage, welche Paradigmen, Doktrinen, oder gar ethischen und gesetzlichen Richtlinien die genaue Form von Menschenzentriertheit in der Informatik bestimmen sollen. Gerade in der Diskussion um den Einsatz von automatisierenden Entscheidungssystemen, die sich zunehmend Architekturen künstlicher Intelligenzen bedienen, zeigen sich wie in einem Kontinuum Meinungsvertretungen von einer dystopischen Charakterisierung der Zukunft bis zur Erhebung der künstlichen Intelligenz (KI) zu einem Allheilmittel. Bei dem Versuch, sich an eine Definition ethischer Grundsätze zu wagen, so muss man anerkennen, dass die Auslegung moralischer Prinzipien von Gut und Böse als eine Frage der individuellen Argumentation verbleibt. Die Trennung in beide Instanzen erschien daher nicht sinnvoll, sich dem Begriff der Menschenzentriertheit zuzuwenden. Offen gesagt, ist die Hermeneutik von *Menschenzentriertheit* in einem Umfang komplex, die einen Fokus auf alternative, vermeintlich robustere Entwicklungsdoktrinen notwendig machte: Die Harmonisierung von Menschenzentriertheit und eudaimonischer Zufriedenheit. Der oder die Einzelne kann auch die rhetorische Frage stellen: Ist ein System womöglich dann menschenzentriert, wenn es den Menschen *in einer gewissen Weise zufrieden* stellt?

Dieses Paradigma bildet den Kern der gesamten Dissertation. Im engeren Sinne ist dieses Paradigma ein Kompromiss, dass die Schwäche der Ethik verhindert, ein Bindungsobjekt oder ein theoretisches Rahmenwerk für die Informatik zu formalisieren, strukturieren oder gar zu definieren. Die Eudaimonie, als historische Denkweise der Aristotelischen Philosophie, ist eine Tugendethik, die den Einzelnen dazu ethisch verpflichtet, seine Tugenden, und nicht das Endziel seiner Handlung, zu fokussieren. Man möge meinen, sie ist als Tugendethik zu schwach, um hier den eigenen Wortlaut wiederzuverwenden, jedoch hat die Eudaimonie eine psychologische Forschungsperspektive erhalten, die sich im Laufe der letzten Jahrzehnte in sich abzeichnenden Regelmäßigkeiten, Handlungsmustern und Orientierungen manifestieren ließ. Es ergab sich somit eine Chance für die Informatik und zugleich eine Forschungslücke, die Form menschenzentrierter Entwicklung von Systemen mithilfe der eudaimonischen Perspektive zu zeichnen. Die eudaimonische Perspektive von Zufriedenheit eröffnete die Möglichkeit, sich entlang der erfassten Dimensionen des Handelns einer Diskussion um Gut und Böse zu entziehen.

Die Dissertation soll eine verständliche Einführung in die Thematik bieten, d.h. zunächst wurde die Begriffsverwendung von Eudaimonie in der Mensch-Computer-Interaktion (MCI) erarbeitet. Sie wurde darüber hinaus über eine weitere Literaturarbeit ergänzt, die eine Gesamtheit an Messanwendungen konkret

im Kontext der MCI aufzeigt. Sie dienen uns, ein einheitliches Begriffsverständnis abzuleiten, die Perspektiven auf Eudaimonia in der MCI zu berücksichtigen, aber auch Widersprüche in ihrer Auslegung aufzuzeigen und Lösungsvorschläge zu formulieren. Abseits dieser Literaturarbeiten, die aufgrund der fehlenden Existenz eines Bindungsobjekts der Eudaimonie in MCI notwendig waren, wurden in multiplen Studien die Wahrnehmung unterschiedlicher Systeme auf eudaimonische Tugenden des Handelns überprüft. Im Rahmen dieser Dissertation sollen insgesamt fünf Studien kapitelweise beschrieben werden, die im Rahmen der eudaimonischen Zufriedenheit in MCI zu weiteren Erkenntnissen führen sollten. Die vier Entwurfsprinzipien eudaimonischer Interaktionen wurden aus den Studien abgeleitet und sind in mehreren theoretischen Rahmenwerken der Analyse und Entwicklung von Interaktionssystemen unter Berücksichtigung eudaimonischen Handelns und damit eudaimonischer Zufriedenheit aufbauend integriert worden. Sie dienen als Entwurfskriterien für menschenzentrierte Systeme und thematisieren sowohl die analytische als auch die Entwicklungsebene. Diese Dissertation ist als Grundlagenwerk zur methodischen Herangehensweise zur Entwicklung von eudaimonisch-zentrierten Systemen gedacht, sie beinhaltet aber darüber hinaus zwei konkrete architektonische Umsetzungen, um den ingenieurstechnischen Charakter dieser Dissertation zu betonen. Auch diese Studien haben erweiterte Erkenntnisse hervorgebracht, die Konzeptualisierung von Eudaimonie in HCI zu konkretisieren.

Abschließend lässt sich formulieren, dass diese Dissertation mit ihrer Verwendung von philosophisch-psychologischen Forschungsarbeiten die Erarbeitung theoretischer Konzepte und die konkrete Entwicklung von Systemen ermöglicht hat und somit zugleich zukünftige Inspiration für Ambitionen sein soll, sich der gemeinsamen Thematik von eudaimonischer Zufriedenheit und Technologienutzung fokussiert zu widmen.

Publications

The content of this thesis has already partially appeared in the following publications or are currently under review:

Jörs, J. M. & De Luca, E. W. (2025). Eudaily: Supporting University Students in Daily Eudaimonic Reflection Using the Reflective Play Framework. In Proceedings of the 17th International Conference on Computer Supported Education (CSEDU 2025) - Volume 1, ISBN 978-989-758-746-7, ISSN 2184-5026, pages 484-491, doi: 10.5220/0013347000003932.

Jörs, J. M. & De Luca, E. W. (2025). Examining the Eudaimonic Experience: Differences between Well-Being Orientations Regarding Motivation, Engagement, and Basic Psychological Needs in Interaction with AI, 58th Hawaii International Conference on System Sciences (HICSS 2025), pages 5995-6004. https://hdl.handle.net/10125/109566.

Jörs, J. M. & De Luca, E. W. (2025). LLM-Enhanced Exploratory Learning with LaLaMoSuLe: Understanding the Interplay between AI-Powered Educational Interfaces, Eudaimonic Experience, Autonomy, and Competence Perceptions. 15 pages. The 26th International Conference on Artificial Intelligence in Education (AIED 2025), July 22-26, 2025, Palermo, Italy, doi: 10.1007/978-3-031-98420-4_21.

Jörs, J. M. & De Luca, E. W. (2025). Measuring the Experience of Eudaimonic Virtues in Technology Interaction: Development and Validation of the Eudaimonic Interaction Inventory (EII), in The Weizenbaum Journal of the Digital Society (WJDS), Special Issue: Well-Being in the Digital World, Vol. 5 No. 3, 29 pages, doi: 10.34669/wi.wjds/5.3.4.

Jörs, J. M. & De Luca, E. W. (2024). Can We Ethically Influence Learning Processes By Technology? Effects Of Interruptions On Knowledge Assessment, Journal of Technology, Knowledge and Learning, doi: 10.1007/s10758-024-09805-7.

Jörs, J. M. & De Luca, E. W. (2024). Perfect Eudaimonic User Experience Design That Aristotle Would Have Wanted, ACM Designing Interactive Systems (DIS 2024), pages 96-101, doi: 10.1145/3656156.3663737.

Both subchapters of Chapter 3, are literature reviews and at the time of submission under review at the Journal of Behavior & Information Technology.

Jörs, J. M. & De Luca, E. W. (2025). Eudaimonic HCI: Building a Multi-Level Conceptual Framework for Eudaimonia in HCI Using a Hybrid Thematic Analysis, Behaviour & Information Technology, Special Issue on Designing with AI for wellbeing, 27 pages. *under review.*

Jörs, J. M. & De Luca, E. W. (2025). Measuring the impact of interactive technology on eudaimonic well-being: a scoping review, Behaviour & Information Technology, 40 pages. *under review.*

Other related work that was not part of this dissertation:

Jörs, J. M. & De Luca, E. W. (2024). Tell Me What You Like & I Tell You What You Aim For: A Well-Being Centered Group Recommender System Using A Hybrid Approach, WI 2024, Short Paper. https://aisel.aisnet.org/wi2024/107/.

Jörs, J. M. & De Luca, E. W. (2024). Through Eudaimonia's Lenses: EudAImonic Well-Being Variables As Guiding Principles For AI Design, ACM CHI Conference on Human Factors in Computing Systems Workshop: (Designing (With) AI for Well-Being, 6 pages.

Jörs, J. M. & De Luca, E. W. (2024). Emphasizing Well-Being: Building The First Public Eudaimonic and Hedonic Dataset For Well-Being-Centered Recommender Systems, doi: 10.21203/rs.3.rs-4589418/v1.

Jörs, J. M. & De Luca, E. W. (2023). Predictive Behavior Modeling Through Web Graphs: Enhancing Next Page Prediction Using Dynamic Link Repository, @ 2023 IEEE International Conference on Web Intelligence and Intelligent Agent Technology (WI-IAT). link, doi: 10.1109/WI-IAT59888.2023.00068.

1 Introduction

1.1 Preface

Taking the simple example of an input-transform-output paradigm, computer science is primarily concerned with improving the quality of the output by optimizing the transformation. In interaction research, the analysis shifts to improving the quality of the transformation process. For example, the idea of "slow technology" [188] was an attempt to conceptualize a development doctrine that moves away from necessary materialistic effectiveness, i.e., solely focusing on a certain outcome, but rather perceiving technology design as *process-oriented experience* design. The idea of eudaimonia, which forms the core of this dissertation, requires a focus on activity and its facets, rather than the fulfillment of a simple goal. The logic of this *tricky* transfer of a doctrine, focusing on the experience of a transformation process, seems to be difficult for HCI research. This can be seen, for example, in the analysis of the Eudaimonic Technology Experience Scale (ETES) [550], which, inter alia, addresses the fulfillment of personal goals under the dimension "Eudaimonic Goals": "This system stimulated me to pursue my goals" [550, p. 1909]. In this interpretation, the idea of a eudaimonic experience with technology remains as a relation of personal goal fulfillment, which basically dresses up every form of a goal as eudaimonic. Furthermore, the possibility of differentiation with hedonia as a goal-oriented ethic of pleasure fulfillment is lost. A personal goal can also be *pleasure*, so the boundary between hedonia and eudaimonia becomes blurred. Does this mean that the concept of eudaimonia in HCI is a *dead end*? With Robert Nozick's thought experiment from 1974 [352, pp. 42-45] (see illustratively in Figure 1.1), one returns to a fundamental question regarding well-being effects and technology: Is the physical connection to

a machine having a permanent hedonic stimulation of goal fulfillment *a valid generator of well-being*? *Does a life like this make one actually happy?* For most of the participants of Nozick's thought experiment, this was not the case. The interpretation of eudaimonia as personal fulfillment causes a problem of authentically capturing the effects of technology on eudaimonic well-being in education, work, and private life. Is the human being,

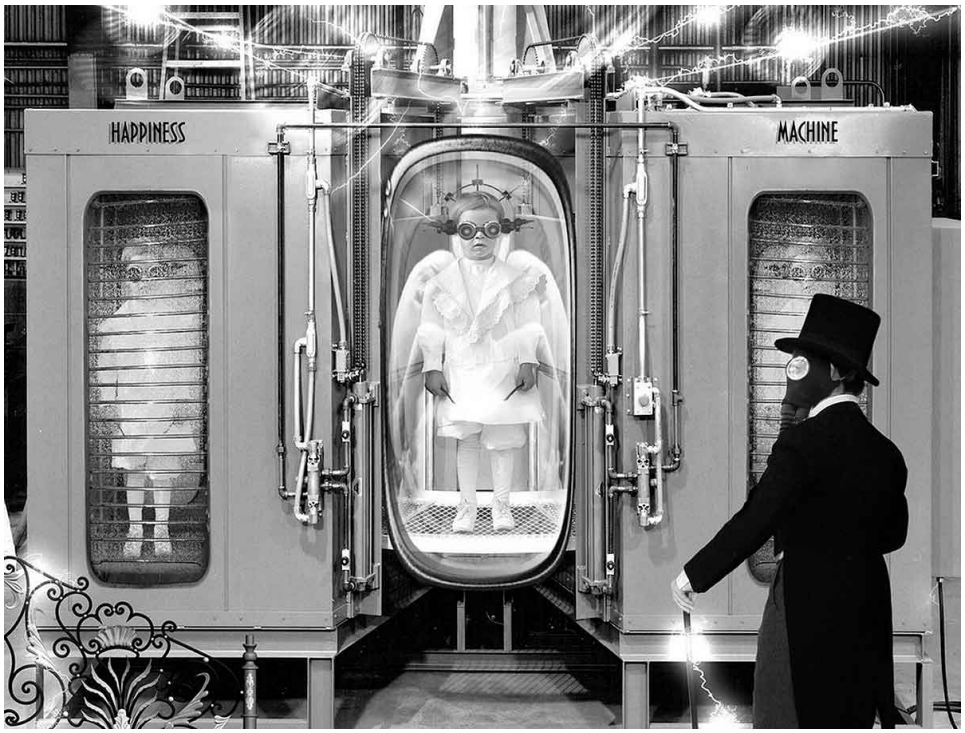

Figure 1.1: Robert Nozick's 'Experience Machine' (1974), illustration extracted from The Collector [397]

perhaps, according to the Aristotelian perspective, actually keen to optimize his or her virtuous actions and to orient himself or herself against the mere fulfillment of a goal? These lines of thought are already finding favor in HCI research, that not only the mere hedonic goal of pleasureful use can represent a doctrine of development. In 1995, Artz illustrated in his article "Computers and the Quality of Life" the importance of developing excellence and virtuous behavior while referring to the concept of eudaimonia [25]. When one comes across the position paper by Sarkar [433], one might find the doubt cast on a doctrine of simplicity and Sarkar's plea for intensive, long-term use, which he called "negotiated complexity". Tractinsky's

paper [500], which certainly led to controversy, on the question of whether usability is an umbrella term and his call for well-defined constructs to be investigated, may also be linked to these paradigms. Particularly in the reflection of hedonistic social structures ("Hedonic psychology reflects our times." [413, p. 203]), a virtue-oriented interaction conception was thus appealing. In our correspondence, Sarkar pointed towards a study by Mekler and Hornbæk [324] that led to the idea of concretizing eudaimonic interactions on the way to developing a conceptualization of eudaimonic well-being. The results of Mekler and Hornbæk [324] suggest that there is an opportunity in the psychological interpretation to address the behavioral orientations of a group of users who differ from hedonistic and extrinsically motivated individuals. This opened up the possibility that a psychological perspective on eudaimonia could provide more robust arguments as to which principles of action within a technological interaction need to be addressed and respected, and whether the influence of these interactions on well-being can be measured. The philosophical-psychological perspective thus opened the door to defining an interdisciplinary research project - the conceptualization and implementation of eudaimonic well-being in HCI.

1.2 Motivation of this thesis

A *minimal* adjustment of interaction leads to significant differences in human thought processes and behavior [56, 57, 95, 98, 157, 240, 247, 302, 440]. Hence, if one considers accepting the possibility of a change in thought processes and behavior as a consequence of technological interaction, this constellation can equally result in changes in psychologically relevant variables in the short or long term [69]. Analyzing those effects is anything but trivial: For example, the sense of control, as a form of agency, is a significant element during the interaction with technology [50, 344, 458]. However, equating autonomy in life and agency during the interaction is not recommended when considering the numerous understandings of autonomy [45]. It may be more useful to consider autonomy in different spheres (e.g., experiences within an environment and in everyday life), as Calvo et al. illustrate in a paper with the Spheres of Autonomy in HCI [74, p. 38] or Peters et al. with the Motivation, Engagement and Thriving in User Experience (METUX) model [372]. Furthermore, is the maximization of agency

per se a plausible call for maximizing perceptions of an autonomous self? Unfortunately, it's not that simple.

For example, the principle of the marginal control of technology [379, p. 40] is a prerequisite for enabling an individual without profound information technology (IT) knowledge to use technology for doing a task at all. It is only with the necessary autonomy that an interface provides that a person can take on their task and, to a certain extent, *feels well* doing it. Maximizing autonomy as a strategy of opening up complete control of technological processes (e.g., demanding code expression using Assembler) would thus be a misleading conclusion, in order to contribute in some way to, for example, the much-discussed dimension of autonomy as a factor of eudaimonic well-being [418] or basic psychological needs theory [514].

On the other hand, technology can influence perceptions of one's own autonomy in such a way that users feel frustrated in their own perception [57, 69, 244]. One might polemically advise the user to simply not use the technology, but this shortcut in reasoning cannot be taken too easily. Norman puts it: "As I watched people struggle with technology, it became clear that the difficulties were caused by the technology, not the people" [349, p. 7]. This statement indirectly requires us to consider that the technology we design can have consequences outside the interface sphere. For example, Partala and Saari show in their work that the valence of the user experience is also affected by the fulfillment of psychological needs [363]. The authors advocate that more attention be paid to the users' psychological needs and understandings of value: "The technologies and activities have to be in line with the users' values (cf. value-sensitive design) and they also have to fit into the use's life so that the user thinks that any changes contribute positively to overall well-being (flourishing; cf. life-based design)" [363, p. 392]. It opens up the space, apart from the mere concept of usability and thus a mere problem-oriented design of technology [399], for alternative doctrines or in the words of Tractinsky's "well-defined constructs" [500, p. 131]. In the book *The Design of Everyday Things* by Norman, the following section can be found: "Interaction design draws upon principles of psychology, design, art, and emotion to ensure a positive, enjoyable experience" [349, p. 5]. The technology must create an *enjoyable* experience. With reference to Sarkar [433], alternative doctrines can also be formulated that can be viewed independently of the enjoyability of a system. As an engineer, one has the choice of implementing certain

values in a system [70, 160, 307, 358]. Looking at current developments, the notion of "well-being" is emerging as a new development doctrine.
In Aristotle's conception, eudaimonia is a virtue ethics, i.e., the individual strives for deeper principles of his or her actions such as authenticity, meaningfulness, excellence, and growth [224] that emphasizes living in accordance with the *daimon* or "true self" [35, 351]. The normative of eudaimonia [127] is therefore a way of aligning actions in one's own life with virtues for the benefit of one's own *daimon*. Ruini and Ryff provide an overview of numerous positive connections attributed to the strengthening of physical health as well as the reduction of biological risk factors through a eudaimonic way of living [406, p. 156]. Not surprisingly, Soren & Ryff call for a "eudaimonic vision" of the experience of work and life [468]. The Institute of Electrical and Electronics Engineering's (IEEE) 7010 standard introduces the need to consider implications for an individual's well-being with regard to artificial intelligence [438]. The institute had already advocated in 2017 that well-being and human autonomy over productivity should be prioritized when developing technology [81]. Furthermore, the Organization for Economic Co-operation and Development (OECD) published two working papers in the last quarter of 2024, one addressing the influence of digital technologies on well-being [290] and the other measuring eudaimonic well-being within a population [1]. For the OECD, specific measures of eudaimonic elements within a population are important [1, p. 42]: meaning, purpose, autonomy, relatedness, competence, and accomplishment. In addition to that, the Sustainable Development Goals (SDGs) also include good health and wellbeing as a third element[1]. Shneiderman formulates the rhetorical question of his HCAI systems regarding well-being: "Does the system support human health, comfort, and values?" [457, p. 246]. In the context of developing recommender systems, several experts have also considered facets of eudaimonic well-being, such as authenticity or personal growth [220], in the context of a common vision of *human values* that should be taken into account in development [480, p. 6]. A recent workshop at the CHI conference on Human Factors in Computing Systems, titled "Designing (with) AI for Well-Being," was specifically dedicated to the question of how AI opens up "new opportunities for the development of systems and technologies for wellbeing" [134, p. 1]. In addition, a research group has

[1] https://sdgs.un.org/goals

been established that is specifically concerned with design issues related to well-being: the SIGWELL (Special Interest Group in Design for Wellbeing, Happiness, and Health in the Design Research Society) [498]. Finally, *humanity-centered* design [175] has evolved considering entire ecosystems and populations over the long term in the process of designing technology. Thus, eudaimonic well-being is becoming increasingly important for design considerations in HCI.

This can be seen as a more advanced form of HCI. Hans-Georg Gadamer, a German philosopher, characterized technology in an interview with Swiss TV in 1984 as a construct for distancing oneself from nature, referring to Aristotle, who saw technology as an instrument for filling the gaps left by nature[2]. The omnipresence of technology leads to HCI research gaining an extraordinary role, as it no longer only understands the technologies it develops as problem-solving constructs being evaluated by their effectiveness [399], e.g., to fill the gap left by nature, but also as a "shaper" of a significant part of our realities. Thus, for HCI, several questions arise: what significance does a particular technology have, how does it influence my actions and relations, and how does it affect my well-being? Or to put it provocatively: The question of a *supposedly* right way to live also seems to be a question of the way we interact with technology and the world.

In this context, the discussion of a right and wrong way of living seems to be insufficient, especially for deriving an engineering perspective. Since the introduction of the term *Affective Computing* [375], moralizing concepts can be found such as *Value-Sensitive Design* by Friedman [160] connected vice versa to human-centered AI [457], which calls for an increasing moralization of technology in dimensions such as trustworthiness, safety, and reliability. Furthermore, ethical frameworks and statements on information systems and AI, in general, can be found [154, 470, 510]. Especially in the context of AI, the necessity of an analysis that critically evaluates *value sensitivity* in every design phase is becoming important [427]. One also finds further forms of moralizing aspirations in interaction research, pointing to considerations such as the "Ethics of User Experience Design" [519] or the "Ethics of Conversational User Interfaces" [291].

This dissertation is specifically not intended to be integrated into the *sole* canon of philosophical positioning. Its foundation is a compromise solu-

[2] https://www.youtube.com/watch?v=I-5_I8Z6PmA

tion, namely the connection to psychological research, which provides a basis for the deduction in HCI. Norman shares a definition of the approach of human-centered design, which at the same time represents a paradigm of the work: “Good design starts with an understanding of psychology and technology.” [349, p. 8]. Stephanidis et al. [476, p. 1248] formulate in their

Figure 1.2: “Seven HCI Grand Challenges”, illustration extracted from [476, p. 1231]

declaration of the seven major HCI challenges (see Figure 1.2), eudaimonia as one of their declared challenges. The problem is that human eudaimonia is “entirely subjective” [476, p. 1248] from their perspective. The perspective of Krontiris et al. can also be added, that a “universal moral code” cannot be defined [274, p. 7]. Taking into account existing psychological research on well-being orientations (eudaimonic, hedonic, and extrinsic motivated individuals), differences can be found in terms of experiences, specific behavior, and orientations in behavior [220, 223, 357, 527, 561] as well as specifically in HCI research [163, 244, 245, 253, 269, 324]. One shares Diener’s interpretation that eudaimonia is “a particular value framework” [126, p. 543] and that one can use these understandings of value from psy-

chological research instead of opening oneself to an ethical discussion of values. This is how the interdisciplinary bridge of this dissertation is formed. The discussion about well-being has been given new impulses by the rise

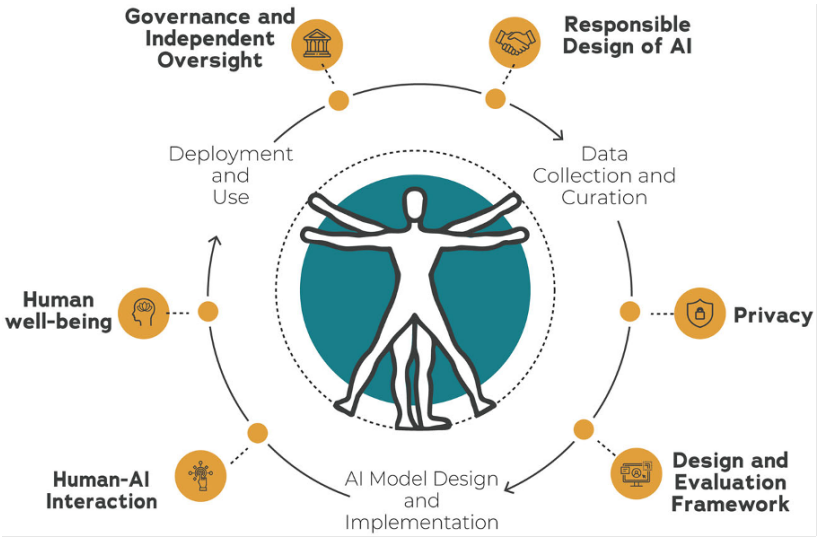

Figure 1.3: "The six Human-Centered Artificial Intelligence Grand Challenges", illustration extracted from Garibay et al. [165, p. 392]

of AI [134, 139, 244]. When formulating the six "Human-Centered Artificial Intelligence Grand Challenges" [165] (see Figure 1.3), the authors address the promotion of eudaimonic well-being and flourishing, in particular in interactions with AI [165, p. 394].
The general aim of this thesis is to formulate a profound engineering strategy in the face of the multitude of demands for a reorientation of technology development towards eudaimonic well-being, while also focusing on the question of AI and its impact on eudaimonic well-being. The exact aim will be presented in the following chapter.

1.3 Aim of this thesis

First of all, it may be useful to formulate what the aim of this thesis is *not* intended to be. It is not intended to provide a complete reproduction of Aristotle's idea of eudaimonia (1), nor to claim to have finalized the form of eudaimonic HCI (2). The aim is to take an interdisciplinary engineering perspective to capture the gravitational field of eudaimonic experiences in

HCI, because one is still confronted with the "broad moniker of eudaimonia" [509, p. 3]. Stephanidis et al. formulate: "Moreover, in a world where technology is omnipresent, the question arises of how its role towards enhancing well-being and human eudaimonia can be optimized, especially addressing interaction issues and ensuring a human-centered approach" [476, p. 1232]. Specifically, three essential challenges regarding eudaimonic well-being in HCI are mentioned [476, p. 1249]: (1) the problematic definition and measurability of eudaimonia, (2) the subjective nature of the concepts (which makes modeling and analysis difficult), and (3) the scope of the concepts, which is too broad, such that eudaimonia is related to community well-being, planet goodness, and human rights and fair labor. These issues also served to derive five fundamental research questions that are addressed in the context of this dissertation:

Research Question 1 (RQ_1): Is it possible to derive a common understanding of eudaimonic well-being in HCI?

Research Question 2 (RQ_2): Can philosophical-psychological research be used to systematize eudaimonic experience in HCI?

Research Question 3 (RQ_3): Which forms of eudaimonic behavior can be contextualized in HCI?

Research Question 4 (RQ_4): How can a eudaimonic experience be modeled and implemented in HCI?

Research Question 5 (RQ_5): How can eudaimonic experience be systematically measured regarding eudaimonic functioning in HCI?

In Chapter 4, which contains an overview of all studies conducted, it should be noted that further research questions and hypotheses have been partially formulated for a specific research context. However, the totality of all research efforts consistently addresses the five general research questions of this dissertation, which were defined above. In order to focus on these research questions of the dissertation, the structure of this thesis will be explained to illustrate the overall organization of the dissertation (a graphical overview can be found in Figure 1.4 below).

1.4 Structure of this thesis

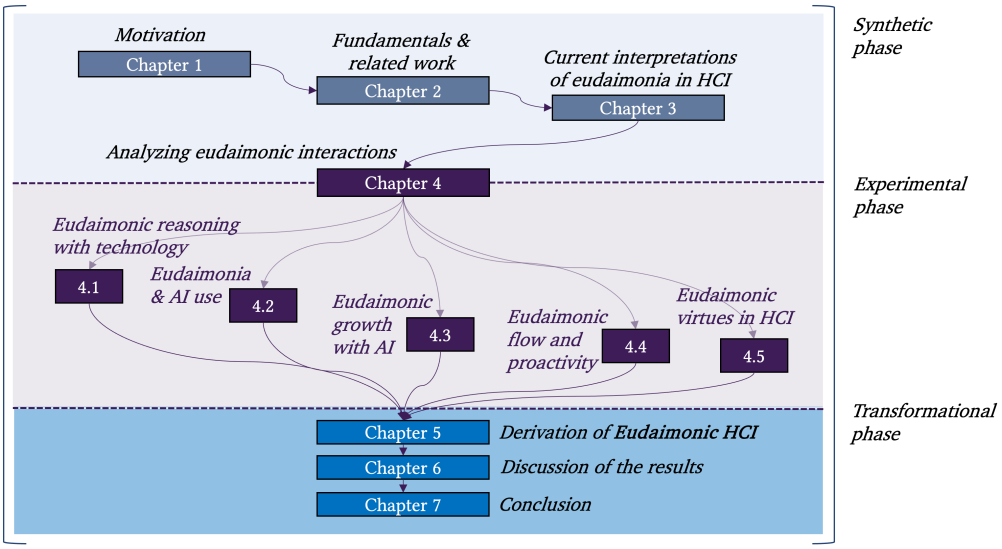

Figure 1.4: An overview of all chapters and the respective topic addressing in a structure graph.

The studies and literature reviews (Chapter 3 and Chapter 4) are purposely arranged so that the reader of this dissertation can follow how the eudaimonic interaction principles and the corresponding micro, macro, and measurement models are derived in Chapter 5. A conscious decision was also made against a chronological order of the de facto publication date in Chapter 4, in which the results of the studies are presented, in order to achieve a logical order within the dissertation. The interdisciplinary nature of this dissertation, i.e., in addressing psychological, philosophical, but also primarily computer science and engineering perspectives, should make the dissertation comprehensible in its reasoning to many different domain experts.

Thus, the dissertation begins with a fundamental introduction to the motivation, objectives, and structure (*Chapter 1*). In the final subchapter of this first chapter, the novelty of this thesis is outlined. In addition, the added value for computer science and other research disciplines is stated.

The following *Chapter 2* provides an extensive presentation of the historical context surrounding the question of well-being. The Chapter 2

is divided into several subchapters, which then enable the transition to conceptual considerations in HCI. The aim is to make the reader aware of the topic of well-being and existing theoretical considerations of these topics in HCI.

Chapter 3 contains two extensive overviews of previous uses of the term and measurement applications of eudaimonic well-being in HCI. Both chapters are separate literature reviews. The overview of all definitional interpretations, studies, and position papers was processed using a hybrid thematic analysis (inductive and deductive approach) [384]. In Chapter 3.2, the results of an analysis of existing psychological measurement applications regarding eudaimonic well-being in HCI are presented. Through the interdisciplinary application of measurement methods, which extends from game research to the application of tourism technology, a scoping review proved to be a suitable research approach, which was implemented using the PRISMA extension and corresponding guidelines [373, 501].

This work builds the foundation for the development of a proprietary measurement tool, the Eudaimonic Interaction Inventory (EII), the validation process of which can be found in *Chapter 4*. In general, Chapter 4 includes all the studies presented that contributed to the development of the conceptual model repertoire of eudaimonic HCI. They also include a total of two finalized engineering examples: a pragmatic learning tool called “Large Language Model Supported Learning tool” (LaLaMoSuLe) and a web-based contemplation application called “eudaily” (eudaimonia + daily). A total of five studies are presented, the methodology of which is explained in detail in each chapter. For the derivation of one’s own scale, it must be mentioned that three distinct studies were conducted within the study. All studies were carried out to justify the derivation of eudaimonic HCI in Chapter 5.

In *Chapter 5*, one synthesizes the results of the studies from Chapter 4. This chapter transfers all the study results into theoretical frameworks that are derived from them. Under the term “Eudaimonic HCI”, there are several models that build on each other. One begins with the introduction of the four C’s of eudaimonic interaction, a distinction between two developmental doctrines (*doctrine of support* and *doctrine of simulation*), and

transfer this constellation into a model of how the design principles can be integrated into the interaction and measured in their effect. Through the connection to psychological research, measurement recommendations, and interaction strategies are also derived.

In *Chapter 6*, a general discussion is formulated of what contribution has been made with eudaimonic HCI and to what extent computer science can benefit from this framework. It also shows possible points of criticism and the necessity of a discussion of certain interaction principles regarding eudaimonic well-being, e.g., the quantification of user activities.

Chapter 7 is the final chapter of this dissertation, which primarily provides a summary of the conducted studies and once again contextualizes the previous motivation and problem definition of this dissertation. Finally, eudaimonic HCI is to be placed in the canon of future research for eudaimonic well-being in HCI in order to highlight contributions, but also open research questions.

1.5 Novelty of this thesis

The novelty of this dissertation consists of taking an engineering perspective on eudaimonic well-being. Furthermore, despite an extensive presentation of theoretical foundations, the fixation of contributors to subjective, psychological, or eudaimonic well-being is a perspective on the interactive level of the experience only peripheral or in isolated studies. Despite existing contributions, eudaimonic well-being is still declared as a challenge in HCI [165, 476], whose common foundation is simply missing. This dissertation is an attempt to synthesize all existing theoretical considerations and studies (see Chapter 2 and 3) in order to develop a common conceptual understanding. In Chapter 4, two concrete architectural ideas are illustrated to demonstrate the transition of theory into practice. In the following, the presentation of the results of the two literature studies in Chapter 3 marks the beginning of the entirety of all research efforts in the direction of eudaimonic well-being.

2
Fundamentals

Chapter 2 can be characterized as a theoretical introduction to the psychological perspective of well-being, different forms of well-being, and well-being theories (Chapter 2.1) that are related to eudaimonic well-being. In addition, the chapter concludes with related theoretical frameworks in HCI (Chapter 2.2) that will be presented in the context of eudaimonic well-being. A general introduction is given below.

Human beings in their wonderful diversity find stimulation of their own well-being from many resources. Some forms of behavior can be identified that one pursues because these aspects of life are simply enjoyable. We like to be entertained, to communicate with each other, to engage in physical activities, or to read a good book [561]. It seems to be important how we reward ourselves and what goal motivates our actions [348, 453]. Our mere satisfaction apparently gives way to the question of the meaningfulness of our own existence. Within research, sources for a stimulation of one's own meaningfulness can be identified: It manifests itself through altruistic behavior [40, 64, 135], positive relationships with others [40, 104, 259], a sense of nostalgia when listening to music, [36], or in certain states of complete immersion and concentration in the sense of *flow* [102]. However, materialism also serves many people today as a source of their well-being [309], which is not reflected in a sustainable life aspiration [254]. With the thought experiment of Nozick, the system of eternal technical hedonism should appear questionable [352]. The idea of *radical* hedonism by Aristippus of Cyrene had already been given to his audience several hundred years earlier: "the goal of life is to experience the maximum amount of pleasure" [411, p. 143]. Aristippus of Cyrene stated, "that pleasure is the sole good, but also that only one's own physical, positive, momentary pleasure is a good,

and is so regardless of its cause" [491, p. 317]. In conclusion, hedonia is "[...] the belief that one is getting the important things one wants, as well as certain pleasant affects that normally go along with this belief" [273, p. 178].

Aristotle proposed an alternative to this hedonic perspective, that the satisfaction of appetites cannot be the long-term reason for one's actions: "For the many, they suppose, tend towards it and are in fact enslaved to pleasure" [35, p. 210]. Ryan & Deci summarize the Aristotelian position as follows: "Aristotle, for example, considered hedonic happiness to be a vulgar ideal, making humans slavish followers of desires" [411, p. 135]. In Aristotle's work, Nicomachean Ethics (Book 1, Chapter 4), the term eudaimonia occurs for the first time [35, p. 5]. Eudaimonia is a virtue-oriented concept of happiness, i.e., the individual strives for deeper principles of his or her actions, such as authenticity, meaningfulness, excellence, and growth [224] that emphasizes living in accordance with the daimon or "true self" [35, 351]. For example, Ryff states: "Daimon, then, is an ideal in the sense of an excellence, a perfection toward which one strives, and it gives meaning and direction to one's life" [416, p. 1070]. In order to live in accordance with their "daimon", eudaimonic-oriented individuals must align their activities with the development of their own best potential, engage in the sharing of experiences with others as a form of self-expression, or engage in spiritual activities [532]. The idea of eudaimonia and its psychological derivation serves as the theoretical foundation of this dissertation. However, before these translations are presented, a brief summary of the theoretical conception of well-being is provided, since the identification of certain psychological dimensions of eudaimonic well-being is historically grounded.

In 1921, Allport wrote an article in "The Psychological Bulletin" entitled "Personality and Character". [13, pp. 347-357]. In this article, Allport presents various perspectives that offer a contemporary definition of personality. It contains references to contemporary psychiatrists and Freudian psychologists who are developing the first theories on the psychology of personality. It is less a derivation of facets, which makes us happy, but rather an interpretation of the primitive human being, with which doctrine it encounters the world, e.g., the perspective of Adler [5] and the human *inferiority complex* or the formulation of the biologist Le Dantec, that the

action is determined by egoism [288]. However, it can be deduced that at that time, the satisfaction of the individual was considered to be the general doctrine by stimulating his or her egoism or reducing his or her inferiority complex.
In 1954, Maslow wrote his famous work "Motivation and Personality" [317], which to this day is the basis for the hierarchical representation of human needs in the form of Maslow's hierarchy of needs. He is also known for introducing the term *positive psychology* with the title of the last chapter in his book: "Toward a Positive Psychology" [317]. As a more personally motivated concern, Maslow addresses in Chapter 11, "Self-Actualizing People: A Study of Psychological Health," the question of how a particular group of people, to whom Maslow attributes a certain level of self-actualization, articulate, behave and, above all, what characteristics they have [317, pp. 149-180]. The selection of participants was heuristic, as Maslow also emphasizes, and he explains that the results of the study cannot be considered scientifically robust [317, pp. 149-151]. Maslow formulates one of the core heuristics for this study as follows: "They are people who have developed or are developing to the full stature of which they are capable" [317, p. 150]. Regarding the selection of suitable participants, Maslow further writes [317, p. 151]: "We had to stop excluding a possible subject on the basis of single foibles, mistakes, or foolishness; or to put it in another way, we could not use perfection as a basis for selection, since no subject was perfect". Maslow presents an evaluation of the abilities and characteristics of this group of people, which allows them to be attributed to his form of psychological wealth. It is an "efficient perception of reality" [317, p. 153] that protects individuals from making false judgments and identifying lies. The own acceptance of the self, others, and nature is a further aspect [317, p. 154]. Maslow adds properties such as spontaneity, simplicity, naturalness, problem-centering, need for privacy, independence, autonomy, and activity. The totality can be found on the following pages in his book [317, pp. 154-180]. Remarkably, many of the facets listed in this section are also found in the psychological or eudaimonic well-being research [416].
But before the concept of eudaimonic well-being is even recognized, Diener introduces the concept of "Subjective Well-Being" (SWB) [126]. In the '60s and '70s, the emergence of the concept of SWB began. Wilson had just formulated the conclusion in a review after submitting his dissertation in 1960 that little theoretical progress had been made in the process of

understanding the concept of happiness [546]. Diener ties in with this review and refers to hundreds of studies that have appeared since this publication [127, p. 543]. Diener also mentions the idea of recognizing normative definitions of happiness that go beyond subjective feelings. In this context, he also mentions *eudaemonia*, the process of achieving "a virtuous life" [126, p. 543] through harmony with one's own value framework. This also includes a reference to flow theory, which Diener sees as an explicit formulation of an activity theory in combination with SWB [100]. However, his own position, regarding SWB, is reduced to a text fragment [126, pp. 548-549], which states that a person is exposed to a constant balance of positive and negative effects so that a constant dominance of positive or negative effects determines an individual's overall feeling. Sander refers to this interpretation as the hedonic approach to well-being in his book contribution "Positive Computing" [432, p. 310]. Based on the work of Diener, Wilson, and Maslow, efforts are constantly being made to develop psychological measurement instruments and theories of the dimensions of the good life or the meaning of life in general. Battista and Almond [37] exemplarily address the meaning in life when developing "The Life Regard Index" [37]. Watson et al. present the Positive and Negative Affect Schedule (PANAS) Scale, which is designed to measure a dichotomous structure of positive and negative effects in a given period of time [536].

In 1989, Ryff drew attention to the lack of focus on aspects of psychological well-being [416]. Ryff contextualizes her concept of well-being with the Aristotelian idea of eudaimonia: "It may also be the dimension of well-being that comes closest to Aristotle's notion of eudaimonia [...]" [416, p. 1071]. Thus, the psychological interpretation of virtue ethics begins to emerge, which is reflected in further contributions of psychological research [225, 531, 532].

To provide a better overview, also with regard to the previous applications of well-being concepts in HCI, a series of well-being theories will be presented that have already formed a theoretical foundation in HCI. Eudaimonia has left its mark on these derivations and is constantly reflected in other concepts of life, such as ikigai [276, 338, 388] or Confucian ethics [543]. However, the following Chapter 2.1 only contains a collection of theories that are both closely related to eudaimonic theory (1) and have already served as a theoretical foundation in HCI (2). Huta's psychological

modeling of eudaimonia is, inter alia, outlined, which offers us, in this dissertation, the theoretical foundation for eudaimonic HCI in Chapter 5.

2.1 Well-Being Theories

2.1.1 Flow Theory

Vittersø sees flow theory included in the idea of eudaimonic well-being [520, p. 143]. As early as 1975, Csíkszentmihályi formulated the idea of autotelic activities, which justifies pursuing an activity solely out of intrinsic motivation to do it [100]. In his famous work, "Flow - The Psychology of Optimal Experience" [101], Csíkszentmihályi makes a significant plea for the things that should actually satisfy us. In this book, Csíkszentmihályi formulates the reclaim of the experience [101, pp. 16-20] by creating an independence from socially conditioned duties, an awareness of the "here and now", a form of consciousness realization, and, to a certain extent, justifiable satisfaction of needs. Furthermore, Csíkszentmihályi attempts to derive an *optimal experience*, which he deduces from the functioning of one's own consciousness [101, p. 39]. In a later section, Csíkszentmihályi refers to this experience as *flow* [101, p. 54]. These processes are accompanied by a sense of growth [101, p. 40]. A few years later, Jackson and Csíkszentmihályi formulated nine dimensions of flow, a term that Csíkszentmihályi had already introduced in a book a decade earlier [230, pp. 16-31]:

1. **Challenge-skills balance**: Enlargement of the self to new levels and the importance of one's own belief in one's abilities is more important than the ability per se.
2. **Action-awareness merging**: The alignment of one's actions with one's awareness (can also be understood as the alignment of body and mind). Both authors also characterize this as a process of total absorption [230, p. 20].
3. **Clear goals**: A further flow component is the clarity of intention, to focus attention and avoid distraction. This is a kind of "moment-by-moment awareness" [230, p. 21].
4. **Unambiguous feedback**: It is less about correctly understanding and more about learning from clear mistakes, than about directing the

flow state through external feedback or body signals. The information environment is used by those in the flow state to check their objectives and make any necessary adjustments [230, p. 23].

5. **Concentration on the task at hand**: In this point, the authors formulate the necessity to exclude irrelevant thoughts from consciousness and to transform oneself into a state of a "disciplined mind" [230, pp. 25-26].

6. **Sense of control**: This feeling implies the certainty that one does not have to be in direct control, but is aware that one can be [230, p. 26]. The prerequisite for this is one's own belief in having the necessary skills for the task at hand.

7. **Loss of self-consciousness**: The flow state ensures the disappearance of worries or negative thoughts because you are absorbed in the activity. Becoming one with your own activity implies a release from a certain self-consciousness.

8. **Transformation of time**: The flow state is characterized by a lack of perception of time, which arises as a "[...] by-product of total concentration" [230, p. 29].

9. **Autotelic experience**: This is where the connection to the types of motivation in self-determination theory arises, characterizing the autotelic experience as one that is based solely on intrinsically desired motivation. This results in enjoyment of the activity itself [230, p. 30].

Several works have already been dedicated to selected dimensions of flow theory in HCI. As an example, the theoretical model of flow by Hoffmann and Novak [207] can be found in Figure 2.1. Furthermore, in their paper, Finneran and Zhang show various architectures that should enable the implementation of flow experiences in computer-mediated environments [150]. In addition, flow theory serves as the theoretical foundation for the architecture of "Positive Technology" [394]. The architecture of "Positive Technology" will be characterized in Chapter 2.2.4. Aside from this architecture, there are numerous studies on the consideration of a flow experience in HCI, especially in games research [82, 83, 84, 96, 97, 171, 197, 232, 337, 356, 377, 378, 485, 516]. In the following, one of the theoretical models that

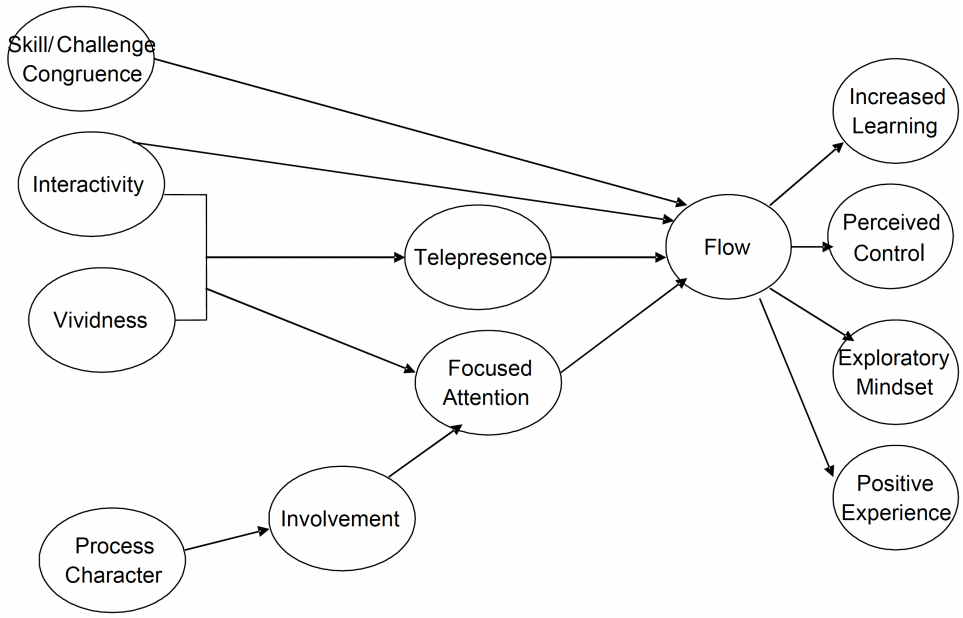

Figure 2.1: Extracted from [150, p. 85], Finneran and Zhang describe it as an adaptation of Hoffmann and Novak [207].

has been shown to be a common reference in many HCI contributions will be presented: Ryff's variables of psychological well-being [416].

2.1.2 Ryff's Psychological Well-Being

One year after the publication of Watson et al. [536], Ryff published under the title "Happiness Is Everything, or Is It? Explorations on the Meaning of Psychological Well-Being" with the formulated necessity to reconsider the shape of psychological well-being [416]. Key aspects of positive functioning have still not been formulated [416, p. 1069]. Ryff therefore aims to define the "contours" of psychological well-being and provides a brief description of these variables [416, p. 1071]. In Figure 2.2, the components are illustrated and will be characterized in greater detail below.

Autonomy

A person's autonomy encompasses their "independent, self-determining, and self-regulating qualities" [418, p. 376]. With reference to Maslow's interpretation of self-actualization, Ryff formulates the importance of "au-

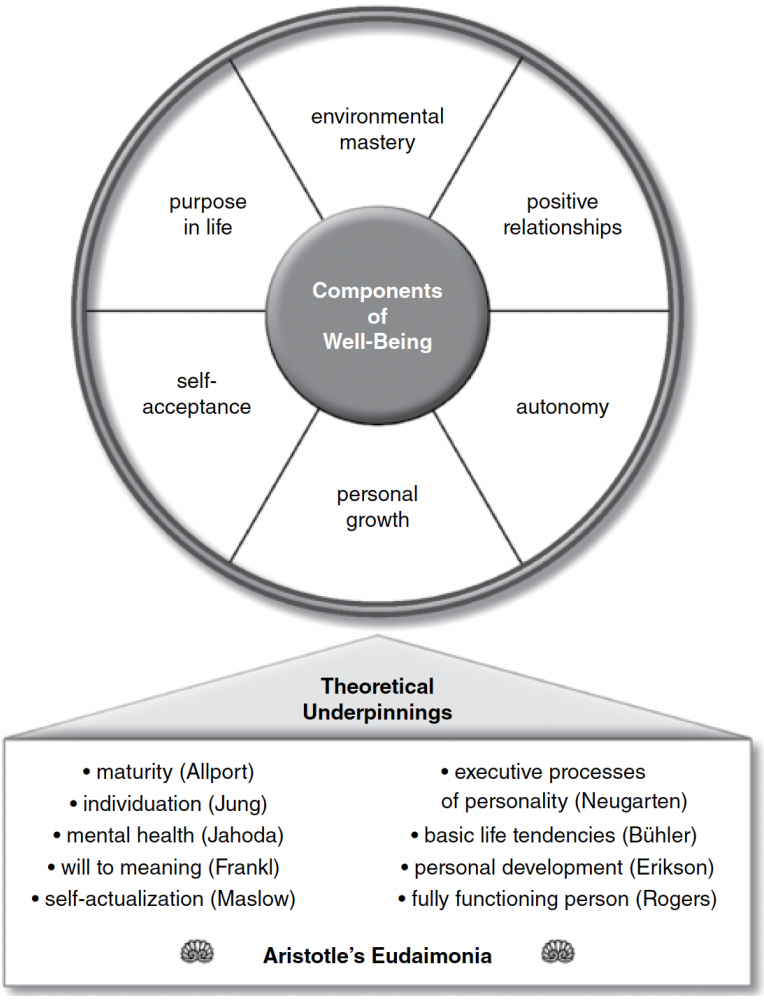

Figure 2.2: Components of eudaimonic well-being defined by Ryff, the illustration is extracted from Ryff [418, p. 377].

tonomous functioning and resistance to enculturation" [416, p. 376]. Figure 2.2 shows that Ryff's theoretical underpinnings also include Rogers, Jung, Erikson, and Neugarten and their corresponding values of internal locus of evaluation, deliverance from convention, turning inward in later life and even "gaining a sense of freedom from the norms governing everyday life" [418, p. 376]. In particular, the internal locus of evaluation, with Ryff's reference to Rogers' work, can be linked to the concept of autotelic personalities [136].

The definition of autonomy is set at a high level. In all subsequent chapters, the aspect of autonomy will turn out to be a hierarchical variable in HCI,

which means that it is necessary to differentiate between an understanding of autonomy in life and during an interaction. This will be outlined in Chapter 5 in greater detail.

Environmental Mastery

The second of Ryff's six components is "environmental mastery" [416]. Environmental mastery involves a sense of competence and mastery in managing one's environment, making effective use of the opportunities in one's environment, and selecting the appropriate means for one's personal needs and values [416]. It reflects "a kind of fit between one's outer and inner worlds" [418, p. 378]. Under this component, Ryff also positions Allport's maturity, i.e., "being able to extend the self into spheres of endeavor that go beyond the self" [418, p. 378]. In the previous elaboration of the "Questionnaire for measuring Eudaimonic Experiences in School (QEES)" [143], a measuring instrument for capturing eudaimonic experience in school with technology, there is a dimension of "environmental control" based on the theoretical basis of Ryff's components, so that the idea of environmental mastery in HCI is reflected. As with the discussion of autonomy as a component of eudaimonic well-being, feelings of environmental mastery in life must be carefully derived through the stimulation provided by games and technology interactions [444, 445]. This transfer is discussed in detail in the general discussion (Chapter 6).

Purpose in Life

The third component, "purpose in life" [416], is more complex. In general, Ryff states: "One who functions positively has goals, intentions, and a sense of direction, all of which contribute to the feeling that life is meaningful." [416, p. 1071]. However, this meaningfulness changes in the course of one's life history and also manifests itself in the redefinition of one's own purposes [418]: In childhood, we tend to have a passion for learning and experimentation, are creative or productive in midlife, and yearn for emotional integration in later life [342]. Having a purpose in life at all is likely to reduce possible pathological signs in old age [419]. In Chapter 6, the severity of the issue of integrating purposes or meaningfulness in HCI is addressed again. In the course of developing one's own inventory in Chap-

ter 4, this has become particularly apparent through the emergence of a distinct purpose within the interaction. The term “meaning” has been used in HCI in many different ways [325], so it is recommended to determine the chosen semantics of meaningfulness in the interaction in advance in the course of conducting research in this regard. This will be made clear in the development of the inventory in Chapter 4, as already indicated.

Personal Growth

Regarding personal growth, it is important that the individual continues “to develop one’s potential, to grow and expand as a person” [416, p. 1071]. Personal growth is not limited to a final goal but represents a permanent process. In this context, Ryff states: “Such an individual is continually developing and becoming, rather than achieving a fixed state wherein all problems are solved” [416, p. 1071]. This component is often referred to in connection with HCI. This notion of growth is found synonymously in many contributions to eudaimonic well-being, expressed as self-improvement, seeking challenges, striving for inspiration, curiosity, and working on one’s personal best [219, 225, 416, 535]. In the fact that we grow with our decisions, there are also more critical voices [139, 395] that the increasing transfer to technology, making decisions for us, may be an obstacle to our own growth. Consequently, the experience of personal growth will also have a dimension in the inventory to evaluate this facet during an interaction with technology (see Chapter 4).

Positive Relations with Others

An interpersonal aspect is the component of positive relations with others, which is qualitatively associated with terms such as warmness or trustness [416]. Ryff provides a clear characterization: “Self-actualizers are described as having strong feelings of empathy and affection for all human beings and as being capable of greater love, deeper friendship, and more complete identification with others” [416, p. 1071]. For example, Keyes systematizes five dimensions of social well-being [258, p. 209]: social integration, social coherence, social actualization, social acceptance, and social contribution. In this dissertation, the component of social technology has been specifically excluded due to its own complexity and dynamics. However, it has

been included as an element in the combined model in the hybrid thematic analysis (Chapter 3) as a form of possible experience in interaction with technology. In Chapter 6, a research claim is made for intensive research regarding the social dimension of eudaimonic well-being in HCI.

Self-Acceptance

The sixth and final component is self-acceptance [416]. Ryff again refers to Maslow: "Having positive self-regard is a central feature of self-actualizers" [418, p. 379]. It encompasses perceiving and accepting oneself in the moment, but also in the past [416]. To develop self-acceptance, it is necessary to create time and space for self-reflection [219]. In one of the studies presented in this dissertation, an example of a technological interaction is shown of how spaces for reflection can be created. A theoretical work has already been contributed with "Slow Technology" [188], which understands technology as an enabler of reflection processes (characterized in Chapter 2.2.2).

The six dimensions of psychological well-being [420], proposed back in 1995, received empirical counter-opinions [86, 511]. In a commentary by Ryff and Singer [421], the authors defend the existence of a six-factor model after further authors have critically commented on this theory. Ryff and Keyes defended the six-factor model in a further study several years after the first publication [420]. These principles are closely intertwined with eudaimonic well-being as a concept [220]. Ryff's defined "core dimensions" of psychological well-being, i.e., autonomy, environmental mastery, personal growth, self-acceptance, purpose in life, and positive relationships with others [417], ought to be "consistent with a eudaimonic perspective" [417, p. 11] on well-being. In Chapter 3, when exploring measurement applications of eudaimonic well-being in HCI, Ryff's scale on its dimensions is a preferred approach for capturing an effect on overall eudaimonic well-being through technological interaction. Considering Huta's psychological framework [220], the analysis of eudaimonic functioning with the help of these variables is a reasonable strategy, but it addresses a relatively *high level* so that it was only partially considered within the conceptualization of eudaimonic HCI, namely as a measurement dimension of technological interactions on general eudaimonic well-being. This is

discussed in detail in Chapter 5. Another related well-being theory and an established theoretical foundation in HCI, which will be outlined below, is the Self-Determination Theory (SDT).

2.1.3 Self-Determination Theory

The Self-Determination Theory (SDT) is one of the most well-known meta-theories for deriving basic human needs and the significance of types of motivation [116, 408]. The theory is divided into several subtheories, as illustrated in the work of Vansteenkiste et al. (e.g., causality orientations theory, cognitive evaluation theory, goal contents theory, and organismic integration theory) [514]. These subtheories address the way people experience life, i.e., how their motivations, goals, and values are understood in interpersonal and cultural interactions [117]. The most well-known subtheory, which is most frequently applied, is the basic psychological needs theory (BPNT). The BPNT of SDT contains the declaration of three basic psychological needs for *competence*, *autonomy*, and *relatedness* [117]. Autonomy characterizes the stimulation of striving for personally motivated purposes to pursue what one authentically strives for [391]. Ryan et al. state that when a human being acts "with autonomy, a person is fully functioning, willingly engaged in activity with awareness and congruence, and able to harness vitality in the self-regulation of action. This full functioning is reflected as well in indicators from physiology to performance" [412, p. 98]. There is also a reference to the connection between autonomy and the internal perceived locus of causality (IPLOC): "Whether or not we experience an IPLOC is critical to a sense of personal responsibility, guilt, interest, and other significant psychological processes and the behaviors that follow from them" [412, p. 98]. "The need for competence concerns the sense of efficacy one has with respect to both internal and external environments" [414, p. 153]. Thus, competence points to the need for efficacy and personal growth, which one achieves by overcoming challenges, learning new things, and feeling mastery [392]. Finally, "the need for relatedness refers to feeling connected to and cared about by others" [414, p. 153]. These basic needs must be fulfilled in their entirety; we cannot do without them [117, 314].

Furthermore, SDT is understood as a growth-oriented model [117], which sees people actively seeking challenges to growth on a personal and in-

terpersonal level. Hence, a connection manifests itself in the idea that eudaimonic-oriented individuals strive for autotelic purposes. The SDT declares this kind of intrinsic purposing as an optimal form of motivation on a continuum of different types of motivation [409]. The continuum is shown in Figure 2.3. The SDT distinguishes between different types of

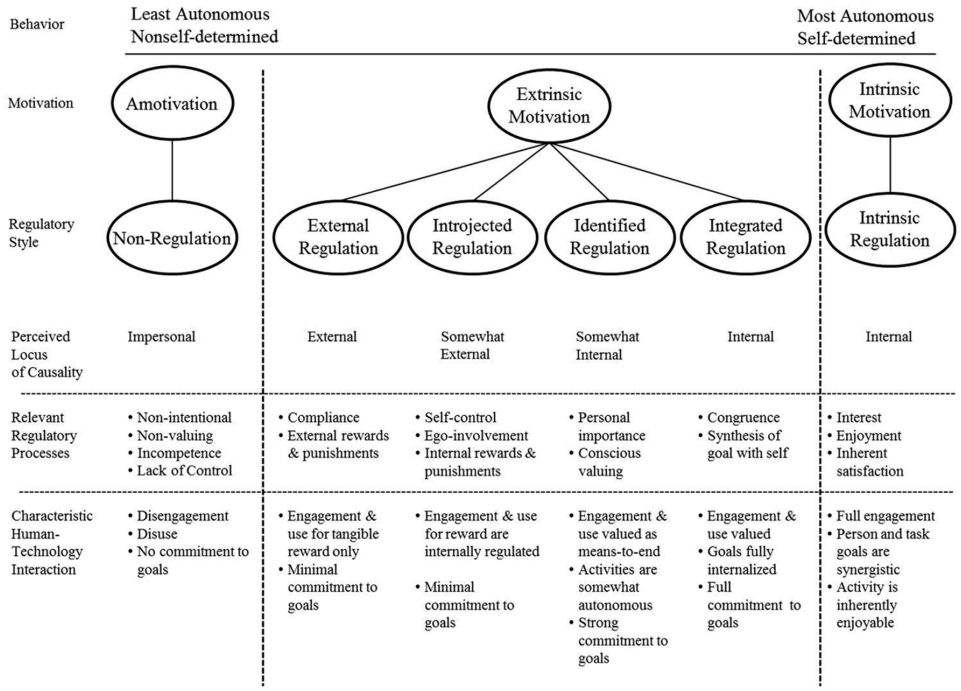

Figure 2.3: Extracted from Ryan and Deci [408] by Szalma [486, p. 1459] in the context of defining motivational design principles for human–technology interaction.

motivation: “SDT focuses on the multiple kinds of motivations underlying human behaviors, holding that not all types are created equal.” [412, p. 98]. This is also shown by the reference to one of the subtheories, the causality orientations theory [514, pp. 125-126]. Low feelings of autonomy thus bring about changes in behavior that are associated with an experience of control, whereas high feelings of autonomy are associated with acting “in accord with their own emerging interests and self-endorsed values [...]” [514, p. 125]. Empirically, extrinsic motivation has a negative effect on the composition of one’s intrinsic drive [115, 453]. Hence, there is a connection between eudaimonia and the SDT [119, 410, 413, 414, 414, 422]. DeHaan and Ryan state: “SDT’s focus on full functioning has linked it with

eudaimonic thinking, a tradition that also distinguishes mere happiness from living well" [119, p. 42]. The reference to "self-endorsed values" may also imply a kind of normative standard, as does eudaimonia [126, p. 543]. There are further subtheories within SDT [514]. The organismic integration theory (OIT) suggests the existence of different extrinsic types of motivation so that it cannot be assumed that there is only one type of extrinsic motivation, but that it should be understood in layers [514, pp. 112-113] (see also Figure 2.3). Thus, the form of an "identified regulation" is classified as autonomous motivation [514, p. 115], hence, extrinsic motivation does not always have to be completely rejected. Another subtheory is the goal contents theory, i.e., the SDT separates the content of the goals and the process that regulates the achievement of the goal [117]. There is empirical evidence that extrinsic goals, which an individual feels pressured to achieve, can affect well-being [453]. Another subtheory of SDT, the cognitive evaluation theory (CET), "proposes that events and conditions that enhance a person's sense of autonomy and competence support intrinsic motivation, whereas factors that diminish perceived autonomy or competence undermine intrinsic motivation" [415, p. 3]. The subtheories thus always revolve around the three basic psychological needs, which are more or less stimulated by different dynamics of one's own goal setting and motivation.

The SDT is a popular theoretical framework in HCI. There is a wide range of studies that use SDT to analyze the effects of design factors on user behavior, thus only a small selection of previous work can be referenced [9, 11, 31, 66, 69, 124, 189, 304, 371, 415, 503, 505, 554, 556]. However, it has been formulated, for example, that "self-determination theory is the Pikachu[1] of motivation research in HCI" [376, p. 261]. Tyack and Mekler state regarding the use of SDT in HCI: "Despite the popularity of SDT-based measures, however, prominent core concepts and mini-theories are rarely considered explicitly, and few papers engage with SDT beyond descriptive accounts." [503, p. 1]. The SDT, therefore, often serves as a convenient all-rounder that overshadows the use of alternative motivation theories [376, p. 262].

[1] Pikachu, as an allegory for the researcher and their over-reliance on SDT, is a Pokémon that serves as a one-size-fits-all solution for every Pokémon battle in the series of the same name [376, p. 261].

2.1.4 Positive Psychology & PERMA

The concept, which was introduced by Maslow earlier, is reintroduced by Seligman and Csíkszentmihályi in 2000 [450]. In their article titled "Positive Psychology," Seligman and Csíkszentmihályi describe the need to refocus psychology away from a purely reparative agenda and toward the development of positive qualities for human flourishing [450, p. 5]. They advocate for the field of positive psychology as one that recognizes multiple levels, e.g., subjective level, individual level, and group level [450, p. 5]. They divide the subjective level into three time units (in the past, for the future, and in the present), each associated with different values. For example, hope and optimism are important for the future, while flow and happiness are important in the present. Being important for the past, the authors name well-being, contentment, and satisfaction as variables. In 2011, Seligman formulated his "PERMA" model in his book "Flourishing" with the variables Positive Emotions, Engagement, Relationships, Meaning, and Accomplishment [449]. The school of thought of positive psychology, for example, has been the basis for "Positive Technology" by Riva et al. [394]. In her review article, Diefenbach discusses the idea of positive psychology and interactive technology [125]. She formulates various challenges in this context, such as the design of a "therapeutic dialogue" [125, p. 9], but also the importance of psychological perspectives within the design, the effects of which often cause the non-recording of possible dynamics that are not desired [125, p. 11].
The subdivision into three broad levels (subjective, individual, and group) did not appear suitable for a targeted approach to eudaimonic well-being. However, it draws on concepts and a range of experiences that are consistent with eudaimonic-oriented individuals, such as the flow concept. In the course of the literature research, however, a theoretical concept was encountered that can be identified as such in the context of the dissertation as a suitable foundation for deriving eudaimonic well-being in HCI.

2.1.5 Huta's Concept of Eudaimonic Well-Being

After completing her dissertation in 2005 [218], Huta, together with Ryan, one of the pioneers of SDT, formulated an article in the *Journal of Happiness Studies*, which addresses the differentiation of hedonia and eudaimonia in

more detail [224]. Four studies show differences for both orientations, but also that the greatest form of well-being could be achieved by combining both sources of well-being [224, p. 735]. A questionnaire called the Hedonic and Eudaimonic Motives for Activities (HEMA) scale was used to divide the subjects into two well-being orientations (hedonic and eudaimonic), and the respective items are reported in their paper [224]. The HEMA scale is a common instrument in HCI for a differentiation between eudaimonic and hedonic experiences in HCI[2] [324, 390, 446]. The scale has been also used for the majority of one's own studies in this dissertation [242, 244, 245, 246]. In 2014, Huta and Waterman formulated a significant concept, i.e., a classification and terminology for eudaimonic well-being [226, p. 1431]. Huta and Waterman derive four distinct categories of analysis of eudaimonic well-being: *orientations*, *behaviors*, *experiences*, and *functioning* [226]. In addition, both also define the concept of *degree of centrality* and *level of measurement*. The latter will be of particular importance in Chapter 5, as we will take into account the different spheres of interaction when analyzing eudaimonic effects. However, the most important component of the conceptualization is the division into four categories of analysis of eudaimonic well-being [226, p. 1433]:

Eudaimonic Orientations

The level of orientation organizes "[...] the direction of a person's behaviors" [226, p. 1433]. Huta denotes a general orientation of one's actions towards authenticity, meaning, excellence, and growth [220].
The four levels should be briefly characterized by further references because they are of the utmost importance for the content of the dissertation. For example, regarding authenticity, Pearce et al. formulate: "eudaimonic authenticity is about sincerity and following deeply held values and one's true nature" [255, p. 2]. Huta describes authenticity as a process of clarifying one's true self and values, as well as a way of acting that is in line with these values [220, p. 216]. In a book chapter, Huta provides a detailed characterization of all categories [219], which, with regard to authenticity, recommends a strict inventory of one's own character traits and a form of "soul-searching" [219, p. 227]. Accordingly, the authenticity of action is a permanent examination of whether one's own actions are in line with

[2] In most cases, a modified HEMA version is used. Details can be found in Chapter 3.2.

one's own values. Furthermore, eudaimonic-oriented individuals pursue excellence through a willingness to take risks, a commitment to achieving higher standards, and a focus on mastery orientation rather than on competition or the outcome [527]. This finding aligns with the existing literature on the subject, which has demonstrated that eudaimonic-oriented individuals prioritize the process of achievement over demonstrative achievements, in contrast to hedonic-oriented individuals [527]. Meaning as an experience cannot be assigned trivially [221]. The orientation is to strive for an understanding and contribution to a bigger picture, a relationship and contribution to this picture [219, p. 228]. Self-transcendence is also found as a concept [219, p. 229]. As with the six psychological components of psychological well-being in Chapter 2.1.2, meaning in HCI should be addressed by choosing a preferred hermeneutic [325]. Nevertheless, the aggregation of meaningful experience with technology would be desirable if it ultimately leads to a sense of meaning in life. Because the effects of preserving meaning can also be seen in long-term health benefits [42, 60, 203, 252, 263, 264, 265, 419]. Finally, growth encompasses all forms of personal development, e.g., personal growth, self-improvement, seeking challenges, and learning in general [219, p. 231]. The orientation towards growth should be stimulated by "feelings of progress, accomplishment, and competence, and the fulfillment of bringing a personal project to fruition" [219, p. 231]. These virtues are a representation of the aims and priorities a person pursues [226, p. 1433]. Huta and Waterman group the concepts of orientations, values, motives, and goals together, but refer to them as distinct concepts [226, p. 1433], so they cannot all be equated. This will be important again in Chapter 3 to recognize this distinction. Perhaps the simplest way to characterize this dimension is to ask "why" people behave in a certain way [226, p. 1433].

Eudaimonic Behavior

In contrast to the "why" of behavior [226, p. 1433], the dimension of eudaimonic behavior addresses the "what" of behavior [226, p. 1433]. It encompasses both the content and the characteristics of the activity. Huta and Waterman also see the existence of a continuum of variables, i.e., how strongly the activity is characterized by personal commitment or how much objectively the performance of that activity means in terms of increasing

one's own skill set [226, p. 1433]. Specific eudaimonic behavior and differences to hedonic-oriented individuals can be found in previous work [220, 255, 527, 561]. Huta gives specific examples of volunteering, expressing gratitude, listening, or persevering at a specific valued goal despite obstacles [220, p. 224].

Eudaimonic Experience

To characterize the dimension of eudaimonic experience, Huta and Waterman formulate: "This approach to defining eudaimonia or hedonia focuses on subjective experiences including affects and cognitive-affective appraisals." [226, p. 1433]. Both authors ascribe a high form of subjectivity to this conception, although a systematization by Landmann can be added [285]. The conceptual framework for eudaimonic emotions includes forms of experiences such as hope, gratitude, nostalgia, pride, awe, and adoration [285]. Landmann describes them as "positive affective reactions to human virtues (e.g., moral and intellectual virtues)" [285, p. 192]. In Figure 2.4 the entirety of her systematization is given.

Feeling-Specific Eudaimonic Emotions			
Elevation (elevated, sublime, heightened) *Appraisal:* Powerful Self		**Awe** (in awe, humble, devoted) *Appraisal:* Small Self	
Being Moved (moved, overwhelmed, poignant) *Appraisal:* Positive Deviation from a Standard		**Tenderness** (touched, stirred, tender) *Appraisal:* Vulnerability	
Elicitor-specific Eudaimonic Emotions			
Aesthetic Awe *Elicitor*: Beauty	**Musical Chills** *Elicitor*: Music	**Hope** *Elicitor:* Positive Future	**Nostalgia** *Elicitor:* Positive Past
Religious Awe *Elicitor*: Supernatural	**Kama Muta** *Elicitor:* Closeness	**Admiration** *Elicitor:* Others' Achievements	**Adoration** *Elicitor:* Others' Character
Awe in Nature *Elicitor*: Nature	**Moral Elevation** *Elicitor:* Moral Virtue	**Pride** *Elicitor:* Own Achievements	**Gratitude** *Elicitor:* Receiving Help

Figure 2.4: Types of eudaimonic emotions - Extracted from the work by Landmann [285, p. 194].

Eudaimonic Functioning

Finally, the individual evaluates "indices of a person's overall positive psychological functioning, mental health, and flourishing, that is, how

well a person is doing" [219, p. 217]. In a tabular presentation, Huta shows various facets of eudaimonic functioning, such as wisdom, individuation, achievements of meaning, purpose, or big picture framework as well as generativity, perseverance, long-term view, and resilience [220, p. 224]. These facets are also considered to be long-term outcomes of this way of life [226, p. 1433]. On page 1434, an implicit reference to Ryff's psychological well-being (referring to Chapter 2.1.2) is given again by linking to environmental mastery and self-acceptance [226].
The distinction between hedonic and eudaimonic orientations, and their respective notions of well-being, may initially appear to be straightforward. However, upon further analysis, research findings have revealed a more nuanced relationship between these concepts [26, 39, 118, 200, 336, 411, 532, 561]. Nevertheless, a clearer distinction emerges in the context of preferences with regard to activities, as evidenced by other studies [324, 522, 527, 561]. Based on a study by Walker et al., hedonic-oriented individuals were only interested in the outcomes (social status and academic performance), whereas eudaimonic-oriented individuals were interested in a deep and meaningful understanding of educational material focusing a personal growth [527]. This finding aligns with the results reported by Vitterso et al., which indicated that individuals with a preference for hedonic experiences tend to favor simple and non-challenging episodes [522].

In conclusion, experiences and functioning seem to be the results of orientations and behaviors of eudaimonic-oriented individuals or as Huta states: "Orientations and behaviors reflect the choices a person makes, whereas experiences and functioning are often outcomes of those choices." [222, p. 2]. Addressing these dimensions is the theoretical foundation of this dissertation. It should especially address the eudaimonic experience dimension, which turned out to be a suitable category in the course of developing corresponding study designs. Nevertheless, we will address all dimensions in Chapter 3, when an overall overview of previous contributions to eudaimonic well-being in HCI is provided using the categories by Huta and Waterman [226]. To complete the theoretical foundation, previous models of well-being in HCI will be presented as examples to also emphasize the conceptual gap of eudaimonic HCI based on Huta's categorization.

2.2 Related Theoretical Work in HCI

2.2.1 Pragmatic and Hedonic Qualities of Technology

In the discussion of the qualities that technology can transmit and the forms of experience it can provide, the works of Hassenzahl et al. [193] and the differentiation between pragmatic and hedonic attributes of technology cannot be bypassed. In Figure 2.5, this distinction is presented from two perspectives. In Chapter 19 of the revised book *Funology 2*, Hassenzahl describes these attributes as follows [192, pp. 304-306]: A pragmatic attribute of technology leads to a manipulation of the environment, which is defined by a relevant functionality (utility) in user-friendliness (usability). Typical characterizations of these technologies are clarity, support, usefulness, and control. Hedonic qualities of technology are more clearly characterized by the effect of pleasure so that reactions such as being excited, impressed, interested, or even outstanded are associated with them. In the course of this dissertation, this constellation is critically examined again, taking into account alternative studies [324], i.e., a clear distinction cannot always be made that a technology cannot generate fun through its pragmatic quality; even the opposite must be emphasized: pragmatic quality can be the origin of a eudaimonic experience [324]. However, Hassenzahl does not separate these stimulations into other forms of satisfaction; he generally subsumes these product attributes under the hedonic quality of products [192, p. 304]. With the help of *AttrakDiff 2* [193], a measuring instrument for both quality dimensions (pragmatic and hedonic), Hassenzahl offers a tool for measuring the experience of different qualities in interaction with technology. The aspects of the qualities are evaluated on a 7-point Likert scale and form a polarity profile. In its original form, *AttrakDiff 2* was formulated in German and contains 21 items [193]. For readability reasons, the shortened version of the measurement instrument [196] is shown to complement this theoretical background on hedonic and pragmatic qualities (see Table 2.1). Hassenzahl does not initially use the eudaimonic level in his theoretical considerations; he even ascribes a “normative stance” to it [189, p. 14]. Hassenzahn sees in a eudaimonic perspective on well-being the attempt to separate good and evil, virtues and vices [189, p. 14]. In a collaborative definition of experience design, on the other hand, Hassenzahl and his co-authors open up to the idea of internalizing two forms of

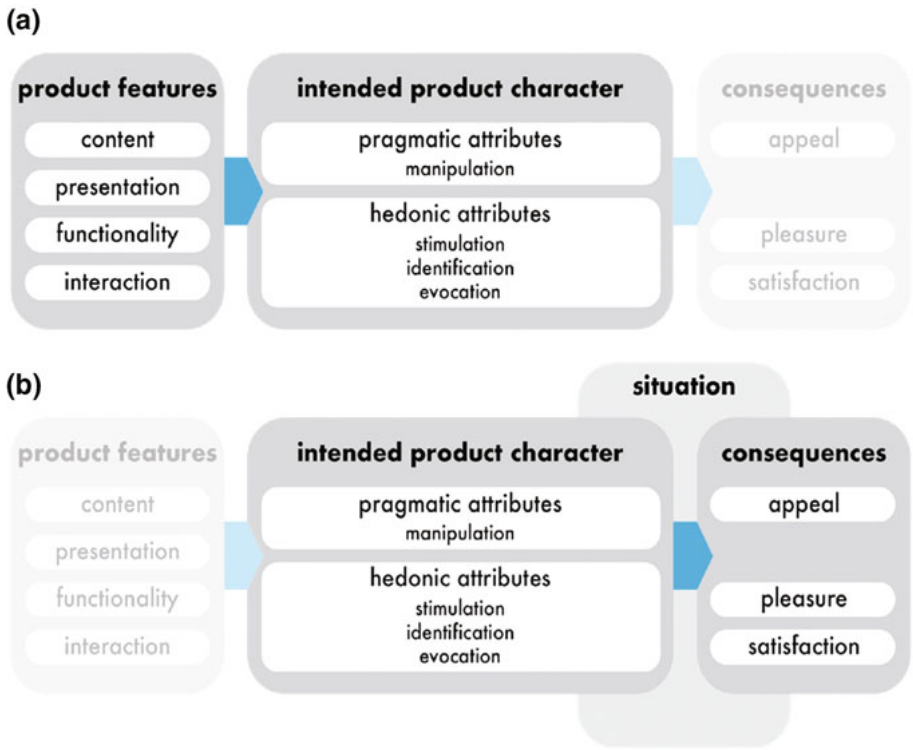

Figure 2.5: Pragmatic and hedonic attributes: (a) represents a process-oriented model and (b) a user perspective of technological product design (extracted from [191, p. 19]).

moments (pleasurable and meaningful) as central design doctrines [194]. Hassenzahl had already introduced this concept of experience design several years earlier with his own book *Experience Design* [190]. When defining possible needs that are suitable for experience design, needs for autonomy, competence, relatedness, popularity, stimulation, and security are mentioned [194, p. 22]. This shows that the strict separation into both attribute forms carries an added eudaimonic component, which is emphasized by the connection of references that are congruent with eudaimonic facets of behavior [408, 450]. Thus, the facets of eudaimonic well-being meander through the needs that are addressed with experience design.

As an alternative perspective on possible forms of intensifying an experience, the concept of "Slow Technology" will be presented [188]. It positions itself less as purely pragmatic than as purely hedonistic and somewhat breaks up the dichotomy. It may be a primordial idea of a eudaimonic

Item	verbal anchor 1	rating (1-7)	verbal anchor 2
PQ 1	confusing	o o o o o o o	structured
PQ 2	impractical	o o o o o o o	practical
PQ 3	unpredictable	o o o o o o o	predictable
PQ 4	complicated	o o o o o o o	simple
HQ 1	dull	o o o o o o o	captivating
HQ 2	tacky	o o o o o o o	stylish
HQ 3	cheap	o o o o o o o	premium
HQ 4	unimaginative	o o o o o o o	creative

Table 2.1: The items of a shortened version of AttrakDiff 2 [196], which originally contained 21 items [193]. PQ = Pragmatic Quality, HQ = Hedonic Quality.

experience in interaction with technology that cannot be reduced to either of these two qualities.

2.2.2 Slow Technology

The concept of "Slow Technology" as initially articulated in the work of Hallnaes [188], proposed an alternative development doctrine for technology that shifted the emphasis from the immediate accomplishment of specific tasks to the creation of spaces designed to facilitate reflection and promote deep thinking. In line with this doctrine, Betran et al. formulate: "[...] we argue that, in a world where technology is increasingly present, functional and productive; it is equally important to also support the socio-emotional value of play" [16, p. 3]. The idea of "slow technology" propagates the non-efficiency-related instance of *informative art* as a design principle in HCI. It excludes a problem-oriented paradigm of computer science (see Roozenburg and J. Eekel [399]) and calls for a conscious slowdown: "Calm technology and ambient displays are designed to reside in the periphery of our attention, continuously providing us with contextual information without demanding a conscious effort on our behalf." [188, p. 202]. Such a conscious slowdown can be seen as an example in Figure 2.6. Eudaimonic habits are activities such as abstract thinking and perspective-taking [220], thus forming a bridge from slow technology to eudaimonic activities. Contributions in HCI often refer to eudaimonic perspectives when addressing these activities [241, 324, 441]. Beyond the doctrine of simplicity in HCI [433], thus one can create spaces for humans to engage with profound

questions and activities, foster deeper self-exploration, and “dwell more in this world”. Perceiving “slow technology” remaining “somewhat vague

Figure 2.6: “Three pieces of informative art” - extracted from [188, p. 202].

as to what constitutes reflection” [41, p. 587], Baumer proposes the term “reflective informatics” [41], i.e., a conceptual formulation of designing for reflection in HCI. Further applications of concepts of de-acceleration can be found in a large number of prototypes that have been published [43, 98, 280, 296, 299, 364, 436]. Recently, Miller et al. developed the “Design Framework for Reflective Play” [326] presenting a procedural design guideline for reflective activities in interaction with games. In Chapter 4, this framework is used to develop a prototype for meaningful, aesthetic interaction.

2.2.3 Framework for Positive Design

With reference to the positive psychology theory [450], Desmet and Pohlmeyer develop the “Positive Design Framework” [122]. It is divided into three design doctrines (design for virtue, pleasure, and personal significance), as can be seen in Figure 2.7. Each “ingredient” contributes

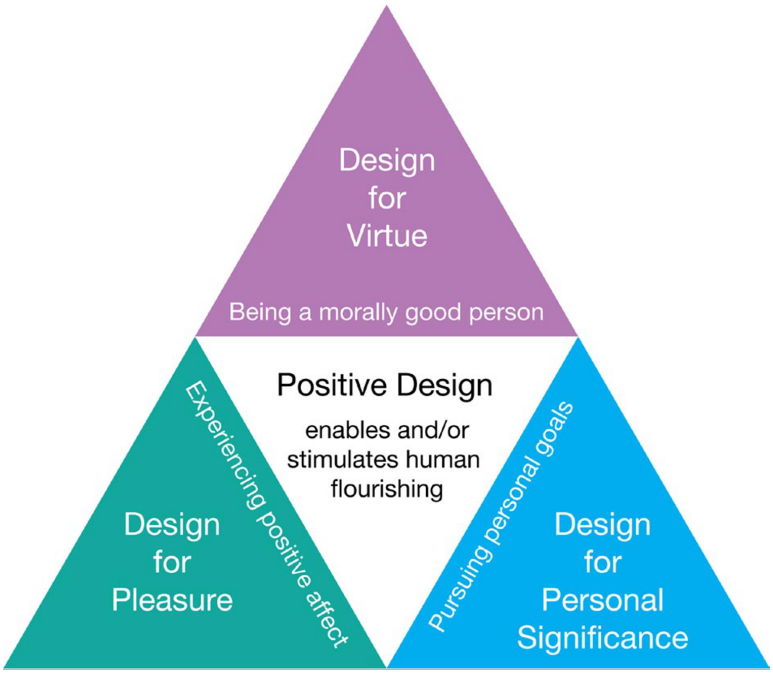

Figure 2.7: Taken from the introductory paper by Desmet and Pohlmeyer [122, p. 7].

independently to subjective well-being, but in the intersection of all doctrines, the hoped-for "flourishing" of the individual arises [122, p. 8]. Design for pleasure involves the development of technology for the development of happiness *in the moment*, the achievement of momentary pleasures [122, p. 8]. Desmet and Pohlmeyer make use of Diener's hermeneutics and the promotion of the presence of positive affect and the absence of negative affect [127]. The second component, the design for personal significance, addresses the form of happiness that results from a personal meaning [122, p. 9]. Examples of meaningful moments and activities of the individual are mentioned here, which are intended to support long- or short-term goals and aspirations. The third doctrine, "design for virtue", comes close to the eudaimonic notion of well-being. The aim is to promote people's efforts to be virtuous [122, p. 9]. Finally, the authors mention five characteristics of their positive design [122, p. 11]: Possibility-driven, striving for balance, accommodation of a personal fit, promotion of active user involvement, and offering means for long-term impact.

2.2.4 Positive Technology

In 2012, Riva et al. [394] presented their "Positive Technology" approach, which is characterized by three specific forms of experience: affective quality, engagement/actualization, and connectedness. This approach serves "to promote adaptive behaviors and positive functioning" [394, p. 69]. It is conceptually based on the work of Seligman [448, 449]. Based on the "three pillars" [394, p. 71] of a good life according to Seligman, Riva et al. derive three forms of personal experience with technology: Firstly, they name technologies that help to evoke a hedonic experience (1). This is associated with positive and pleasant experiences. Second, technologies that enable engaging and self-actualizing experiences address a eudaimonic level (2). Third, technologies can be used to shape social interactions and connections between individuals and societies. The authors refer to this as the social or interpersonal level of technology (3). In the following explanations, Riva et al. increasingly link the eudaimonic level with flow theory [394, p. 72]. In the discussion about the present and future of the idea of *Positive Technology*, Botella et al. [59] expand the spectrum of the eudaimonic level of their model to include various types of interventions, such as reminiscence training, life theme training, or simply systematic positive mood induction training [59, p. 79]. Botella et al. formulate these eudaimonic levels of their model more closely to the dimensions of psychological well-being [416] and attempt to address these dimensions using technology interaction.

2.2.5 Positive Computing

In 2011, Sander published a book chapter titled "Positive Computing" and in his position paper, he advocates for the study of information technology from the perspective of human flourishing [432, p. 309]. In the chapter, Sander initially lists six reasons why computers are able to support people in the process of flourishing. These reasons can be summarized as follows [432, pp. 311-313]: The omnipresence of ubiquitous and mobile technology (1), availability of useful data streams (2), computational capacity of persuasion (3), design opportunities of computer-mediated environments (4), scalability (5), and openness and participation (6). This is how Sander derives a first example, the "Personal Happiness Assistant (PHA)" [432,

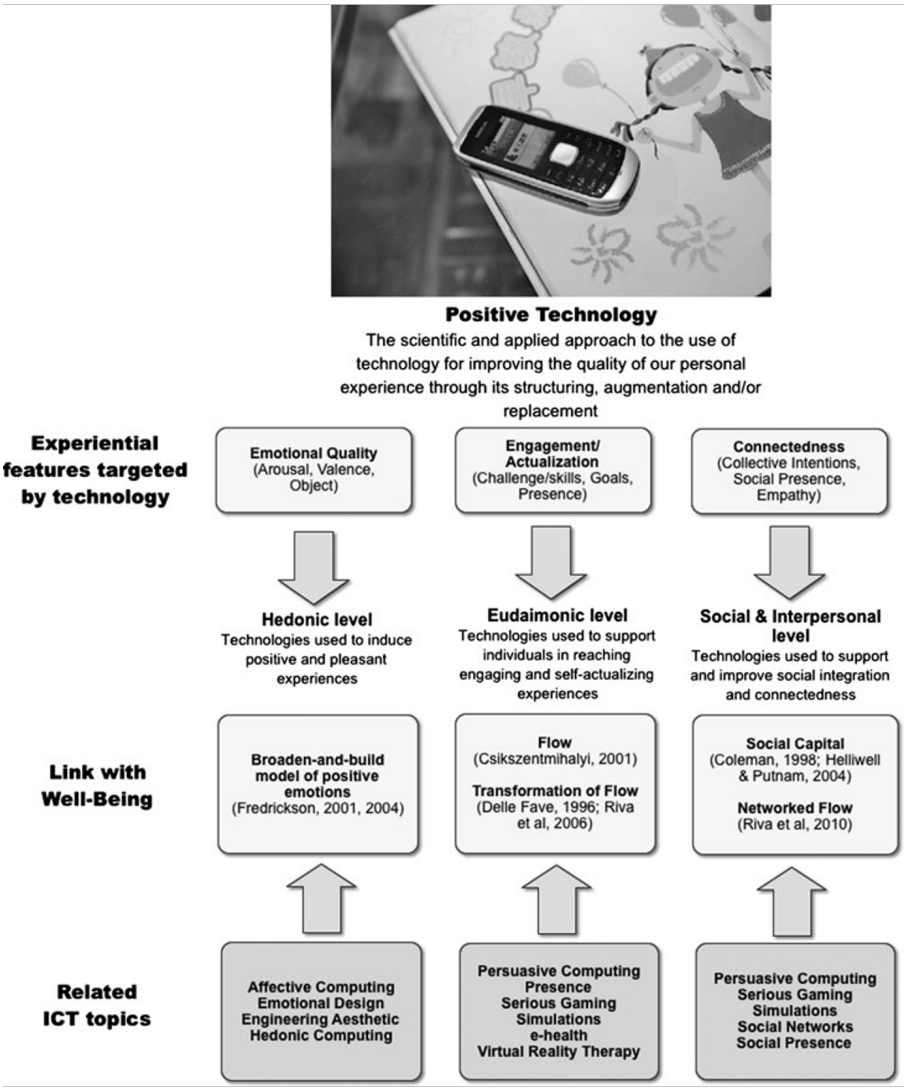

Figure 2.8: Model of "Positive Technology": Riva et al. [394, p. 71].

p. 316], whose task initially consists of collecting emotional and spatial data. With the help of this data, the user should annotate good experiences in their life that feel pleasurable and convenient to use. This form is intended to encourage users to take more "positive actions" [432, p. 317], such as relaxation, playing, exercise, or comforting acts (Sander gives a total of twelve examples). Eudaimonic well-being is not mentioned as a term in his contribution, but the connection is often implicitly indicated by Seligman's theoretical foundation, so Sander defines "Positive Computing" as "the study and development of information and communication technology

that is consciously designed to support people's psychological flourishing in a way that honors individuals' and communities' different ideas about the good life." [432, p. 311]. In Chapter 3, it becomes clear that terms such as *the good life* or *psychological flourishing* are closely related to eudaimonic well-being and eudaimonia, and in some cases are equated with them.

However, one finds a work with the same title, "Positive Computing", by Calvo and Peters [75], who also devote themselves to the consideration of well-being facets in HCI. In their collaborative work on *positive computing* [75], Calvo and Peters show the necessity of increasingly incorporating well-being as a doctrine in HCI research in order to escape the dominant pragmatic and behavioristic mindset of computer science, which the authors point out by referring to the words of Richard H. Harper. The embodiment of the individual into a machine itself internalizes the unfortunate need for a performance of one's own self [75, p. 9]. Eudaimonic Psychology receives a brief section in this work [75, pp. 21-22]. The authors characterize eudaimonic psychology as a form of the "golden mean" [75, p. 22], i.e., that is beyond a simple positive emotion and can be positioned by aspects such as engagement, meaning, relationships, and human potential. In a later section of "Positive Computing", eudaimonic well-being is linked to connectedness and purpose [75, p. 29]. The authors also refer to the long-term effect of eudaimonic well-being and its facets as being mainly due to the biologically advantageous reactions that are triggered by a reference to the work of Fredrickson et al. [158]. In the course of the discussion, in Chapter 5 of their book a framework to help develop technologies in the sense of "Positive Computing" is provided. It is a compromise solution that takes into account many forms of the perspective on well-being and is divided into factors such as positive emotions, motivation & engagement, fostering gratitude, empathy, or altruism.

In Chapter 5 of this dissertation, this perspective of *Positive Computing* will be supplemented with a granular conceptualization that, on the one hand, recognizes different forms of eudaimonic interaction in HCI and, on the other hand, introduces the four necessary dimensions of eudaimonic interaction. *Eudaimonic HCI*, as derived in Chapter 5 of this dissertation, also includes a hierarchical structure that is known from

the authors' continued work in the analysis of variables of SDT [69, 76]. This also results in a novelty compared to the existing theory of positive computing and an extension of the exemplary spectrum for applications of eudaimonic well-being theory in HCI. In conclusion, and in line with the words of Calvo and Peters, the point in deriving eudaimonic HCI is not to define the "right choice for use in technology fields" [75, p. 16]. A moral claim is not being formulated. It does not represent the *right choice* of an interaction concept, but merely one that is based on the theoretical concept of eudaimonic well-being. In Chapter 5, an architectural idea will be presented to stimulate forms of eudaimonic experience in technological interaction in order to achieve possible effects on eudaimonic well-being. We, as engineers, might be able to make a comprehensible and recognizable contribution to eudaimonic well-being in this way.

2.3 Summary

This chapter began with a general introduction to the theoretical modeling of well-being and the differentiation between hedonic and eudaimonic elements of well-being. In Chapter 2.1, various well-being theories were presented that are related to eudaimonic well-being and are used in HCI. Finally, in Chapter 2.2, concepts in HCI are introduced that relate to the domain of eudaimonic well-being. The focus on the model of eudaimonic well-being defined by Huta [220] proved to be a useful groundwork for developing an engineering design perspective on the topic. Eudaimonia and its facets meander through the previous theoretical foundations and concepts. Based on the previous theoretical models, this research gap can therefore be identified and placed in the context of the existing canon. In the following chapter, the specific inventory of all contributions in HCI to eudaimonic well-being will be systematically collected. Both research methods used are typical procedures for obtaining an overview of the topic. Thus, the following Chapter 3 is dedicated to both the understanding of the term and the measurement strategies of eudaimonic well-being in HCI. Both literature reviews have led to the identification of important (research) questions in the first step, but also valuable elements for the conception of eudaimonic HCI.

3

Landscape of Eudaimonia in HCI

Despite an initial historical outline of the facets of eudaimonic well-being and related theoretical models in psychology and, more specifically, HCI, the basic understanding, application of the terminology, and classification of existing contributions to eudaimonia in HCI is important in order to capture the comprehensiveness of all translation efforts in studies by the HCI research community. Not all contributions are always based on the same idea of eudaimonia, as will be seen in Chapter 3.1, and the measurements of influences seem to be anything but consistent in Chapter 3.2. The latter analysis is important to complete the shift to a more quantifiable methodology, which would otherwise have meant a purely qualitative consideration of eudaimonic well-being in HCI. A conception of an exclusively qualitatively developed foundation would have meant reducing the work to an ethical concept, which is precisely what this dissertation does not claim to be. The contents of the two individual chapters, Chapter 3.1 and Chapter 3.2, have been submitted and are under review at the Journal of Behavior & Information Technology [238, 239]. They were separate analyses, each with a different scope. The methodology is described in detail in the respective chapters.

3.1 Understandings of Eudaimonia in HCI

In the context of the aforementioned declaration of eudaimonia as a challenge [476], Stephanidis et al. emphasize the lack of consistency in the modeling and definition of eudaimonic well-being in HCI. This may lead to a lack of coherence and comprehensibility, but there may be opportunities to aggregate certain tendencies to identify patterns. In order to address these challenges, it is necessary to systematically retrieve all concepts, trans-

lations, and understandings of eudaimonic well-being in technology. This encompasses a range of elements, from long-term happiness and profound experiences to the achievement of personal goals. The absence of a shared understanding of eudaimonia in HCI hinders the effective coordination of research efforts. After an initial exploration, the application of a hybrid thematic analysis seemed to be a suitable research method for capturing the theoretical scope of eudaimonia in HCI. A review of the conceptual usage of eudaimonia in HCI was conducted on 137 papers (1991-2024) using an inductive thematic coding method. Subsequently, psychological and philosophical research was utilized to classify the inductively developed codes and to derive potential open research areas using a deductive approach. In the first instance, the result of the hybrid thematic model serves as an introduction to the topic for other researchers and to help them recognize existing work in the canon. Furthermore, in the course of this dissertation, the results have been used to, inter alia, form the theoretical derivation of eudaimonic HCI in Chapter 5.
Chapter 3.1 is structured as follows: In the methodology section (in Chapter 3.1.1), the concept of a hybrid thematic analysis will be presented in great detail. In Chapter 3.1.2, the findings are presented. Subsequently, general implications are outlined (Chapter 3.1.5). A short summary in Chapter 3.1.6 is intended to highlight the key findings of the hybrid thematic analysis and to provide a transition to Chapter 3.2.

3.1.1 Methodology

The interdisciplinary shape of eudaimonia, which acknowledges both philosophical and psychological perspectives, suggests that hybrid thematic analysis [384] can be employed to align one's own perspective (HCI) with existing research from other disciplines. Additionally, the evaluation questions for conducting a thematic analysis by Braun and Clark were used [62, pp. 345-346]. A "free from any pre-conceived theory or conceptual framework" [73, p. 1396] based approach implies an inductive perspective to identify themes that have not been considered in analyses of psychological research. Hence, this may lead to a possible expansion of the psychological research spectrum. On the other hand, existing psychological models can be used to classify existing studies into the spheres of eudaimonic well-being. The models used will be outlined in Chapter 3.1.1.

Inductive Analysis

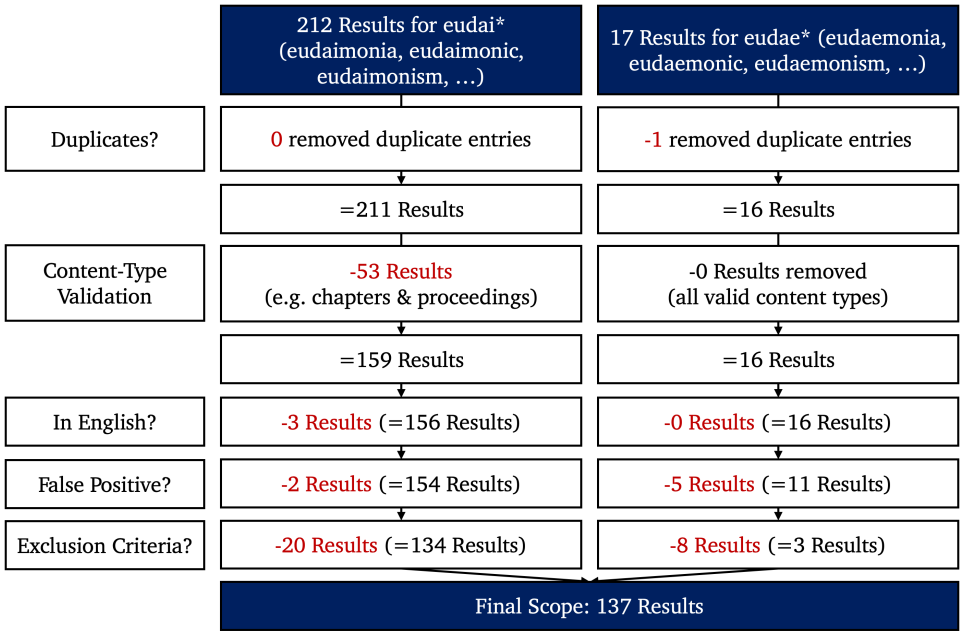

Figure 3.1: The inclusion process of the inductive analysis of eudaimonia in HCI.

The time span of this review is from November 2023 to the 19th of August, 2024, with the inclusion of a work by Bennett and Mekler [44] as the last contribution identified using the search operators. The entire inductive analysis was carried out exclusively on the ACM Digital Library[1] database. The aim was solely to capture the use of terms, associations, and related concepts in the HCI context. The straightforward wildcard operators eudai* and eudae* were used (eudaemon or eudaemonia are both valid spellings). Thus, a total of 212 articles for eudai* and 17 articles for the search operator eudae* were found (between 1991 and 2024). A detailed description of the search and selection strategy can be found in the appendix. Hence, reference will be made to Figure 3.1, which offers an illustrative representation of the selection and filtering process that occurred during the course of the inductive analysis. The description of the valid corpus will be presented: 105 research articles, eight articles, six short papers, six abstracts, five work-in-progress, four posters, two extended abstracts, and one editorial (based on the ACM given content types) were included. 52 conference papers published at CHI conferences (CHI, CHIWORK, CHI Play), ten articles from

[1] https://dl.acm.org/

the Proceedings of the ACM on Human-Computer Interaction (PACMHCI), six articles from the ACM Transactions on Computer-Human Interaction (TOCHI), as well as the ACM Designing Interactive Systems (DIS) conference (n = 8) and the ACM Conference on User Modeling, Adaptation and Personalization (UMAP) (n = 5) were identified. The remaining 56 articles are spread across a variety of other conferences. Finally, all contributions have been additionally coded with regard to the research domain (based on title, keyword, and introduction), deriving possible focal points and research gaps for specific domains (e.g., education).

Deductive Analysis

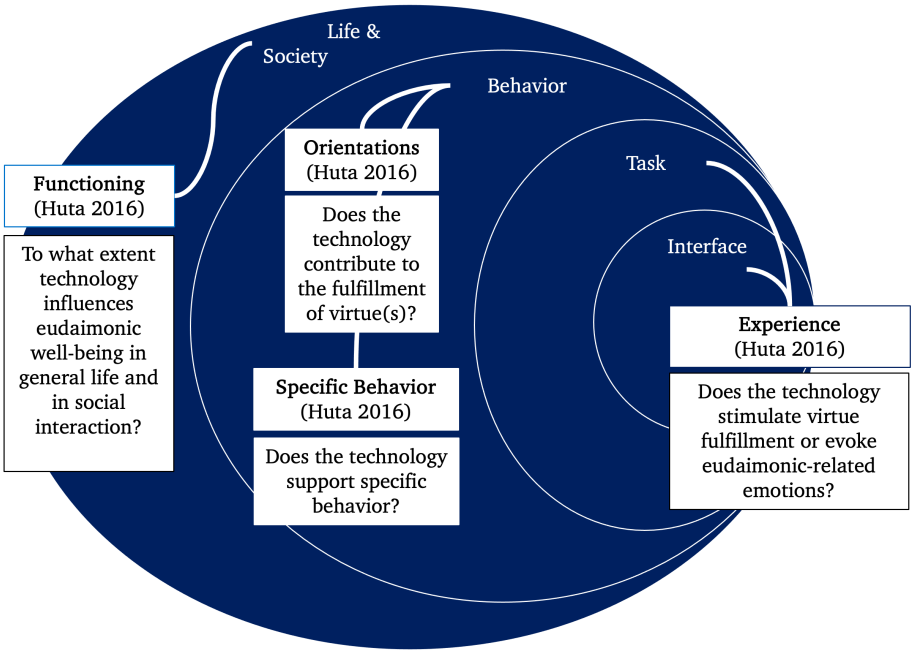

Figure 3.2: The structural model for the deductive analysis: Combining the spheres of the METUX model [372, p. 4] and the dimensions by Huta [220].

To categorize the relevant literature into the canon of philosophical-psychological eudaimonic well-being, two theoretical models were combined. Firstly, Huta's definitional concepts of eudaimonia were used (1): Eudaimonic orientations, specific behavior, experience, and functioning [220]. This differentiation is important to recognize the focal points within HCI in relation to these dimensions. For example, the question is to be

answered whether so far a consideration of certain eudaimonic orientations has been addressed, which are reflected in HCI by different forms of experience, or whether more research tends to be done on the question of whether eudaimonic experience in HCI has an effect on the general functioning of the individual. For a differentiation of these dimensions, a reference is made to Chapter 2.1.5, which contains a detailed description of the differences between the dimensions.
The second reference model (2) complements the necessary consideration of hierarchical spheres of interaction that need to be taken into account in well-being research [372]. Peters divides the interaction into four different spheres (interface, task, behavior, as well as life & society) [372, p. 4]. Peters et al. define it as the Motivation, Engagement and Thriving in User Experience (METUX) model [372]. It is not considered as an explicit reference model for eudaimonic well-being, but its foundation is the SDT, which was presented as a related theory in Chapter 2 (reference to Chapter 2.1.3). In a contribution by Burnell et al., different perceptions across different spheres are identified [69]. Therefore, it is recommended that this should be considered: an analysis of facets in terms of eudaimonic well-being must occur in a hierarchy. Figure 3.2 illustrates how a match between the two models was done. The matching process is based on Huta's explanation: "Orientations and behaviors reflect the choices a person makes, whereas experiences and functioning are often outcomes of those choices." [222, p. 2]. The synthesis of these two theories is, therefore, to be understood as follows: In the life sphere of the METUX model, the primary research question concerns the extent to which technology influences eudaimonic well-being in general life (i.e., eudaimonic functioning). In the behavior sphere, the question is whether technology can promote specific eudaimonic behaviors or consider one's virtues. In the task and interface sphere of the METUX model, which has been summarized under Huta's dimension of eudaimonic experience, questions concerning specific eudaimonic emotions or the stimulation of virtue fulfillment emerge.

3.1.2 Results

First, an overview of the domain-specific occurrence is provided. Contributions that include a form of eudaimonic conceptualization are primarily found in games research. A total of 32 contributions can be found in the

corpus, which thus make up 23.36% of the corpus [16, 23, 30, 58, 92, 113, 114, 120, 147, 153, 155, 156, 173, 227, 271, 281, 298, 326, 368, 369, 441, 444, 445, 460, 475, 497, 499, 506, 509, 538, 539, 540]. The domain of software development includes a total of 28 papers, including the use of eudaimonia in the development of recommendation systems or user experience (UX) models for example [71, 80, 138, 178, 179, 201, 206, 250, 253, 282, 283, 305, 331, 333, 354, 370, 381, 396, 401, 402, 442, 473, 494, 495, 542, 543, 547, 548]. Almost an identical number of contributions (n = 26) can be found in the explicit application area of mental and physical health in HCI [6, 17, 19, 49, 140, 148, 177, 209, 234, 237, 251, 261, 262, 266, 277, 315, 329, 345, 398, 492, 518, 525, 544, 545, 549, 560] (18.98%). For the concrete analysis of specific types of technology use, there are also 26 papers that use the concept of eudaimonia [20, 24, 25, 44, 45, 66, 77, 79, 130, 131, 172, 241, 275, 287, 303, 322, 324, 325, 334, 335, 343, 353, 389, 395, 515, 550]. Eight contributions focus on the work technology context [89, 168, 426, 428, 429, 459, 467, 484] and 7 papers on the educational context [21, 51, 143, 181, 187, 217, 463]. Five articles discuss urban applications (both smart cities and immersive spaces) [14, 15, 67, 316, 558] and three articles have been coded as contributions to “social technology” [137, 346, 557]. Finally, two articles explicitly present automotive technology approaches [163, 274]. In the following, all understandings of eudaimonia are segmented across domains and exemplified.

3.1.3 Understandings of Eudaimonia

Eudaimonia frequently functions merely as a conceptual notion within the theoretical framework. If one filters the corpus for a sole definition of the term in the introduction and/or motivation, or theoretical background, or related work, this results in 56 contributions (40.88%). The following categorization covers all occurrences, both those who have integrated eudaimonia only in a minor manner (introduction and/or motivation, or theoretical background, or related work) and those who have integrated it more intensely as a concept in their work. Finally, it should be noted that this classification does not imply that the authors always claim this perspective for themselves, but rather that they may have simply presented it or added an explanation when they used the words eudaimonic or eudaimonia.

Flourishing

A set of contributions interpret eudaimonia primarily as the principle of (human) flourishing [130, 131, 187, 187, 206, 217, 250, 395, 396, 401, 444, 445, 459, 484, 497, 506, 506, 515, 543, 545, 560]. For example, flourishing is described as a positive maximum on a continuum of mental well-being, and thus eudaimonia as a kind of maximization of mental well-being [549]. From Steen's perspective, for example, acting virtuously helps to flourish and thus increase people's well-being, which is associated with eudaimonia [473].

Goal-Oriented Growth

Eudaimonia is also associated with goal-directed growth whereby the eudaimonic-oriented individual explains his or her goals as personally meaningful, meaning-oriented, inherent, qualitative, or complex [19, 21, 25, 44, 143, 163, 173, 316, 324, 331, 389, 442, 495, 545]. Mekler and Hornbæk state: "[...] eudaimonia denotes striving to learn new skills, work towards and achieve personally relevant goals, as well as realize one's personal potential." [324, p. 4510].

Long-term Perspective of Well-being

Furthermore, eudaimonia is conceptualized as a long-term perspective, in contrast to the pursuit of short-term pleasures. Eudaimonic well-being may be realized through the pursuit of long-term goals that have enduring significance for the individual [19, 21, 25, 67, 173, 250, 253, 283, 369, 445, 525, 542]. Referring to Mekler and Hornbæk, Lakier & Vogel formulate the following regarding their reflections on software application easter eggs: "Another take on educational Easter eggs is to consider how they can provide eudaimonic value, in other words, longer-term value [...]" [283, p. 21].

The Good Life or Ultimate Good

In addition, eudaimonia is also referred to as "the good life" or "the ultimate good" [130, 147, 172, 266, 274, 305, 324, 515, 550]. For example, eudaimonia

is described as "the final and utmost goal of human life" [20, p. 2]. Lyngs et al., for example, explain the concept of eudaimonia as one that can be defined with the addition of "living the good and virtuous life" [305, p. 850]. Mekler and Hornbæk also indicate this possible interpretation [324]. Krontiris et al. similarly interpret the concept of eudaimonia, namely as the ultimate good [274], which one can achieve through virtuous actions.

Happiness or Happy Life

Additionally, eudaimonia is equated with happiness or a happy life [20, 21, 71, 381, 401]. Graziotin et al. define eudaimonia as a form of happiness in which a person conducts a satisfactory life full of quality [178, 179]. Gouveia and Epstein refer to "wanting to feel better" [177, p. 12] as a form of eudaimonic need satisfaction. Moore et al. associate eudaimonic well-being with an overall feeling rather than a current feeling [329]. This state-oriented perspective is also presented in an interpretation by Masciadri et al., i.e., a eudaimonic perspective on wellness (well-being is mentioned as a literary synonym) is defined as a combination of physical and psychological functioning [315]. This combination of physical and psychological functioning can be retrieved from three other publications [21, 140, 315].

Self-Actualization

If one recalls the title of the eleventh chapter of Maslow's book "Motivation and Personality" [317], the concept of self-actualization meanders through literature. Interpretations of it can also be found in HCI. One finds an equation with self-actualization in a couple of contributions [172, 428, 429, 550]. Furthermore, for Fernando et al., eudaimonia can be explained as the actualization of one's potential [148]. Nunes and Darin define eudaimonia as "an individual having a latent potential and that happiness, or the state of well-being, would be achieved through the profound experience of this potential." [353, p. 2].

In Accordance with Virtues

Along the tradition of eudaimonic theory in philosophy, the HCI field also attempts to formulate an alternative explanation of eudaimonia along Aris-

totelian notions using the characteristics of virtue ethics. The accordance with one's soul or virtue is thus mentioned, for example, Grodzinsky writes [181, p. 13]: "For Aristotle, if we are ever to achieve eudaimonia, we must learn to live our lives world and train our souls through our actions". Siapka refers to this accordance with virtue or excellence (*aretê*) [459]. Artz states that eudaimonia is the "activity of the soul in accordance with virtue" [25, p. 18]. The pursuit of virtue, when undertaken with discipline, has been demonstrated to stabilize the individual, thereby facilitating long-term happiness [25].

The six most common understandings of eudaimonia are therefore: *flourishing, pursuit of personally meaningful and complex goals, the good life, happiness or happy life, self-actualization*, and *activities in accordance with soul/virtue*. In addition, interpretations were found for which one could not otherwise find any matches[2]. In the following, a classification into the respective spheres of eudaimonic well-being of the works is given, before moving on to the general implications.

3.1.4 Merging inductive and deductive analysis

Following the inductive analysis, the multitude of interpretations and eudaimonia and its facets mentioned in the papers were assigned to the deductive model. The result was graphically summarized in Figure 3.3 and is described in detail in the following sections.

Eudaimonic Functioning in HCI (Life & Society Sphere)

The eudaimonic functioning level is principally concerned with the perception of eudaimonic well-being and its manifestations in life in general in interaction with technology. Thus, the hermeneutics of the categorized sources addresses the level that does not mean a form of experience, specific behavior, or orientation, but a fundamental facet of an individual's functioning in the sense of eudaimonic functioning. Autonomy, for example, as an aspect of eudaimonic well-being [418], is understood in this sphere as a sense of self-sufficiency. Bennett et al. mention *autarkeia*, i.e., self-sufficiency in action and thought, which is said to play a central

[2] The mention of unique interpretations was moved to the appendix.

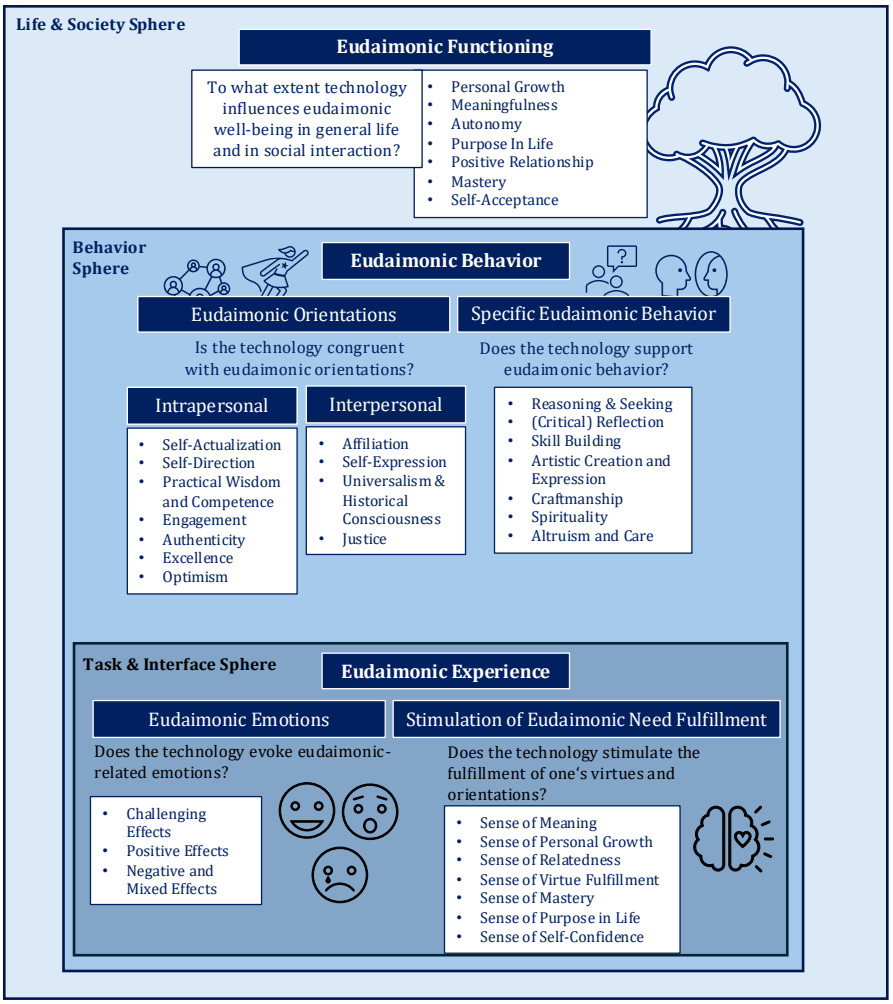

Figure 3.3: Merging the results of inductive and deductive analyses in a hierarchical model.

role in eudaimonia [45]. Self-sufficiency can also be found in the work by Ardagh [21], i.e., the freedom to choose behavior is an element within his theoretical framework of eudaimonia [21]. Kuo and Horn state: "They can freely choose to perform this behavior" [277, p. 4] as this kind of reference to autonomy in life. Autonomy as an aspect of eudaimonic functioning in HCI thus implies a higher level of perception that indicates a character of a basic psychological need. This is shown by the contextualization of contributions using the SDT [143, 206, 241, 324, 506].
Besides autonomy, the most mentioned aspects of eudaimonic functioning were personal growth, meaningfulness, purpose in life, positive relation-

ships, mastery, and self-acceptance. For better readability, all references to the respective dimension in Table 3.1 have been documented in a structured manner. These factors represent components of an individual's comprehensive perception of their eudaimonic well-being, which is a reflection of the individual's overall functionality and how technology can either contribute positively or negatively to this functionality. A description of each dimension of eudaimonic functioning is listed in Table 3.1.

Eudaimonic Dimension	Contextualized for HCI	Mentions
Personal Growth	Personal growth encompasses various aspects, including one's perception of self-development and the enhancement of capabilities through technological utilization.	[24, 25, 138, 241, 251, 370, 398, 426, 444, 542]
Meaningfulness	The use of technology creates an experience of meaningfulness in work and social life.	[19, 89, 168, 206, 237, 241, 250, 316, 345, 354, 484, 544, 557, 558]
Autonomy	Key aspects include explicit consent, autonomy in behavior and actions, non-instrumentalization of the self, and self-sufficiency in interaction with technology.	[21, 45, 241, 277, 345, 398, 463, 494, 547]
Purpose in Life	The technology enables the establishment of a sense of purpose in life or the facilitation of the pursuit of that purpose.	[237, 262, 426, 441, 494, 542, 558]
Positive Relationships	The development of deep friendship and an overall positive attitude towards others is facilitated by technology.	[21, 140, 441, 463, 499]
Mastery	The eudaimonic-oriented individual perceives the ability to manage their environment and establish contexts for their work through the utilization of specific technologies as a means of achieving personal growth and development.	[241, 463, 499, 542]
Self-Acceptance	Technology plays a role in fostering self-acceptance, defined as the acknowledgment and acceptance of an individual's positive and negative attributes.	[398, 494, 499]

Table 3.1: Contributions categorized to the life and society sphere based on METUX [372] and Huta's dimensions [220].

Eudaimonic Behavior in HCI (Behavior Sphere)

The behavior sphere of eudaimonic HCI encompasses two distinct research categories: *orientations* (1) and *specific behavior* (2)[3]. As illustrated in Table 3.2, the findings reveal the existence of two distinct eudaimonic orientations addressed across the evaluated research papers in HCI: *intrapersonal* and *interpersonal*.

Type	Dimension	Contextualized for HCI	Mentions
Intra-personal	Self-Actualization	Technology has the potential to facilitate the process of self-actualization by simulating experiences associated with self-fulfillment, self-improvement, and personal growth.	[21, 66, 138, 163, 168, 209, 282, 283, 303, 316, 324, 333, 335, 343, 345, 370, 428, 429, 442, 444, 492, 542, 557]
	Self-Direction	Technology respects the autotelic motivation of the individual in the performance of activities and supports the pursuit of personal ideals	[25, 89, 209, 241, 274, 324, 325, 345, 369, 396, 506, 542, 545, 557]
	Practical Wisdom and Competence	The development of practical wisdom, far-reaching skills, maturity, ethics, and prudence is identified as a potential objective of technological development.	[21, 25, 163, 274, 324, 345, 441, 460]
	Engagement	The integration of technology is expected to result in a significant enhancement of engagement in the activities.	[89, 137, 241, 250, 445, 484, 542]
	Authenticity	Technology fosters the development of an authentic personality by emphasizing values such as honesty and authenticity.	[21, 241, 274, 396, 545]
	Excellence	Technology has the potential to assist in cultivating high standards and the quality of one's virtues, e.g., the development of discipline in activities.	[25, 241, 251, 282, 325]
	Optimism	Technology should support the development of positive attitudes, wholeheartedness, and forms of wittiness.	[251, 274, 506]
Inter-personal	Affiliation	Technology is designed to simulate the desire to contribute to a greater whole.	[143, 277, 331, 333, 354, 396, 495, 542, 558]
	Self-Expression	The integration of technology can facilitate the realization of several objectives, including increased community involvement, pro-environmental behavior, and benevolence.	[21, 163, 262, 324, 335, 444, 445, 550]
	Universalism & Historical Consciousness	Technology serves as an enabler, facilitating the adoption of a universal and history-conscious behavior that incorporates civics, ethics, and history into one's actions.	[441, 542, 550]
	Justice	Technology plays a role in facilitating comprehension of justice.	[21, 274]

Table 3.2: Contributions categorized to the behavior sphere (orientations) based on METUX [372] and Huta's dimensions [220].

Intrapersonal orientations are self-related and primarily formulate the striving for self-actualization, self-direction, development of one's wisdom,

[3] Both are definitional categories by Huta [220] and used to deductively classify the papers.

authentic self, and an optimistic attitude towards life. Interpersonal orientations have both an egocentric perspective through forms of self-expression and a sense of universalism, justice, and compassion for humankind.

Activity-specific interpretations were categorized under Huta's definitional category of eudaimonic specific behavior [219]. A detailed aggregation and description of mentions can be found in Table 3.3. For example, reflection is described as an activity that leads to eudaimonic appreciation [326]. Reflective thinking includes activities such as evaluation, appreciation, habituation, and documentation [544]. Certain activities can indeed be intertwined, i.e., improving one's own reasoning may be one facet of skill building, but this distinction seemed appropriate in the coding process. However, a few examples from the studies will be highlighted. Forms of

Behavior	Contextualized for HCI	Mentions
Reasoning & Seeking	Technology can facilitate enhanced argumentation processes, ethical decision-making, frequent meaning-seeking, and improved reasoning skills.	[21, 155, 172, 281, 303, 322, 331, 396, 441, 445, 463, 492, 494]
(Critical) Reflection	The interaction of technology leads to far-reaching reflection processes and the adoption of critical perspectives.	[6, 49, 241, 324, 326, 441, 540, 544]
Skill Building	Technology facilitates skill development, including deep reading and the cultivation of self-regulation, which can result in enhanced coping mechanisms.	[21, 143, 241, 251, 287, 324, 353, 463]
Artistic Creation & Expression	The pursuit of aesthetic experiences with technology is not a novel concept; however, it is a subject that should be addressed, as aesthetic practices such as art, theater, dance, singing, poetry, and music are constantly associated with eudaimonia	[21, 143, 401, 545]
Craftmanship	Technology has the potential to foster the development of skills related to writing, recreation, and engagement with riddles, which are forms of playful intellectual exercise.	[21, 287, 545, 558]
Spirituality	The potential of technology to augment the practice of spiritual activities, such as meditation and contemplation, is a subject that can be explored.	[21, 495, 550, 558]
Altriusm and Care	A technological system should be designed to promote altruistic behavior, thereby indirectly contributing to eudaimonic well-being	[19, 441, 558]

Table 3.3: Contributions categorized to the behavior sphere (specific behavior) based on METUX [372] and Huta's dimensions [220].

seeking as eudaimonic specific behavior are reflected in pro-environmental

behavior because it creates a sense of meaningfulness towards life [277]. Lazar and Nguyen argue that the pursuit of accomplishment is driven by eudaimonic motivation, which can be fostered through a variety of activities, including writing, reading, sewing, and crossword puzzles [287]. In another contribution, Wilson et al. mention several examples that are associated with eudaimonic well-being, such as poetry, painting, drawing, dancing, writing, or singing [545]. Zakzak identifies an opportunity to facilitate the fulfillment of eudaimonic needs through activities such as community involvement, craftsmanship, and spiritual practices [558]. With regard to spirituality as specific behavior, Laato et al. establish a connection between the exploration of spirituality and the meaning of life as eudaimonic gratifications that emerge from activities such as truth-seeking and pondering of the ultimate[4] [281].

Eudaimonic Experience in HCI

The experience sphere contains two dimensions: *emotions* and *stimulations of need fulfillment*. This represents an essential finding. Both forms are an inductive derivation from the HCI research papers that one could not obtain from deductive analysis. They are intended to emphasize that one can address specific eudaimonic emotions, but also the pragmatic stimulation of certain virtues. This is to be accompanied by the distinction of a game with a learning technology: the game is built around a narrative [147, 401, 509] that implies the targeted effecting of certain effects (positive, challenging, or mixed effects). The alternative doctrine is expressed in the formulation of Egger-Lampl et al., who interpret the eudaimonic component of interaction as the "purpose-of-use" [138]. In Chapter 5, these two forms are clearly outlined, as they will form the basis for a novel interpretation of eudaimonic HCI.

However, the range of possible emotions is broad, as can be seen from the mentions in the papers. Examples and references can be found in Table 3.4. Chambel et al. list some examples of pleasing effects such as feeling moved, awe, compassion, hope, or enthusiasm [80]. Bowman et al. state that these emotions are associated with more complex emotional expressions [113]. In their study, Bopp et al. found that the majority of aesthetic experiences

[4] https://dictionary.cambridge.org/us/thesaurus/pondering ("pondering" is to be understood synonymously with reflection or serious thought)

in video games are associated with feelings of beauty, enchantment, fascination, awe, being moved, interesting, intellectually challenging, and insightfulness [58].

Type	Dimension	Contextualized for HCI	Mentions
Stimulation	Sense of Meaning	Technology triggers associations of a meaningful life and may even contribute to it.	[92, 138, 156, 163, 173, 227, 277, 281, 303, 324, 326, 334, 335, 369, 401, 402, 444, 475, 494, 538, 540, 542]
	Sense of Personal Growth	Technology can serve as a catalyst for self-actualization, facilitating the realization of one's latent potential. Additionally, it can promote emotional self-expansion.	[67, 130, 137, 156, 163, 201, 353, 494, 499, 509, 518, 525, 539, 542]
	Sense of Relatedness	The purpose of technology is to elicit feelings of deep empathic connection and resonance, thereby fostering the development of robust personal bonds with others.	[23, 138, 143, 271, 494, 509, 540, 542]
	Sense of Virtue Fulfillment	Technology should serve as a catalyst for virtuous behavior, fostering deeper self-reflection and contemplation.	[130, 173, 303, 324, 353, 494, 509, 542]
	Sense of Mastery	This encompasses the notion of stimulation by technology, which evokes experiences of accomplishment, mastery, or achievement.	[51, 287, 499, 542, 558]
	Sense of Purpose in Life	Technology should contribute to a sense of purpose in life.	[326, 354, 499, 538]
	Sense of Self-Confidence	The technology fosters a sense of self-confidence and promotes self-awareness, leading to the identification of one's own personal strengths and weaknesses.	[51, 324, 499]
Emotion	Challenging Effects	The technology should facilitate experiences that offer greater insight, intellectual or emotional challenge, ambiguity, meaning, decisiveness, nuance, and subtlety, as well as elements that provoke thoughtful consideration.	[15, 23, 51, 58, 80, 92, 113, 114, 155, 173, 227, 250, 287, 298, 322, 324, 326, 353, 369, 401, 441, 475, 499, 509, 525, 538, 539, 540]
	Positive Effects	The interaction evokes a range of emotions, including emotional movement, aesthetic awe, beauty, motivation, curiosity, inspiration, enthusiasm, and spiritual awe, such as elevation, hope, enchantment, and humanism.	[21, 51, 58, 80, 92, 130, 138, 153, 173, 227, 250, 275, 281, 298, 322, 326, 334, 499, 509, 538, 540]
	Negative & Mixed Effects	This technology fosters mixed affect experiences that contribute to reflective behavior. Encounters with discomfort, which extend beyond the scope of mere enjoyment, should also be mentioned.	[58, 92, 155, 227, 298, 509]

Table 3.4: Contributions categorized to the experience sphere based on METUX [372] and Huta's dimensions [220].

3.1.5 General Implications

Despite the extensive analysis of existing interpretations, one has to conclude that several aspects can be identified that are debatable. The idea of

hybrid thematic analysis was not just an outline of the current state, but the identification of possible problems, which should also be addressed with the help of this dissertation.

The Empty Goal of Eudaimonia

The fact that eudaimonia often remains in the theoretical section of the papers (40.88% of the contributions) gives the impression that the lack of a conceptual basis for eudaimonia in HCI means that it is mainly used as an umbrella term. Eudaimonia therefore often serves simply as a "filler term" in the presentation of a theoretical background or as an associated concept of a related model such as SDT. It indicates a form of under-complexity of conceptual understanding that, for example, a form of goal orientation towards personal or meaningful goals is often associated with or even equated with as a eudaimonic concept of interaction.
One has to state that is not sufficient to derive a robust theoretical concept or a boundary object in HCI [471] if one defines eudaimonic interaction as a goal pursuit. Furthermore, it is often not clear which goals are meant at all and how meaningfulness is to be understood. The hybrid analysis has shown that we need to differentiate the exact sphere of meaningfulness (life? behavior? interface?) in order to concretize it sufficiently to understand the authors' hermeneutics. For example, it is often not clear what goals are defined at all. For example, Gomez and Lankes define the eudaimonic experience as the accomplishment of personal goals [173]. Scott et al. speak of progress towards personal goals [442]. The Eudaimonic Technology Experience Scale (ETES) to measure eudaimonic experience includes a subscale entitled "eudaimonic goals" [550] including items for perceived learning, the pursuit of own aspirations, and *the stimulation of goal pursuit*. Particularly for the last item, it is not possible to deduce from its logic which goals are meant at all. The problem arises that in principle all goals can be perceived as being eudaimonic.
The deductive analysis has shown that we can use eudaimonic values, orientations, and preferences to formulate concrete eudaimonic goals. In the course of the deductive analysis, an alternative approach to determining orientation emerges. It is not only that Huta's model provides a list of concrete forms of orientation [220, p. 224], but also that the inductive analysis resulted in the aggregation of concretely mentioned forms of orientation

that can be addressed. Furthermore, there is empirical evidence that the goals of other well-being orientations, such as a hedonic attitude towards life, differ from those of eudaimonic-oriented individuals [223]. In the quantitative analysis of eudaimonic experience using the ETES, this would lead to an erroneous assessment that a general fulfillment of personal goal pursuit is understood as eudaimonic striving. The synthesis of existing work in Figure 3.3 is intended to serve as an initial conceptual resource for addressing certain forms of orientation and behavior.

Quantification of Interaction

The lack of specific goals makes it difficult to understand the idea of promoting the quantification of eudaimonic goals as an element of interaction. Based on the analyzed contributions and further literature, two positions can be identified in response to this question. At the end of this section, a personal standpoint will be briefly presented.
One group of contributions advocates the implementation of quantification mechanisms for eudaimonic interactions in HCI. Niess & Woźniak propose the "Tracker Goal Evolution Model", which employs the concept of eudaimonic well-being as an underlying principle [345]. In this model, eudaimonic needs, including self-fulfillment and meaning, are transformed into quantitative objectives with the intention of making the activity and its success measurable. According to Villalobos-Zúñiga et al., the process of counting daily steps in an app may evoke a "eudaimonic effect" [518, p. 9], i.e., striving towards one's personal best. This would lead to reactions from the participants that would potentially be described as positively having a "constant need for fulfillment and self-improvement" [518, p. 9]. Additionally, Khot et al. propose the eudaimonic pursuit of their application as a form of self-expression through assistance tracking [262]. Referencing the "Tracker Goal Evolution Model" [345], Agapie et al. underscore the importance of reflection in facilitating the transition from eudaimonic goals to more concrete objectives [6]. The hermeneutics of reflection is therefore to be understood as more than a form of examination or comparison with a set goal. This hermeneutic can also be found in a work by Bentvelzen et al. [49]. When discussing the development of metrics representations for fitness trackers, Bentvelzen et al. argue that the absence of a connection between eudaimonic aspiration and metrics results in a "sub-optimal

reflection experience" [49, p. 13]. In this group of contributions, there is a doctrine of interaction that conceptualizes eudaimonic goals as a form of quantifiable self-improvement. In this instance, the reflection process can be conceptualized as a process of alignment.
However, this conception stands in contrast to that of a group that questions the adequacy of such quantification.
Mekler and Hornbæk point to the possible error in reasoning [325], i.e., the attempt to transform "high order goals" of eudaimonia into simple purposes. Hassenzahl et al. also express criticism of activity trackers, as these applications create an externalization in the form of work perception [195]. Besides the analyzed corpus, there is a position by Sicart in the book "The Gameful World: Approaches, Issues, Applications" (Chapter 8), which can be added as a contrasting position to the above group of contributions: "[...] We run not for the activity, but for what we make of the activity. The data tracked by the Nike+ system does not reflect this purpose of running. It's an excellent reminder of the need for running, but it only addresses one part of the virtuous life. It offers an external acknowledgment of a manifestation of the good life, a shadow image of a virtuous practice" [461, pp. 227-228]. In another contribution by Wittingslow [547] found in the course of the inductive analysis, the author illustrates a position of Habermas and his position on Aristotelian eudaimonia and transhuman technologies. According to him, instrumentalization is an obstacle to the potential achievement of a eudaimonic life [547, p. 4]. Referring to a passage from Aristotle's Nicomachean Ethics, in a translated version by Crisp [99], one finds the following fragment in Chapter 7: "We speak of that which is worth pursuing for its own sake as more complete than that which is worth pursuing only for the sake of something else, [...]" [99, p. 10].

According to the findings of the aforementioned review, it is evident that there is an absence of a consensus regarding the quantification of eudaimonic goals. This prompts a call for further research that is more profound in its methodology and that explores the long-term implications of quantification on the individual. However, as indicated in the introduction to this section, a personal opinion is given: There are several reasons to push for a reduction of quantification within interaction. Firstly, due to the autotelic characterization of eudaimonic behavior [101], the idea of quantification, i.e., a shift in motivation, is already problematic.

Secondly, the lack of translatability of a mere goal-oriented understanding of eudaimonia makes the translation into quantification redundant *per se*. Eudaimonia in HCI would thus no longer recognize any distinction between eudaimonia itself and any form of personal goal definition, and thus conceptualization would be impossible. Third, there is empirical evidence that motivation for extrinsic goals is not beneficial: one loses the possibility of increased subjective vitality of the individual through the intrinsic motivation of his or her actions [348]. Furthermore, Sheldon et al. recommend favoring personal motivation over pressure-based mechanisms based on their study results [453]. Sheldon et al. conclude their work with the following statement: "The finding also has important implications for theories of well-being, suggesting that people seeking greater well-being would be well advised to focus on the pursuit of (a) goals involving growth, connection, and contribution rather than goals involving money, beauty, and popularity and (b) goals that are interesting and personally important to them rather than goals they feel forced or pressured to pursue" [453, p. 485]. One agrees with the findings of their studies that a pressure-like fulfillment of quantifiable goals carries too high a risk of a shift in motivation. This recommendation will be outlined again in Chapter 5.

Cross-Sphere Argumentation

The third and final general implication is the identification of a so-called cross-sphere argumentation. Based on the deductively derived model, lines of argument can be found that conclude from an experience to a functioning. Fundamentally, a technological interaction can lead to conflicting feelings in different spheres [69]. If I feel autonomous as an individual in direct contact with technology, e.g., through maladaptive behavior in games [445] fulfilled by feelings of mastery and personal growth, the effect on feelings of environmental mastery or personal growth does not have to be implied. There are actually different positions regarding this question of transition. In one interpretation, eudaimonic play experience was connected with having a lasting effect on well-being, in contrast to hedonic play experiences, which do not mark any "additional forces or reasons" [77]. França et al. are very concrete in their formulation: "Eudaimonic experiences provide an extra outcome than the experience itself, they

promote well-being" [77, p. 2]. An experience is therefore more than just a simulated effect, but should directly stimulate the components of eudaimonic functioning. Waterman's position on the question of maldaimonic play experience is that this form of experience is rather symbolic [534]. A stimulating effect is therefore understood as a symbolic surrogate for authentic experience. A more diplomatic argument is presented in the remarks by Seaborn and Iseya. They use a "half-real" perspective to argue that the boundaries between experience in games and life could not be clearly separated [444]. Rigby and Ryan also explore the impact of entertainment media, such as games, on eudaimonic well-being. They assume that the awareness of the interaction is a significant mediator of this effect, meaning how deeply one's self and one's activities are integrated into the interaction [391]. This reflects a fundamental notion that is taken up again in one of the studies on which this dissertation is based, namely that of a sense of causality and focused attention (see Chapter 4 and Chapter 5). Furthermore, research indicates that players may link their in-game experiences with real-life experiences [227]. According to the results of the study by Bopp et al., it can be deduced that some of the participant groups would have experienced some kind of change after engaging in an artistic experience [58]. In another experiment, this effect was not observed [539]. A transformation of the player beyond playing the game was not identified. Schrier is convinced that the skills developed in games can be applied to real-life behavior [441]. She reports on the effectiveness of eudaimonic games in helping players and people live their best lives, connect with others, or find fulfillment.

The ambiguity pointed to the importance of hierarchical measurement strategies and a possible distinction between development doctrines. Seaborn et al. specifically separated orientation and impact on eudaimonic functioning using two separate measurement instruments [445, 446]. Furthermore, the necessity of including facets such as focused attention, flow perception, and degree of interaction in the analysis becomes apparent, since according to Rigby and Ryan [391], transfer effects from an interaction environment can only be assumed in this particular setting. These issues are explicitly examined in Chapter 4.

3.1.6 Summary

The hybrid thematic analysis has revealed three essential problems: First, equating eudaimonia with a personal goal orientation is not sufficient to develop a conceptual basis despite the frequent use of the term. It is arguably the orientations, specific behaviors, and concrete facets of general eudaimonic functioning that need to be addressed. These research variables should be selected and communicated on the basis of the thematic model. In Chapter 6, the general discussion of this dissertation, the existence of possible further contexts will be addressed.
Secondly, the application of quantification within the interaction is, according to current knowledge, open to debate and, in accordance with one's own argumentation, one should tend to favor reduction. In the narrower sense, it is a violation of the eudaimonic virtue of autotelic activity and a risk for forcing extrinsic-motivated activity.
Thirdly, the cross-sphere arguments can be explained by a lack of conceptual basis. However, the agreement on a hierarchical analysis of effects logically leads to the question of whether the HCI has sufficient measurement methods available to measure these (cross-sphere) effects. It is therefore necessary to determine the scope of these measurement applications in order to compile different measurement strategies and structure them for future research projects. This is the final review contribution in the following Chapter 3.2.

3.2 Measuring Eudaimonic Facets in HCI

Subsequently, a separate scoping review is presented that is based on an even larger body of literature. In the course of this review, one moves away from the methodological concept of only determining an understanding, but also the concrete measurement of an impact on eudaimonic well-being evoked by technology interaction. This scope is unclear and only partially mapped by related reviews in games [111] and the generic term of flourishing in life [407]. Since this dissertation is based on Huta's understanding of the term, a paradigm will be shown that is based on the following implication of Huta [222, p. 2]: "[...] it is essential for researchers and practitioners to think carefully about the definition category and measurement level they want to assess for a given purpose". Hence, a corresponding overview should be provided in this regard. Despite the research questions defined so far for this dissertation, the following granular research questions (*RQ*s) arise for this study:

RQ_1: How is the influence of technology use on eudaimonic well-being measured?

RQ_2: Which measurement methods are used to analyze the influence on eudaimonic well-being in interactions with technology?

RQ_3: What dimensions of eudaimonic well-being are being measured in interactions with technology?

3.2.1 Methodology

In the course of the scoping review, the PRISMA extension was utilized [501], in accordance with the guidelines for conducting systematic scoping reviews by Peters et al. [373]. A comprehensive search of the following databases was conducted to identify relevant studies: ACM Digital Library (1), ScienceDirect (2), Frontiers (3), APA PsycNet (4), and Google Scholar (5). The databases were filtered from 2009 to 2024.

Search Strategy

A variety of search strategies were employed and refined in a sequential manner to identify the most substantial corpus. For instance, within the ACM Digital Library, the wildcard operators eudai* and eudae* led to 157 results, whereas in Google Scholar, this operator led to 2,700 results, requiring optimization. In Table 3.5 an overview of the optimized search

Platform	Search Operator	Filters	# of Results
ACM Digital Library	eudai* (150 results) eudae* (7 results)	-	157
Google Scholar	(eudaimonia OR eudaimonic OR eudaemonia OR eudaemonic) AND (HCI or "Human-Computer-Interaction" or "technology")	exclude citations and patents	829
ScienceDirect	(eudaimonia OR eudaimonic OR eudaemonia OR eudaemonic) AND (technology OR technologies OR interaction OR HCI)	Category: psychology, social science and Computer Science; Content-Type: Research Article	775
Frontiers	(eudai* (102 results) eudae* (1 result)	-	103
APAPsycNet	(eudaimonia OR eudaimonic OR eudaemonia OR eudaemonic) AND (technology OR technologies OR interaction OR HCI)	-	21
			$\sum$ = **1,885**

Table 3.5: Search Strategy: search operators and filter settings of each database

operators is presented. The Peer Review of Electronic Search Strategies (PRESS) checklist was used for a general check of search operator quality, which also led to the addition of alternative spellings such as *eudaemonia* [319].

Selection Process

Required by the PRISMA extension [501], the selection process is presented in a narrative manner. The process was initiated in four databases (in order: ACM Digital Library (1), ScienceDirect (2), Frontiers (3), and APAPsycNet (4)). At the end of the search process, Google Scholar, the fifth database, was scanned to identify additional studies from alternative platforms. A general heuristic was applied to assess the relevance in the first stage of the contribution: a technological connection had to be recognizable from the title, abstract, and, in cases of uncertainty, a look at the full text. If these three factors were met, the subsequent step was to determine whether it was merely a hit in the references.
Only English-language contributions were considered. The majority of non-English publications were located directly via the title in Google Scholar (n = 28). In three cases, English titles were found, but the studies were non-English in the ACM Digital Library [105, 327, 405]. The following publication types were excluded from the present study: work-in-progress papers, extended abstracts, posters, pre-prints, master's theses, and dissertations. This selection process was more stringent than in Chapter 3.1 by excluding work-in-progress contributions. Specifically, on Google Scholar, dissertations and master's theses were automatically removed using an additional search term operator ("this thesis" in full-text) (n = 85). A manual check of the 85 matches ought to prevent false positives. On ScienceDirect, a total of 775 articles were checked for relevance (categories: computer science (n = 65), psychology (n = 410), and finally social sciences (n = 530)). This category-based approach was necessary because contributions were also found that analyzed technology effects but were not categorized in computer science. Relevant articles were also found in the selection process that were not classified in the computer science category, e.g., an analysis by [555] on eudaimonic factors and virtual-reality-based learning. A search of the APA PsycNet database resulted in the sole retrieval of studies on media consumption; this particular field was excluded from the study due to the exclusion of studies on sole *passive media consumption*. Using Google Scholar was beneficial because considering this platform resulted in retrieving 23 relevant papers published on alternative platforms such as Springer or SagePub.

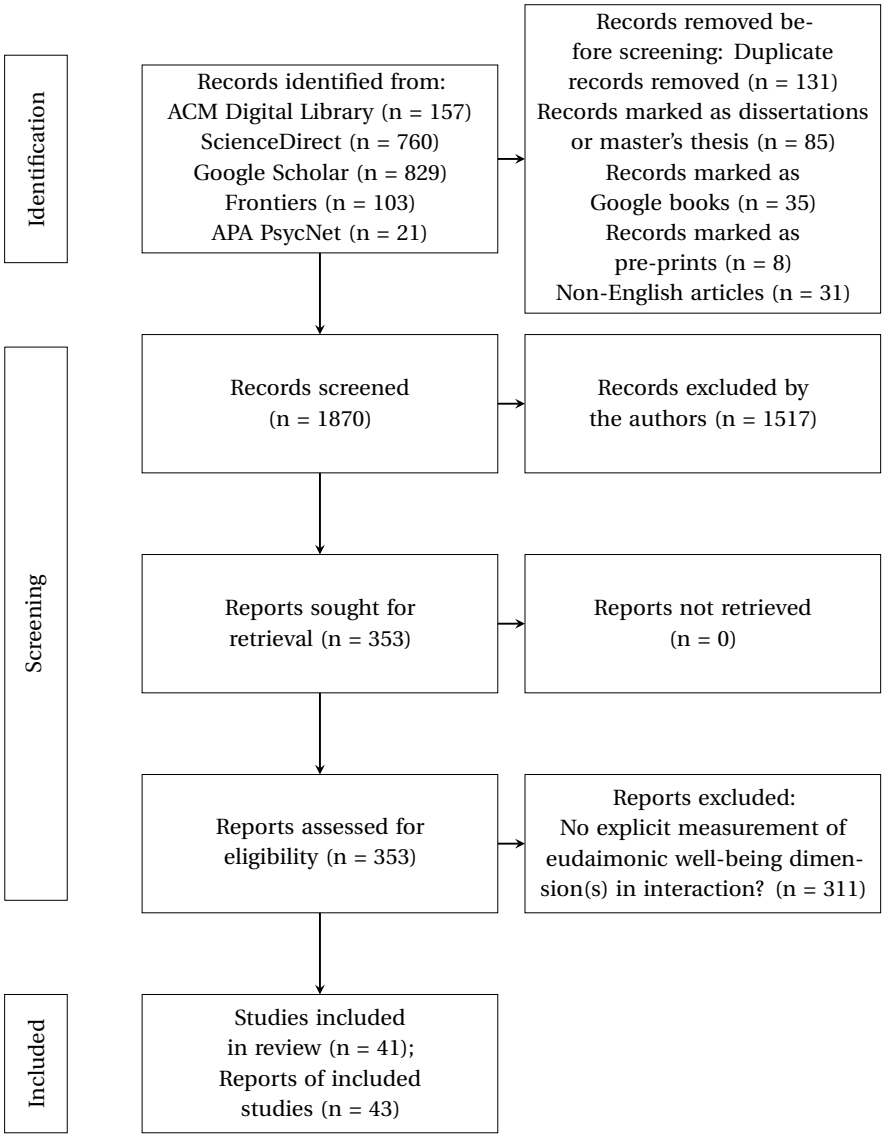

Figure 3.4: PRISMA diagram [501] of the selection process resulting in a total of 41 studies and 43 reports.

Eligibility Criteria

To ensure the reliability of the scoping review, only reports explicitly referencing a quantitative analysis of a eudaimonic-oriented dimension (orientation, experience, behavior, and functioning) examined in interaction with any type of technology were included in the final corpus. The application of existing scales, custom items, or adaptations of existing items, and multiple

scales, in the study was documented. The definition categories by Huta (orientations, specific behavior, experiences, and functioning) were used to accomplish the latter step of thematic coding (identical to the process in Chapter 3.1). Studies categorized under the dimension of eudaimonic functioning are those that investigate a direct link between technology use and an overall impact on eudaimonic well-being. In contrast, studies of eudaimonic orientations distinguish interaction from other well-being orientations, such as hedonic or extrinsic, and indicate different outcomes or forms of experience in technology use. Independent of the orientation, studies of the dimension of experience measure the general outcome of a eudaimonic experience in technological use. Finally, studies were categorized into specific behaviors in case they quantify the potential support of technology for eudaimonic behaviors. If multiple categories are addressed within a report, they are categorized in multiple dimensions.

3.2.2 Results

The final screening process is illustrated in Figure 3.4, indicating 41 valid studies and 43 reports: Frison et al. have presented the same results twice (at a conference and as a journal article) [162, 163]. In addition, Seaborn published partial results of her work [443] before the final paper was published [446]. The coding into Huta's definitional categories can be retrieved from Figure 3.5. In fact, there are seven cross-dimensional studies (17.07%) in Figure 3.5 (in bold), as these papers contain at least two distinct definitional categories addressed [278, 324, 354, 445, 446, 508, 541]. Of the 41 studies examined, the majority investigated the direct link between technology use and its impact on eudaimonic well-being. (n = 24, 58.54%). The effect of eudaimonic experiences is addressed in 13 papers (31.70%), and a total of 10 papers identify eudaimonic preferences regarding the interaction by measuring a eudaimonic orientation in activities (24.39%). Finally, only one study measures effects on specific eudaimonic behavior (2.44%). This isolated study, the work by Leung [294], is outlined in Chapter 3.2.2.
Lastly, the domain distribution of the 41 studies should be noted. The majority of the studies were conducted in the field of mental health support (n = 6). Furthermore, analyses on smartphones, social media, and games were identified (with five studies each). The remaining studies were grouped into the following categories: work technologies (n = 3), virtual spaces (n = 3),

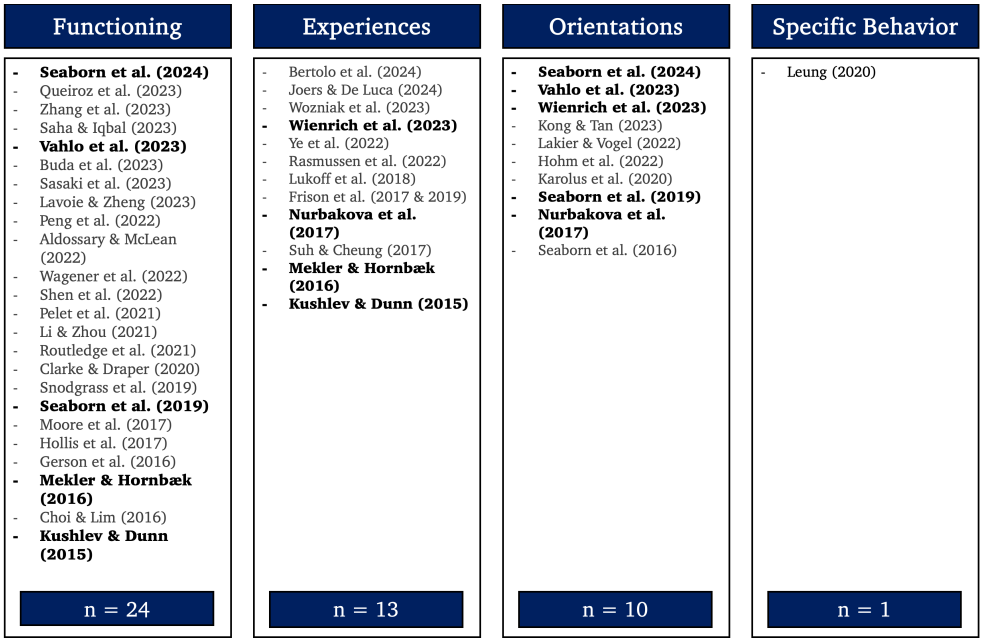

Figure 3.5: A categorization in the definition categories (functioning, orientations, experiences, and specific behavior) according to [220]. **Bolded studies** can be found in at least two definition categories in the analysis.

education (n = 2), and automotive technologies (n = 2). A number of studies were identified in the corpus, including investigations concerning smart home technologies, a digital piano keyword (music technology), internet use, and the analysis of eudaimonic preferences in recommender systems. In four studies, general eudaimonic preferences in interaction with HCI were examined, but no concrete domain was addressed.
All included studies (n = 41) are presented in great detail in the appendix (see Table A.1). Studies from the same year are sorted by publication date in descending order (2015-2024). The subsequent sections provide a more detailed description of each study.

Eudaimonic Functioning

As already summarized, a majority of contributions (58.54%) attempt to measure the effect of technological interaction on eudaimonic well-being. The most common applications are the Psychological Well-Being Scale (n = 5) [416] and the Questionnaire for Eudaimonic Well-Being (QWEB) (n = 2) [535]. The first scale refers to the six components of Ryff from Chapter

2.1.2 and has a total of 42 items [416]. The QWEB was designed to measure eudaimonic well-being, including items on self-discovery, perceived development of one's best potential, or a sense of purpose and meaning in life [535]. Lastly, in six studies, the influence was measured via a single item. For example, Moore et al. propose a mobile app to help people achieve more "genuine smiling" by setting themselves a timer and capturing a smile via the built-in smartphone camera [329]. To measure an effect in their "soHappy affective technology system architecture" [329, p. 3], they propose the use of a single-item 11-point scale "Do you feel happy?" [2]. The authors state: "This direction promotes responses that relate to eudaemonic well-being, rather than hedonistic happiness." [329, p. 5]. Li and Zhou examined the Internet use of Chinese older adults on eudaimonic well-being by using an impressive representative sample of 7,862 participants aged 60 and over [297]. They equate the perception of self-confidence with eudaimonic well-being and measure this via a single item with reference to "the participant's confidence towards him/herself in the future" [297, p. 4] (5-point Likert scale). The authors of the study found no direct effect of Internet use; however, they did identify an indirect effect due to the increased frequency of contact, which served to strengthen the relationship with their children. In the investigation of maldaimonic game experiences, i.e., destructive, exploitative, and egocentric in-game approaches to play, Seaborn et al. refer to the maldaimonic theory of Waterman [534] and provide a related work on eudaimonia [445]. Maldaimonia is called the "wicked twin" [445, p. 2] of eudaimonia, evoking experience of mastery and growth, fostering destructive and egocentric behavior in games. The Japanese version of the HEMA Scale [26] and an item to measure a long-term meaning potential for the player ("If you consider your life one year from now, how important will you find this experience?") [445, p. 5] were used. This custom item can also be found in the study by [324], who measured the long-term effect of a hedonic or eudaimonic experience in the interaction using a single item. In general, works by Seaborn are recommended to explore examples of cross-measurement consistency [445, 446]. As this study focuses on Japanese players, the authors found a significant relationship between the eudaimonic orientation and the long-term meaning potential of a maldaimonic game experience.

Peng et al. quantify an impact on eudaimonic well-being within a virtual medical tourism community (V-MTC) using an adapted version of a single-

item of a well-being scale by Hsieh et al. [215] ("purposeful and meaningful life in the V-MTC", 7-point Likert scale) [367]. The authors point out that influencing variables on well-being within the V-MTC are primarily high user interactivity and social interactions. Finally, Buda et al. investigated the influence of screen time using an application over a period of three weeks [68]. They measure a "worthwhileness", which they describe as the eudaimonic component of subjective well-being [68]. Their findings indicate that the question of influence is primarily context-dependent and should not be generalized. This finding was obtained through the implementation of a daily survey that employed a custom 10-point Likert scale. However, the specific item utilized in this survey remains unclear.

As shown in the domain coding, the study of mental health applications explicitly includes most of the measurements. Wagener et al. measured a lasting impact on eudaimonic well-being of their virtual reality application "Mood Worlds" [525]. They used the Oxford Happiness Questionnaire to measure this impact [204]. In their experiment, the application did not lead to any significant lasting impact.

Hollis et al. present a reflective technology, "Echo", to support users in reflecting on life events [212]. The authors used the Psychological Well-Being scale (PWBS) (a 54-item version by Ryff and Keyes [420]) in the pre- and post-test. In interaction with their "Echo", the authors found significant positive effects on eudaimonic well-being for their participants.

To investigate an application called "Happiness Mom", Sasaki et al. measured the influence on the psychological well-being of working mothers with preschool children. The authors state that psychological well-being represents "the eudaimonic idea that 'living well' means being self-realized, fully functioning, and purposefully engaged" [434, p. 34]. Due to this explicit association, it was included in the corpus. Furthermore, the authors used the Japanese version of Ryff's psychological well-being scale [435].

A solitary yet substantial influence on positive relationships with others was identified. In two studies focused on health applications, alternative scales were utilized to assess the impact on eudaimonic well-being (despite variations of the psychological well-being scale [416, 420]).

In another study, the effectiveness of online brain training for 352 adult twins, in particular, is evaluated [404]. The authors refer to hedonic and eudaimonic dimensions using the COMPAS-W measure [166] to quantify the influence of cognitive and emotional online training on mental well-

being. They were unable to determine a direct effect on well-being. Clarke and Draper [88] investigate effects on eudaimonic well-being of interaction with "Calm", a practice app for mindfulness, on users applying the Short Warwick-Edinburgh Mental Well-Being Scale (SWEMWBS) [478]. The authors state that this scale contains both hedonic and eudaimonic elements. In fact, they found a significant increase in the scores on the SWEMWBS when using the app.

Besides the single-item scale application for V-MTCs [367], four additional studies were added to the corpus that examined the impact of social media use on eudaimonic well-being based on common scales [85, 170, 286, 559]. Gerson et al. investigated the relationship between an intense use of Facebook and eudaimonic well-being [170]. An impact was analyzed using the QEWB [535]. In conclusion, intensive Facebook use was not significantly connected to lower perceptions of eudaimonic well-being. But there are conflicting findings on this. In contrast to the aforementioned results, Choi and Lim conducted a study that examined the impact of social and technology overload on the utilization of social network services (SNSs) among young South Korean adults [85]. They refer to psychological well-being as "the basic concept of eudaimonic well-being" [85, p. 247]. The classification in the corpus resulted from this association. To quantify a technological impact, they use the Rosenberg Self-Esteem Scale [400]. The authors conclude that addiction serves as a mediator for a negative influence on eudaimonic well-being; however, no direct influence can be identified. In another paper related to social media, Zhang et al. position the "eudaimonic approach" of well-being into the canon of psychological well-being and analyze the influence of social media [559]. A Chinese version of the PWBS was applied [420] in the course of the study. They conclude that self-esteem and online social support are important factors for a positive or negative effect on eudaimonic well-being. Finally, Lavoie and Zheng apply two items from the PWBS [420] to measure the relationship between smartphone screen time, flow perceptions, and eudaimonic well-being [286]. Their findings vary for different demographic groups[5]. Significant effects on eudaimonic well-being of participants aged 24 or older are captured, due to enhanced fluency perceptions on social media (flow as an underlying mechanism). For participants under the age of 24, a negative correlation between time

[5] One belongs to Generation Z if the person was 24 years old or younger, otherwise one belongs to the group of Millennials, Gen X, and Baby boomers [286, p. 4].

on social media and eudaimonic well-being was found.
Within the category of eudaimonic functioning, there are three contributions that analyze an effect in the work context. Saha and Iqbal examine the effect of automatic scheduling of focus time in the work context, distinguishing between short-term and long-term effects [429]. Slightly atypical of the norm in previous scale applications, several context-specific scales were applied, i.e., the Utrecht Job Engagement Scale [437], Work and Meaning Inventory [474], and Job-related Affective Wellbeing scale [512] measuring aspects such as self-fulfillment, perseverance, personal growth, or meaningfulness. A significant effect was identified on learning perception through the application, but no significant effect was found for personal growth, meaningfulness, perseverance, or self-fulfillment [429, p. 7].
In another study on the reading behavior of e-mails, Kushlev and Dunn quantify the experience of meaning in life, social connectedness, and environmental mastery as the "eudaimonic components of well-being" [278, p. 222]. The authors use different scales for different periods (day-based and week-based), i.e., a day-level measurement was intended to capture an experience, whereas the week-level measures were intended for an overall evaluation of one's eudaimonic well-being. This study, therefore, addresses two spheres of eudaimonic well-being concurrently. The subscale of PWBS [420] for environmental mastery was used for both the daily analysis and the weekly report. Furthermore, two different measurement methods were applied for assessing meaning (a single-item for the experience of meaning [279] (day-based) and "The Meaning in Life Questionnaire" [474] (week-based)). Lastly, for social connectedness, two items of the social connectedness scale [292] were used (only day-based evaluation). The findings indicate that persistent stress from e-mail technology can have a substantial impact on environmental mastery over an extended timeframe. Finally, Queiroz et al. [386] investigated the influence of video conferencing tools ("zoom fatigue") on eudaimonic well-being using a 5-item scale of life satisfaction [129]. In particular, the frequency of use has a negative effect on eudaimonic well-being.
Three studies can be categorized in (consumer) eudaimonic well-being, which refers to technology interactions in the economic sector and their impact on eudaimonic functioning. Pelet et al. [366] focus on the effect of sensory-driven Internet of Things (IoT) devices in hotels on eudaimonic

well-being using the QEWB [535]. The researchers identified a substantial impact of IoT devices, capable of generating smell and taste perceptions, on the eudaimonic well-being of guests.
Shen et al. examine the aspects of perceived connectivity, personalization, controllability, and responsiveness on the perception of autonomy, which in turn should have an impact on eudaimonic (consumer) well-being in online shopping systems [455]. Based on the work of Waterman [532], the authors developed a set of ten custom items measured on a 7-point Likert scale to assess the influence on eudaimonic well-being. The findings indicate that autonomy functions as a mediator, thereby influencing the positive effects of perceived connectivity, personalization, controllability, and responsiveness on eudaimonic well-being.
In a final paper contributing to this domain, the study examined the ability of virtual reality to prolong the effect of a past vacation experience on eudaimonic well-being, utilizing four distinct measurement time points [12]. The authors of the study reported a significant impact on eudaimonic well-being, with sustained effects observed up to eight weeks following the virtual reality experience.
Finally, Snodgrass et al. investigate the physical relationship between eudaimonic (mental) well-being and the so-called "stress-induced gene profile" of "avid online videogame players" [466]. They use 11 items (5 items for social and 6 items for psychological well-being) of the Health Continuum-Short Form (MHC-SF) [260, 284] to assess the impact of increased online video gaming on mental eudaimonic well-being. This research has identified a significant component of an influence on eudaimonic well-being in video game interaction: psychosocial involvement. A reduced increase in the release of stress via the sympathetic nervous system is thus linked to positive effects on eudaimonic well-being. Important implications of the analysis of this dimension can be found in the summary (see Chapter 3.2.4).

Eudaimonic Experience

The next largest dimension (31.70% of the contributions) for which studies were found is the eudaimonic experience. These studies are mainly based on a state level, i.e., the perception in direct interaction with the technology. The analysis of explicit eudaimonic experiences is achieved

through adaptations of the HEMA Scale or custom items (n = 8, 61.53%). The review of the literature reveals that only two studies make reference to alternative theories despite a modified application of HEMA. Specifically, these studies refer to the Orientations to Happiness (OTH) measure of a eudaimonic experience [354] as well as the individual scale applications for three different experiences (perceived utility, curiosity, and superior influence) that are explicitly declared as eudaimonic emotions [555]. In two studies, one found scales specifically constructed for eudaimonic experience in HCI [483, 550]. Suh and Cheung conceptualize eudaimonic motivation for personal information technology (PIT) utilization, primarily as a development of "aesthetic experience as eudaimonic motivation for PIT usage" [483, p. 121]. The authors developed a scale of nine items to capture the three experience dimensions (sense of self-expansion, meaningfulness, and active discovery). These dimensions are theorized to lead to an aesthetic experience and thus stimulate a eudaimonic motivation for technology. In their structural model, there are significant paths of the three dimensions to the aesthetic experience and thus stimulation of eudaimonic motivation [483, p. 121].

Woźniak et al. present the Eudaimonic Technology Experience Scale (ETES) [550]. The eudaimonic experience of or with technology is theorized to be measured based on two defined dimensions: eudaimonic goals and self-knowledge. This scale was used in quantitative studies in this dissertation [244, 245, 246].

One of the most cited papers on eudaimonia in HCI is the comparison of eudaimonic and hedonic user experiences by Mekler and Hornbæk [324]. A modified HEMA Scale was used to conduct a study on general hedonic and eudaimonic experiences with technology [324, p. 4511]. Significant differences were found for effects such as self-assurance, attentiveness, and contemplativeness. Furthermore, the need fulfillment of competence, popularity, security, and self-actualization turned out to be significantly more important for eudaimonic-oriented individuals in comparison to hedonic-oriented individuals.

This finding contradicted the existing paradigm, which posited the existence of only two types of quality (pragmatic and hedonic) (see also Chapter 2.2.1). The novel finding suggested that a pragmatic quality of technology as a source of eudaimonic experience could be empirically demonstrated. Rasmussen et al. choose a similar research methodology to analyze smart-

phone use with regard to hedonic, pragmatic, and eudaimonic experience [390]. Again, HEMA [224] is repurposed as a tool for eudaimonic experience (same methodology as the above-mentioned contribution by Mekler and Hornbæk [324]). The authors of the study identify learning skills and exploring new ideas as eudaimonic experiences. Frison et al. use the identical approach of Rasmussen et al. [390] and Mekler & Hornbæk [324] in the analysis of an interface for automated driving [163, p. 239]. The study revealed that the modified eudaimonic items for manual driving achieved the highest values when compared to semi-automated or fully automated solutions.

Furthermore, in two studies, a single item was utilized to quantify a specific eudaimonic experience. This includes the work of Kushlev and Dunn [278], which was described above, and also the work of Lukoff et al. [303]. Lukoff et al. measure the "construct of meaningfulness, a key component of the eudaimonic conception of well-being" [303, p. 2] using a single-item scale (7-point Likert): "How much do you feel like you have spent your time on something meaningful?".

Finally, two studies will be presented that were specifically conducted in the field of education. Ye et al. [555] investigate virtual reality-based learning in three individual dimensions referring to the "S-O-R" framework (stimuli, organism, and response) [323]. An investigation was conducted to examine the eudaimonic stimuli of the interaction in relation to utility, curiosity, and superior influence. The results of the study indicated that the fulfillment of these perceptions would result in cognitive absorption and reflective thinking, which, in turn, would favor the continuation of technology use. The study employed three different scales for the respective stimuli. [310, 517, 559]. Finally, the paper by Bertolo et al. [51] addresses the evaluation of their artifacts under the name "CalMe" (an ensemble of tangible artifacts) the "personal learning experience" of pupils using four custom eudaimonic items [51, p. 24]: a sense of accomplishment, self-confidence, curiosity, and generated interest (during and after the activity). Despite the latter differentiation, an experience of pleasure during and after the activity was not associated with an influence on eudaimonic functioning because it was interpreted as more of an overall final experience of the interaction. According to their statement, the design artifacts were beneficial to the pupils in "doing well" [51, p. 38], leading to positive, eudaimonic experiences.

Eudaimonic Orientations

The third category of eudaimonic orientations includes ten contributions, which thus account for 24.39% of the corpus. 80% (n = 8) of these studies reference the HEMA scale [224], which has already been mentioned in Chapter 2.1.5. Therefore, only two alternative approaches can be found: Vahlo et al. use a specific inventory, the "Motives of the Autonomous Player" (MAP) inventory [508]. Vahlo et al. address the question of whether there is a connection between gameplay motives and (eudaimonic) well-being outcomes [508]. The researchers investigated their research objective by examining immersive agency, competitive mastery, social motives, and utility using the MAP inventory. They characterized these motives as eudaimonic and requested that the participants rate them on a 7-point Likert scale. Their results indicate that there is a direct correlation between the fulfillment of the four motives and an influence on well-being [508, p. 11]. Nurbakova et al. [354] use their own item, which formulates personal orientation toward meaning as a form of *eudaimonic orientation* (based on a scale to differ from orientations to a life of meaning, pleasure, or engagement [374]).
However, the majority of contributions used modified items or derivations based on HEMA. Wienrich et al. use two separate eudaimonic measurement levels in their study on intelligent voice assistants (IVAs) [541]: First, the fulfillment of usage motives is to be determined via 4 adapted items of the HEMA [220]. Second, to quantify the fulfillment of eudaimonic goals, the authors derive subscales for eudaimonic experiences such as a sense of value, implication, awe, inspiration, transcendence, and carefreeness (7-point Likert Scale) based on the work by Huta and Ryan [224].
In a first publication [443], Seaborn illustrates the use of the HEMA Scale [224] for a game for people with limited mobility, comparing experiences based on each well-being orientation (hedonic and eudaimonic). In the completed work of Seaborn et al. [446], eudaimonic well-being is measured separately at the "state-level" and "trait-level". A eudaimonic orientation was assessed using the HEMA Scale [224], and eudaimonic functioning was assessed using the Flourishing Scale (FS) [128]. The findings indicate a significant correlation between eudaimonic orientation and flourishing as a result of engaging in the game. The HEMA Scale is used in further studies. For example, to analyze an extended system for playing a piano keyboard

[253], immersive environments [282], problematic smartphone use [269], or acute care technologies [208].

Eudaimonic Specific Behavior

A single study has been conducted that focuses on specific behavioral characteristics of individuals who are eudaimonic-oriented [294]. Leung's study differentiates between eudaimonic and hedonic smartphone activities, with the objective of identifying any potential differences in the activities performed on smartphones [294]. Leung's conceptualization encompasses 14 items, categorized into three dimensions: sociability, information seeking, and utilities, which collectively represent the eudaimonic use of smartphone technology. In addition, five items are designated for entertainment purposes, which Leung terms "hedonic use". All items are listed with the opening question "How often do you use the following features of your smartphone?" on a 5-point Likert scale. Leung's research revealed significant differences, including the perception of a lack of meaningful engagement with smartphones during leisure time. In the following, the multitude of studies explored will be synthesized to identify general implications.

3.2.3 General Implications

The scoping review was formulated to supplement the hybrid thematic analysis in order to gather further insights into an understanding of eudaimonic well-being in technology and to capture the necessary overview of existing measurement methodologies in order to understand the possibilities and limitations of current impact analyses and to synthesize important insights to conceptualize eudaimonic HCI.

Spheres and Demographics

The proportion of studies that address several spheres at the same time is proportionally low (7 of 41 studies). That points to the problem that not only does the problem of cross-sphere argumentation exist, but it can also be seen in the measurement strategy. Studies that have considered multiple dimension analyses serve as an example [354, 445, 446, 508, 541]. Again,

the separate analysis of the spheres is important [69, 223, 372], and their addressing must be clearly stated. This has been shown to be necessary in addition to the analysis of specific contributions in this corpus [85, 286]. Furthermore, demographics must be taken into account in the analysis. Technology can evoke different emotions depending on age [286].

Time and Frequency

The results of Queiroz [386] and Kushlev & Dunn [278] show the importance of temporal dimensions when analyzing eudaimonic well-being. Immediate effects do not necessarily persist in the long term. The results of Queiroz et al. [386] in particular show frequency as a dimension to be examined that can alter the effect on eudaimonic well-being. It is therefore of great importance to consider the extended interaction over time, because even negative effects may arise from long-term use.

Use of Measurement Methods

Although a large proportion of the studies use custom items (39.02%, n = 16), certain scale applications can be aggregated to determine a certain level of acceptance within the research corpus. While there is no one-size-fits-all recommendation for measuring well-being [513], a certain consensus can be derived based on the frequency of application. For example, the use of Ryff's scale [416] is an accepted approach to measuring eudaimonic functioning. In Chapter 5, her scale is therefore included in the list of recommendations for measuring the impact on eudaimonic well-being. However, a concrete measurement method for analyzing the influence of any kind of technological interaction on eudaimonic well-being does not exist. HEMA is also a popular tool for clustering participants into certain behavioral orientations. This scale can be considered an accepted procedure for analyzing differences between well-being orientations. However, this scale is also mainly interpreted in a modified form as experience. This brings us back to the problem that an indirect form of cross-sphere application becomes apparent. The scale refers in the narrower sense to general orientations that are not explicitly formulated in the technological context. In Chapter 4, a separate conception has therefore been developed with the EII to analyze an experience of eudaimonic orientations during an

interaction with technology. Furthermore, there is a considerable corpus of eudaimonic-correlating scales for experience that have not yet been considered and are thus available for further investigation [220, p. 226].

Concering Eudaimonic Behavior

Only one analysis is dedicated to eudaimonic-specific behavior in the form of a frequency analysis of smartphone activities [294]. Given the multitude of contexts identified in Chapter 3.1, the identified eudaimonic-specific behaviors are available for further analysis. Furthermore, the lack of measurement instruments for eudaimonic specific behavior is becoming particularly clear. One of these gaps, the characteristic of eudaimonic specific behavior in HCI, was specifically addressed in the first study presented in Chapter 4.

Confirming Interactivity and Flow

In particular, two studies have shown the importance of experiences such as cognitive absorption, high user interactivity, and flow perception [286, 367, 555]. It confirms the general implications from Chapter 3.1 that these factors are not insignificant for an eudaimonic interaction. These levels are confirmed by empirical studies in Chapter 4.

3.2.4 Summary

In the same way as in Chapter 3.1, this section should be concluded with a summary. Firstly, the differentiation into spheres and demographic dimensions is of the highest importance in the impact analysis on eudaimonic well-being in interaction(s) with technology. Secondly, the temporal component of interaction is not insignificant; it can lead to positive but also negative perceptions over time. Thirdly, eudaimonic behavior is largely underresearched, both in terms of certain characteristics of the action and the content of the behavior. Fourth, based on the scoping review and the evaluated results of the studies, the aspects of cognitive absorption, flow, and high user interactivity are emphasized again. These aspects will be important in the following section of the next chapter, which contains one's own research attempts regarding a eudaimonic experience with technology.

4

Analyzing Eudaimonic Interactions

In this chapter, a variety of studies focusing on eudaimonic experience in HCI are presented that have already been partially published. A corresponding justification for each research attention is attached to each chapter individually. The first study is an attempt to address the gap of missing contributions on eudaimonic specific behavior in HCI (see the summary of Chapter 3.2.4). Furthermore, the analysis of eudaimonic experience and AI is addressed in Chapter 4.2 and 4.3. The following Chapter 4.1 and Chapter 4.3 contain examples of concrete prototypes for eudaimonic-oriented technologies. In Chapter 4.4, a study on proactivity as an element in interaction for eudaimonic growth in HCI is presented. Finally, in Chapter 4.5, the development of the Eudaimonic Interaction Inventory (EII) is outlined as a measurement method for the experience of eudaimonic virtues in interaction with technology.

4.1 Study 1: Developing Meaningful Experiences

This chapter is based on a study that has been accepted for presentation at the International Conference on Computer Supported Education (CSEDU) in April 2025 in Porto (Portugal) [243].

Based on the hybrid thematic analysis in Chapter 3.1, it is necessary to address the question of how facets of eudaimonic specific behavior can be mapped in HCI. In Table 3.2 and Table 3.3 of the hybrid thematic analysis in Chapter 3.1.4, two different dimensions of eudaimonic behavior in HCI were found. In particular, two facets across both dimensions are to be addressed: First, the intrapersonal level of practical wisdom and competence: “The development of practical wisdom, far-reaching skills, maturity, ethics, and prudence are identified as potential objectives of technological

development" (see Table 3.2). Second, the level of (critical) reflection is to be addressed (see Table 3.3): "The interaction of technology leads to far-reaching reflection processes and the adoption of critical perspectives".

4.1.1 Building Eudaily

Framework for Reflective Play

For the systematic development of a web-based prototype, a corresponding framework has been used that can be categorized as part of the canon of eudaimonic interaction design: the reflective play framework by Miller et al. [326]. The design framework for reflective play has five sequential compo-

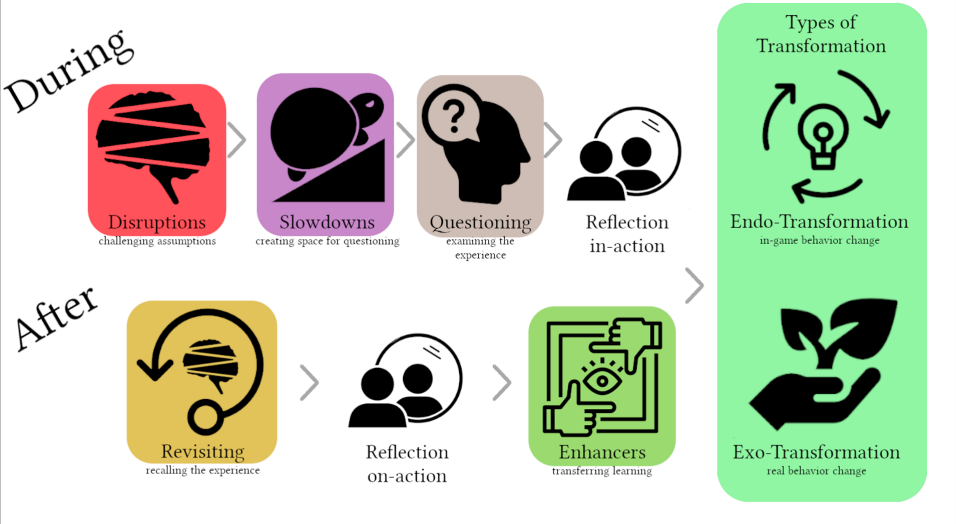

Figure 4.1: The framework for reflective play - extracted from Miller et al. [326, p. 5].

nents: *disruptions*, *slowdowns*, *questioning*, *revisiting*, and *enhancers* [326]. The translation of each phase is demonstrated in eudaily's architectural analysis below. In general, the objective of this framework application is twofold: to facilitate reflection during interaction (endo-transformation) and to promote authentic behavioral change (exo-transformation). In the development of the interaction during the slowdown, the guidelines for slow serious games [313] were taken into consideration as illustrated in the following.

Design Guidelines for Slow Serious Games

Marsh states in the course of introducing the design guidelines for slow serious games: "Through slow interaction/gameplay and removal of attention demanding activities we aim to free the mind and open opportunities for thinking and reflection on the serious experience issues, threats and impacts" [313, p. 49]. A total of eleven recommendations were formulated, e.g., "slow interaction/gameplay can be used as an alternative to the usual fast interaction and gameplay and hyper attention, through the removal of attention demanding activities and gameplay with an aim to open opportunities for thinking and reflection" [313, p. 50] or more simplistic recommendation such as "no commentary/narration used/permitted" [313, p. 50]. All forms are intended for a decelerated interaction with the system and are related to the doctrine of slow technology. In the following, the engineering perspective will be discussed.

Architecture of Eudaily

The web-based application "eudaily"[1] was developed using a wordplay of *eudaimonia* and *daily*. The fundamental concept underlying "eudaily" is to motivate students to engage in reflective practice concerning a range of philosophical concepts, including the laws of nature, subjective truth, free will, infinity, and love, while acknowledging the existing perspectives of philosophers. In this regard, a comprehensive database of philosophical perspectives on various subjects was utilized in the development of "eudaily". This initiative was made possible by the preliminary work of Gibson and Berry, who collectively maintain the website "Philosophy Ideas"[2]. Through this initiative, it was possible to access a database comprising 22,126 perspectives on 1,507 topics, including freedom of lifestyle, nature, and virtue of courage. The students engage with these perspectives in a playful manner, reflecting on the eudaimonic process of reflection. The topic is selected at random via a web interface, and the perspectives are loaded into "eudaily" accordingly. The subsequent subsections illustrate the exact course of the interaction in great detail. Architecturally, "eudaily" is presented as a sequence diagram (see Figure 4.2) due to the necessity

[1] http://eudaily.joersi.com/
[2] http://www.philosophyideas.com/

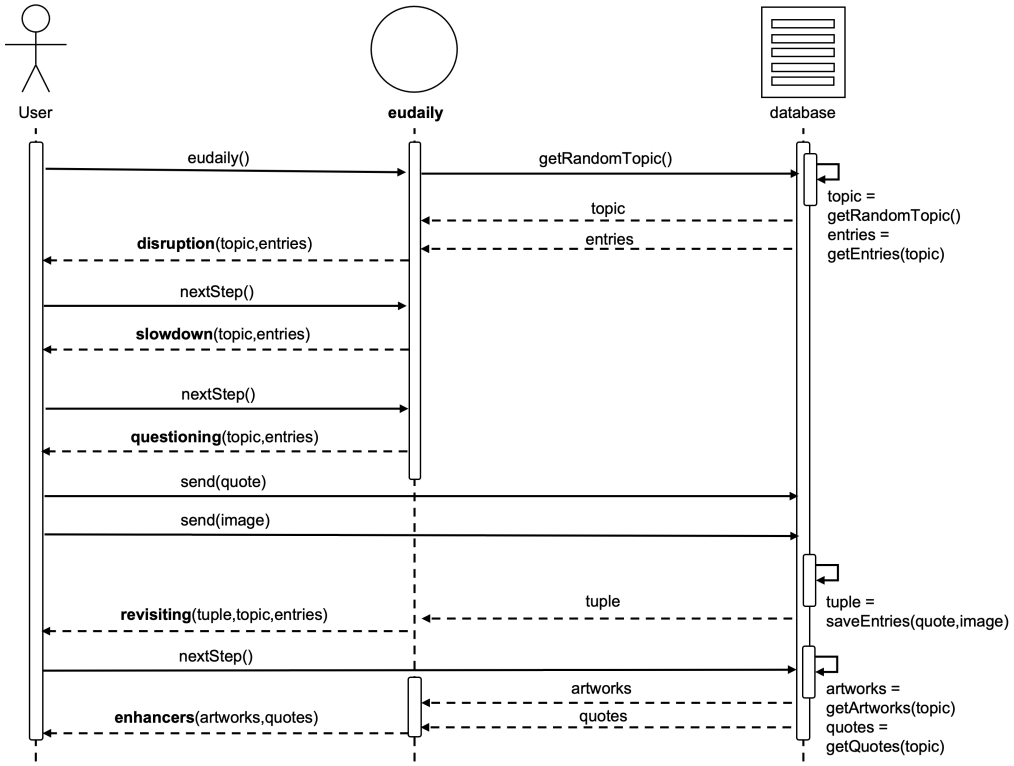

Figure 4.2: Sequence Diagram For “eudaily”. The bold elements are the reactive functions of eudaily, predefined by the framework of reflective play [326].

of a narrative that conditions the development of aesthetic interaction in games [147, 368, 401, 509]. It is implicitly necessary to predefine the story of an interaction in this doctrine in order to “schedule” an aesthetic effect in a way. The interaction has a clear sequence, as also described in the “Framework for Reflective Play” [326]. A meaningful transformation of the user is a targeted approach in this form of interaction [326, p. 5].

Disruption. There are various forms of disruption [326, p. 6]. Miller et al. formulate [326, p. 5]: “Disruptions are instances during gameplay that create cognitive friction or conflict, which players can seek to understand and resolve”. In the case of “eudaily”, this is a simple confrontation with one’s own opinion on randomly selected perspectives of a topic. It is intended to be uncomfortable, “as an opportunity for reflection” [326, p. 5]. The algorithmic part using the “getQuotes” function is demonstratively shown in Algorithm 1. The graphical implementation can be seen in Figure

4.3. The background is an animation implemented using the Three.js[3] library. It shows a robot contemplatively wandering in the rain. The can-

Figure 4.3: Phase of disruption: The "eudai-bot" takes a walk in the rain and reflects on the philosophical positions of a construct.

vas.js file for implementing this animation has over 500 lines of code, so the algorithm was not outlined in this dissertation. However, during the disruptive phase, one "creates an opportunity for the player to question their own assumptions and re-evaluate their own systems of thought" [326, p. 5]. It must be made clear once again that randomization was an important stylistic element in the development of "eudaily". Participants can change the topic at any time using a refresh button re-activating the getQuotes function (see Algorithm 1). However, in the evaluation, the participants have expressed a desire for pragmatic functions, including a pre-selection of topics. This will be taken up again in the implications of this study. To conclude this phase, the direct *confrontation* "with the player in relation to their beliefs and actions" [326, p. 7] has been chosen as a design approach to create *discomfort* in the interaction. The perspectives are shown overlapping and randomized (see Algorithm 2), forcing the student to "solve" the thought by clicking on the perspectives and moving on to another statement (jQuery[4]-based manipulation). Only after all possible thoughts have been clicked, the student can access the next page

[3] https://threejs.org/
[4] https://jquery.com/

Algorithm 1 getQuotes: retrieves quotes from two-folded database query.

Require: $sql\_db_{connection} \leftarrow True$
  $topic \leftarrow sql\_rand(limit = 1)$;
  $result \leftarrow sql\_query(topic)$;
  while $row \leftarrow (result = sql\_fetch\_assoc())$ **do**
    if True **then**
      $random\_topic \leftarrow row[topic\_name]$
      $random\_description \leftarrow row[topic\_description]$
      $result_2 \leftarrow sql\_query(random\_topic)$
      $l \leftarrow 1$
      $row_{count} \leftarrow sql\_num\_rows(result_2)$
      $elements \leftarrow array()$
      while $row_2 \leftarrow (result_2 = sql\_fetch\_assoc())$ **do**
        if True **then**
          $l \leftarrow l + 1$
          $quote \leftarrow row[quote_{text}]$
          $author \leftarrow row[quote_{author}]$
          $c \leftarrow createContainer(l, quote, author, rowcount)$
          $elements \leftarrow elements + c$
        end if
      end while
    end if
  end while
  $sql\_db\_close()$

Algorithm 2 randomPos: calculates random positions for each element.

  $h \leftarrow \#main\_div.height()$
  $w \leftarrow \#main\_div.width()$
  for `e in elements` **do**
    $e.width \leftarrow \#e.width()$
    $e.height \leftarrow \#e.height()$
    $height_{max} \leftarrow h - e.height$
    $width_{max} \leftarrow w - e.width$
    $left_{e.css} \leftarrow Math.floor(Math.random() \times width_{max})$
    $top_{e.css} \leftarrow Math.floor(Math.random() \times height_{max})$
  end for

by an activated next button[5] and thus enter the phase of *slowdown*.

[5] jQuery-based manipulation using class injection ("clicked") as well as click event on elements using regular expression: div[id^='box'].

Slowdown. Using the wording of the reflective play framework, it is intended, in the following, to implement a speed bump as "attention as a mechanic" [326, p. 8]. For example, (de-)acceleration through input devices can be a significant mediator of interaction, such as writing a tweet using an old-fashioned typewriter [98]. It is essential that the user is exposed to the content again without *simply rushing* through Phase 1. The user is presented with a comprehensive overview of previously issued statements and thereby transitions into a more de-accelerated phase of interaction. This phase is exemplified in Figure 4.4. In accordance with the

Figure 4.4: Phase of slowdown: The text statements are displayed again with additional questions to guide the students.

game principles of slow serious games [313], this section of the interaction is intended to facilitate opportunities for cognitive engagement and introspection. Concurrently, according to guideline number 10 of the design guidelines for slow serious games [313], the user can utilize a button to access a random selection of reflection questions. These questions are displayed in the respective text boxes through a random generator (using trivial server-based query and jQuery-based manipulation). All reflection helpers are listed below:

1. How would you explain this to a friend?

2. Could you rearrange the sentence?

3. Can you put it into your own words?
4. Is there a word here that is unclear that you should look up?
5. Would you put it exactly like that?
6. Can you possibly rephrase it?
7. Can this be generalized for everyone?
8. Are all the concepts here clear to you?
9. Is there a synonym for which this statement could also apply?

After leaving the slowdown phase, users enter the questioning phase, in which they are supposed to make their first own contribution.

Questioning. In the third phase of the interaction, in the sense of "demanding self-explanation", a "reflection-in-action" is enabled [313, pp. 10-11]. The gained perspectives are then expanded to include their own interpretation. The participant's own activation, apart from the study of existing perspectives, occurs in a two-fold process. Firstly, their own quote is to be formulated using a text field (1). This first step of questioning is illustrated in Figure 4.5. After successful formulation, a jQuery-based manipulation of the interface is effected, so that an HTML5 paint canvas opens. Along the

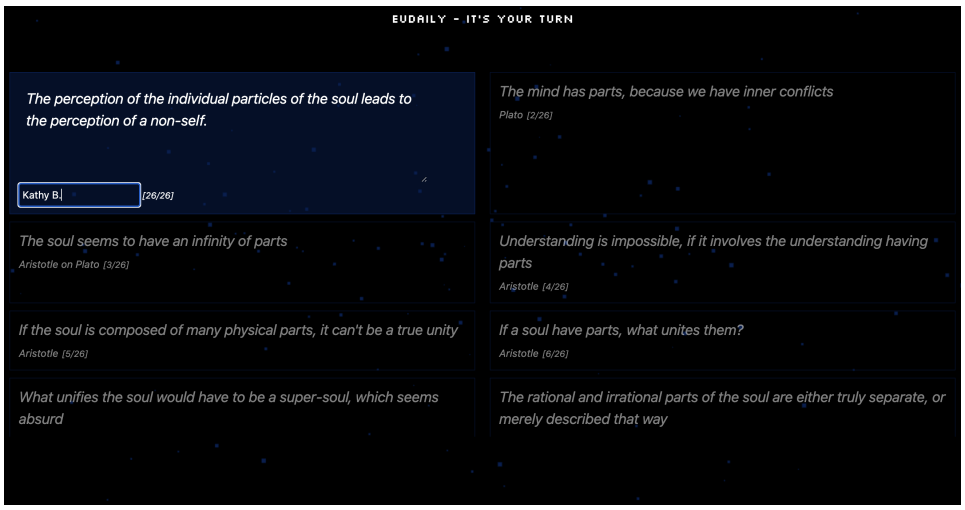

Figure 4.5: Phase of questioning (1/2): the users become active by providing their own quotation.

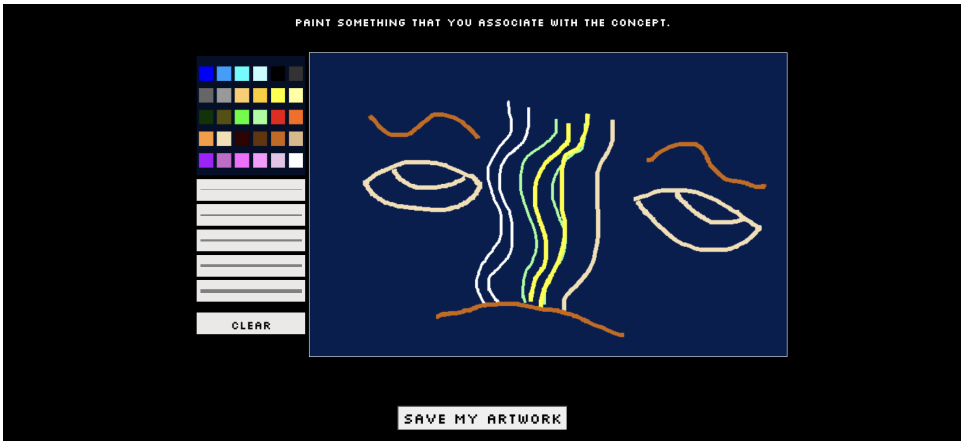

Figure 4.6: Phase of questioning (2/2): a minimalist painting surface designed to foster artistic activities.

design principle of "ambiguous instructions" [326, p. 11], the users express themselves creatively and visually on a small HTML5 canvas (2). This step can be seen in Figure 4.6. A simple editor (color selection and brush thickness) was provided, which, after saving the artwork via a secured file transfer protocol (SFTP) to the web server, redirects to the page that enables the *revisiting* of the experience.

Revisiting. In the *revisting* phase, a form of *reflective revisiting* was chosen (using the strategy proposed by Miller et al. [326, p. 12]). Miller et al. state: "[...] The pattern of reflective revisiting refers to any tool which allows the player to review their past experiences in ways that support reflection." [326, p. 12]. The player's own artwork is artistically re-integrated into the environment and the player's own textually formulated idea is displayed alongside the others. In addition, the dwell time within the system is displayed and provided with words of recognition that encourage the user to review their previous reflection process. In fact, actively informing users about their time spent on video platforms initiates reflection processes [436]. However, users' dwell times are not stored user-specifically. A shift in extrinsic motivation has to be prevented, i.e., avoiding a shift in focus to long usage times in the system, rather than engaging deeply with the topics. The total dwell time is also only displayed at that moment; there is no timer during the interaction, because *forms of evaluation* may cause decreases in creativity [18], complex problem solving [320], and deep conceptual

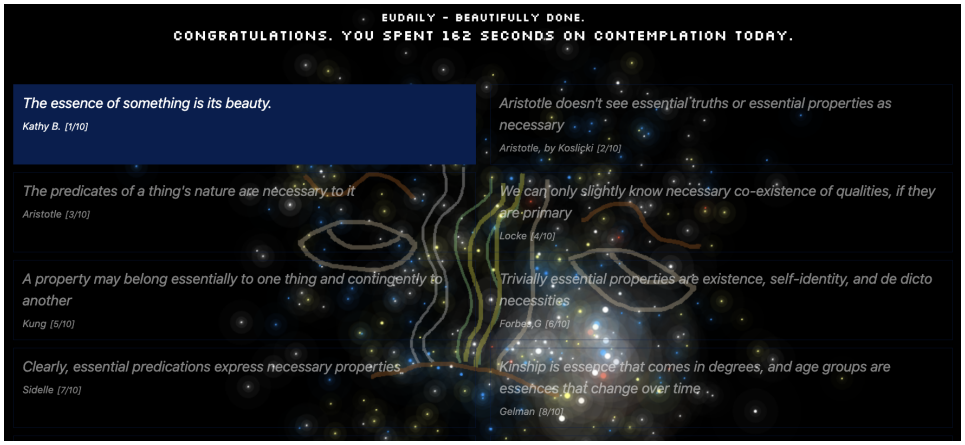

Figure 4.7: Phase of revisiting: The image is displayed with slight transparency in the background, and the user's quote definition is displayed next to the concepts. The user is simply informed about the dwell time in the system.

processing of information [182]. However, at the end of the phase, a small fireworks simulation is played in the background[6] to acknowledge the time spent in the system by the user (see Figure 4.7). The actual moment of the *enhancer* takes place in the last interaction.

Enhancer. The final phase of the enhancer is intended to motivate reflection practices outside of this environment. It should be considered in two moments of amplification: first, a pre-defined enhancing quote is played (simple extraction from one's own database). Examples are: "Since everything is a reflection of our minds, everything can be changed by our minds (Gautama Buddha)," "Without reflection, we go blindly on our way (Margaret J. Wheatley)," or "Learning is a process where knowledge is presented to us, then shaped through understanding, discussion and reflection (Paulo Freire)". Secondly, all previous user artworks are displayed on the last page of the interaction - no likes, just text, acronym, and the artwork, arranged from last to newest timestamp. Hence, it is a combination of two design templates, *explicit encouragement of reflection* and *breaking the fourth wall* [326]. It can be seen in Figure 4.8. The latter element, the confrontation with other artworks, is at the same time a novel feature that is also intended to address social reflection, because Miller et al. formulate an important aspect of reflective play: "Lastly, reflective revisiting features can be made

[6] it is more of a gesture.

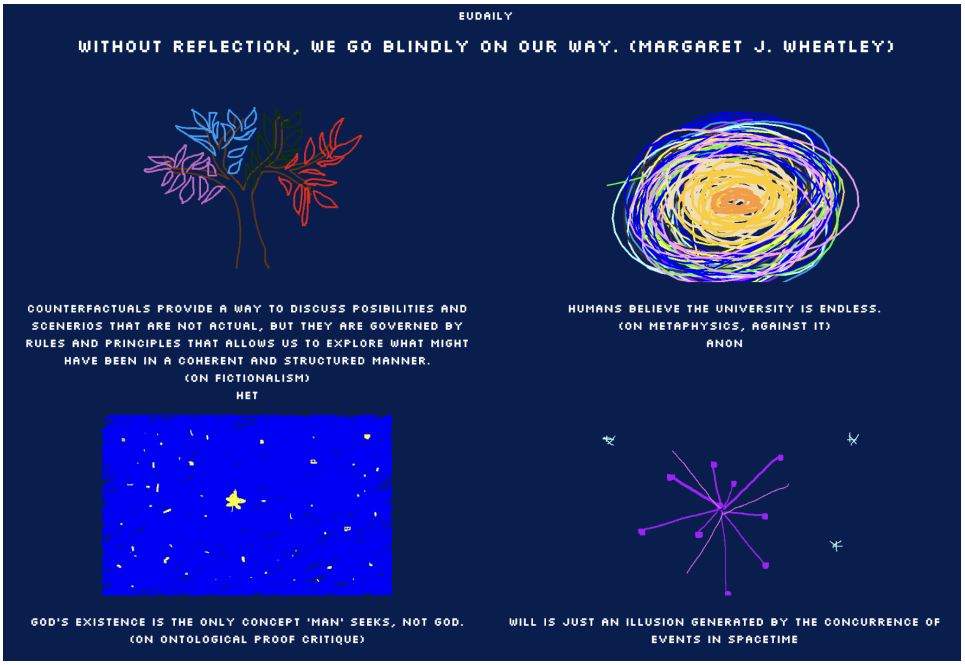

Figure 4.8: Phase of enhancer: the user can view different interpretations of other concepts by other users.

into social learning activities. Instead of reviewing your own processes and playbacks, reviewing your friends' gameplay can provide opportunities for comparison, mentorship, and other forms of social learning." [326, p. 16]. In the course of the subsequent user study, particular interest was expressed regarding the question of whether this feature contributes to a heightened sense of collective enjoyment during the interaction, or if the feature could result in an uncomfortable and thus undesirable sharing of personal artworks.

4.1.2 Methodology

The analysis is primarily qualitative and has an additional quantitative part. In total, 21 participants on Prolific[7] were recruited explicitly indicating a student status in their profiles. In the study description for the application as a participant, interest in philosophical activities was assumed in order to maintain a certain seriousness of participation. The age range of the participants was between 18 and 46 years old, with eleven men (52.38%)

[7] https://www.prolific.com/

and nine women (42.86%) participating in the study, along with one trans man (4.76%). The participants also shared their nationality (have been already anonymized when retrieved from Prolific): Eleven European students, seven African students, and three American students. On average, the participants spent 36.03 minutes on "eudaily" and participating in the subsequent survey. Participants were required to write a statement of at least 50 words detailing the negative and positive points of use. A small-scale quantitative analysis has also been included to verify the type of reflection (multiple types of reflection measurable). All participants had to indicate scores on all three subscales (*reflection*, *rumination*, and *self-focused thinking*) of the "Reflection, Rumination and Thought in Technology (R2T2)" scale [300].

With the items for *reflection*, the consciousness of one's self, his or her behavior and the support of reflective activities are measured in interactions with technology. It is therefore a suitable tool for measuring the experience of eudaimonic specific behavior referring to the dimension of (critical) reflection in Table 3.3. The second subscale of R2T2 addresses the supposedly more nostalgically negatively charged variant of reflection. *Rumination* subscale items are designed to assess the extent to which one produces negative thought cycles and reflects on past situations when interacting with technology. Lastly, the items of *the self-focused thinking* measure the influence of technology on evaluating one's own feelings and the actual origin of one's own thoughts. The utilization of subscales is intended to quantify the extent to which these aspects manifest in interaction with "eudaily", thereby ensuring holistic coverage of all scale-related dimensions in the interaction analysis. The objective of this analysis is to assess the extent to which all forms of reflection are addressed in the interaction. However, especially the first subscale (*reflection*) was important for measuring the extent to which a reflective practice was addressed.

4.1.3 Results & General Implications

Regarding the limited quantitative analysis, the Cronbach's alpha were at least satisfactorily (>0.6) consistent [487] (reflection: α=0.81, rumination: α=0.66, self-focused thinking: α=0.88). The evaluations are shown as box plots in Figure 4.9. Furhermore, all comments from the 21 participants were

thematically coded. This revealed important facets of critical reflection practices in HCI. The most frequent factor mentioned in the evaluation was the variety of perspectives to be evaluated in the disruptive phase (n = 5, 23.81%). Furthermore, there were participants sharing positive feedback on the artistic expression on the canvas (n = 4, 19.05%). One participant notably highlighted the absence of pressure for perfection in the painting process. Another participant noted the capability to concentrate on the reading process, a capacity that has been positively acknowledged. To summarize and structure each of the four implications, they will be addressed in the respective subsections.

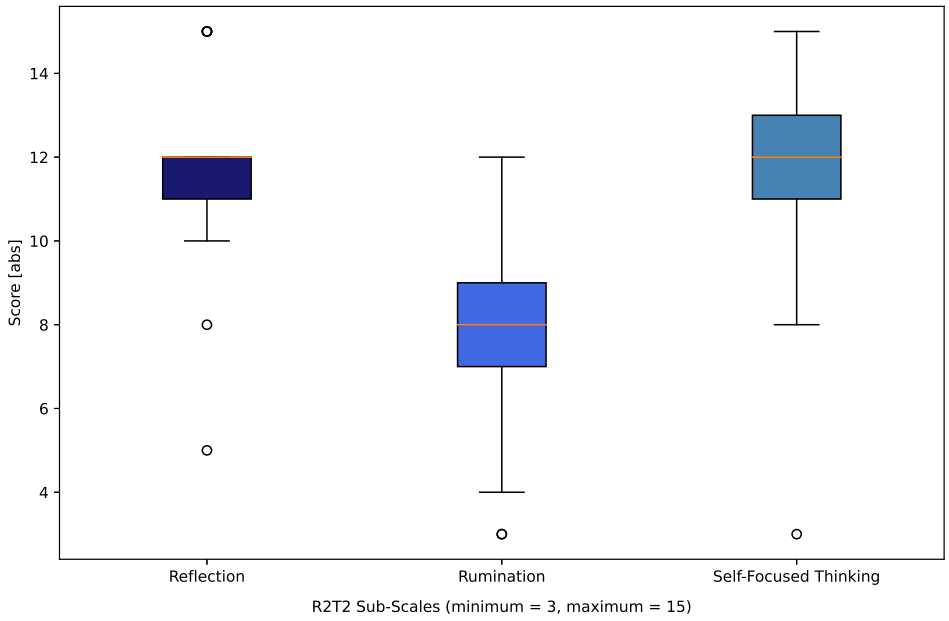

Figure 4.9: The evaluation of the R2T2 scale (each sub-scale). The *Rumination* subscale shows lower scores on average.

Fostering Mindful Exploration

The first important implication is the finding that mindful exploration is a stylistic element of aesthetic experiences with technology. For example, the most frequently mentioned positive aspect among the participants was the variety of perspectives (n = 5, 23.81%). The corresponding statements were added to the appendix. With the help of the small, additive quantitative

analysis using the R2T2 scale, it can be seen that high average scores for self-focused thinking and reflection point to a successful reflection based on *positive disruption through mindful exploration.* In contrast, low values were found for rumination. Two t-tests showed significant differences in the mean values for reflection and rumination (t=4.939, p<.000***) as well as self-focused thinking and rumination (t=4.546, p<.000***). Of course, these values must be carefully evaluated because a valid G*Power [145] cannot be guaranteed with certain assumptions (effect size d = 0.5) and the number of participants of 21. However, despite the small sample size, the p-values seem to clearly show the correlation that nostalgic association processes logically occurred less often because they were not addressed by "eudaily". Rumination "is considered to be a negative cognitive process, as it can involve a focus on loss and failures" [300, p. 2], thus this process was not intended and therefore may be not initiated. The type of *positive disruption* may be close to the experience of moral elevation, which can be found in the framework of eudaimonic emotions by Landmann [285]. Hence, such technology for reflective play can also be designed to promote positive eudaimonic emotions.

Increase Customization & Immersion

Another implication that emerged from the use case analysis was the notable demand for customization in both the ambience and interaction spaces. Identical to the upper implication, the statements were added to the appendix, which referred to this aspect of customization. The customization of the environment as such can be understood as a higher-level quality of interaction. The intentional customization of the participants' environment again points to the necessity of a high degree of interaction and can also reflect the desire for the highest possible absorption similar to the work by Ye et al. [555]. For example, two participants requested the inclusion of ambient music so that they could fully devote themselves to the experience.

Variety of Interactions

Two participants have indicated that the expression of reflection is limited to their quote and that it should be expanded by incorporating additional

forms of expression. The necessity for diverse forms of expression in reflection can be derived from these perspectives. Within the range of statements, some individuals may seek to express themselves artistically, while others may prefer to avoid it. In systems of reflection, a broad array of forms of expression must be facilitated. The connection between high user interactivity and eudaimonic well-being may fit into the line of argument [367], that the technical implementation of a variety of interaction possibilities can be an enabler.

Minimal Instructions Required

The statements for this section can also be found in the appendix. First of all, the principles of slow serious games demand the avoidance of instructions manifested by two recommendations ("7. No commentary/narration used/permitted" and "8. No extra information or text boxes displayed during gameplay" [313, p. 50]). Unfortunately, the participants were sometimes unable to understand the phases and the corresponding tasks. Despite the initial briefing for the study, it was not clear to a few participants what exactly was to be done in the respective sequences. This process of reflecting on the material requires a minimal prompt, i.e., informative feedback on what can be done and how. It should be noted that a help button was available. However, it may not have been sufficient to support the interaction. Nonetheless, minimal instructions might have been useful. It seems that a certain need for guidance in the process is required.

4.1.4 Summary

This primarily qualitative study (with the addition of a quantitative analysis) led to four key implications when developing aesthetic technologies that are designed to support eudaimonic specific behavior, such as critical reflection, are addressed: Firstly, mindful exploration by providing many perspectives on a philosophical construct is an appropriate positive element of the first encounter. The reflective play framework may serve as a structured development framework. Secondly, customization and immersion are important factors with regard to the feedback from the participants to enhance the quality of the experience in the environment. Thirdly, the variety of (artistic) expression should enable a user-centered variety of

interactivity. Fourthly, despite largely autonomous interaction, minimal feedback mechanisms and hints within the interaction are necessary to provide the user with sufficient instructions on how to complete the respective sequences.

4.2 Study 2: Eudaimonic Experience with AI

Parts of this study have already been presented and published at The Hawaii International Conference on System Sciences (HICSS) in January 2025 [244]. In comparison to the previous study, the following study is dedicated to an investigation of a differentiated perception that not only focuses on a specific experience of eudaimonic-specific behavior but on the interaction between eudaimonic-oriented individuals and AI applications in general. Important implications for eudaimonic interaction design are to be derived from this interaction. This study addresses the level of eudaimonic orientations and not explicitly that of eudaimonic specific behavior. In Table 3.2 in Chapter 3.1, frequent mentions of certain intrapersonal orientations were aggregated. In particular, “competence”, “engagement”, “authenticity”, and “excellence” are significant in this study. The differentiation of certain well-being orientations in relation to the experience with technologies is not a novelty on the basis of the findings in Chapter 3.2. However, no differentiation has been made in the interaction with AI so far. This justified the purpose of this study. Furthermore, the novel approach of a hierarchical analysis is to be implemented in this study.

The specific research question (*RQ*) for this study is defined as:

RQ_1: *Do eudaimonic-oriented individuals have a different motivation to use and different expectations of an AI interaction with regard to the following qualitative aspects: a specific eudaimonic experience, autonomy, competence, focused attention, usability, aesthetic appeal, and perception of reward.*

The methodology of the mixed-methods approach (quantitative and qualitative) is outlined in the following.

4.2.1 Methodology

Identical to the previous study, Prolific[8] was used to compose an international group of participants. The mixed-methods approach was chosen to contextualize the quantitative analysis evaluation with the corresponding AI usage data. For example, the diversity of AI usage as well as the usage intentions of the AI should be coded accordingly. Both forms of analysis are briefly characterized below.

Qualitative Analysis

The qualitative analysis was carried out using two open questions: firstly, the participants had to choose one AI, and secondly, they had to describe the reason for using this AI. Although this was formulated as an open question, the information was limited to one AI so that the reason for using the AI could be assigned accordingly. These reasons for use were then thematically coded using a codebook [63]. The corresponding usage descriptions sometimes contained multiple coded usage intentions, so that a description could be coded with multiple categories.

Quantitative Analysis

The quantitative analysis can be understood in a two-step process. (1) First, the participants had to answer all 15 items of the Hedonic, Eudaimonic, and Extrinsic Motives for Activities (HEEMA) Scale, a psychological scale for classifying a participant into one of three possible well-being orientations [293]: Hedonia (seeking for pleasure, relaxation, and enjoyment), eudaimonia (seeking for self-actualization and excellence), and extrinsic goals (desires for prestige, fame, and financial wealth). It is an extension of the HEMA-R scale [220] to include the latter category of extrinsic goals, which Huta considers in the newer conception of HEEMA. The values of these items were factorized using a principal component analysis (PCA) in order to apply a k-means clustering. Thus, the subjects can be divided into three distinct clusters, so that one can differentiates between three subject groups regarding their well-being orientations.
The second step of the quantitative analysis (2) is consequently the collec-

[8] https://www.prolific.co

tion of certain experience scores. To evaluate a *eudaimonic experience* in interaction with different AI interfaces, the Eudaimonic Technology Experience Scale (ETES) (2 subscales, 3 items each) was used. Using the ETES, which is based on a two-dimensional model (eudaimonic goals and self-knowledge), the experience of learning, aspiration, goal stimulation, as well as a deep connection to oneself and personal fulfillment are examined.
The intrinsic or autotelic experience is an important component of flow experiences [100, 230], which in turn was identified in Chapter 3.1 under the eudaimonic orientations as "self-direction". Thus, to evaluate the motivation to use AI, the User Motivation Inventory (UMI) [66] (6 subscales, 3 items each) was used. This inventory, developed by Brühlmann et al., is conceptually based on the SDT, which, as explained in Chapter 2.1.3, has close links to eudaimonic well-being. The inventory is designed to measure the motivation to use AI, i.e., whether the use of AI is solely extrinsically motivated or a certain self-interest exists.
For the further experience of cognitive absorption and flow, which are assumed to be important elements of eudaimonic experience with technology, a short version of the User Engagement Scale (UES-SF) [361] (4 subscales, 3 items each) was used. In their paper, the authors point to a correlation with measures of cognitive absorption and flow. In the course of this study, all four interaction qualities are to be measured: *focused attention*, *perceived usability*, *aesthetic appeal*, and *perception of reward*.
Finally, the hierarchical analysis of the influences of AI interactions is analyzed by comparing the three well-being orientations. The Technology-based Experience of Need Satisfaction scales (TENS) were used for this purpose [69]. The scale has an important feature: the scales and sub-scales are divided into four spheres of the METUX model, and each has a separate polarity profile (need support and need frustration, 3 items each). The METUX model was already used in Chapter 3.1 to transfer the elements of the inductive analysis into the deductive model. The four spheres are the life sphere, behavior sphere, task sphere, and interface sphere. The life sphere represents the highest form, the task and behavior sphere respectively represent perceptions during task completion and general behavioral orchestration, and the interface sphere represents direct contact with technology. This differentiation is used to analyze different effects on basic psychological needs. The elements of the Basic Psychological Needs Theory (BPNT), a sub-theory of SDT, are referenced as well, thus providing a

link to eudaimonic well-being. As illustrated in Chapter 2.1.3, the three basic psychological needs are *autonomy*, *competence*, and *relatedness*, of which *autonomy* and *competence* were examined. All items for the interface, task, and life sphere (6 subscales, 3 items each subscale) [69] were used. In this way, the experience of autonomy and competence in the life, task, and interface sphere can be analyzed separately to see if contradictory results arise, as in the work by Burnell et al. [69]. To address the eudaimonic-oriented individuals, being essential for the derivation of eudaimonic HCI in Chapter 5, the average scale was calculated, which already allows initial conclusions to be drawn. However, the values were additionally checked for significant mean differences with all well-being groups using a one-way ANOVA. Subsequent post hoc Tukey's Honestly Significant Difference (HSD) tests should determine the "honest" group differences [3].

Participants

Non-serious submissions were excluded in the first place with the time limit (at least 4 minutes participation) and submissions were double-checked to ensure proper quality of submissions using common guidelines [103]. In total, 301 participants took part in this study, thus the statistical power of the results is formally guaranteed ([145], d = 0.5, at least 252 participants, α = 0.05). A detailed description of the demographic data can be found in the appendix.

4.2.2 Results

One first gives a brief overview of the AI usage evaluation, before going on to discuss the results of the categorization into well-being orientations and the respective scales in the following sections.

AI Usage

The intention to use is concentrated in 76.08% of cases on OpenAI's Chat-GPT, further analysis relates to interactions with Google Services such as Gemini, Translate, or Bard (n = 16). In eight cases, the participants evaluated their experience with Microsoft's Copilot. Seven participants commented on interactions with voice assistants. A supportive AI for correcting

one's own text, Grammarly, was mentioned in four cases. The remaining mentions are distributed across various AIs, with some mentions like a helper for identifying scientific literature, typical image generation (Midjourney), or AI-powered Bing services. The full list with the number of mentions is attached in the appendix. All usage intentions were coded accordingly and are shown in Table 4.1 according to their frequency.

Purpose	Occurrences	Examples
Work and Schoolwork	n = 106 (24.77%)	*Helping with assignments, create a presentation preparation for a job interview, ...*
Entertainment	n = 38 (8.88%)	*Creating haikus and poems, having philosophical conversations, chatting just for fun, ...*
Text Generation	n = 35 (8.18%)	*Writing cover letters and CV's, social media posts, e-books, slogans, product descriptions, ...*
Rewriting and Spell Check	n = 34 (7.94%)	*Paraphrasing essays, assessments, emails, dialogues, CV's, ...*
Explorative Search	n = 34 (7.94%)	*Searching for travel destinations, ways to make income, or advice on certain topics, ...*
Code Development	n = 29 (6.78%)	*Generating code, rewrite code, debugging, code fixing, learning how to code, ...*
Personal Improvement	n = 28 (6.54%)	*Improving writing skills, discovering topics, create workout routines and diet plans, ...*
Fact-Checking	n = 25 (5.84%)	*Clarifying historical facts, retrieving weather information, day-to-day questions, ...*
Media Generation	n = 23 (5.37%)	*Creating compositions of one's artwork, random images and videos, product images, ...*
Personal Assistance	n = 22 (5.14%)	*Setting timers, structuring assignments, playing music, finding telephone numbers, ...*
Summarization	n = 16 (3.74%)	*Writing a summary or outline, creating a list of aspects based on a research article, ...*
Translation	n = 6 (1.40%)	*Translating texts into another language, doing homework in a foreign language, ...*

Table 4.1: List of AI usage intentions in interaction with AI.

Principal Component Analysis

In the first step of the research, the results of the HEEMA Scale enabled the participants to be clustered into their respective well-being orientations. The execution of the PCA shows the possibility to choose three principal components that explain a total of 62.83% of the variance in the evaluation of the HEEMA scale. In addition, the factor loadings are shown in Table 4.2. There is no high cross-loading (> 0.4) for the items so that the formation via a k-means clustering was carried out as defined in the methodology. This is illustrated in Figure 4.10, where three green clusters can be clearly formed,

representing one of these well-being orientations (hedonic, eudaimonic, and extrinsic orientation).

HEEMA Items	Factor I	Factor II	Factor III
Eudaimonia			
Seeking to develop a skill, learn, or gain insight into something?	0.0341	**0.605**	0.109
Seeking to do what you believe in?	0.158	**0.633**	0.328
Seeking to pursue excellence or a personal ideal?	0.212	**0.763**	0.065
Seeking to use the best in yourself?	0.176	**0.769**	0.143
Seeking to contribute to others or the surrounding world?	0.200	**0.675**	0.091
Hedonia			
Seeking relaxation?	0.080	0.260	**0.676**
Seekin pleasure?	0.275	0.152	**0.695**
Seeking enjoyment?	-0.040	0.264	**0.749**
Seeking to take it easy?	0.053	-0.059	**0.451**
Seeking fun?	0.088	0.164	**0.780**
Extrinsic Goals			
Seeking to have lots of money and nice possessions?	**0.601**	0.237	0.139
Seeking to have high status and prestige?	**0.757**	0.263	-0.029
Seeking power and dominance over others?	**0.773**	0.026	0.114
Seeking to be admired and well-known?	**0.751**	0.170	0.066
Seeking to be popular and have an attractive social image?	**0.691**	0.077	0.139

Table 4.2: Loadings of the items on the respective factor: factor loadings above 0.4 are marked in bold for the respective question.

One-Way ANOVAs

Subsequently, the mean values of the experience scales were analyzed by group differentiation. Cronbach's α was calculated to evaluate the internal consistency of the scales. All Cronbach's α were at least 0.7 (acceptable). The full list of Cronbach's α is included in the appendix. Subsequently, a one-way ANOVA was conducted for each sub-scale. After identifying significant p-values for certain scales (see Table 4.3), the post hoc Tukey's HSD test results are presented.

Post hoc Tukey's HSD tests

In the respective detailed analyses in the form of post hoc Tukey's HSD tests, differences can still be identified. Eudaimonic-oriented individuals show significantly lower average values for the dimension of eudaimonic goals (EG) (eudaimonic vs. hedonic: p = .0052** and eudaimonic vs. extrinsic: p = .0257*). For self-knowledge (SK), there is a significantly lower average

Figure 4.10: Correlations between the items of the HEEMA Scale: The loadings generate three squares consisting of the items that each “border” a well-being orientation.

value compared to extrinsic-motivated individuals (p = .0015**).
In addition, significant differences can be found in the motivation to use AI. Furthermore, in Table 4.3, the ANOVA revealed significant differences regarding the forms of integrated regulation and intrinsic motivation. Integrated motivation is considered a self-determined form of extrinsic motivation [66, 486], which requires the system to be in line with personal values. In the sense of SDT, intrinsic motivation is considered the highest form of autotelic motivation, i.e., the utilization arises entirely from one’s own value system. The types of motivation were shown in Chapter 2.1.3 (see Figure 2.3 in particular). Both distinctions have been confirmed in the post hoc Tukey’s HSD tests. A significant difference in intrinsic motivation between eudaimonic-oriented individuals and extrinsic-oriented individuals has

Scale	Hedonic	Eudaimonic	Extrinsic	Cronbach's α	F	p
ETES						
Eudaimonic Goals (EG)	10.68	9.22	11.04	.78	4.96	**.007****
Self-Knowledge (SK)	6.16	5.03	7.17	.92	7.06	**.001****
UMI						
Amotivation	2.45	2.65	2.63	.87	0.63	.53
External Regulation	1.37	1.56	1.51	.75	1.46	.23
Introjected Regulation	1.58	1.53	1.89	.89	2.62	.07
Identified Regulation	4.54	4.43	4.66	.82	0.38	.68
Integrated Regulation	2.42	1.70	2.86	.93	7.98	**.000****
Intrinsic Motivation	5.07	5.56	5.52	.92	3.97	**.019***
UES-SF						
Focused Attention (FA)	2.44	2.19	2.63	.72	3.77	**.024***
Perceived Usability (PU)	4.06	3.93	3.96	.62	0.90	.405
Aesthetic Appeal (AE)	3.10	2.90	3.25	.70	2.32	.099
Reward (RW)	3.94	3.64	3.91	.78	2.63	.07
TENS						
Interface						
Autonomy (Support)	4.77	4.39	5.13	.81	4.96	**.009****
Autonomy (Frustration)	3.09	3.54	2.98	.79	2.16	.11
Competence (Support)	5.77	5.50	5.98	.89	2.89	.05
Competence (Frustration)	2.01	2.38	2.05	.89	1.51	.22
Task						
Autonomy (Support)	5.17	4.68	5.19	.87	2.39	.09
Autonomy (Frustration)	2.52	3.05	2.53	.87	2.58	.07
Competence (Support)	5.44	5.03	5.63	.89	3.42	**.03***
Competence (Frustration)	2.08	3.05	2.05	.79	7.78	**.000****
Life						
Autonomy (Support)	3.71	3.10	4.24	.88	6.99	**.001****
Autonomy (Frustration)	1.85	2.44	2.13	.75	5.03	**.007****
Competence (Support)	5.06	4.54	5.34	.92	4.08	**.01***
Competence (Frustration)	1.71	2.30	1.81	.87	5.13	**.006****

Table 4.3: Results of the carried out one-way ANOVAs. Significant p-values are bolded and marked (* = p < .05, ** = p < .01).

been identified (p = .0193*). Regarding integrated motivation, there are differences between eudaimonic-oriented individuals and hedonic-oriented individuals (p = .0337*) as well as extrinsic-oriented individuals (p= .0004**) respectively.

For the four dimensions of the UES, i.e., *focused attention, usability, aesthetic appeal, and perception of reward*, a sole significant difference between the eudaimonic group and extrinsic group for focused attention (FA) can be found (p = .0253*). The mean evaluation of the aesthetic appeal (AE) of AI is 2.9, which is below average. However, this result is not significantly different from that obtained for hedonic or extrinsic-motivated individuals.

The evaluation of the TENS scales resulted in different experiences of *autonomy* and *competence* in the respective spheres (interface, task, and life). For the task competence dimension, i.e., the completion of tasks, the frustration of the eudaimonic group is significantly higher compared to the hedonic group (p = .0003**) and extrinsic group (p = .0021**). In addition, there is a significant difference between eudaimonic and extrinsic-motivated individuals for autonomy support in life (p = .0015**). Significant differences regarding frustration values for autonomy in life between eudaimonic-oriented individuals and hedonic-oriented individuals can be found (p = .0119*). For competence frustration in life, there is a significant difference between eudaimonic-oriented and hedonic-oriented individuals (p = .0043**) as well as extrinsic-motivated individuals (p = .0316*). For the experience of autonomy and competence in the interface sphere, no differences were found between the well-being orientations. The p-value in Table 4.3 points to a significant difference between the hedonic and extrinsic group (p = .0136*), but no difference between eudaimonic and the other groups can be identified. The results are used to derive the corresponding implications, which are then summarized below.

4.2.3 General Implications

Congruence with Values

The analysis of the motivation to use AI also points to a lack of stimulation of essential values in the interaction. The integrated regulation of motivation, i.e., a technological interaction corresponding to "personally endorsed values, goals, and needs that are already part of the self" [66], was significantly different for eudaimonic-oriented individuals. The second dimension of the ETES, self-knowledge, also measures a close connection to one's own self in the interaction, which was significantly different for eudaimonic-oriented individuals and showed a low average score in general (5.03 out of a possible 15 points). It shows that the exact dimensions of the interaction that are supposed to be harmonized with existing virtue need to be addressed. In the last study of Chapter 4, which, i.a., form the foundation of this dissertation, these dimensions are derived in a three-part study design. Nevertheless, for a certain group of eudaimonic-oriented individuals, AI seems to have at least a pragmatic value. The evaluation

of the UMI scale values has shown that high values have been obtained for statements such as *using AI is a good way to achieve what I need right now*, which rather justifies a momentary advantage, a pragmatic reason for use, as Mekler and Hornbæk have found for a group of eudaimonic-oriented individuals [324]. The internal consistency of perceived usability (α = 0.62) shows that the usefulness of AI is perceived very individually, which, furthermore, may reinforce the emphasis on contextuality.

Interplay between Orientations and Functioning

Finally, the results of the TENS scales were used to address an important interplay between orientations and functioning. The low scores for autotelic motivation and integrated regulation in the UMI may be reflected in higher frustration scores on the autonomy and competence scales in the task and life spheres. For example, among the eudaimonic-oriented individuals, a total of 17.14% of respondents made contradictory statements about autonomy across the spheres (above midpoint experience of autonomy in the interface sphere, but below midpoint experience of autonomy in life). Furthermore, a total of 28.57% of eudaimonic-oriented individuals are frustrated by the reduced autonomy in their task completion and at the same time indicate a high level of autonomy on the interface. This connection between the weak forms of motivation measured by the UMI and the frustration of basic psychological needs indicates an important interplay of one's own experience of virtues in interaction with AI and an effect on basic psychological needs. It particularly addresses eudaimonic-oriented individuals and again emphasizes the importance of an analysis of specific interaction virtues and hierarchical analysis.

Experience of Learning and Aspiration

Compared to other well-being orientations, the perception of a sense of achievement or aspiration is significantly different for eudaimonic-oriented individuals. The average values are lowest for the dimension of self-knowledge (SK) so that the eudaimonic experience is generally the weakest. Interaction with AI has certain facets that need to be examined in follow-up studies to determine why this experience is not perceived to the same extent. It may be an attitude issue (1) *or* a form of interaction

design (2). This question is addressed in the follow-up study by developing and examining another prototype that harmonizes AI and eudaimonic experience in Chapter 4.3.

Lack of Focused Attention or Immersion

Eudaimonic-oriented individuals do not "lose" themselves in the interaction (1) and do not feel deeply involved in the interaction (2), as was determined based on the results of the items evaluation of the UES. Differences in focused attention (FA) in AI interaction, which measures, e.g., deep involvement in the interaction, are identified as significant ($p < 0.05$). This is congruent with the previous study in Chapter 4.1, which found that increased immersion of the participant could be a condition for eudaimonic experience. This facet will be addressed in two further studies, in Chapter 4.4 and Chapter 4.5.

4.2.4 Summary

The results of this section will be summarized addressing the four implications once again shortly. *Firstly*, interaction with AI proves to be weak for eudaimonic-oriented individuals in terms of their own personal values and a (spiritual) connection to their own self. Research into these specific values of interaction will be addressed in follow-up studies. *Secondly*, there seems to be a technological interplay between orientations and functioning, thus the way an interaction is structured can cause frustrations with regard to basic psychological needs. It again emphasizes the importance of hierarchical analysis. *Thirdly*, the experience of learning and aspiration was significantly different for eudaimonic-oriented individuals, so that facets of learning and aspiration must also be addressed by further studies. Both experiences are significant in eudaimonic interaction in interaction with technology according to the present results. *Fourthly*, this study reaffirms the quality of deep involvement and immersion as facets of eudaimonic interaction. These qualities will be important in the three follow-up studies.

4.3 Study 3: Supporting Self-Actualization with AI

Parts of this study have already been submitted and accepted at the 26th International Conference on Artificial Intelligence in Education (AIED 2025) in July 2025 in Palermo, Italy [245].
The aim is to directly tie in with the open question from the previous study in Chapter 4.2 as to whether it is a general aversion to AI by eudaimonic-oriented individuals (*AI is fundamentally problematic for my way of growing personally*) or the interface design that makes an AI create a low experience of personal growth (*I can't use the AI in a way to grow personally*). This study should further shed light on which facets of interaction are relevant for eudaimonic-oriented individuals, so a variant of the HEMA scale, the HEMA-R scale [220], is used once more to refer to possible differences between hedonic-oriented and eudaimonic-oriented individuals. As in the previous analysis, the dimensions of eudaimonic orientations should be addressed (experience of "competence", "engagement", "authenticity", and "excellence") and, in the context of this study, the specific behavior of "skill building" (see Table 3.2 and Table 3.3 in Chapter 3.1). For this research purpose, the "Large Language Model Supported Learning" tool (LaLaMoSuLe) was developed, supporting explorative learning and vocab training with LLM-based functionalities. In general, "LaLaMoSuLe" is a web-based application that integrates AI as a supporting element in the process of vocab exploration as well as pronunciation training. One's own tool was evaluated in the course of a quantitative analysis concerning the experience of eudaimonic experience, autonomy, and competence with regard to a eudaimonic orientation. In addition, the same scales (ETES and TENS scales) were used to compare the results of the previous study to retrieve further possible findings. Referring to the question at the beginning (aversion vs. design issue), the following research question is formulated for this study in particular:

Research Question 1 (RQ_1): *Does the mere presence of AI functionalities affect the perception of technology for eudaimonic-oriented individuals?*.

Based on the previous studies, one generally assumes negative effects. This leads to two hypotheses:

(H_1) *A eudaimonic experience is negatively influenced by the mere presence of AI in learning systems for eudaimonic-oriented individuals.*

(H_2) *The experience of autonomy and competence is negatively influenced by the mere presence of AI in learning systems for eudaimonic-oriented individuals.*

4.3.1 Methodology

Development of LaLaMoSuLe

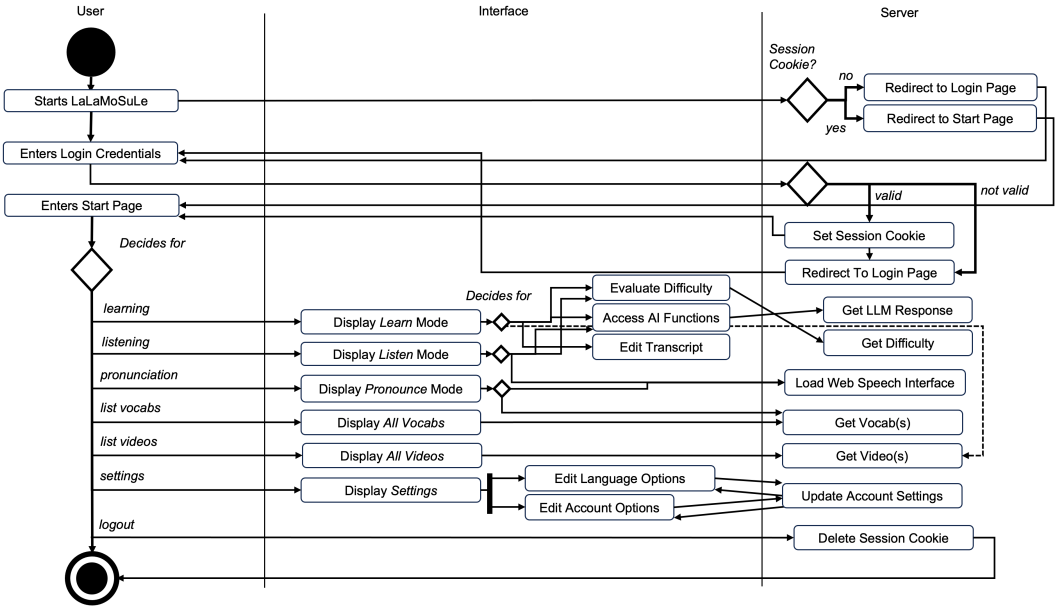

Figure 4.11: UML Activity Diagram For LaLaMoSuLe.

The Large Language Model Supported Learning (LaLaMoSuLe)[9] tool is an explorative learning environment for intermediates in which users can save YouTube videos enabling an exploration of vocabulary and sentences in a foreign language with the help of LLM-based functionalities. The implementation of the individual functionalities is described below and partially supplemented by pseudocodes. In contrast to a UML sequence diagram representation of "eudaily", the entirety of the functionalities is illustrated in a UML activity diagram (see Figure 4.11). Basically, "LaLaMoSuLe" is

[9] https://tech.joersi.com/lalamosule/

programmed with a login/logout logic, so that a username and password must be set to use it[10]. This is the necessary mechanism for saving the videos and vocabulary.

Learning mode. In the learning mode, the participant is confronted with videos that can be stored in the system directly. The user is asked to enter the video ID in a field that is sent to an upload script via a jQuery post-function. This video ID is automatically stored in a database and can be explored immediately in the learning system. A transcript of the video is automatically loaded via a Python script using a cron job in a certain time period, so there may be delays in generating the transcript to the right of the video. In addition, the user can access a total of seven built-in

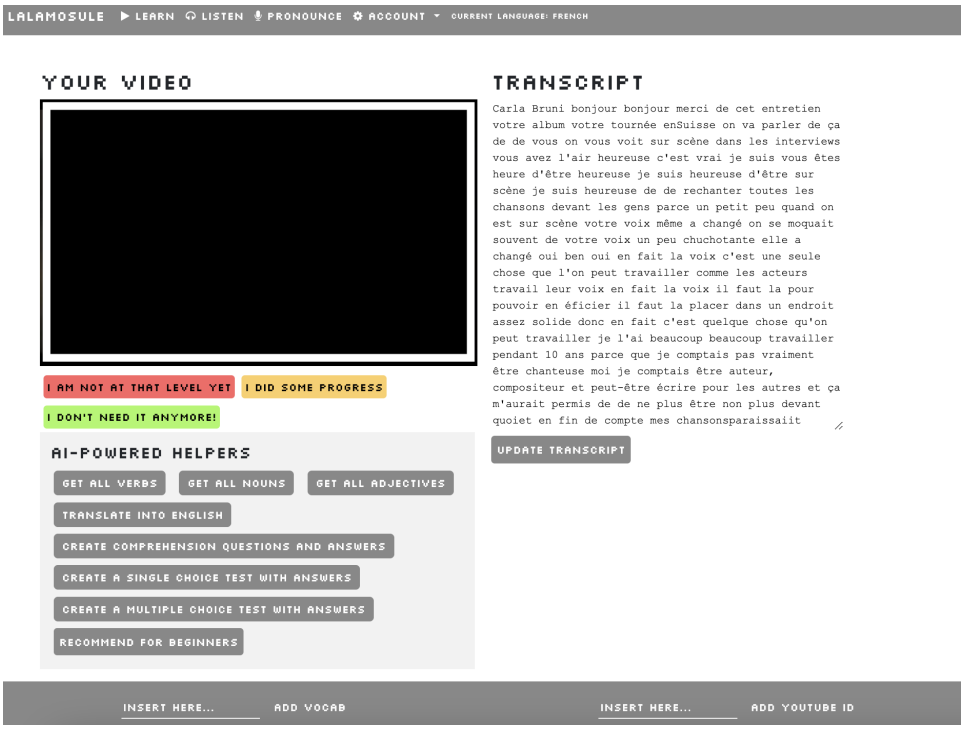

Figure 4.12: Vocabs are explored through the video material supported by the transcript. The AI features can be used to supplement learning playfully.

LLM-based functionalities: the user can generate all verbs in infinitive form (1), all nouns (2), all adjectives (3), as well as an English translation

[10] Functionality integrated via PHP-based session and cookie setting). Cookies therefore had to be activated in the browser to test the prototype correctly.

of the video transcript (4) and comprehension questions and answers (5). Further extras are single-choice (6) and multiple-choice (7) tests. In Figure 4.12, the learning mode is shown as an example. The transcript is used in combination with the built-in prompts, whereby the answers are displayed to the user after a couple of seconds (it varies in terms of the length of the transcript). A "traffic light system" (green, red, yellow) was implemented that allows the user to rate the difficulty of the video. This rating is updated in the database as a simple integer. The label is updated after each interaction and changes the videos played so that easier content is shown less often than content that is perceived as difficult. A simple recommendation button leads to the logging of the recommendation of the video by marking it in the database. Finally, the algorithm for linking the LLM-based prompts in an algorithmic pseudo-code is to be illustrated to complete the section covering the shape of the learning mode on "LaLaMoSuLe".

Algorithm 3 getAIAnswer: calling LLM to load the responses into the interface.

Require: m, t ▷ loaded via jQuery.post, t = transcript, m = module
  $api\_key \leftarrow string$
  $url\_endpoint \leftarrow string$
  $c.curl\_setopt(post = true)$
  $c.curl\_set(http\_header = (content-type: JSON, api = api\_key)$
  $d \leftarrow array(model = gpt.4o.mini, role)$ ▷ role: "give simple answers"
  $r \leftarrow json\_encode(d)$
  $response = curl\_execute(r)$
  $answers = json\_decode(response)$
  if $is\_set(answers)$ **then**
    switch m **do**
      case get_verbs **return** $prompt_1 + t$ ▷ "Extract verbs [...]"
      case get_nouns **return** $prompt_2 + t$ ▷ "Extract nouns [...]"
      case $get\_adjectives$ **return** $prompt_3 + t$ ▷ "Extract adjectives [...]"
      case $translate$ **return** $prompt_4 + t$ ▷ "Translate [...]"
      case q_and_a **return** $prompt_5 + t$ ▷ "Create Q&A based on [...]"
      case sc_test **return** $prompt_6 + t$ ▷ "Single choice test for [...]"
      case mc_test **return** $prompt_7 + t$ ▷ "Multiple choice for [...]"
  end if
  $curl\_close()$

Listening mode. The second macro functionality of "LaLaMoSuLe" is the listening mode. The listening mode has integrated the Web Speech API[11], which actively dictates the vocabulary or a sentence in this phase. Thus,

Figure 4.13: Listening mode on "LaLaMoSuLe".

hearing can be trained or used as a dictation in this mode. In "LaLaMoSuLe", entire sentences can also be stored. The button is located in the learning mode on the bottom left of the screen, visible to the user in an interface bar. These words are stored in a separate database and linked to the user ID. Only the logged-in user has access to his or her own vocabulary. In listening mode, a traffic light system is used, identical to the learning mode, only this time the vocabulary and phrases are evaluated according to the respective level of difficulty. For each stored vocabulary or phrase, five example sentences with English translation are automatically loaded (LLM-based). In addition, the user can define notes for each keyword using a tinyMCE editor[12]. The content can be stored in the database in the same

[11] https://developer.mozilla.org/en-US/docs/Web/API/Web_Speech_API
[12] https://www.tiny.cloud

way as text content. An example of the "Listening Mode" can be seen in Figure 4.13.

Pronunciation mode. In *Pronounce* mode, the user can test their pronunciation of the vocabulary based on the Mozilla Web Speech API. This mode is shown in Figure 4.13, but the general process is to be presented additively in an algorithmic pseudo-code because it is challenging to explain how the synchronization is technically implemented based on the Figure solely (see Algorithm 4). The web speech recognition is automatically loaded into

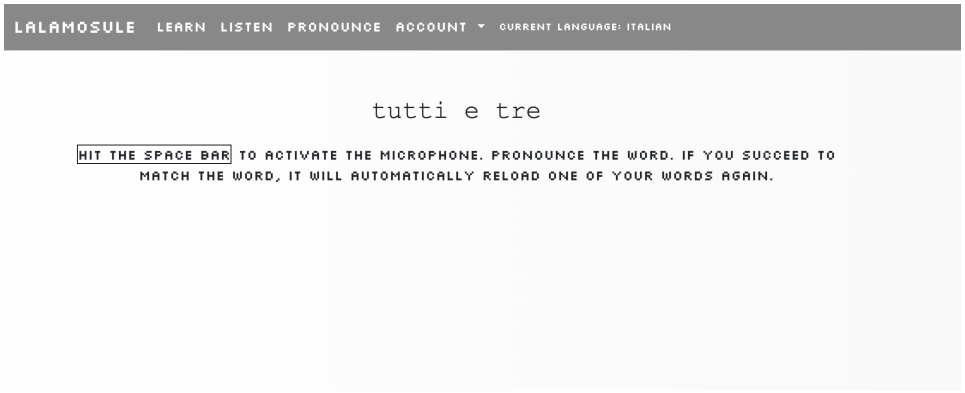

Figure 4.14: Pronunciation mode on "LaLaMoSuLe".

an HTML container and compared with the web speech grammar. The web speech grammar consists of a random vocabulary item that can be retrieved from the database based on the user ID. Of course, it is a prototype, so the correctness of the pronunciation by web speech recognition cannot be fully guaranteed. However, it is an initial functional technical idea that complements the "LaLaMoSuLe" system. To conclude, in Figure 4.15, the user interface is visualized once more in its entirety. Finally, it should be noted that the interface can be switched to other languages in the profile settings of "LaLaMoSuLe". In addition, there is an option to deactivate all AI functionalities. This function is stored as binary information in the user database and is used to control the display of the interface elements. Furthermore, users can access their profile notes and download all of their vocabulary items via an export script.

Algorithm 4 pronounceCheck: Match input voice and web speech grammar.

```
Require: sql_db_connection ← True
  random_vocab ← sql_query(session_user_ID);
  result ← sql_query(random_vocab);
  while row ← (result = sql_fetch_assoc()) do
    if True then
      vocab ← row[vocab]
    end if
  end while
  recognition ← SpeechRecognition();
  recognition.grammar ← vocab
  output ← document.querySelector(output)
  while recognition.getVoiceInput() do
    if True then
      user_voice_text ← string
      output.set(user_voice_text)
    else                                   ▷ user stops giving a voice input
      if (user_voice_text == vocab) then
        document.reload()
      else
        print(again?)
      end if
    end if
  end while
  sql_db_close()
```

Quantitative Analysis

As in the previous study designs, an online study was conducted via Prolific. The randomization process (a group with (1) and without AI features (2)) was managed via the online survey system SoSci[13]. Participants had to indicate that they were fluent in English, as the "LaLaMoSuLe" interface was developed in English and a small text feedback had to be sent after the interaction. It has been explicitly indicated that participants were requested to explore and engage with new vocabulary by utilizing existing videos, with the option of supplementing these with their own videos through a temporary demo login. The potential languages for exploration included French and Italian.

[13] https://www.soscisurvey.de/

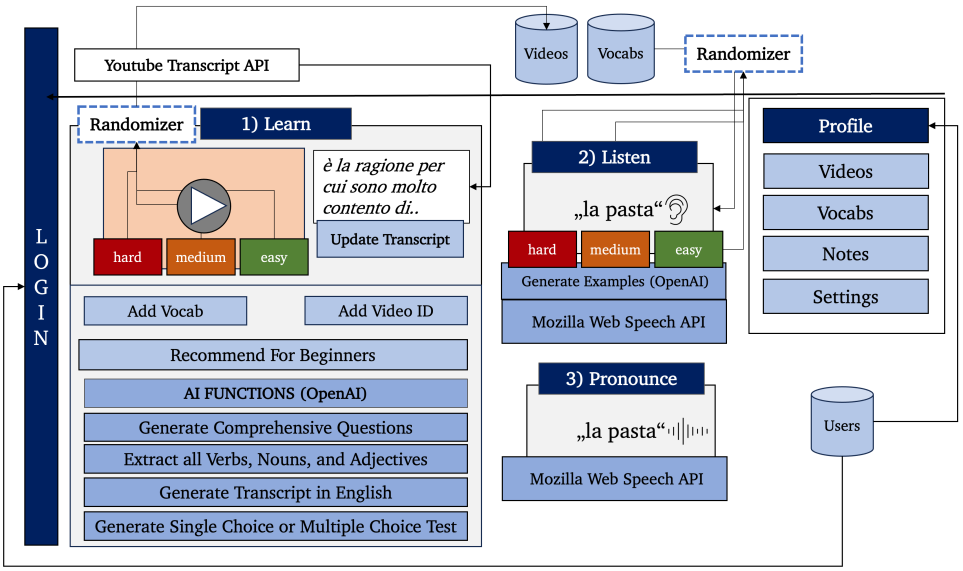

Figure 4.15: The user interface of “LaLaMoSuLe”.

The research design is similar to the previous concept.
First, the participants were divided into two clusters using the Hedonic and Eudaimonic Motives for Activities-Revised (HEMA-R) scale [220]. In this case, the division was made into only two well-being orientations. The subdivision into extrinsically motivated individuals did not appear relevant in the exploration of eudaimonic experiences with “LaLaMoSuLe”. The HEMA-R consists of a total of 10 items, with 5 each for eudaimonic-oriented aspects of behavior and hedonic orientations [220]. Identical to the previous methodology, the factor loadings of a PCA are used to apply a k-means clustering.
Second, in order to evaluate the hypotheses, a technical replication of LaLaMoSuLe was set up. Participants who were randomly assigned to the first group had access to all LLM-based functionalities. Members of the other participant group were redirected to the alternative version, which did not have any of these functions. This applies to all AI features that were available in both learning mode and listening mode. However, the Web Speech API was still available. This ultimately results in four different participant groups: The HEMA-R scale initially divides two groups, which are then randomized in the second order (“LaLaMoSuLe” with and without LLM-based features). As a result, differences can be determined both between well-being orientations and within well-being orientations.

Identical to the previous study, the eudaimonic experience was measured with the ETES [550] and hierarchical effects on autonomy and competence were measured with the TENS scales [69]. In this case, however, the focus was limited to the feelings of autonomy and competence in the interface and task sphere, since the effects on the life sphere would not have been adequate for prototypical testing in such short term. A G*Power was also calculated (two-sided t-test, α = 0.05, moderate effect size d = 0.5, min. 210 participants) [145]. In case of a lack of normality of the data, a Mann-Whitney U test should be used (α = 0.05, moderate effect size d = 0.5, min. 220 participants) [145]. Normal distribution of the data was evaluated using the Shapiro-Wilk test [451].

Table 4.4: Factor loadings for the respective items of the HEMA-R Scale. Factor loadings are indicated in bold of .40 or greater.

HEMA-R Item (No.)	Factor I	Factor II
Eudaimonic-Related Items		
Seeking to develop a skill, learn, or gain insight into something? (2)	**.752388**	.098676
Seeking to do what you believe in? (3)	**.674600**	.308517
Seeking to pursue excellence or a personal ideal? (5)	**.767401**	.184467
Seeking to use the best in yourself? (8)	**.788294**	.148651
Seeking to contribute to others or the surrounding world? (10)	**.691573**	.267985
Hedonic-Related Items		
Seeking relaxation? (1)	.126138	**.542218**
Seeking pleasure? (4)	.177680	**.749034**
Seeking enjoyment? (6)	.283336	**.691662**
Seeking to take it easy? (7)	.052051	**.510032**
Seeking fun? (9)	.333080	**.630952**

Participants

Eight non-serious participants (minimum of four minutes for study completion) were filtered out. The remaining submissions were double-checked to ensure quality and common instructions by Curran were taken into account [103]. Thus, in total, 228 valid submissions were evaluated. The average completion time was 11 minutes and 32 seconds. A detailed description of the demography is attached to the appendix.

4.3.2 Results

In Table 4.4, the factor loadings for each item are listed, indicating stable factor loadings for two factors. In this factorization, 61.21% of the variance can be explained. In the first cluster, 140 eudaimonic-oriented participants and 88 hedonic-oriented individuals were classified after applying k-means clustering. The Cronbach's α can be interpreted as high and reliable (>0.85) [487]. The Shapiro-Wilk test [451] for nearly all scales (by group or by well-being orientation) shows no normal distribution, hence, the Mann-Whitney U test was used [311]. During the first analysis, a distinction was made between two participant groups: those who utilized LaLaMoSuLe with AI-enhanced features (n = 112) and those who were not able to use these features (n = 176). The results for this distinction (with AI features and without AI features) can be seen in Table 4.5. The mean ranks for autonomy support, competence support in the interface sphere, and autonomy support and frustration experience in the task sphere are significantly different. Regardless of the well-being orientation, the values of the basic psychological needs were significantly higher when the AI features were present. These findings are discussed in the implications. The second Mann-Whitney U test was based on a differentiation between the clusters of well-being orientations (eudaimonic and hedonic). The results can be retrieved from Table 4.6. All mean ranks were highly significantly different. The group of eudaimonic-oriented individuals perceives the experience with LaLaMoSuLe, both with and without AI features, to be significantly higher than participants in the hedonic-oriented group. This is an important finding regarding the study-specific research question, which is addressed in the implication. Lastly, two Mann-Whitney U tests were conducted, which were carried out within the well-being orientations. For eudaimonic-oriented individuals, the following two group constellations exist: 140 participants used "LaLaMoSuLe" with LLM-based features, and 74 participants without them. In consequence, the same test for hedonic-oriented individuals (n = 88) was conducted (with AI features (n = 38) and without AI features (n= 50)).

Among the eudaimonic-oriented individuals, there were no significant differences, whether the AI functions were built in or not. Comparing hedonic-oriented individuals, only one significant difference regarding the support of autonomy in task completion can be found (U = 1201.5, .034*)

Table 4.5: The results of the Mann–Whitney U test for a differentiation between the experience of LaLaMoSuLe with AI and no AI features. Significant p values are marked accordingly (*<.05,**<.01,***<.001).

Scale	$\bar{x}$	U	p
ETES-EG (Eudaimonic Goals)		6606.0	.826
LaLaMoSuLe With AI Features	11.357		
LaLaMoSuLe Without AI Features	11.388		
ETES-SK (Self-Knowledge)		6785.0	.563
LaLaMoSuLe With AI Features	9.179		
LaLaMoSuLe Without AI Features	8.862		
TENS Interface (Autonomy Support)		**7477.5**	**.049***
LaLaMoSuLe With AI Features	5.426		
LaLaMoSuLe Without AI Features	5.029		
TENS Interface (Autonomy Frustration)		5913.0	.243
LaLaMoSuLe With AI Features	3.170		
LaLaMoSuLe Without AI Features	3.414		
TENS Interface (Competence Support)		**7546.5**	**.0349***
LaLaMoSuLe With AI Features	5.714		
LaLaMoSuLe Without AI Features	5.379		
TENS Interface (Competence Frustration)		5695.0	.108
LaLaMoSuLe With AI Features	2.443		
LaLaMoSuLe Without AI Features	2.761		
TENS Task (Autonomy Support)		**8043.0**	**.002****
LaLaMoSuLe With AI Features	5.408		
LaLaMoSuLe Without AI Features	4.805		
TENS Task (Autonomy Frustration)		**5418.5**	**.030***
LaLaMoSuLe With AI Features	2.682		
LaLaMoSuLe Without AI Features	3.218		
TENS Task (Competence Support)		7411.0	.066
LaLaMoSuLe With AI Features	5.512		
LaLaMoSuLe Without AI Features	5.190		
TENS Task (Competence Frustration)		5826.5	0.180
LaLaMoSuLe With AI Features	2.289		
LaLaMoSuLe Without AI Features	2.626		

Table 4.6: Mann–Whitney U test results using the well-being clusters. Significant p values are bolded and marked (*<.05,**<.01,***<.001).

Scale	$\bar{x}$	U	p
ETES-EG (Eudaimonic Goals)		**9315.5**	**.000*** **
Eudaimonic Group	12.350		
Hedonic Group	9.818		
ETES-SK (Self-Knowledge)		**9403.0**	**.000*** **
Eudaimonic Group	10.350		
Hedonic Group	6.898		
TENS Interface (Autonomy Support)		**8963.0**	**.000*** **
Eudaimonic Group	5.617		
Hedonic Group	4.598		
TENS Interface (Autonomy Frustration)		**4020.5**	**.000*** **
Eudaimonic Group	2.926		
Hedonic Group	3.878		
TENS Interface (Competence Support)		**9008.5**	**.000*** **
Eudaimonic Group	5.971		
Hedonic Group	4.864		
TENS Interface (Competence Frustration)		**4069.5**	**.000*** **
Eudaimonic Group	2.274		
Hedonic Group	3.133		
TENS Task (Autonomy Support)		**8699.5**	**.000*** **
Eudaimonic Group	5.467		
Hedonic Group	4.519		
TENS Task (Autonomy Frustration)		**4045.0**	**.000*** **
Eudaimonic Group	2.610		
Hedonic Group	3.504		
TENS Task (Competence Support)		**9226.5**	**.000*** **
Eudaimonic Group	5.795		
Hedonic Group	4.636		
TENS Task (Competence Frustration)		**4492.5**	**.000*** **
Eudaimonic Group	2.226		
Hedonic Group	2.833		

if AI-enhanced features were available or not. Autonomy was assessed as significantly higher in the task sphere among hedonic-oriented individuals. Hence, both hypotheses can be rejected (H_1 and H_2). The findings indicated that the implementation of AI-supported functionalities in the context of the eudaimonic group showed no substantial differences across all the examined aspects. This suggests that the mere existence of AI did not negatively impact the utilization of the wrapper by eudaimonic individuals. Additionally, eudaimonic individuals provided significantly higher ratings in all aspects of their experiences with the wrapper compared to hedonistic individuals. The implications of the findings are presented below.

4.3.3 General Implications

AI as a Pragmatic Helper

Both hypotheses have been rejected (H_1 and H_2), there is no general aversion to AI, but the current design of interaction with an AI leads to a low eudaimonic experience. When AI-based features are implemented in a pragmatic environment in such a way that they can be used as supportive elements of one's own striving, the eudaimonic experience with the system is higher. This can also be seen in the comparison with the average values of the previous study results of the ETES. For the dimension of eudaimonic goals, an average value of 12.35 is found, in the previous study across all AI applications the value was 9.22. For self-knowledge, the difference in the mean values is more noticeable (5.03 in the first experiment, 10.35 with "LaLaMoSuLe"). One has to be careful in the derivation, that a study explicitly on AI-based learning tools might have reduced these differences. Furthermore, they are not tested for significant differences with a statistical test. However, this should be taken as an indication that the average score for eudaimonic experience is not biased by a strong aversion, but rather a question of interaction design. This implicitly underscores the results of the HEMA-R differentiation, that eudaimonic-oriented learners, regardless of whether AI features were present or not, significantly rated their interaction higher (in all aspects). It is reasonable to hypothesize that this may be a trivial correlation. Technology that is supposed to contribute to personal growth by increasing self-knowledge addresses the virtues of

these individuals [220]. However, it is important to note that the integration of AI does not influence this experience negatively.

Gravitational Forces of Interaction

The initial Mann-Whitney *U* test, which was conducted without taking the well-being orientations of the individuals into account, revealed that the presence of AI-enhanced functionalities significantly alters the experience of autonomy support and competence support in the interface, as well as at the measurement level of learning task completion, in aspects of autonomy support but also autonomy frustration. However, according to the findings of this study, this discrepancy cannot be attributed to the well-being orientation. It is hypothesized, in the context of the work by Tuch and Hornbæk [502] once again, that certain aspects of interaction cannot be maximized in order to maximize the user experience, but that they are simply assumed to have a certain level such as autonomy and competence in interface or task sphere. On the one hand, this finding suggests that enhancing the pragmatic value of educational technology through the integration of AI features is possible without negatively impacting the eudaimonic experience and basic psychological needs. On the other hand, people expect a certain level of functionality, and dissatisfaction arises if this is not met, but the experience is not made any more rewarding. To conclude, this is consistent with the assumption of Tuch and Hornbæk [502] that some qualitative factors of interaction may be simply "expected".

4.3.4 Summary

In this case, two further implications for this dissertation can be formulated. Firstly, the pragmatic value of skill-building technology is not affected by AI features, since no general aversion to AI could be detected in eudaimonic-oriented individuals, which can be beneficial for the development process. However, the sensitive integration of AI will be addressed again in the discussion, as it has significant implications in educational and work contexts. Secondly, it can be deduced that certain principles of interaction have a different gravitational field, i.e., their existence is required, but their targeted increase cannot "maximize" the eudaimonic user experience. But

these factors also prevent the experience of a eudaimonic interaction from falling below a sufficient level.

4.4 Study 4: Proactivity as an Enabler

Parts of this study have already been published in the Journal of Technology, Knowledge, and Learning [240].
This study ties in with the findings of the hybrid thematic analysis of focused attention (FA) in Chapter 3.1. It therefore shifts away from the previous analysis of interaction with AI and focuses on the facets of focused attention, flow perception, and degree of interaction, which emerged as an important implication of Chapter 3.1. Rigby and Ryan formulate the question of whether the eudaimonic experience of media consumption has a lasting effect as follows: "In this regard, one potential mediator of whether engagement with entertainment media will facilitate eudaimonia (or simply engender transient emotional experiences) is how mindful the individual is while engaging in media use" [391, p. 46]. This question is slightly decontextualized for the following study, i.e., it does not look at passive media consumption, but at a technological interaction. In the context of eudaimonic interaction design, the creation of a form of mindful interaction is important, which we can also use for technological interactions.

Is the quality of an activity itself stimulated by the system's proactivity? In addition, another question arises: Does this proactivity of the system have a positive effect on the user's growth process? This should not be confused with an increasing decrease in the user's agency, i.e., the user has to contribute fewer inputs, but the system intentionally uses elements of focused attention to promote user immersion. Before the methodology for this study is presented, it should be further contextualized theoretically, because cognitive science considerations are discussed in greater detail.

4.4.1 Theoretical Contextualization

When discussing "immersion", "flow experience", "deep involvement", and "high interactivity", cognitive aspects of HCI must be taken into account

[78, 90]. In general, technology is having an impact on our memorization behavior and thought processes [141, 146, 152, 164, 199, 256, 312, 318, 330, 355, 385, 462, 464, 469, 479, 528, 529], which can cause biological change processes [110, 144, 151]. It is our intention as humans to offload cognition [22, 29, 87, 231, 270, 425, 526, 530] and technological possibilities increasingly allow us to outsource these processes [33, 199, 469, 528]. Contextualization with "skill building" as eudaimonic specific behavior as well as intrapersonal orientations towards "self-actualization", "self-direction", "competence", "authenticity", and "excellence" points to a potential implicit effect of these strategies. If one wants to interpret the eudaimonic experience of a sense of personal growth from a biological brain reward system perspective, then the training of internal memory performance is a prerequisite for being able to process "external memory" at all[14] [149].
In this understanding of two memory systems (external[15] and internal) [211, 341, 393], an important question arises as to how this ultimately affects one's sense of personal growth and even shows de facto learning in the sense of internal memorization processes. The framework for this study was provided by another study that found that information obtained externally leads to significantly poorer memorization behavior [318]. In four individual studies, the participants were always significantly worse in the subsequent quizzes when the information was obtained from external sources. The other group received the texts directly from the learning system, so the cognitive processing of this information is already influenced by the location of the information. However, this is not the core of this study, which is to address whether, in a setting where participants have to obtain information externally, the system's proactivity can achieve an improvement. Thus, this doctrine is in line with Voinea et al [523], pointing to encouraging users to *more intensively* consume information by proactively managing information and resource behavior. Thus, the research questions (*RQ*s), explicitly for this study, are as follows:

RQ_1: *Are the average performance scores equal independently from all interaction constellations?*

[14] In 2007, Joseph Weizenbaum gave a lecture at the Otto-Von Guericke University in Magdeburg. In his lecture, he spoke of the importance of knowledge in order to ask a *good* question (https://www.youtube.com/watch?v=Ssks6y7Xskw, 28:58 - 29:05).
[15] Digital technologies, archives, storage media, AI systems, etc.

RQ_2: Do participants achieve significantly better results if they receive an ethical appeal by an interface to read the content again?

RQ_3: Do participants achieve significantly better results if they are temporarily forced by an interface to study the content again?

4.4.2 Methodology

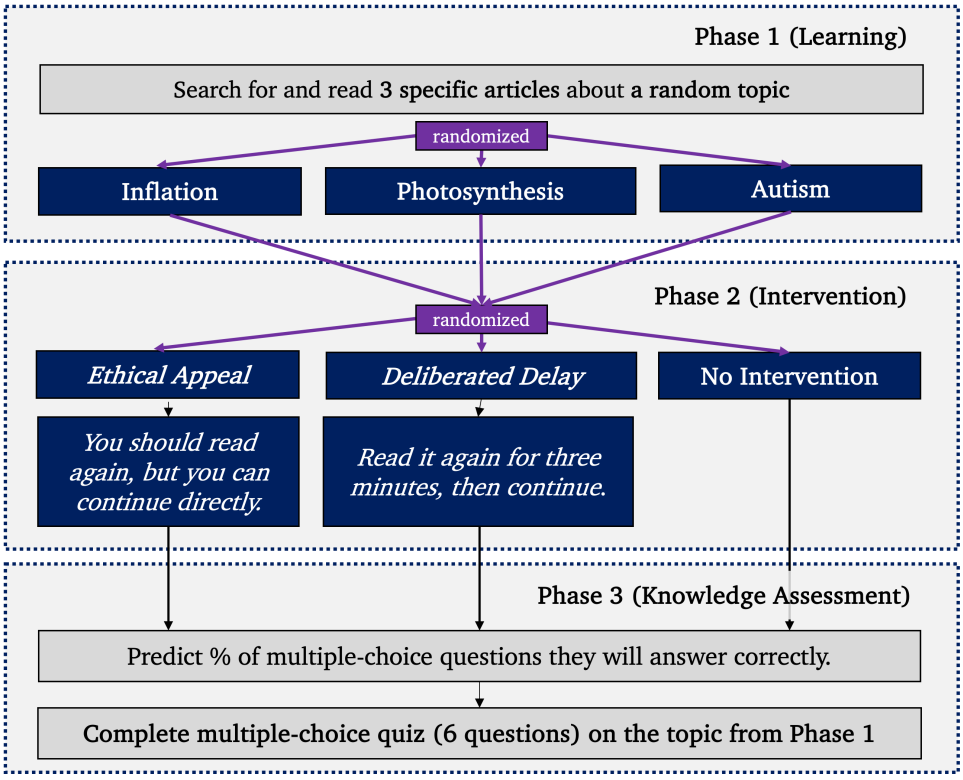

Figure 4.16: The systemic approach for the fourth study.

Participants were recruited on Prolific. The forms of interruption were realized directly via SoSci, the survey system. The exact procedure and the branches of this experiment can be seen in Figure 4.16. A single participant can be assigned to six possible group constellations through randomization in Prolific: First, in line with Fisher et al. [318], three subject areas were possible (inflation, photosynthesis, and autism). The participant was then asked to find three explicit sources on the internet, which had to be

entered in the corresponding fields on SoSci (to validate that the person was able to prepare themselves correctly). These sources, which contain the necessary information to answer the quiz questions, should be found using a predefined keyword + domain name, i.e., the participant has received the search parameters. The necessary links to explore the topics were chosen in accordance with Fisher et al. [318], but some web domains had to be replaced (e.g., content hidden by paywalls in the meantime). It was carefully analyzed whether all six questions for the respective topic could be answered using the web links. In the next randomization stage, three possible group assignment options were available: In the first group, no intervention was chosen, i.e., the user could simply process the web links and directly answer the six questions. In the "ethical appeal" group, a systemic reminder was inserted before forwarding to the quiz questions, stating that, as a human being, one would tend to use cognitive strategies, so it would be reasonable to review the content before taking the quiz. In the last group, a time blocker forced the user to review the content (the "Next" button did not appear for three minutes). In the introduction, an additional reward for participating in the study was announced, in accordance with Fisher et al. [318], if the participant answered 80% (five out of six questions) correctly. The participants were thus all set in the expectation of seriously and consciously committing themselves to this online test. Every participant had to indicate the degree of "feeling-of-knowing" [393] via a Likert scale (7 levels, from 1 (not at all confident) to 7 (very confident) (identical to Fisher et al. [318]). Finally, a six-question multiple-choice quiz with a time limit of 90 seconds (preventing quick lookup strategies) had to be completed.

Quantitative Analysis

A one-way ANOVA was applied. Multiple significant differences will be calculated for the quiz score, confidence, test completion time, learning times, and quiz time. The term "learning time" is used to denote the time spent engaging with online articles. This is distinct from the term "quiz time", which refers to the time spent on the six quiz questions. The G*Power was calculated (one-way ANOVA, effect size f = 0.25, α = 0.05, thus at least 252 participants) [145]. A total of 262 valid submissions were evaluated.

This selection was made on the basis of a detailed selection process, which is attached in the appendix.

4.4.3 Results

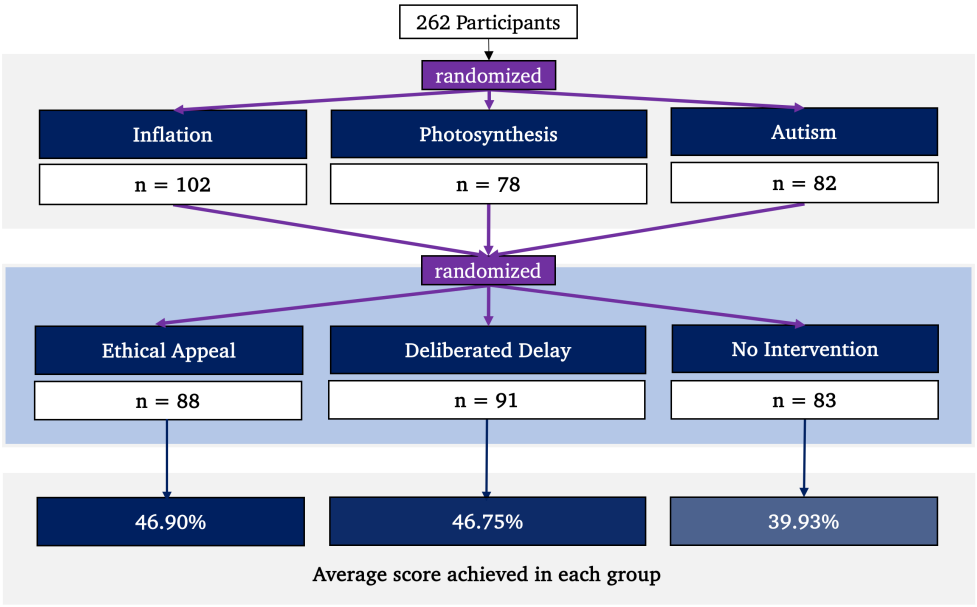

Figure 4.17: Results of the fourth study: Across all topics, the no intervention group performed significantly the lowest.

A detailed description of the demographic data of the participants can be found in the appendix. The calculated p-values of the individual group values indicate a normal distribution of the data [108, 109]. Furthermore, variance homogeneity can be assumed [295]. The results of all group constellations are presented in Figure 4.17.

Mean Quiz Scores

The one-way ANOVA (mean scores for groups of interventions and group of no intervention) resulted in a statistically significant p-value of .041* ($F = 3.2459$, $p < .05$). The first group with an ethical appeal achieved an average of 46.90% across all participants, the group with a temporarily enforced delay achieved 46.75% on average, and the group without interruptions 39.93%. In the following, a t-test was conducted to compare the two groups, the first being the one with the ethical appeals and the second being the

group with the enforced time delay. The results of the t-test revealed that there was no significant difference between the groups ($t = 0.047$, $p = .962$). Regarding the means between the group with the ethical appeal and the group with no interruption, there is a statistically significant p-value of .023 ($p^* < .05$). The same statistically significant difference can be identified between the group without interruption and forced time delay ($t = 2.078$, $p = .039* < .05$). To conclude this first analysis, the boxplots of the mean scores are shown in Figure 4.18.

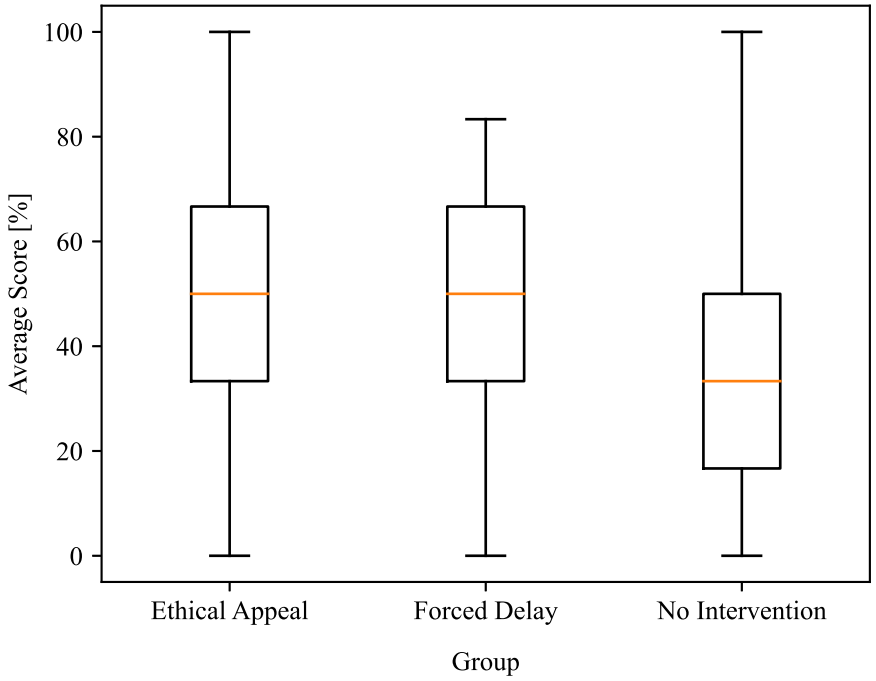

Figure 4.18: Boxplots of the different groups in comparison.

Time Differences

In addition to the mean scores analysis, a one-way ANOVA for the test time shows a highly significant difference ($F = 14.590$, $p^{***} = 9.897 * 10^{-7}$). The subsequent post hoc t-tests show highly significant values between the ethical appeal and forced time delay group ($t = -4.359$, $p^{***} = 2.180 * 10^{-5}$) and the forced time delay and no interruptions group ($t = 4.774$, $p^{***} = 4.080 * 10^{-6}$). No significant difference between the mean value of the group

without interruptions and the ethical appeal regarding the *quiz completion time* can be found ($t = 0.517$, $p = .605$). In fact, the mean quiz time of all groups is quite identical ($M_{ethicalAppeal}$ = 79.480 seconds, $M_{forcedDelay}$ = 80.024 seconds, $M_{noInterruption}$ = 81.705 seconds). If one looks at the learning times of the respective groups, the learning time for participants without interruptions is highly significant in comparison with the group that had a forced time delay ($t = 5.339$, $p < .001$). However, there was no significant difference between the group with ethical appeal and no interruption ($t = 1.056$, $p = .293$). Between the group with ethical appeal and the forced time delay, there is a highly significant difference regarding learning time ($t = -4.408$, $p < .001$). Likewise, the section concludes with the presentation of the box plots (see Figure 4.19).

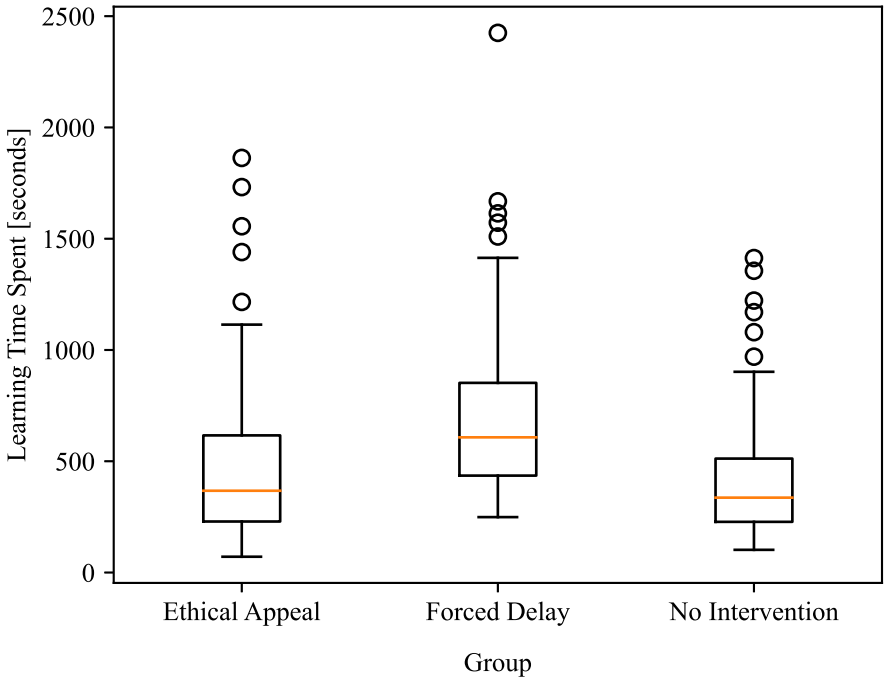

Figure 4.19: Boxplots of learning times for all group types (Ethical Appeal, Forced Time Delay, and No Interruption). The learning time describes the time spent preparing for the quiz. It does not include the invested time for the respondent's confidence score indication or the completion of the quiz.

Confidence values

The difference in confidence intervals between "No Interruption" and "Ethical Appeal" is only weakly significant ($t = 1.714$, $p = 0.088 < 0.1$). This is also the case for the difference in confidence intervals between Group 2 (forced time delay) and Group 3 (no interruption) ($t = 1.746$, $p = 0.082 < 0.1$). No significant difference was found between the two proactive approaches ("Ethical Appeal" and "Forced Time Delay") in terms of confidence for the test at the end of the learning phase.

4.4.4 Practical Implications

In relation to the research questions specified for this Chapter 4.4, the results showed significantly different mean values in relation to an interruption and no interruption (refers to RQ_1). In relation to RQ_2 and RQ_3, there were also significantly different values, thus, both forms of interruption led to better average values (across three different knowledge assessments). The topic performances per se did not have significantly different average values, so a statistical influence by the topic can be excluded. In conclusion, the significant increase in time per se was not significant, but rather a change in attitude is assumed, which may have become apparent through a focused re-evaluation of the external resources. This can be described as "support for consciousness".

Support for Consciousness

Regardless of the type of interruption (ethical appeal and forced time delay), higher average values were achieved. The improvement cannot be explained by a general, average increase in learning time. Two reasons can be formulated: Firstly, like a child's priming of cognitive abilities by a teacher [8], the perception of the external content seems to have been changed in such a way that interaction with the content was intensified again. Secondly, not all participants, as shown by the lack of a significant increase in the average learning time, were motivated to study again by the ethical appeal. It is possible that only a certain proportion of the participants could be persuaded to study the content once again. This is probably also indicated by the sporadic increases in learning time seen in Figure 4.19.

Nevertheless, a notable finding is that a forced time delay approach is not necessary to achieve equivalent results as with an ethical appeal. Ethical feedback may be sufficient to affect a shift in the participant's behavior. Perhaps it can be explained by a combination of both behaviors, which combined have caused an improvement.

Build Flexible Environments

The first study, presented in Chapter 4.1, pointed to the importance of personalization and customization based on the results of the qualitative analysis. This should be recontextualized with the help of the confidence values of the participants with interruption, regardless of whether ethical or forced. These confidence values were only slightly significantly higher than in the case of no interruption. This is linked to the assumption that this primarily requires a person-specific consideration, which is fundamentally manifested by different confidence perceptions and offloading strategies [55]. Therefore, the implication of a necessary personalization of learning systems is reinforced. In abstract terms, the necessity of flexibility in systems designed for self-actualization and skill-building can be seen. Both learning types [106, 198, 553], game-based concepts [32] and cultural differences must be taken into account [496]. These facets are considered in Chapter 5 when assessing the sense of personal growth and de facto impact on eudaimonic functioning.

4.4.5 Summary

This study originally served to analyze the form of focused attention, as part of a eudaimonic interaction. The focused attention identified in Chapter 4.2, which seems to be relevant for eudaimonic-oriented individuals, can be linked to the results of this study: the proactivity of the interface can be seen as an essential enabler for personal growth processes, orchestrating the consciousness of the user. The participants did not invest significantly more time, but their perception was changed by a simple system signal. It is important to analyze how far proactivity can be designed to take into account the authentic and autonomous perceptions of a eudaimonic-oriented individual. The following Chapter 4.5 presents a scale for measuring these aspects of interaction. However, the results of this study of Chapter 4.4

point to the possibility of using *light* feedback instead of forced delay approaches, because it is sufficient to have a significantly positive effect on memory behavior. This form of *light* feedback is addressed again in Chapter 5 and placed in the sphere of eudaimonic HCI. Finally, the two implications, support for consciousness and flexible environments, connect to previous implications and further substantiate the theoretical development of eudaimonic HCI. In the following Chapter 4.5, a measuring instrument for assessing eudaimonic orientations in interaction with technology will be introduced.

4.5 Study 5: Addressing Eudaimonic Orientations

This study has already been submitted and accepted at the Weizenbaum Journal of the Digital Society (WJDS) for the special issue of "Well-Being in the Digital World" [246].

The implications of the studies conducted so far can be utilized in a final study. The concept of the Eudaimonic Interaction Inventory (EII) is designed to assess the experience of the identified facets of eudaimonic HCI and can be understood as a kind of synthesis of all the studies already conducted and the literature reviews [238, 239, 241, 243, 244, 245]. The EII is a psychological measurement method that has been validated in a total of six steps. Various validation tests were carried out with three distinct participant groups to address eudaimonic orientations (excellence, authenticity, meaning, and growth). Their translation into HCI was enforced and is discussed in the methodology section of this chapter.

In addition, the ETES [550] was used in several studies underlying this dissertation to measure a eudaimonic experience with technology. The EII should be a further measurement technique alongside the ETES [550], and this will be justified in the following:

The validity of the ETES is not to be undermined, but there were several reasons to justify the development of a corresponding measurement instrument: the ETES primarily measures eudaimonic experiences of the system based on a two-dimensional conceptual model (eudaimonic goals and self-knowledge). The development of a scale based on the four eudaimonic dimensions (authenticity, excellence, meaning, and growth), which form a common leitmotif throughout the dissertation, would be implied by the

"assumption of a dystopian, technology-saturated reality" [550, p. 1912] as the authors state and no four-factor solution would emerge from the empirical data. However, rejecting the derivation of the dimensions solely on the basis of a dystopian perspective did not appear to be a rational approach for the purpose of disregarding the development of items across all dimensions and subsequently adopting a reduced conceptual model. Moreover, the findings of convergent validity demonstrate that the EII assesses two additional levels (concerning authenticity and excellence) in comparison to the ETES, thereby positioning it as a legitimate alternative for utilization, perhaps, in combination with the ETES. Especially since it is recommended to use at least two scales concerning well-being research [513].

4.5.1 Development of EII

The development of the EII was based on best practices for qualitative scale development [54, 123]. The scale development was structured in six steps using three distinct study groups (see 4.20).

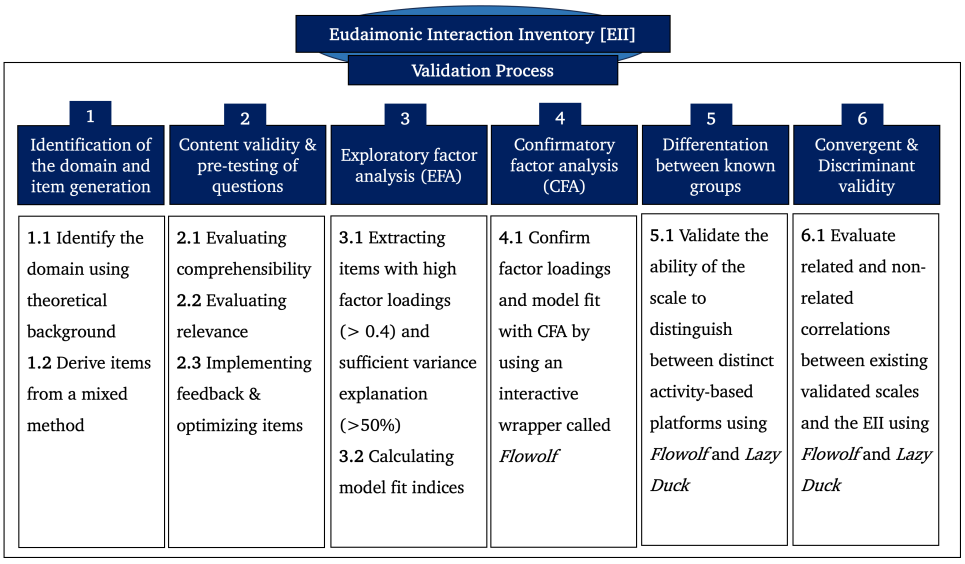

Figure 4.20: The development of the EII in six steps.

4.5.2 Eudaimonic Interaction Dimensions

According to the guidelines of Boateng et al. [54], the scope used to construct the scale should be named first. The EII is intended to measure the experience of four eudaimonic aspects during interaction with technology based on Huta's eudaimonic classification [220]. However, these orientations need to be contextualized for HCI research, especially aspects of *meaning* need a concrete classification (see review paper by Meker and Hornbæk [325]). The dimensions of eudaimonic orientations will therefore be characterized based on specific hermeneutics for eudaimonic HCI in the following chapter.

Meaning in Interaction

Meaning is one of the most challenging eudaimonic orientations [219], since "meaning" as a subjective experience [221] is difficult to systematize. Based on the classification of meaning in HCI [325], the meaningfulness of interaction is understood as a form of *significance*, i.e., "the sense that our experiences and actions at a given moment feel important and worthwhile, yet also consequential and enduring" [325, p. 6]. In connection to this, there is a strong association between eudaimonia as an orientation and the level of effort one invests in activities [533]. The orientation towards *meaning* is reflected as a significantly perceived contribution of one's own actions in interaction with technology. The interpretation of "significance" as "meaning" forms a semantic connection to the eudaimonic experience and the study results of the scoping review: it carries the semantics of a causal relationship between one's own actions and the technology and may be connected by deep involvement perceptions and high user interactivity [555]. Hence, when formulating the items, the main focus was on *how* the user, the technology, and the outcome are connected.

Excellence in Interaction

As a point of reference, a statement by Ryff on excellence should first be pointed out: eudaimonia is "the idea of striving toward excellence based on one's unique potential" [422, p. 14]. In this logic, an internal alignment of one's own potential is required. Huta provides a detailed characterization

of the concept of excellence [219, pp. 230-231]. The effort and involvement are key indicators of an experience of excellence in behavior, performance, or accomplishment. In comparison to the semantic interpretation of meaning as significance, which also considers involvement in the generation of the output, excellence refers to the way in which the outcome is achieved: It describes moments in which "something has culminated because you've given it your all" [219, p. 230]. According to Waterman et al. [535], flow activities involve tasks that require your full attention. These activities are associated with feelings of deep focus and interest, as well as the ability to discover new perspectives. Thus, it is close to the shape of flow processes [136, 230]. Orlick and Partington exemplify full focus, distraction control, and mental readiness as three of the seven elements of excellence [360], thus this may justify the argumentation that the experience of excellence may be aligned with flow perceptions. The flow theory was taken into account when designing the items.
Thus, the experience of an activity with technology that enables a state of excellence in one's tasks, through the experience of intense involvement and deep concentration, has been equated with the dimension of excellence.

Authenticity in Interaction

Identical to the orientation of excellence, an interpretation close to Huta's explanation of authenticity should first be chosen [220]: authenticity indicates the process of "clarifying one's true self and values, and acting in accord with them" [220, p. 216]. In an earlier contribution, associations such as identity, personal expressiveness, autonomy, constitutive goals, or integrity are found [225]. Smallenbroek et al. argue that authenticity is characterized by actions that are driven by intrinsic motivations, which in turn fulfill psychological needs [465]. The theory of intrinsic motivation is already known from Chapter 2.1.3 of this dissertation and is considered a related theory of eudaimonic well-being. Furthermore, the second study in Chapter 4 indicated that autonomy is influenced across several spheres by AI interaction. In addition, the results of the third study showed that a certain expectation of autonomy experience is expected in the interaction. These facets should be understood through the experience of an autotelic experience in the interaction (in accordance with Brühlmann et al. [66] that technology use may be differently motivated). This form of intrinsic

experience is intended to address the dimension of authenticity. It calls, for example, for the reduction of quantification or extrinsic rewards during the interaction, which was discussed in Chapter 3.

Growth in Interaction

Finally, the dimension of growth is to be modeled [220]. Many aspects serve as examples of an experience of personal growth: self-improvement, learning, seeking challenges, striving for inspiration, curiosity, and working on one's personal best [219, 225, 416, 535]. In contrast to the previous study, the goal is not to measure the exact learning success, but simply whether the technology enables the experience of these possible facets. However, this is also to make it clear that no *concrete* learning success is measured. This must be done by additional assessment tests. In the course of the item reduction analysis, it should become clear which items best reflect this dimension of personal growth.

4.5.3 Items Generation

The results of the literature reviews in Chapter 3 were used to generate the items. By using the results in Chapter 3.2, a variety of scales were considered when designing the own items, e.g., Psychological Well Being scale (PWB) [416], the Hedonic and Eudaimonic Motives for Activities (HEMA) scale [226], the Questionnaire for Eudaimonic Well-Being (QEWB) [535], the Flourishing Scale (FS) [128], and several related scales on experience of flow, autonomy, competence, engagement, or causality [66, 69, 176, 350, 361, 372, 536]. This can also be described as the deductive part of this item generation. In addition, the items were modified in several review processes and supplemented with missing items that resulted from the conceptual understanding (inductive part). Finally, a total of 152 items were derived in the first step (35 items for meaning, 26 items for excellence, 37 items for growth, and 54 items for authenticity).

4.5.4 Item Reduction Analysis

In the course of the item reduction analysis, a consistent understanding of all items should be aimed at [54]. This was done in a two-step process:

First, comprehensibility (I) was evaluated by six raters, who rated each item on a 4-point scale ranging from (1) fully not comprehensible to (4) fully comprehensible. A Content Validity Index (CVI), in this case an I-CVI, was calculated for all six raters. The professional background of the raters is as follows: one professor of human-centered artificial intelligence (HCAI), one professor of behavioral economics, one psychologist, one social scientist, and two computer scientists. The diversity of the professional profiles should ensure that the scale is comprehensible in its formulations across research domains and areas of expertise. This "strategy" is in accordance with the best practices calling for a mix of experts and target population [54]. The minimum value for I-CVI for an item was 0.83[16] and thus represents an excellent content validity that requires items receiving an I-CVI of 0.78 at minimum [306]. In the first step, the list was almost halved (-44.74%) and was reduced from 152 initial items to 68 items. A short feedback session after each rater led to minor optimizations of the items.
In the next step of evaluating relevance (II), three computer scientists with eudaimonic-related expertise checked the items for relevance to assess the impact on eudaimonic orientations in HCI in particular. For the final relevance assessment of the remaining 68 items, only an I-CVI of 100% was accepted, i.e., only if all three reviewers gave a 3 or 4 on a 4-point Likert scale[17] for an item. Over half of the items were removed, resulting in 38 items (-55.88%). One of these items was removed due to its high semantic similarity to another item in the final analysis. The final inventory is therefore 37 items with the following distribution: 12 items for meaning, 10 items for growth, eight for excellence, and seven for authenticity. All items were rephrased, including a placeholder, for example: *I don't feel passive in the interaction with [the system]*, in order to check them with the explorative factor analysis (EFA).

4.5.5 Exploratory Factor Analysis

In the third step, an exploratory factor analysis (EFA) is to be carried out. In accordance with the recommended guidelines for EFA, a sample size of 200 to 300 subjects is considered adequate to ensure the reliability of the results to a plausible degree [93, 183, 214]. Once again, a combination of Prolific

[16] 5 out of 6 reviewers have to rate an item with a minimum of 3 or 4 (4-point Likert scale)
[17] (ranging from (1) fully not relevant to (4) fully relevant)

and SoSci was chosen to conduct this study. The only requirement for participation in the study was fluency in English. In the course of the survey, participants were invited to evaluate their experience with a technology of their choice using a 7-point Likert scale that encompassed the 37 items. The free choice of technology was permitted on the condition that it would serve to guarantee internal consistency and stable factor loadings of the items across a range of technology types. To be precise, the scoring of the items should be consistent in both directions. Therefore, in the case of a low experience of eudaimonic orientations, all items should be scored consistently in the same direction, and vice versa. All items were presented in a randomized order to prevent biased tendencies.
236 participants took part in the first study, but only 202 submissions were categorized as valid. Common instructions, in line with the process in 4.4, were applied [103], leading to the partial exclusion of submissions[18]. The average processing time was 4:59 minutes. In addition, an attention check was utilized, with the following item being inserted: [the system] helps me work fourteen months in a year (adapted and modified from [216]). This response is to be marked with 1 (strongly disagree), as it is evidently not possible. Demographic information regarding the participants and the technologies mentioned can be found in the appendix. The Kaiser-Meyer-Olkin (KMO) test demonstrated that the conditions were optimal for factorability (KMO = 0.88 > 0.8) [249]. In order to verify the existence of a four-factor solution, the Kaiser criterion, which is defined as eigenvalues greater than 1, was applied. In addition, a scree plot was generated to provide a visual evaluation of the solution [61]. In order to reduce the data set, the items with weak factor loadings were removed (below 0.40). In the analysis, correlations among the items were assumed, i.e., experience of excellence and personal growth may be intertwined [150]. Thus, an oblimin rotation was chosen, allowing these correlations in the course of the EFA.
To facilitate the application of the inventory, a maximum of three items per subscale was considered, ensuring the provision of the minimum number and the assurance of an efficient application with reliable results [54]. In total, 69.75% of the variance is explained by the four factors (12 items, 3 items for each dimension). All items have at least a factor loading of 0.4 and explain at least 50% of the variance (< 69.75%), pointing to reliable EFA

[18] e.g., answering all items with the exact same value or answering the survey very quickly in relation to others

results [481]. Furthermore, Cronbach's α were all acceptable and therefore the subscales were all internally consistent referring to Taber's classification [488]: Eudaimonic Interaction Inventory (EII): α = 0.90, Meaning (EII-M): α = 0.73, Excellence (EII-E, three items): α = 0.82, Growth (EII-G): α = 0.88, Authenticity (EII-A): α = 0.70. All items of the EII can be found in Table 4.7. Interestingly, all items of EII-A are reversed items, i.e., each score is to be reversed accordingly[19]. Structural model data was also collected: theoretical model fit variables such as the Tucker-Lewis Index (TLI) (= 0.94), Comparative Fit Index (CFI) (= 0.95), and Root Mean Square Error of Approximation (RMSEA) (= 0.06) were in the acceptable range based on previous research by Fabrigar et al. and Byrne [72, 142].

4.5.6 Confirmatory Factor Analysis

The fourth step of the six steps of the validation process is a re-factor analysis, the confirmatory factor analysis (CFA) [54]. An independent second study must indicate the relevance of the items and good model fit indices (RMSEA, TLI, and CFI) [54]. Generally speaking, the exact same factor analysis is conducted again. This time, however, the participants were not asked to name and evaluate a random technology but to interact with a prototypical demo that was designed for the CFA.

"Flowolf"

The system is designed to recommend activities to users for their personal development and inspiration, such as selected content on altruism, universalism, and contributions to a larger whole. A palindrome was considered, such as "flow" (a word that reads the same backward or forms another valid word (flow = wolf)), which led to the name "Flowolf" for the prototype. In the survey, participants were able to view finished screenshots of the demo and use the demo interactively via a web link. In Figure 4.21, the mainpage of "Flowolf" can be seen. It included placeholder buttons because not all functions were available, but nevertheless, it was always exemplified textually what the functional scope of 'Flowolf' should be if the participants clicked on a button.

[19] 7 = 1 on the 7-point Likert scale

No.	Item	Factor I	Factor II	Factor III	Factor IV	$h2$
	EII-M (Meaning)					
1	I don't feel passive in the interaction with [the system].	-0.111	-0.003	**0.485**	0.116	0.261
2	I feel involved in the process of the result with [the system].	0.060	0.056	**0.855**	0.025	0.739
3	I am largely responsible for the quality of the actions with [the system].	-0.065	-0.061	**0.738**	-0.032	0.554
	EII-E (Excellence)					
4	[The system] lets me concentrate on my task.	-0.033	**0.975**	-0.046	0.006	0.955
5	I can be concentrated when I use [the system].	0.170	**0.541**	0.147	0.010	0.343
6	[The system] lets me focus my attention.	0.070	**0.642**	0.143	0.027	0.438
	EII-G (Growth)					
7	I feel inspired by using [the system].	**0.767**	0.011	0.0556	-0.114	0.604
8	[The system] awakens my curiosity for things.	**0.712**	-0.106	-0.075	0.134	0.542
9	[The system] makes it fun to learn.	**0.756**	0.111	0.009	0.033	0.584
	EII-A (Authenticity)					
10	I use [the system] to please others, but not me. (-)	0.071	-0.008	-0.108	**0.537**	0.305
11	I feel controlled and restricted by the interface of [the system]. (-)	0.028	-0.026	0.028	**0.836**	0.702
12	[The system] prevents me from freely deciding how I want to interact. (-)	-0.087	0.114	0.058	**0.625**	0.415

Table 4.7: The EII with four dimensions. The communalities (h2, explained variance by the item) can be taken from the last column. The factor loadings are rounded to three decimal places. (-) means that the item is to be calculated in reverse.

Structure Equation Model

A total of 292 participants took part in the second survey (demographic data can be found in the appendix). It has been ensured that none of the participants from the initial study participated in the subsequent study[20]. The average submission time was 2:55 minutes. Regarding the Cronbach's α, acceptable values can be achieved [456, 488]: EII: α = 0.87, EII-M: α = 0.61, EII-E: α = 0.92, EII-G: α = 0.88, EII-A: α = 0.77. The loading of item no. 3 ("I don't feel passive in the interaction with Flowolf.") was lower (0.39)

[20] prevented by an exclusion list on Prolific.

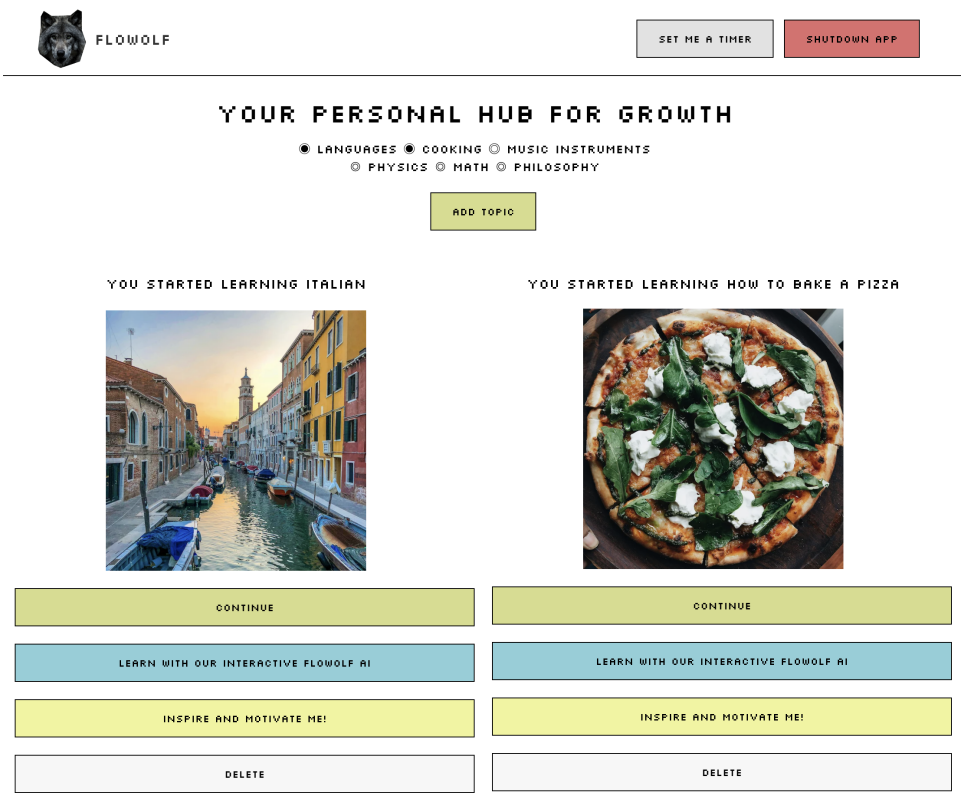

Figure 4.21: *Flowolf* is a prototype for promoting personal growth through learning interaction and the discovery of new content. For example, filter options are designed to give the user a sense of autonomy in direct interaction.

compared to the other items (0.70-0.72), but acceptable (>0.3) [186]. The prototype status with limited interaction options may explain this lower value. In this constellation (four-factor solution), 75.77% of the variance can be explained. The semopy package[21] was used to generate the structural equation model (SEM) using a maximum likelihood estimator (Wishart log-likelihood). The chi-square value of the model is not significant (χ^2 = 54.43, p = 0.23), hence a good model fit can be assumed [10]. The fit indices show an improved model fit (CFI = 0.996, TLI = 0.995, RMSEA = 0.021) in comparison to the EFA results. The model results are finally illustrated in Figure 4.22.

[21] https://semopy.com/index.html

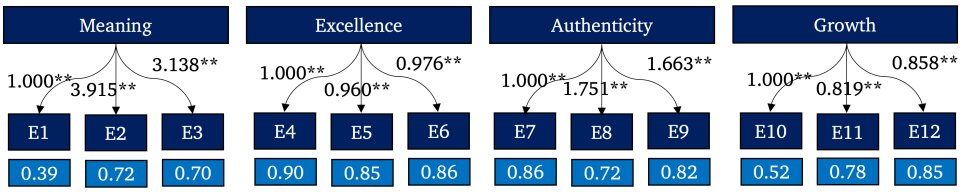

Figure 4.22: Model fit of the second study: The direction arrows show the estimators of the model for the respective item. All p-values show significant estimators in the model ($p < .01^{**}$). The factor loadings for each item are noted in the dark green boxes.

4.5.7 Differentiation

The second-last step requires the validation that the EII leads to different results depending on which system one is evaluating, e.g., a system for promoting a eudaimonic experience and one that does not stimulate it. If the EII does not make this distinction, the design of the eudaimonic interaction would be poorly conceived. It is therefore the necessary "stress test" for the EII.

"LazyDuck"

A second web-based prototype called "LazyDuck" was developed for differentiation purposes. It is a simple recommender system with a feed display of various entertainment videos. It is intended to simulate the orientation towards comfort and pleasure, as the hedonistic orientation is characterized using these aims [220]. Behind the thumbnails[22] pre-selected videos were linked, which the user could watch accordingly. Furthermore, the page layout is identical to that of Flowolf to mitigate the impact of further effects on the evaluation by the EII. The system design of LazyDuck is illustrated in Figure 4.23. All previous participants who took part in one of the two previous studies were excluded. The participants were automatically divided into two groups via SoSci ("Flowolf" or "LazyDuck"). An alternative attention check was tested in which the participant was explicitly asked to check an item with "strongly disagree". Both group members had to evaluate the experience with the respective wrapper using the EII. In the case of a normal distribution of the data, the t-test is employed to determine

[22] a free AI image generator was used: https://www.craiyon.com/

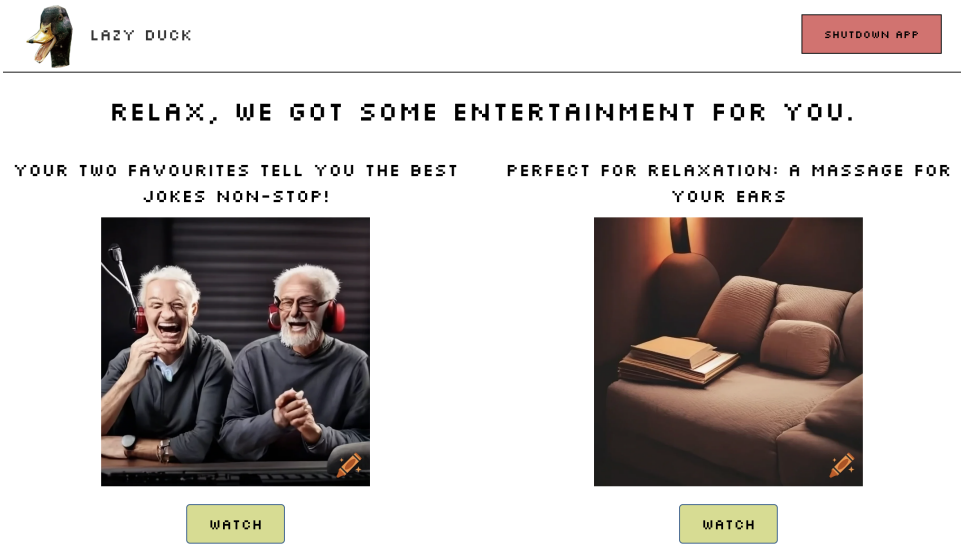

Figure 4.23: The UI of "LazyDuck". The page layout and font are identical to "Flowolf", preventing possible bias regarding the differentiation validity.

whether the mean values of the EII are significantly different. Otherwise, in case of a non-normal distribution of the scores, the Mann-Whitney U test is used [308] (identical to the study 1). In total, 86 valid submissions were evaluated. The average completion time was 07:35 minutes. The subsequent manual review revealed contradictory entries, which were labeled as not serious submissions (n = 12, 12.24% of all submissions (n = 98)). The Cronbach's α are acceptable [456, 488]: EII (all items): $\alpha = 0.85$, EII-M: $\alpha = 0.69$, EII-E: $\alpha = 0.90$, EII-G: $\alpha = 0.79$, EII-A: $\alpha = 0.90$.

Mann-Whitney U test

The Shapiro-Wilk test [451] shows no normal distribution of the data ($W = 31.48$, $p < 0.000$), so the Mann-Whitney U test was used [311]. For all subscales, the test statistic U is significant ($\alpha = 0.05 > p$): $U = 69365.6$, $p < 0.000^{***}$ (EII), $U = 6371.5$, $p < 0.000^{***}$ (EII-M), $U = 7057.0$, $p < 0.05^{*}$ (EII-E), $U = 4786.0$, $p < 0.000^{***}$ (EII-G), and $U = 6622.5$, $p < 0.01^{**}$ (EII-A). This means that differences in central tendencies in the groups are significantly different from zero, and thus the scale shows different values for different technology types (eudaimonic-oriented or hedonic-oriented technology). In other words, participants in the "Flowolf" group gave statistically sig-

nificantly higher scores than participants in the “LazyDuck” group. The scale thus makes a valid distinction between experience with eudaimonic-oriented and hedonic-oriented activity-focused platforms. The final stage of the validation requires correlations with other related scales. With the help of the third study, further scale data were collected, which were used for the subsequent convergent validity to show the correlation of the EII with existing scales and also the discriminant validity to indicate a low correlation with conceptually unrelated concepts such as extrinsic motivation to use technology.

4.5.8 Convergent & Discriminant Validity

The convergent and discriminant validity were determined on the basis of the participant data from the third study. The participants did not have to evaluate solely the items of the EII, but also other well-known scales that have already been used in a variety of ways in previous study designs. In the course of the convergent and discriminant validity analyses, it is necessary to demonstrate that the EII results in congruent outcomes, aligning with the established measures of eudaimonic well-being (e.g., ETES [550] and related concepts (UMI [66] and TENS [69]) in the context of technology (convergent validity). However, the same applies to the reverse logic, which measures the opposite (e.g., extrinsic motivation of the interaction [66]), resulting in a minor additional “stress test” for the EII (discriminant validity). In order to validate the EII, Pearson correlation coefficients were calculated, as recommended in the guidelines for demonstrating convergent and discriminant validity [54]. The following three scales or inventories were used: first, the ETES [550], which has been used in all previous studies, was assessed for correlations with the EII. Second, the UMI [66], which was already used in the second study on eudaimonia and AI (see Chapter 4.2), should be used for both types of validity. In its continuum of different types of motivation (extrinsic to intrinsic), there should be discriminant validity with the extrinsic dimension and convergent validity with the intrinsic motivational dimension. In Table 4.8, these subscales have been abbreviated as ’UMI-Intr.’ and ’UMI-Extr.’. In all the quantitative analyses conducted so far in this dissertation, the idea of hierarchical analysis was advocated using the TENS scales [69]. This scale should also correlate with the EII in terms of autonomy and competence experience. Since a num-

ber of subscales are available, the following subscales were chosen in the context of convergent validity: the TENS-behavior subscale for autonomy (TENS-B.-A.), the TENS-Interface subscale for competence (TENS-I.-C.), the TENS-Behavior subscale for competence (TENS-B.-C.), and the TENS-Interface subscale for autonomy (TENS-I.-A.). The findings indicate that all correlations are statistically significant in relation to the EII ($p < .05$). The results of the correlation analysis can be found in Table 4.8. In this Table, except for the UMI subscale for extrinsic motivation, which correlates negatively with the EII (-0.27), the EII correlates positively with all other scales at least moderately (> 0.4) [439]. In addition, negative correlations with the frustration subscales of the TENS can be shown. These are attached in the appendix. Convergent validity can thus be substantiated on the basis of the correlation data. In addition, discriminant validity has been derived from the negative correlations with the scales of the UMI for extrinsic motivation and the frustration subscales of the TENS scales.

	EII	EII-M	EII-E	EII-A	EII-G	UMI-Intr.	UMI-Extr.	TENS-B.-A.[1]	TENS-T.-C.[1]	TENS-I.-A.[1]	TENS-I.-C.[1]	ETES	ETES-SK	ETES-EG
EII	1													
EII-M	0.77**	1												
EII-E	0.67**	0.4**	1											
EII-A	0.60**	0.29**	0.14	1										
EII-G	0.82**	0.58**	0.48**	0.25*	1									
UMI-Intr.	0.74**	0.57**	0.37**	0.34**	0.80**	1								
UMI-Extr.	-0.27*	-0.18	-0.26*	-0.27*	-0.08	-0.11	1							
TENS-B.-A.	0.64**	0.54**	0.39**	0.21	0.69**	0.77**	-0.18	1						
TENS-B.-C.	0.59**	0.44**	0.40**	0.25*	0.59**	0.39**	-0.10	0.65**	1					
TENS-I.-A. (S)	0.66**	0.53**	0.28**	0.36**	0.67**	0.77**	-0.12	0.73**	0.64**	1				
TENS-I.-C. (S)	0.43**	0.27**	0.49**	0.23*	0.28**	0.72**	-0.29**	0.43**	0.59**	0.39**	1			
ETES	0.68**	0.49**	0.37**	0.29**	0.77**	0.73**	-0.02	0.52**	0.60**	0.68**	0.28**	1		
ETES-SK	0.55**	0.41**	0.33**	0.19	0.63**	0.60**	0.10	0.41**	0.49**	0.61**	0.26*	0.92**	1	
ETES-EG	0.71**	0.49**	0.36**	0.35**	0.78**	0.74**	-0.14	0.54**	0.61**	0.64**	0.25*	0.92**	0.70**	1

Table 4.8: All Pearson correlations ($p < 0.05^{*}$, $p < 0.01^{**}$) with the subscales used (UMI, TENS, and ETES).

4.5.9 General Implications

Following the completion of three studies, the EII, with its four dimensions, has demonstrated its efficacy as a measurement tool for future research initiatives regarding eudaimonic HCI. The assessment tool, which is composed of 12 items, with three items assigned to each of the four dimensions (authenticity, excellence, meaning, and growth), employs a 7-point Likert scale for further research. A possible introduction to the EII items is: "Please rate the following statements concerning the interaction with [the system] on a scale from 1 (strongly disagree) to 7 (strongly agree)." The development of the EII was the final process of transforming the previous findings into an applicable tool for measuring eudaimonic interaction principles for the concept of eudaimonic HCI. It is only one part of the mosaic of eudaimonic HCI, which is presented in the following chapter as a synthesis of all the implications gained so far. Nevertheless, an explanation of the implications in the context of EII should also be presented.

Meaning as Causality

"Semantics is the study of meaning. Semantic constraints are those that rely upon the meaning of the situation to control the set of possible actions" [349, p. 129]. This is only half of the semantics that emerged from the analysis of eudaimonic interaction. Above all, it is the interpretation of a causal relationship between user, system, and outcome. The items obtained suggest an orientation towards creative involvement, a sense of responsibility for one's actions, and a sense of not feeling passive in the interaction. This is close to the facets of a flow experience [102, 150, 362], but it is a matter of evaluating how much one contributes to shaping the result, and not an exclusively immersive experience. Such an experience may also arise from the permanent extrinsic nature of the technology, so the second level of excellence is important, or, as it is interpreted on the basis of the items, consciousness.

Excellence as Consciousness

The results of the item reduction and their confirmation in the follow-up studies can be seen in three interaction qualities: Intrinsic concentration

and an attention focus that extends into two spheres: on the one hand, the focus on one's own task can be maintained, and, on the other, that the system as such does not make any attempts of its own to direct this focus too vehemently through nudging or similar prompting structures. One's own agency of action is understood as the excellence of one's own work. This conscious, personal orchestration of the available information (this doctrine is known from flow theory [102, 219, 360, 362] is a quality that is understood as a form of excellence. It is consistent with the interpretation of Orlick and Partington, who characterize feelings of excellence through full focus, distraction control, and mental readiness [360]. This has already been outlined in Chapter 4.5.2.

Authenticity as Congruence

For the experience of authenticity, three reversed items can be found in the context of HCI. It, again, confirms the theory of Tuch and Hornbæk [502] that technology cannot maximize feelings of authenticity (just like causality, but this will be discussed in more detail in Chapter 5). The guarantee of autotelic motivation in interaction with technology is therefore not insignificant and also has a semantic connection to higher spheres of autonomy [69]. This negation of externalization is close to the current discussion about quantified-self technologies (QST) [168] and the importance of design decisions to incorporate extrinsic motivators into the interaction itself. In a qualitative survey, Doyuran shows the problem of addressing the instrumentalization of activities, which emerges as a postmodern development strategy [132]. However, the subdimension of EII is intended to reflect this form of authentic interaction, which is understood as the congruence of one's own autotelic aspiration in the interaction.

Growth as Competence

The findings of this study demonstrate that the stimulation of curiosity, the provision of inspiration, and the facilitation of learning processes are of particular importance during interactions with technology. For eudaimonic-oriented individuals, learning as an activity is an important reason for the use of technology [324]. The last level of interaction is therefore the importance of feelings of growth, which was labeled as competence to complete

the set of *C*'s[23]. The ETES had already included an item, the dimension of eudaimonic goals, that encompasses the assessment of a learning experience. In the discussion of this dissertation, it is again explained why the ETES only measures one aspect of eudaimonic HCI, based on the Pearson correlations, so that the EII can be argued as a reasonable alternative. It can also be used to build a bridge to the eudaimonic emotions presented in Chapter 2.1.5. Item no. 7, *I feel inspired by using [the system.]*, indicates the stimulation of inspiration leading to elevating experiences and thus a eudaimonic emotion experience of elevation [285]. This completes the EII.

EII and ETES

A structural nuance of the EII can be posited in relation to the ETES. A form of convergent validity between the EII and ETES was demonstrated, with the validity primarily based on the two subscales of meaning and growth (strongest correlation). The two-dimensionality of the ETES, with questions on an experience of learning and goal fulfillment, primarily addresses the orientation towards personal growth. This phenomenon can be further attributed to the strong correlation between the ETES subscale for eudaimonic goals and the EII subscale for growth, as evidenced by the correlation evaluation method proposed by Schober et al. [439]. However, the dimensions of authenticity and excellence demonstrated weak values (<0.4) [439]. Therefore, the correlation can be primarily explained by the dimension of personal growth (the experience of learning). The ETES appears to primarily address this virtue of growth, and the EII can be used to examine the experience of other virtues, such as authenticity and excellence, acknowledging its structural strength.

4.5.10 Summary

The EII was developed in several steps, confirmed by multiple factor analyses, and its reliability was confirmed in a total of six validation steps. The analysis revealed the measurability of four interaction principles (causality, consciousness, congruence, and competence) that indicate important interaction characteristics for eudaimonic HCI. The EII is intended to be used

[23] Growth as a term is, of course, equally adequate; the choice of competence is more a matter of syntactic aesthetics.

for future quantitative analyses in HCI to capture eudaimonic experience with technologies in terms of eudaimonic orientations. The presentation of this validation process of the EII finalizes Chapter 4. In Chapter 5, a comprehensive framework and definition of eudaimonic HCI will be provided.

5

Derivation of Eudaimonic HCI

It is important to note that 40.88% of the evaluated contributions used eudaimonia only as a theoretical filler (see Chapter 3.1). With regard to the evaluated studies, it has become clear that the goal orientation embodied by eudaimonia falls short. Equating it with goal fulfillment is insufficient in view of the multitude of differences that have been derived on the basis of well-being orientations. The derivation of eudaimonic HCI as a kind of boundary object [471] has therefore been more successful by taking into account the eudaimonic orientation of action than by the previous characterization as meaningful or goal-oriented interaction. Thus, this Chapter 5 is a derivation of all the study results that have already been published [240, 241, 243, 244, 245, 246], as well as those under review [238, 239]. It is a synthesis of the existing research results and forms the thematic conclusion of this dissertation, and at the same time, a proposal to conceptualize, systematize, and quantitatively measure eudaimonic well-being in this way in HCI. In this context, a basic definition of eudaimonic HCI should first be formulated.

5.1 Definition of Eudaimonic HCI

Based on the literature reviews (Chapter 3) and the individual studies (Chapter 4), a general definition can be given:

Definition 1 (Eudaimonic HCI) *Eudaimonic HCI is the body of research that explores the analysis of eudaimonic experience with technology and its transfer to eudaimonic well-being. The main research focus of the interaction is the analysis of the four eudaimonic interaction principles: causality, consciousness, congruence, and competence.*

As a research corpus, eudaimonic HCI consists of several sub-theories and models. It must be considered as a sort of meta-theory, like SDT, which is composed of several "mini-theories" [514]. It provides a conceptual and measurement framework for systematizing contributions to eudaimonic well-being in HCI. In addition, examples of assessment and engineering implementation strategies are given. Certain principles of interaction and analysis are associated with the idea of *Eudaimonic HCI*, which shape principles of *eudaimonic interaction design*. In the context of the last study in Chapter 4, four dimensions of measurement for eudaimonic orientations in HCI were identified. Their semantic transition into HCI led to the derivation of the *four C's of eudaimonic interaction design*.

5.2 The four C's of Eudaimonic Interaction Design

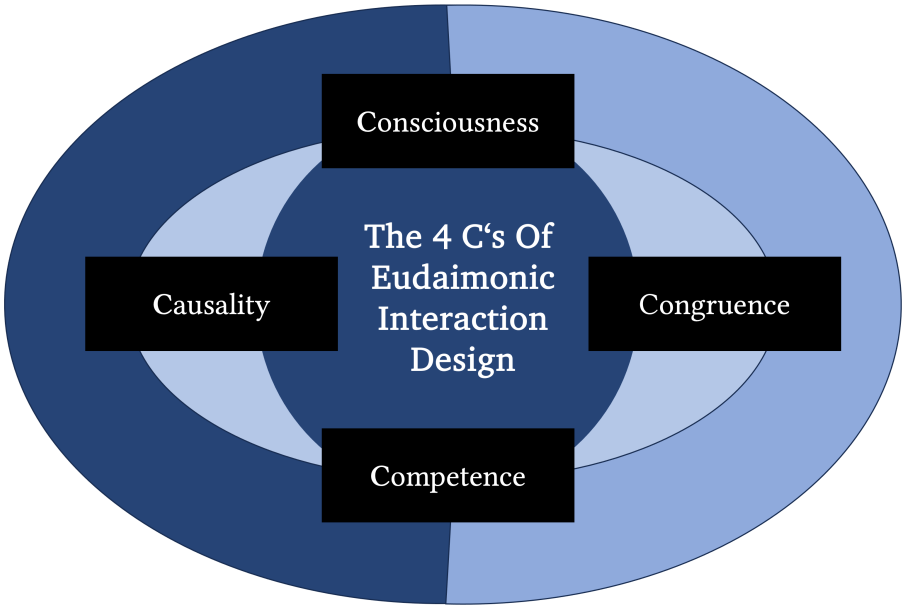

Figure 5.1: An illustration of the 4 C's of Eudaimonic Interaction Design: Causality, Consciousness, Congruence, and Competence.

The four C's of eudaimonic interaction design have emerged both from the theoretical derivation of previous findings and the results of one's own studies. Each principle is characterized individually below.

5.2.1 Causality

According to the results of the studies, the level of one's own involvement in the creation of the output is important. The balancing act between delegating the decision-making processes to the system itself and allowing the user to shape the result in a certain way is the idea of causality. In other words, the user must experience the possibility of shaping the result of their activity to a certain minimum degree. In the history of technological development, the "principle of marginal control" [379, p. 40] is a form that makes the use of technologies possible at all; otherwise, extensive technical know-how would still be necessary to operate them today. Maximizing causality (degree of influence of users with the technology in their activity) is therefore not logical, i.e., formulating texts with Assembler instead of using a text program interface, but it is about ensuring a perceived level of acceptance. In one of the studies [244] on eudaimonic experience and AI, the frustration values of autonomy and competence reactions to this decreasing causality context can be explained. It is justified to ask how a complete reduction of the causality of one's own creative and thought processes could be understood. Robbins [395] pointed towards possible consequences with a dramatic conclusion that eudaimonia as a state could no longer be achieved. Eisikovits and Feldman [139] formulated the same concern about a decline in individuals' decision-making capacity. Another semantic related to the concept of causality is the significance of intrinsic motivation and its connection to a perceived locus of causality (PLoC). With reference to Figure 2.3 in the theoretical foundation of this dissertation, Szalma assigns integrated and intrinsic regulation to forms of an internalized PLoC [486]. They are considered forms of the highest autonomous self-determination, which are reflected in increased interest, enjoyment, and inherent satisfaction of the process [486, p. 1459]. In a further study by Nix et al., a connection between fostering PLoC and increased subjective vitality of individuals is recognized [348]. The perceived degree of one's own involvement may be crucial for an influence on eudaimonic well-being [391]. The study result by Peng et al. can also be referenced again for this assumption [367].

The level of causality is therefore an important element of interaction. As long as we are in the spectrum of interactive technology, and also taking into account the study results, causality emerges as an essential element

of eudaimonic interaction. Its validity has been confirmed by the development of the EII across three studies. It is closely related to the second principle of eudaimonic interaction, congruence, through the connection to the idea of autotelic motivation.

5.2.2 Congruence

The congruence of the interaction means, based on the results of one's own studies [244, 246], an emphasis on the autonomous handling of the interaction. Closely connected with the idea of self-determination [117], a shift of the interaction to extrinsic signals for rewarding interactivity, for example, is questionable. The interaction must be congruent with the idea of autotelic activity. An autotelic activity is one that allows the pleasure of the activity itself to be perceived without merely wanting the end result of the activity. The development of the EII shows that there is a certain level of congruence that needs to be addressed. Congruence as an interaction principle thus comes semantically close to the concept of a hygiene factor according to Tuch & Hornbæk [502]. Maximizing congruence does not mean that you are able to maximize the user experience. Rather, it is more important to ensure the level of interaction is not determined by extrinsic reward. In the self-defined Eudaimonic User Experience (EUX) rules [241], the reduction of gamification elements is also mentioned. Ideas such as quantified self technologies (QSTs) [168] must therefore be critically evaluated. Sicart formulates: "Gamification tends to delegate virtues in data and rewards, neglecting the importance of practice and reflection in the development of the good life." [461, p. 234]. It is more important to create flow-like conditions in order to improve the quality of the work process and thus to perceive *the process itself as a reward.* Another interaction principle is therefore *consciousness.*

5.2.3 Consciousness

Consciousness should not be confused with causality just because aspects of flow are reflected in both aspects. Consciousness means the idea that the awareness of orchestrating information in interaction with technology appears high, while causality refers to the general responsibility of orchestration. In other words, it is not about increasing the breadth of

decisions (quantitative approach), but the depth of these decisions (qualitative approach). The development of the EII has shown that both the structural specification of the system and aggressive nudging strategies do not meaningfully contribute to the eudaimonic experience. In the study results presented in Chapter 4, the form of light feedback was recommended, which, so to speak, represents the tolerance range. The user must continue to stimulate their own sense of excellence if we want to reformulate it in the canon of eudaimonic orientations. To emphasize this point again, full focus and distraction control are facets of a perceived human excellence [360].
Cognitive Load is a problematic term since a definition and interpretation of cognitive workload in HCI has not yet been sufficiently established, at least according to the results of the work by Kosch et al. [272]. In this context, the term *consciousness* makes more sense for formulating the close connection to a flow experience and forms of deep involvement [286, 508, 555] and less for manifesting the progressive exploitation of cognitive abilities. "The events that constitute consciousness the 'things' we see, feel, think, and desire are information that we can manipulate and use. Thus, we might think of consciousness as intentionally ordered information" [101, p. 26]. It can be understood as a form of orchestral information organization, with the user immersing themselves in this orchestration with the help of technology. The proactivity of the interface, which was examined with the help of a previous study [240], is based precisely on the theory of *psychic energy*, which includes a control element of *attention* [101, p. 33]. The component of interactivity, a conscious interplay between activity and reaction, is an important stylistic element in the stimulation of critical thinking skills in e-learning environments [424]. Consciousness thus encompasses the intensity of orchestrating what is available, to organize and reorganize it, and to combine perspectives. The ultimate result of successful orchestration may be, consequently, an experience of one's own competence.

5.2.4 Competence

The interaction principle of competence is not to be understood merely as a learning effect. It is structured in three dimensions: inspiration, curiosity, and joy of learning, which can be derived from the items of the EII. The

derivation of the dimension is congruent with the results of Rasmussen et al. [390], that learning skills and exploring new ideas are empirically demonstrated forms of eudaimonic experiences. Personal growth is a fundamentally desirable doctrine of technology development because it stimulates a core of eudaimonic activity. Learning is considered an important reason for using technology for eudaimonic-oriented individuals [324]. The spectrum of feelings of personal growth also extends beyond a learning effect. Feelings such as elevation or spiritual awe [285] allow one's self to be enlarged, to perceive in a larger context that embodies a higher sense of growth. Thus, aspects of inspiration and curiosity are also dimensions of competence as part of the eudaimonic interaction principle.

5.2.5 Gravitations of the four C's

To conclude the characterization of the 4 C's, one more important characteristic of all four principles will be illustrated. This illustration will be explained utilizing the hermeneutics of Tuch & Hornbæk [502] and their interpretation of Herzberg's Notion of Hygienes and Motivators [202]. The two authors used Herzberg's notion to derive two different dynamics that can be embodied in interaction variables. Firstly, there are *hygiene factors* of an interaction that are expected by the user as a result of a fundamental attitude, but their forced improvement does not necessarily create a great user experience. The authors state: "[...] low usability can create dissatisfaction but high usability in itself cannot create a satisfactory or even a great product experience" [502, p. 2]. Secondly, *motivators* are factors that can actually increase the user experience, but if they are missing, there is no negative experience per se. "Motivators, in contrast, enable positive user experiences, but their absence will not lead to negative experiences" [502, p. 4]. This does not mean that one of the two factors can be ignored, but that the two have different dynamic characteristics, *which implies an increase in one and the guarantee of the other*. On the basis of one's own study results and their results, the following theory emerges for the four C's of eudaimonic interaction design (illustrated in Figure 5.2): Causality and congruence can be interpreted as hygiene factors. The reverse-coded items of the congruence subscale of the EII show that the experience of congruence is always accompanied by an expectation rationale. The higher the value on the scale, the smaller the feeling of congruence. Causality, as

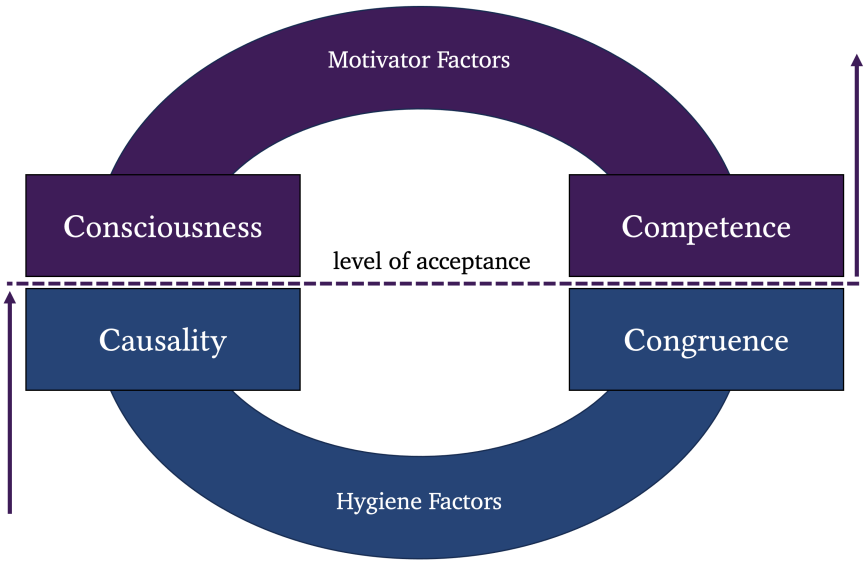

Figure 5.2: Classification of all four principles of causality, consciousness, congruence, and competence in the hermeneutics of Tuch & Hornbæk [502].

explained in Chapter 5.2.1, should not have a maximization doctrine (to have full control over all mechanisms during a process). This balance-like form of the experience of causality comes rather close to that of a hygiene factor, i.e., maximizing it does not necessarily mean a great user experience in the end. A low sense of causality, as indicated in Chapter 4.2 by the study on eudaimonic well-being and AI, may in turn have a negative effect on basic needs such as autonomy and competence. The two motivators of an eudaimonic interaction, on the other hand, are consciousness and competence. It can be explained, in addition to the subgroup within eudaimonic-oriented individuals (with reference to the study by Mekler and Hornbæk [324]), that technology can also function as a pragmatic helper. For example, a text program should just work and can still promote growth processes. However, both forms are important elements in implementing a great eudaimonic user experience, according to the findings of the studies and literature reviews. The four principles can be considered along two separate development doctrines, which are explained below with the introduction of the micro model of eudaimonic HCI.

5.3 Micro Model

The micro model was primarily developed using hybrid thematic analysis (see Chapter 3.1), but also in the developmental experience of the two prototypes ("eudaily" in Chapter 4.1 and "LaLaMoSuLe" in Chapter 4.3). The 4 C's should be used for both doctrines (support and simulation). The micro model is shown in Figure 5.3 and is explained in the following using two different doctrines of eudaimonic HCI: The *Doctrine of Support* and the *Doctrine of Simulation*.

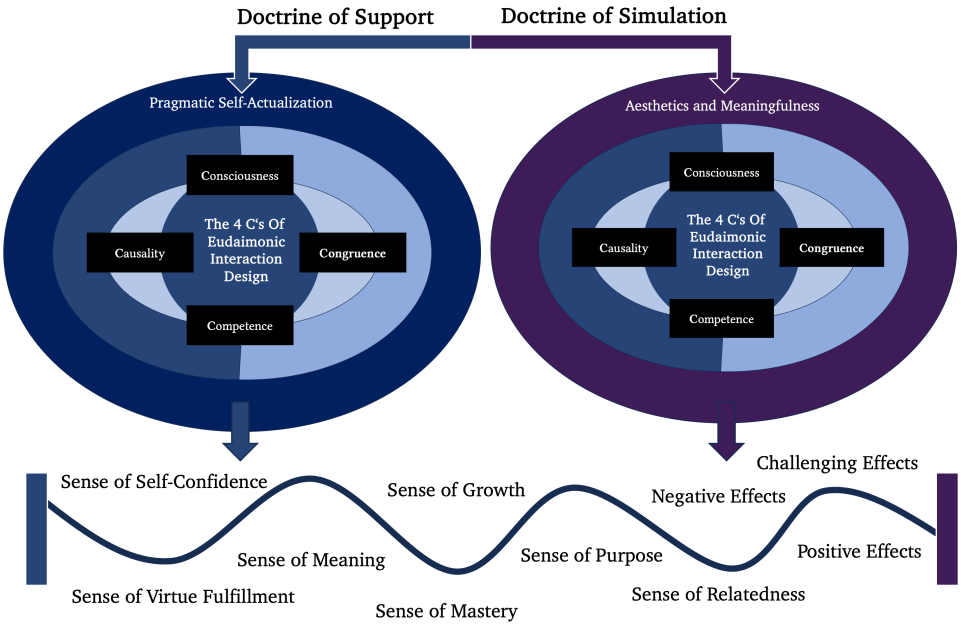

Figure 5.3: The micro model from eudaimonic HCI. It recognizes two doctrines of development and four eudaimonic interaction design principles.

5.3.1 Doctrine of Support

The doctrine of support encompasses the development strategy of technology as pragmatic self-actualization. The inductive analysis of hybrid thematic analysis reveals several perspectives that address this doctrine. For example, eudaimonic HCI as a "means to an end" or as a "pragmatic means to one's self-realization" [201, 234, 442]. The reference to the significance of pragmatic qualities, which can be seen in the interpretation of eudaimonia in HCI, is taken up in several contributions to HCI [66, 89, 138, 324]. The

interpretation of eudaimonia embodies a purpose-built tool for the pragmatic fulfillment of a task. For example, Kuang et al. refer to eudaimonic user experience (UX) as a gain of meaning through need fulfillment [275]. In a theoretical contribution to "Quality of Experience" (QoE), Egger-Lampl et al. formulate the eudaimonic component in the interaction primarily as "purpose-of-use" [138]. Faedda et al. also follow this canon in their interpretation [143]. The authors explain the eudaimonic experience with technology as a "concept that highlights well-being as a component for fulfilling development" [143, p. 850]. Eddy posits the "eudaimonic level" of technology as addressing development in terms of engagement, actualization, self-set goals fulfillment, and thus the experience of self-actualization [137]. Wagener et al. demonstrate the form of eudaimonic technologies as one that can be positioned as self-actualizing technologies, which are intended to promote the personal growth of the user [525]. The value system of a system for eudaimonic HCI is the encouragement of people "to behave as their very best selves" [548, p. 15]. In accordance with this perspective, Torsi et al. see the integration of eudaimonic ideas into the conception of games as a chance to support users' behavioral change [499].
Pragmatic self-actualization is not to be equated with Behavior Change Technology (BCT) [94, 289], but it could serve as such. It is not directly and necessarily aimed at changing the behavior of the individual. Referring to the results in Chapter 4.3, hedonic-oriented individuals indicated stronger support for autonomy in their learning process when AI-enhanced features are available (U = 1201.5, .034*). This is quite interesting, and this perspective is manifested again in Chapter 7 as future work. Inter alia, the question is formulated whether the experience with eudaimonic technology can be an enabler for changing fundamental orientations. However, the doctrine of supporting pragmatic self-actualization encompasses the understanding that a principle in line with the 4 C's can address different forms of eudaimonic specific behavior and pragmatically contribute to growth (de facto or only in the experience). With "LaLaMoSuLe", an engineering example was shown in Chapter 4.3. To substantiate the doctrine more concretely, six eudaimonic user experience (EUX) rules will be presented.

5.3.2 Implementation Strategies for Support

The six eudaimonic user experience (EUX) rules have already been accepted and presented at the ACM conference for Designing Interactive Systems (DIS) in July 2024 in Copenhagen, Denmark [241].

Informative Feeback & Reduce Quantification. In reference to Chapter 4.4, light feedback was sufficient to trigger an increase in performance, i.e., creating the cognitive awareness for the process [240]. In any learning process and other types of flow-demanding experiences, there is an emphasis on providing the user with a sensitive frame of information about the opportunities to interact. In this context, the users orchestrate their own attention. The user *can* react but does not have to. The indication is sufficient. Thus, reward mechanisms and also gamification should be avoided. In the event that the system design involves quantification, it is essential to empower the user to determine the appropriate moments for quantification to be visible or even deactivate it completely (referring to the demand of customization in Chapter 4.1). Again, quantified-self-technologies (QSTs) have to be sensitively built to prevent unwanted consequences. For instance, the system can be configured to track the time spent learning vocabulary and provide feedback on the user's progress. Additionally, the system can serve as a reminder to drink more water, promoting health and well-being [213], but the activity itself cannot be tied to it [132]. The process itself should be rewarding, promoting autotelic motivation. Progress can be illustrated as a form of nostalgic documentation, e.g., as a timeline (see Figure 5.4). Nostalgic emotions are connected to eudaimonic well-being, thus, there might be an opportunity to consider it [28, 38, 285].

Mediate Towards Positive Social Interaction. Even though the social component has been largely excluded, the idea of pragmatic self-actualization should be brought into the context of social self-actualization. In Chapter 3, the social component was shown to have intrapersonal and interpersonal dimensions, thus, there is also an interest in social skills arising from the eudaimonic orientation. Reference is made to Chapter 2.1.2, which includes a subsection on various facets of positive relationships with others that are relevant in the context of eudaimonic well-being. In general, empathy development and trustful relationships are essential components

of eudaimonic well-being [417]. In this context, the idea of ethical mediation of behavior is promoted [430], especially social behavior, in line with the results in Chapter 4.4. The user possesses the autonomy to make decisions; however, the system provides mediative instructions, thereby facilitating moments for self-reflection, deceleration, and the development of empathic reasoning. Warnings are also a possibility, which intervene in the event of potential injury or traumatization of the other person. Nevertheless, the user will always decide. An example is illustrated in Figure 5.5.

Maximize Data Privacy. In accordance with IEEE and the demand for ethically aligned design, the necessary addressing of further aspects that are mentioned in connection with a focus on eudaimonic well-being can be seen, e.g., human rights, respect, privacy, and justice [228, p. 247]. This point ties in with this, which is also shown by the results of the study in Chapter 4.2 on eudaimonia and AI. The effect of technology on the autonomy of the individual should not be underestimated, especially with regard to their well-being and basic psychological needs [69, 244]. A special focus must be placed on the user having extensive options for external tracking of his or her actions in the system itself. Therefore, extensive customization options are required that can be done directly through the interaction. A simple example can be seen in Figure 5.6.

Avoid Tendency Design and The Forbiddance of Dark Patterns. The fourth rule calls for the avoidance of tendency design and, above all, the forbiddance of dark patterns. The optimum would be no-color-guided interactions as illustrated in Figure 5.7, but this is to be understood more as a provocative proposal. In practice, such versions are quite difficult to implement. The implicit demand of this interaction principle is probably more in the direction of preventing psychological strategies that consciously guide the user and establish a usage habitus. It was shown that the design of certain cookie consent boxes can influence choice behavior [185].

Enabling Direct Influence Recommendations & Personalization. The fifth rule is based on the findings of "eudaily" (see Chapter 4.1) that increased intervention in the design of the interaction is desired, especially when it comes to eudaimonic-specific interactions. The current claim of autonomous interfaces, in accordance with the implications from the

third study (Chapter 4.3) and the study by Tuch and Hornbæk [502], is to encourage the strengthening of autonomous customization of the system environment.

Promotion Of User Activity Or "Managed Flow". The active character of an interaction ultimately requires addressing the four principles of interaction, of which competence and consciousness were each referred to as motivators (in line with the hermeneutics of Tuch and Hornbæk [502]). The establishment of a human-centered relationship between the interaction system and the user is essential for promoting active engagement rather than passivity [210]. The more clearly these factors are fulfilled, the greater the eudaimonic experience with the system.

5.3.3 Doctrine of Simulation

The second doctrine emerged de facto through the crystallization of a second perspective, which can be distinguished from *purely* supportive pragmatic self-actualization. “eudaily” is intended to illustrate an engineering example to provide a first indication of this doctrine (in Chapter 4.1): the doctrine of simulation is the conscious generation of eudaimonic emotions, i.e., the doctrine is associated with a meaningful or aesthetic concept of interaction. In the narrower sense, it is not a pragmatic solution, but rather a *calculated approach* to forming an interaction narrative that is intended to generate forms of eudaimonic emotions. This position is reflected in many perspectives: Hohm et al. point to the possibility that technology interaction can also be meaningful beyond its purpose [209]. Accordingly, interaction is not reduced to the “purpose-of-use” [138], but the principle of an aesthetic play that extends beyond the doctrine of material productivity [15]. The conceptual association of play shows the bridge to playful HCI, which specifically addresses the eudaimonic emotions. For example, Seaborn et al. [445] mentioned the concept of *maldaimonia*. This concept concerns vice (negative ethical actions, i.e., egocentric, exploitative, harmful, or destructive) and is called the “wicked twin” of eudaimonia [445, p. 2]. This concept results in a meaningful interaction through a form of enabled escapism [444, 445]. These forms of technology, therefore, do not aim to be pragmatic tools but are explicitly designed to simulate eudaimonic agency. This nuance is important to recognize. Wright and Denisova

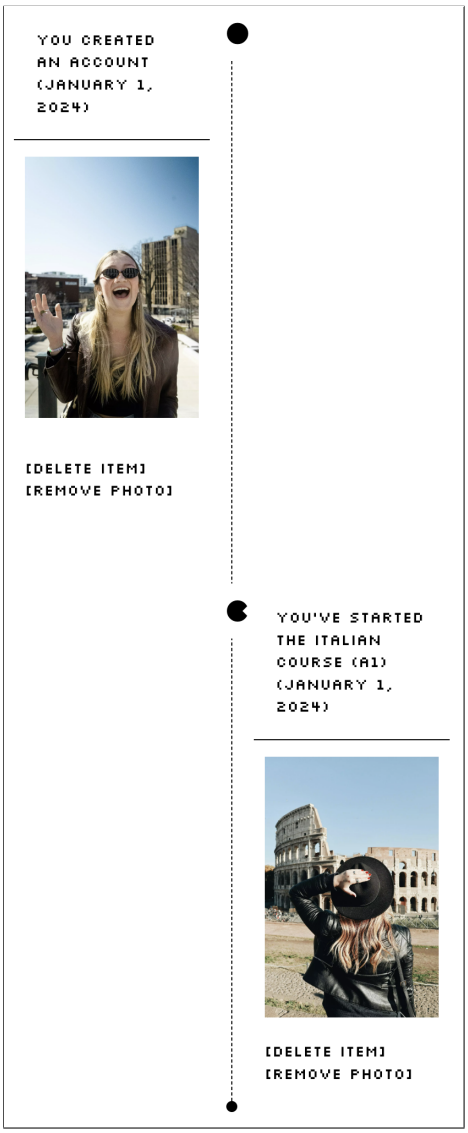

Figure 5.4: Stick to informative feedback instead of promoting a "quantified self". Furthermore, avoid using rewarding mechanisms or even competitive structures.

Figure 5.5: Mediation of positive relationships with others in chat constellations, for example, warning against hurtful messages.

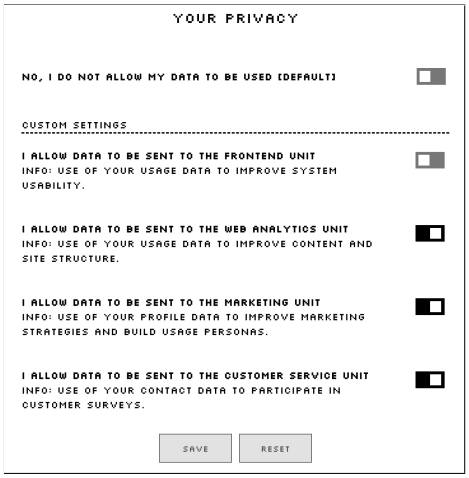

Figure 5.6: The default setting is not collecting data. However, the user can choose to send their data to specific departments or purposes. In addition, the options should be explained in greater detail.

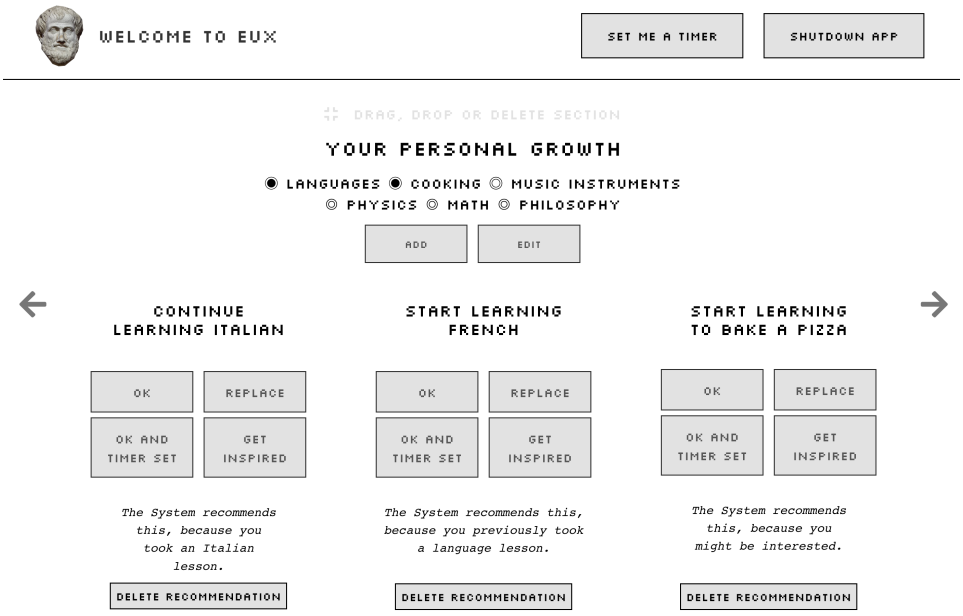

Figure 5.7: Avoiding any tendencies: offering a maximum of options for the user to decide what to do by simultaneously not nudging him.

state regarding eudaimonic experience in games: "the emotionally challenging nature of moral decisions may intensify players' reactions when acting immorally while also acting as a catalyst for players to engage in eudaimonic experiences" [551, p. 14]. The targeted evocation of eudaimonic emotions in games can be seen in systematizations such as the eudaimonic game experience [92], the reflective play framework [326], or the moral decision-making framework [551].

5.3.4 Implementation Strategies for Simulation

The most important characteristic of the doctrine of stimulation is the assumption of a narrative [147, 368, 401, 509]. This was exemplified in "eudaily" with the application of the reflective play framework [326]. Instead of the orchestral opening of the system to a variety of expressions for one's own personal development, the strengthening of logical thinking, and autotelic self-actualization, the doctrine of stimulation intends the targeted, playful experience of eudaimonic emotions. The necessity of separation is discussed again in Chapter 6 by considering several perspectives on a real

transfer from games to eudaimonic well-being. However, there are many untapped possibilities to be mentioned by systematizing the reflective play framework, some examples of which are given in Table 5.1. The interaction elements are collected and should show identically to the EUX rules of the doctrine of support implementation strategies for the doctrine of simulation. The technical implementation of "eudaily" is an example of a concrete application.

Element	Description	Source
Ambiguity	Cole & Gillies calls ambiguity a "key tool" of emotional exploration [92, p. 7]. This form of exploration was also considered in "eudaily".	Cole & Gillies [92], *Study 1*
Dissonance	The dissonance of action takes various forms, such as narrative twist, genre subversion, or intentional ludonarrative dissonance. [326, p. 6].	Miller et al. [326]
Discomfort	Alternatively, Miller et al. identify four types of discomfort that can initiate a meaningful reflection process: emotionally challenging mechanics, confrontation, loss of agency, and brave spaces. [326, p. 6].	Miller et al. [326], *Study 1*
Art & Creation	Bopp et al. contextualize the art experience in video games as a means of stimulating "aesthetic emotions" [58, p.14], the art experience in "eudaily" confirms the pleasantness of such a sequence.	Bopp et al. [58], *Study 1*
Connecting Body and Soul	Roo et al. formulate an interesting perspective in their study that the technical connection between the body and the technical medium promotes mindfulness of bodily signals to strengthen mental work, thus enabling a meaningful interaction between body and mind.	Roo et al. [398]
Failures	Foch & Kirman explain that a failure "can act as a trigger, a mechanism that can constantly change the player's experience and relationship to the game they are playing" [155, p. 9].	Foch & Kirman [155, 156]
Multitude of Perspectives	Galeote et al. illustrate that eudaimonic agency is not limited to influencing the course of the game, but also to reflecting on fictional elements and one's own self. In "eudaily", for example, this was the confrontation with the thought bubbles in phase 1 of the simulation.	Galeote et al. [147], *Study 1*
Moral Dilemma	In their paper, Whitby et al. address, i.a., forms of moral dilemmas that have triggered thought processes among the participants.	Whitby et al. [539]
Ludic Phronesis	Sicart states regarding ethical gameplay: "It is precisely that search for eudaimonia that separates conventional decision making from ludic phronesis" [460, p. 104]. Sicart formulates the significance of the player's moral involvement, otherwise the conception of decision-making remains as a profane cause and effect mechanism.	Sicart [460]
Social Affordance	The element of a collective contribution to the well-being of the individual but also of the group. Bertran et al. point to the possibility of a role for social affordance that translates these dimensions into meaningful interactions.	Bertran et al. [15]
Increased Immersion	For a systematization of different variations of agency, see the framework by Cole and Gillies [91, p.9]. The results of one's own study with "eudaily" also confirm the meaningful doctrine of increased immersion, so that the user "dives in".	Cole & Gillies [91], *Study 1*

Table 5.1: Doctrine of simulation: implementation strategies.

5.4 Macro Model

The micro model of Eudaimonic HCI identifies the existence of two doctrines that primarily serve to achieve a eudaimonic experience with the technology. Subsequently, the findings of the hierarchical analysis must be supplemented in order to assess the de facto impact of the technology. The hierarchical structure of eudaimonic HCI in the embodiment of the macro model is determined by the implications of several studies, e.g., the hybrid thematic analysis (Chapter 3.1, the scoping review (Chapter 3.2, the analysis of eudaimonia and AI (Chapter 4.2 and "LaLaMoSuLe" (Chapter 4.3). The separation of experience and functioning is necessary because previous studies have already negated this transfer [404, 525]. However, Clarke and Draper have demonstrated with their app "Calm" that it is possible to achieve effects on the "sphere of life" [88]. The macro model of eudaimonic HCI and its architecture can be seen in Figure 5.8. It separates the analysis of eudaimonic experience ("level of interaction") and eudaimonic functioning ("sphere of life"). The eudaimonic specific behavior of hybrid thematic analysis is referred to as "context"; these are the addressable contexts and have emerged from the inductive analysis of Chapter 3.1. They exemplify possible application domains within HCI. The list of possible contexts is not complete, and further contexts are certainly possible. However, in this step, the entirety of the knowledge gained so far is included. The contexts are the intentional limitation of specific, eudaimonic application domains. On the "level of interaction", the focus is on a conception of technology with regard to the 4 C's of eudaimonic interaction (congruence, competence, causality, and consciousness). Between this "level of interaction" and the "sphere of life", sensitive measurement strategies must be taken into account. These will be presented in conclusion with the proposal of a measurement model.

5.5 Measurement Model

The last submodel of eudaimonic HCI is determined by a final doctrine, which is necessary to complete eudaimonic HCI. Is the connection between eudaimonic experience and eudaimonic functioning to be assumed after conducting a single study? The scoping review in Chapter 3.2 showed that the frequency of technology use can also have negative effects on

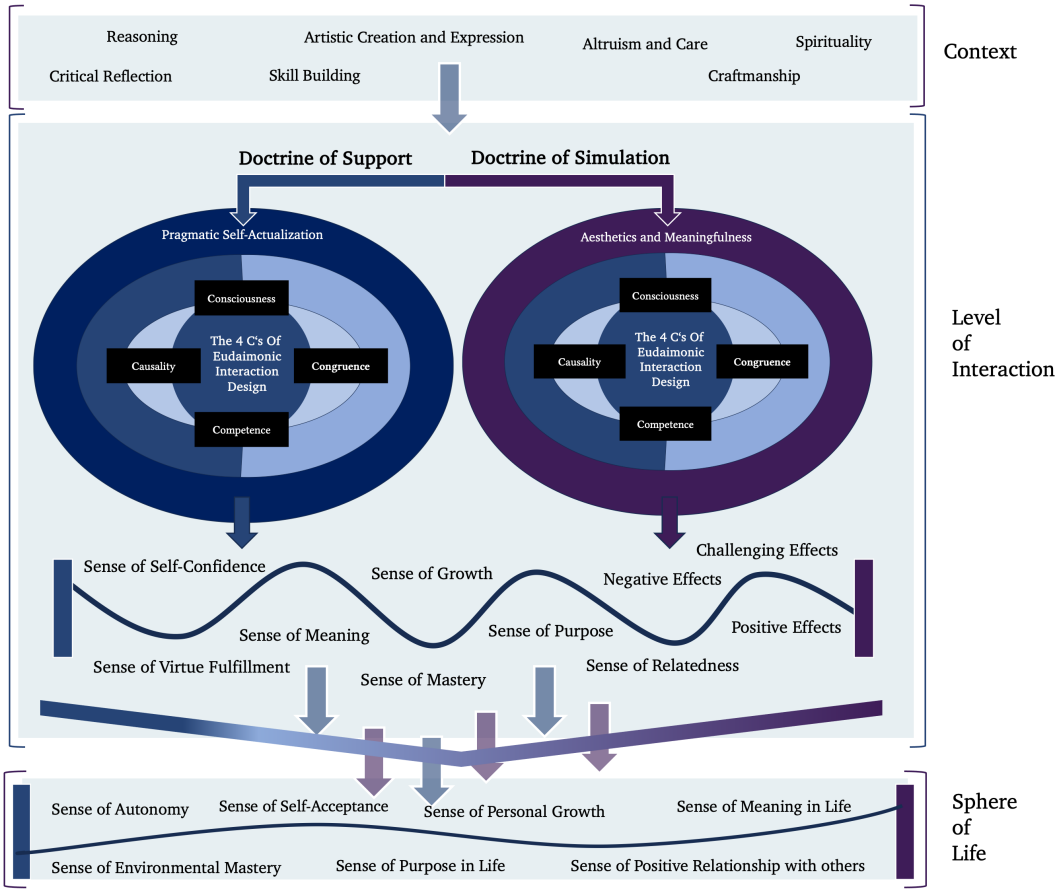

Figure 5.8: The macro model of Eudaimonic HCI.

eudaimonic well-being [386]. The reduction of stress symptoms may have a positive effect on eudaimonic well-being, even in the long term [466]. In the following, a measurement concept for eudaimonic HCI will be proposed on the basis of an understanding that takes into account the hierarchy and frequency of technology use. The model also requires a clear manifestation of the “context” and the addressed demographic group. In principle, the use of at least two different scales is recommended for the analysis of well-being effects [513]. In the first instance, one therefore separates the eudaimonic experience and its effects on the “sphere of life” (as already illustrated in the previous section). Appropriate measurement instruments have been proposed for both the sphere of life and for phases of interaction. The proposals for the sphere of life can be found in Table 5.2. The selection was made with regard to the correlation data with eudaimonic orientations [220,

p. 229]. For further measurement instruments, references to the reviews by Huta [220] and Proctor & Tweed [383] are made.

5.5.1 Measuring Effects for the Sphere of Life

In the first step (see Figure 5.9 for a visualization of the complete measurement model), an actual state of the "sphere of life" must first be determined. Possible measurement instruments that can be used for this are shown in tabular form in Table 5.2.

Table 5.2: Recommended Measurements For Sphere of Life. *For better readability, the list of examples is shortened. Please refer to the original source for all possible items. **Refers to the full possible number of items; shorter versions are partly available.

Name	Author(s)	Year	Examples of Dimensions*	# of Items
Psychological Well-Being (PWB) Scale	Ryff [416]	1989	Autonomy, Environmental Mastery, Personal Growth, Meaning in Life, Positive Relationship with Others, Self-Acceptance	42**
Flourishing Scale (FS)	Diener et al. [128]	2010	Purpose in life, meaning in life, supportive and rewarding social relationship, engagement and interest in one's daily activities, competence and capacity in important activities, future optimism, perceived respect, ...	8**
Questionnaire for Eudaimonic Well-Being (QWEB)	Waterman et al. [535]	2010	Deep involvement in activities, self-discover, maintaining core beliefs, purpose in life, meaning in life , engagement in activities,...	21**
Technology-based Experience of Need Satisfaction scale (TENS)	Burnell et al. [69]	2023	Autonomy, competence, and relatedness (life sphere)	31**
The Life Regard Index	Battista & Almond [37]	1973	Meaning in Life	49**

5.5.2 Context, Doctrines, and Demographics

As the perception of personal growth declines with advancing age, the challenge of preserving eudaimonic well-being emerges [418, p. 380]. Lavoie & Zheng show different mechanisms of action of age structures in interaction with technology [286]. For the older target group, the use of the program increased their eudaimonic well-being, while the authors deduced rather

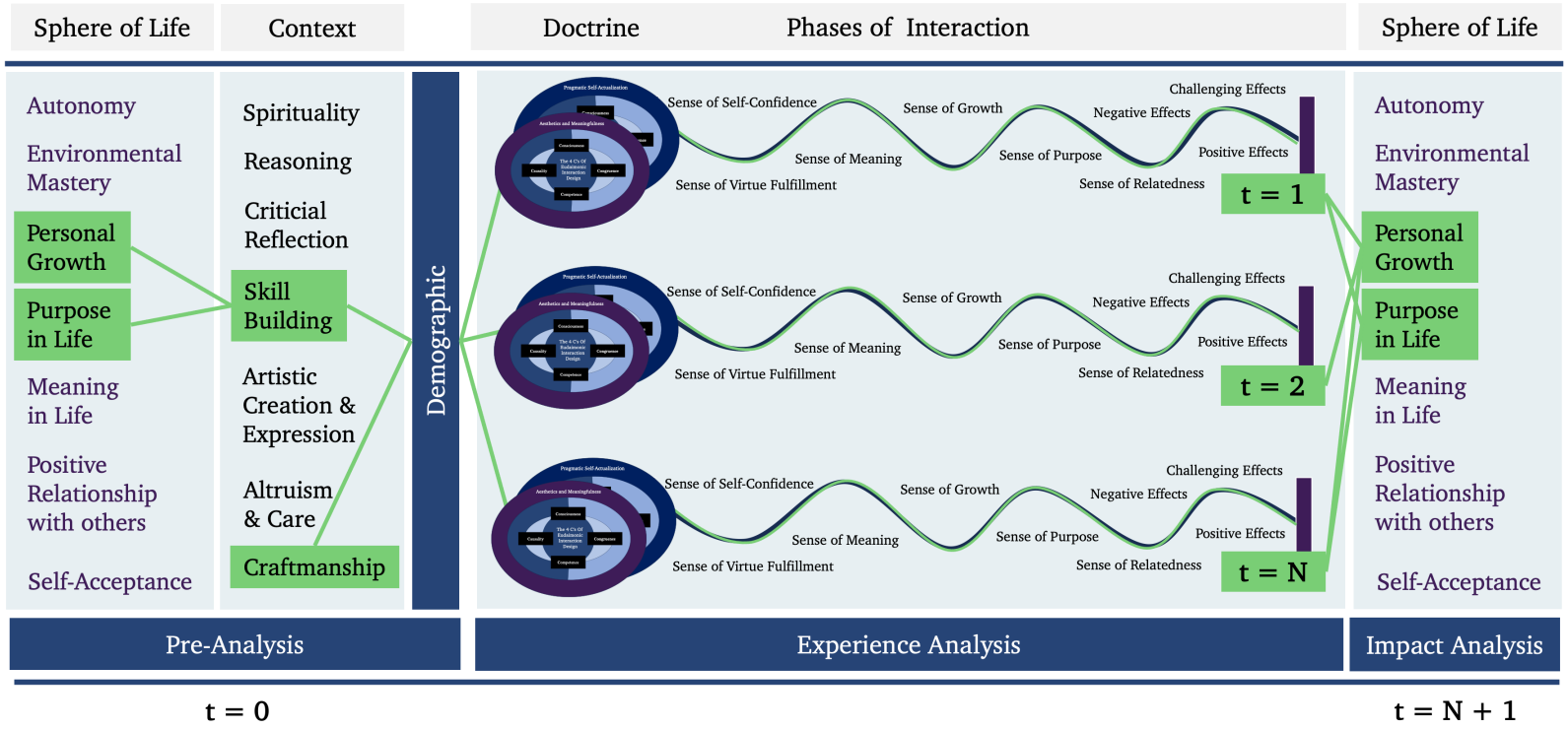

Figure 5.9: Three-part structure of the eudaimonic HCI measurement model: pre-test analysis, experience analysis, and impact analysis.

negative effects for the younger participants. In this contradictory effect, which is mediated by age, the consideration of demographics is explained as an essential element in the measurement model. It must therefore be clearly manifested in the measurement strategy. Furthermore, it is critical to underscore the existence of discrepancies between countries in terms of well-being indicators [229]. Context-specific personas may also be addressed, such as certain learning types [553] and cultural differences [496]. Finally, it must be manifested which doctrine of eudaimonic HCI is used in the development of a system. Is it intended to effect a pragmatic self-actualization of the user or to effect a structured evocation of eudaimonic emotions? In the next step, the experience can then be measured in its facets.

5.5.3 Measuring the Experience

For the evaluation of experiences in interactions with technology, corresponding suggestions are listed in Table 5.3. If the effects of a simulation are to be measured, for example, of a game environment, the Player Experience Inventory (PXI) can be used [4]. The advantage of this is that the inventory measures both immediate effects and psychosocial consequences (second-order emotional experience) [4, p. 10]. There are also more general activity scales such as the Personally Expressive Activities Questionnaire (PEAQ) [532]. The PEAQ contains items designed to assess a sense of aliveness and a strong feeling of being one's self in activity. However, it is not a technology-specific scale, but it might be a purposeful addition to the scope of measurement techniques. Finally, it may not be enough to address only one aspect of eudaimonic experience, considering the results of Saha and Iqbal [429]: the application has achieved a learning effect over time in some way, and all other supposedly meaningful associations have not been affected. It may therefore make sense to measure several facets of a eudaimonic experience at the same time.

5.5.4 The Importance of Repetition

The repetition, or rather the repeated analysis of the eudaimonic experience with technology, is an important component of the measurement strategy. In line with the assumption of Diener [127], the daily striving for intrinsic

Table 5.3: Recommended Measurements For Phases of Interaction. *Refers to the full possible number of items; shorter versions are partly available.

Name	Author(s)	Year	Possible Dimensions	# of Items
Eudaimonic Interaction Inventory (EII)	Jörs & De Luca [246]	2025	Authenticity, Excellence, Meaning, Growth	12*
Eudaimonic Technology Experience Scale (ETES)	Woźniak et al. [550]	2023	Eudaimonic Goals and Self-Knowledge	6*
User Engagement Scale (UES)	O'Brien et al. [361]	2018	Focused attention, Perceived usability, Aesthetic appeal, Endurability, Novelty, Felt involvement	31*
Technology-based Experience of Need Satisfaction scale (TENS)	Burnell et al. [69]	2023	Autonomy, Competence, and Relatedness (Interface, Task, Behavior Sphere)	31*

goals leads to an improvement in well-being. This is shown by the results of Sheldon & Elliot [452, p. 492]. In the long term, only sustainable, more robust derivations can possibly be made. This also applies to the analysis of negative effects, which only become apparent over time [386].

5.5.5 Impact Analysis

In the impact analysis, the identical scale is used to measure eudaimonic well-being in the "sphere of life" to determine a significant increase that has been shown to result from repeated use of the technology. If this effect is shown across different studies for multiple demographic groups, it may be possible to establish a more general effect. This characterizes a higher-order impact analysis.

5.6 Summary

In this chapter, a synthesis has been formed that combines several sub-models to form an overall shape of eudaimonic HCI. *Eudaimonic HCI* is a research concept that has emerged from a combination of psychological and technological factors. One's own studies and the hybrid analysis of previous contributions have enabled the development of a eudaimonic perspective on HCI that does not *lose itself* in the assimilation of goal fulfillment and eudaimonia but rather promotes the use of concrete interaction

principles and their structured analysis over several interaction moments. The definition of two development doctrines, support & simulation, indicates a necessary nuance that needs to be formed between the pragmatic character of technology as an enabler for self-actualization and the conscious use of design principles (e.g., game research) to create eudaimonic experience. However, it is then to be understood as more than a simulation. These forms are then measured in iterative steps to infer a general effect on eudaimonic well-being in the "sphere of life". This expresses the hierarchical characteristic of eudaimonic HCI. The following Chapter 6 contains the final points of a general discussion that have emerged across all chapters, so that the dissertation is finally concluded in Chapter 7.

6

Closing Discussion

The discussion concludes with addressing partial limitations and the extent to which the research questions defined in Chapter 1 could be addressed. In addition, various questions are raised that still need to be addressed for the discipline of eudaimonic HCI.

6.1 Common Understanding

The first research question addresses the overall possibility of defining a common foundation for eudaimonic well-being in HCI (*Is it possible to derive a common understanding of eudaimonic well-being in HCI?*). Critical perspectives, such as the opinion of Krontiris et al., that the definition of a "universal moral code" is problematic for a construct such as eudaimonic HCI, due to the widespread existence of mere subjective virtues [274], are certainly legitimate. Nevertheless, existing research contributions indicate that differentiating between hedonic and eudaimonic-oriented individuals points to different expectations and perceptions of a technology that result from the psychological construct of existing virtues that consistently manifest themselves for each well-being orientation [220, 223, 324, 357, 527, 561]. Furthermore, based on the insights from EII development, certain interaction qualities have emerged (the four C's of eudaimonic interaction design) that can be shown to be robust facets of eudaimonic HCI. For these facets, a fundamental consensus can be found based on the hybrid thematic analysis (Chapter 3.1) and the findings of one's own studies. These facets can be addressed by the two derived doctrines of eudaimonic HCI (doctrine of support and doctrine of simulation, see Chapter 5.3). Regarding the research question, there may be no *singular* doctrine of development, but the doctrine of support and simulation are both legitimate approaches to create

forms of eudaimonic experience. One limitation of the derivation of the two doctrines is the synergy of a mere actual state of the 137 articles in Chapter 3.1. Perhaps, in the future, alternative perspectives on novel types of eudaimonic interaction can be identified. In the claim to define a common understanding, the derivation of eudaimonic HCI is based on the previous collective understanding in order to ensure the comprehensibility of the facets and to avoid getting lost in the realm of speculation. In conclusion, a common understanding of the exact classification of eudaimonic HCI in the canon of well-being in HCI should be formulated. This dissertation was intended to build a systematic foundation for eudaimonic HCI. It might address facets that cannot be entirely characterized in a novelty, e.g., flow experience in HCI [150]. However, the aim was to understand and also limit the psychological concept of eudaimonic well-being in the spectrum of HCI in its form. Existing models are congruent and can also be meaningfully integrated into the canon of eudaimonic HCI. For example, eudaimonic HCI enables the classification of existing theoretical considerations such as "Slow Technology" [188] as an aesthetic or meaningful experience of technology (doctrine of simulation) or "Behavior Change Technologies" [289] as a possible interaction concept for learning self-actualizing practices in a more pragmatic interaction (doctrine of support). The results in Chapter 4.3 point to the opportunity to integrate AI into the interaction as a plausible supportive element. The perceived pragmatic value of skills-building technology is not affected by AI characteristics, as a general AI aversion could not be identified among eudaimonic-oriented individuals (see Chapter 4.3). Furthermore, eudaimonic HCI builds bridges to dichotomous considerations of pragmatic and hedonic qualities of technology [193], but it also confirms the results of other contributions [324] that in the idea of a pragmatic quality of technology, there can be an eudaimonic experience per se (see results in Chapter 4.3).

Finally, there are open questions that can only be analyzed by strengthening eudaimonic HCI as a research discipline and thus remain as further research: with regard to quantification, a line of argument was formed in the context of this dissertation that proposes general avoidance in accordance with similar positions [324, 461, 547]. Other HCI perspectives see this transfer into quantitative goals as less problematic [49, 262, 518, 550]. In this instance, eudaimonic HCI is positioned against the idea of exploiting action on the basis of Crisp's own Aristotelian interpretation [99], as already

explained in Chapter 3.1.5: “We speak of that which is worth pursuing for its own sake as more complete than that which is worth pursuing only for the sake of something else, [...]” [99, p. 10] (*Nicomachean Ethics*, Chapter 7).

6.2 Deductive Challenges

One of the research questions for this dissertation addresses the possibility of utilizing philosophical-psychological research to derive eudaimonic experience in HCI (*Can philosophical-psychological research be used to systematize eudaimonic experience in HCI?*). It must be stated that the deductive analysis was not sufficient to transform the philosophical-psychological hermeneutics of the concepts into the context of HCI. As one explains in Chapter 4.5, it had to be translated into an HCI-specific conceptual interpretation. In the sense of a boundary object, there is a certain freedom of interpretation [471]. The conceptual interpretation and translation work is often critically evaluated in HCI, e.g., cognitive load [272]. In particular, autonomy in its conception is addressed repeatedly [45, 74, 161]. The derivation of the four interaction principles is close to the psychological interpretation of Huta [220]. One of the more difficult elements in this transfer was the dimension of meaning, which was derived as the experience of causality. *Meaning* is one of the main components of eudaimonic or psychological well-being [416, 418] and can basically be found in every well-being scale. Huta, for example, formulates in her article on “Meaning as a Subjective Experience”: “But it is not just about self-consistency and having a clear place in a larger framework. It is about having a nature and a place that matters, that is important” [221, p. 3]. This form of social rootedness of an individual may not be insignificant in a modern working society being structured by the omnipresence of technology [34]. It is continuously confronted with the vortex of new technologies. In particular, the analysis at the interaction level with the help of the measurement model illustrated in Figure 5.9 is thus important. The frequent analysis of the experience with the technology and the analysis of general eudaimonic well-being in work must be therefore separately and hierarchically. Accordingly, it embodies a form of higher causality that perceives participation in the overall context. The question of whether technolog-

ical interaction can create this sense of causality is difficult. At the level of interaction, this relation can be observed - it may embody the direct eudaimonic experience in interaction with technology, but establishing its connection to a social sense of causality is a clear challenge that can only be determined through long-term studies.

6.3 Manifestation of two Doctrines

Initially, two doctrines were defined: the doctrine of support and the doctrine of simulation. There are also in-between positions: emotions may have a transformative stimulating effect on the individual in interaction with games, i.e., they are not *just nice to look at*. Vákevá et al. refer to certain emotions as "facets of transformation" [509, p. 3] such as emotionally complex, mixed-affect, or thought-provoking. These game situations are, in the narrower sense, not only a stimulation but are intended to have an effect on the user's higher sphere, to actually effect a change within them. In Chapter 3.1.5, Franca et al. have already explained that the eudaimonic experience with games is hoped to have an additional effect that contributes to the promotion of well-being [77, p. 2]. The line between support and simulation thus becomes blurred. The separation is mainly due to the engineering perspective that a sequential effecting of emotions through narrative interaction design embodies a different developmental doctrine per se than the approach of a pragmatic tool for self-actualization. This was characterized in detail in Chapter 5.

6.4 Analysis of Context

The third research question at the beginning of this dissertation was: *Which forms of eudaimonic behavior can be contextualized in HCI?*. The contexts emerged from the hybrid thematic analysis and were embodied in the corresponding prototypes. These contexts, identical to the two doctrines of eudaimonic HCI, are limited to the current state of HCI research. However, the following points can be determined: eudaimonic-specific behavior has been researched the least in comparison to other dimensions in HCI. In the results of the scoping review in Chapter 3.2, only one contribution to eudaimonic activities in smartphone use could be found [294]. This

is also indicated by the lack of a variety of measuring instruments and conceptual models to map these activities in HCI. Finally, the analysis of the context also partially concerns the importance of demographic proliferation when analyzing technological impacts on eudaimonic well-being. This was discussed in detail in Chapter 5, i.e., learning styles [553] and cultural differences [496] should be considered when analyzing the impact on eudaimonic well-being, because these contexts may have an influence on the evaluation.

6.5 Modeling Eudaimonic Experience

The findings indicate that the construct of excellence can be conceptualized as a state of concentration in interaction with technology. This association is further substantiated by the literature study, which supports the aforementioned perspective on excellence [102, 219, 360, 362]. The derivation of causality was discussed in detail in Chapter 6.2. Competence and consciousness, which were interpreted as motivators of interaction in the interpretation of Tuch and Hornbæk [502], form the two forms of increasing a eudaimonic experience in its perception. Competence, in the sense of personal growth, aspiration, curiosity, and enjoyable learning, has been identified as an essential component of eudaimonic interaction (see results in Chapter 4.2). Qualities such as deep involvement and immersion have emerged in consequence of the analysis concerning the experience of eudaimonic-oriented individuals and AI (see also Chapter 4.2). Nevertheless, it has been manifested that the acceptance level of causality and congruence should not be forgotten. These gravitational forces are to be considered because their level contributes equally significantly to a eudaimonic experience (see results of Chapter 4.3 and Chapter 4.5). In Chapter 4.2.3, it has already been discussed that many eudaimonic-oriented individuals also appreciate the pragmatic quality of technology [324]. This underlines the gravitational model of eudaimonic HCI. There may be technology that, by ensuring causality and congruence, can be meaningfully integrated into an individual's action process. The meaning of this technology is then merely that of a *tool* [325]. Its perceptible quality as eudaimonic technology per se requires the enhancement of the two further principles of consciousness and competence. Proactivity as a form of light feedback

has been identified as a meaningful component of fostering conscious orchestration of given information (see Chapter 4.4). Thus, it can be labeled as a (positive) priming effect [8], which is caused by the system's proactivity.

6.6 Transferring Interaction to the Sphere of Life

The final research question addresses the transfer from eudaimonic experience to eudaimonic functioning (*how can eudaimonic experience be systematically measured regarding eudaimonic functioning in HCI?*). In the course of the second study on eudaimonia and AI, it was found that basic psychological needs are addressed in a higher order (autonomy and competence perceptions in life). A concrete measurement instrument for eudaimonic functioning in HCI could not be found (see results of scoping review in Chapter 3.2). Only a small proportion of the papers included in the scoping review combine an experience of eudaimonic functioning through a long-term study design, possibly also through the absence of these instruments and a collective concept. First hierarchical measurement analyses can already be determined with regard to basic psychological needs [69, 235]. Regarding the question of the far-reaching effect of eudaimonic experience in HCI, the discussion of eudaimonic game experience and its influence on eudaimonic functioning will be shown below. The concept of the simulation doctrine of eudaimonic HCI has been strengthened as a result of this discussion. The idea of eudaimonic experience in games has been meandering through the playful approach in HCI for quite some time, to reference just a few examples [91, 92, 111, 112, 174, 267, 382, 443, 447]. The strength of the transfer of games to eudaimonic functioning is unclear. Franca et al. specifically put forward the idea that a eudaimonic experience with games should produce a lasting effect [77]. Waterman, on the other hand, argues in the context of maldaimonia in games that these forms of eudaimonic experience carry only symbolic power [534]. After all, the idea of maldaimonia is one that involves killing and destroying environments [444]. This argument reinforces the necessity of a clear separation between the doctrines. The "half-real" perspective of Seaborn and Iseya indicates that the distinction between real and game experiences is not necessary and that we as individuals are constantly on a continuum [444]. This may also be in line with Polanyi [379] and Paton [365] in the sense of the general

existence of subjective realities and Paton's idea of mosaic personalities, that reality and fiction are not always separable. The position of Rigby and Ryan should be remembered, that a person's involvement can be another important indicator of the effect on eudaimonic well-being [391]. In this regard, one can also consider the empirical results that, for example, players connect their in-game experiences with real-life experiences [227] or participants can perceive a change in some way after an artistic experience with games [58]. However, these transformation effects have also been negated [539]. Schrier, on the other hand, clearly positions herself in favor of a possible transfer of games to one's own behavior and way of thinking [441]. The discussion can also be taken to the extreme that Rigby and Ryan suspect a potential overuse of technology if, in the real world, i.e., outside of virtual environments, eudaimonic experience is compensated for by such technologies and media consumption [391]. According to the need density hypothesis of Rigby and Ryan [392], the increased addictive need for games can be understood in the context of an increased lack of basic psychological needs in the real world. The validity of this theory is supported by the findings of Shen et al. [454] that the fulfillment of fundamental needs in daily life leads to a reduction in internet usage, as the need for compensation for lack of satisfaction is reduced. This might at least suggest the existence of short-term stimuli as a kind of substitute for longer-term effects on eudaimonic well-being.

6.7 The Causality Paradox

Finally, a paradox will be introduced. It has been shown that users can tend to claim a causality of their own that they knowingly do not possess. In their work on the behavior of users with regard to artificial text generation, the authors show that although users are aware of the lack of ownership of an AI-generated text, they still declare authorship for it [133]. How can this be contextualized with the eudaimonic level of causality interaction? The effects on variables in the sphere of life must always be evaluated additionally (see the model in Figure 5.9). Hence, the aggregated experience must be measured in this procedural pattern of thought to determine whether the transition to general eudaimonic well-being is plausible. Furthermore, the results of Draxler et al. confirm the model that

causality is an important component that must be embedded in the canon of human-centered design approaches. The authors state in their studies [133, p. 26]: “Human-centered design for AI writing tools should consider (perceived) authorship as a design dimension”. Thus, the perception of one’s own contribution is confirmed again.

To conclude, eudaimonic HCI in its conception forms a common ground for all researchers focusing on eudaimonia in HCI: the division into two doctrines, the four C’s of interaction, and a clear understanding of how the effects on eudaimonic well-being are to be measured.

6.8 Closing Notes

The discussion will be finalized in short follow-up sections entitled *closing notes*. These will mainly consist of future research areas and personal perspectives, particularly on the systematics of eudaimonia, education, and AI, as well as social eudaimonic well-being in HCI.

6.8.1 Eudaimonic HCI and Education

In general, AI should support people in their personal growth, despite advanced automation [340], the simplicity doctrine [433], or the shift of practical judgment tasks to AI [139]. The majority of applications of AI in the study of eudaimonic-oriented individuals are in the field of education [244]. AI influences our learning processes [347], thus their coexistence is a novel phenomenon that needs a clear focus in the context of HCI and eudaimonic well-being. Young people benefit in their development from increased self-worth perceptions by addressing their eudaimonic well-being [167]. The use of the EII is a useful method to evaluate the feelings of increasing technologization in the education sector. If one follows the perspectives of Robbins [396] and Habermas [547], then an increasing transfer of decisions to technology, which may be connected to a decreasing sense of causality of one’s own actions, is a problem for young people in particular to grasp their own causality in the big picture. What does this young person contribute when their thought processes are not challenged? The early integration of AI technology in educational settings can result in a variety of outcomes, depending on its application. For instance, it can serve as a substitute for

learning processes, such as “AI, write my homework,” or function as an assistive tool for correcting expression errors in a foreign language, like “AI, show me my expression errors.” A compelling argument can be made for the emphasis on personal growth-oriented AI design (learning-friendly AIs), which fosters intrinsic motivation, moments of concentration, and, most notably, cognitive load. There is an indirect appeal to promote student-centered design approaches that move away from the material productivity of an economic dogma and focus on strengthening these young people. In the third study on “LaLaMoSuLe”, AI has at least established itself as a supportive element. The use of AI in the education sector is on the rise [27, 53, 328, 472], thus the need to consider the impact on eudamonic well-being in the integration strategies is considered. However, current surveys also show unwanted consequences of a strategy of replacing humans with AI through the fading of long-term effects [552], a lack of education of autotelic motivation [236], and the continued need for teacher integration as a motivator [493].
One should advocate that AI-empowered systems promote an interactive relationship with the user, rather than minimizing their thought processes and promoting passivity [210]. The idea of proactivity from Chapter 4.4 ties in with this way of thinking.

6.8.2 Social Eudaimonic Well-Being in HCI

In the remarks by Rigby & Ryan, one finds an important comment on the current quality of use of social media [391, p. 37]: “Thus, while such technologies hold the promise of allowing for more immediate and accessible communication between people, it is possible these social networks often become an unhealthy substitute for the authentic satisfaction of needs that are associated with eudaimonic living.” The effects of social media on eudaimonic well-being are characterized by different findings [85, 170, 286, 559]. Thus, social interactions play a special role in the analysis of technology and its impact on eudaimonic well-being. For example, Zhang et al. conclude that self-esteem is an important factor for a positive or negative effect on eudaimonic well-being [559], confirming the dimension of self-acceptance as a variable of eudaimonic functioning [416]. Relatedness or positive social relationships with others have not been considered as components of eudaimonic well-being [416, 418] in its diversity. This missing compo-

nent should not be neglected. The transformation of our communication through the channels of social technologies raises questions about how this affects the eudaimonic feelings of connectedness in society. Relatedness as an umbrella term encompasses this dimension, which can also be found in the characterization of important factors for measuring eudaimonic dimensions in populations of the OECD [1].
The significant shift of our social interactions into digital spaces makes the analysis of their effects on eudaimonic well-being important. As an example, the conceptual model "Technology for Situated and Emergent Play" [16] should be mentioned. Within this model, the development of social connections, among other things, can be found. The corresponding examples show that extraordinary interaction designs of gameplay can create positive experiences with technology. These interaction designs thus contribute to eudaimonic well-being. The bridging concept illustrates that a variety of qualities of the eudaimonic experience can be achieved, as in the game "True Colors" [107]. The playful interaction medium *social wearable* serves to establish and deepen social interactions as the authors state [16]. This approach could define novel forms of social interaction in the future, which could prove to be a real enabler for effects on social eudaimonic well-being.

7

General Conclusion and Future Work

This chapter concludes the dissertation. The concept of eudaimonic interaction is placed alongside a supposed hedonic doctrine of development as a principle of comprehensive self-actualization, divided into the ideas of support and simulation. The proximity to philosophical-psychological research requires a controlled measurement methodology that understands several spheres of interaction and only makes both attitude change and influence on general eudaimonic functioning comprehensible by separating at least two measurement instances. The research questions have already been discussed in detail in the previous Chapter 6, but they should be addressed again in conclusion to complete this dissertation.

7.1 Addressing the Research Questions

Regarding the first research question (RQ1), *Is it possible to derive a common understanding of eudaimonic well-being in HCI?*, the hybrid thematic analysis [238] showed that by unifying both analysis procedures (inductive and deductive), an aggregation of certain facets can be achieved (see Figure 3.3). The inductive approach was used to synthesize the preexisting understandings of eudaimonia in HCI, while a deductive approach was employed to align these conceptualizations with existing philosophical and psychological research. The practical implications derived from all conducted studies serve as the foundation for eudaimonic HCI conceptualized in Chapter 5, which aims to determine design strategies and doctrines of development, i.e., aesthetic or meaningful interaction (1) or pragmatic self-actualization (2). The distinction is based on critical perspectives that game simulations and media consumption often only represent a *surrogate for authentic eudaimonic experience.* This modesty has been articulated

through the formation of two distinct doctrines.
The second research question addresses the general usability of philosophical-psychological research to model a eudaimonic experience in HCI. The use of the HEMA scale has shown the differentiated perception of certain interaction variables in three selected study approaches of this dissertation [239, 244, 245]. With one's own measurement tool for measuring a eudaimonic interaction experience (causality, consciousness, congruence, and competence), the measurement methodology of eudaimonic well-being in HCI was extended. Besides one's own contributions, the literature reviews showed that differentiating and addressing certain eudaimonic orientations and the associated experience of these can be captured. Thus, one wants to support the second research question to the extent that the differentiation can at least be recognized between other well-being orientations. Furthermore, certain psychological experiences crystallize in the interaction, leading in a way to a eudaimonic experience, and this in different dynamics. One wants to take a position on the possible transformative capacity of hedonic-oriented individuals in Chapter 7.2, the future work.
The third research question, "Which forms of eudaimonic behavior can be contextualized in HCI?", was addressed by all forms of research methodology, whether through thematic analysis [238] and all forms of mixed method approaches [241, 243, 244, 245]. They form the *context* of the macro model (see Figure 5.8). They are derived from the synthesis of existing work, but this does not mean that they are the ultimate in all possible contexts. This has already been formulated as a limitation, however, it also opens up the playful search for further possible contexts.
The fourth research question (*How can a eudaimonic experience be modeled and implemented in HCI?*) has a hermeneutics of the technical translation of well-being, which means the transfer of theoretical considerations into more concrete strategies. They are addressed by the definition of the doctrines, the 4 C's of Eudaimonic Interaction Design, and the 3-part structural model for measuring the effects of the experience on functioning (pre-test analysis, experience analysis, and impact analysis). The engineering examples in Chapter 4 also serve as architectural references for implementation intentions. In addition, implementation strategies have been formulated for each doctrine, which are based on the findings of one's own studies and examples from gaming research.

Finally, the fifth research question addresses how the effect of technological experience is transferred to functioning (*How can eudaimonic experience be systematically measured regarding eudaimonic functioning in HCI?*). A three-part chain of contributions to this question was formed: Firstly, a scoping review of all measurement methods was conducted to classify previous work and understand measurement applications [239]. Secondly, this was followed by the development of one's own concept to address the lack of addressing the measurement of interactions across all four dimensions of eudaimonic behavior [246], and, thirdly, as the transfer of this concept to the measurement model in Chapter 5.5 to raise awareness of the hierarchical measurement approach that is necessary.
Eudaimonic well-being is characterized as a long-term perspective of well-being; i.e., it is intended to be contrary to hedonistic or extrinsic concepts of well-being. Its form is reflected in positive effects on physical health, mental health stability, and even the reduction of biological risk factors. It appears to be related to the subjective vitality of the individual and thus becomes an important indicator for the general well-being analysis of future technology-driven societies. The calls of the OECD, IEEE, and the outlined tendencies across HCI researchers underline this trend. "New technologies change the meanings of things." [349, p. 130]. Hopefully, future research on eudaimonic well-being in HCI will build on this work to enable more consistent and coordinated research in this area. Hence, some directions for future work in the direction of eudaimonic well-being and technology are recommended in the following.

7.2 Future Work

In principle, due to the societal importance of eudaimonic well-being, which was discussed in detail in the introduction, any technology that claims to produce eudaimonic experience should be investigated in every demographic population. Given the limitations of one's own studies [240, 244, 245], there is an underrepresentation of certain populations, hence, there is the possibility and necessity for further research regarding demographic variables. Despite two examples of engineering implementation of a eudaimonic interaction, further development of eudaimonic prototypes based on the theoretical synthesis in Chapter 5, in particular, is

therefore explicitly encouraged.
This applies above all to the development of social technology that takes into account eudaimonic principles of interaction. As already mentioned as a limitation of the discussion, the absence of the social dimension of eudaimonic well-being has been noted. At this point, reference is again made to Janicke-Bowles et al. [233], who interpret digital flourishing as positive perceptions of mediated social interactions, so the facet of social interactions cannot be excluded in the form of flourishing. This paradigm must be reflected in future designs, whether it is considered in a simulated game environment or a pragmatic means of communicating with others, in the canon of eudaimonic HCI.
Another open research project is the technical detection of eudaimonic orientations based on object preferences or social network structures. The former was addressed with the help of an exemplary recommender system solution, but its limitation is, first and foremost, the cold start problem [242]. It requires the profiling of a user group to reference similarity to other users based on their behavioral attributes. If certain political interests can be predicted by indicating interests in social networks, this may also apply to eudaimonic lifestyles. At the very least, object preferences can be achieved by corresponding object similarities in a certain form of hedonic or eudaimonic categorization [332]. However, the problem is also decontextualization. A eudaimonic-oriented individual may also consume hedonic movies, so a consumption preference cannot always be equated with personality. These questions are to be addressed in the future, whether with the consideration of the context and continued behavioral research, or these forms can be considered from an engineering perspective.

One final open research question that should be addressed is the ability of technology to influence individuals' eudaimonic orientations. For example, can eudaimonic virtues be conditioned by technology?

Allport [13] cites a perspective by Paton from his book "Human Behavior" on the nature of personality, i.e., it is "the progressive synthesis of the mosaic of experiences". [365, p. 454]. Along this paradigm, the regular occurrence of eudaimonic experiences in the life of the individual is an opportunity to condition a synthesis of his or her personality to the essence of eudaimonia. This gives computer science a socioethical dimension

using Allport's interpretation [13, p. 443]. Could the normative idea of eudaimonia possibly be applied as a concept of conditioning [537], so that technology can function as an accumulator of eudaimonic experiences that is capable of shaping a personality? The aim of the present dissertation is to address future research questions that are devoted precisely to this transfer, which is moving away from any supposedly profane question of ease of use. The aim is to internalize the doctrine of engineering for people *to do well and thus be well.*

A

Extended Results

A.1 Study A: Hybrid Thematic Analysis

All results of the inductive analysis are available on a Open Science Framework (OSF) repository:
https://osf.io/mbr3a/?view_only=04a3841a7f794a889b527769ba85c95b.

Search Strategy and Filtering

First Step

In total, 159 articles with a relevant content type were identified.

1. Initial exclusion criteria: no indexes, introductions, and prefactories, chapters, and books.
2. (Research) articles, opinions, columns, posters, extended abstracts, and work-in-progress papers were included.
3. No time frame restriction was selected.
4. One article [140] was found using both search operators and was added to the eudai* hit list.
5. For the search operator eudae*: a total of 16 articles were identified in the first step with 8 articles, 6 research articles (minus the duplicate of both lists [140]), one opinion article, and one column.

Second Step

1. Three non-English articles were removed [105, 327, 405].

2. Seven articles were removed because the term was listed under the search operators, but no occurrences in the body text were found (summarized in Figure 3.1 under “false positives”).

3. For eudai* there were two false positives [184, 489].

4. For the eudae* operator there were five false positives [159, 268, 339, 359, 387].

5. Only results that had at least a direct or indirect textual explanation of eudaimonia were considered. However, an acceptable condition is the mere mentioning of a concept, synonym, or a given statement that somehow indicates a certain understanding of the word itself.

Further exclusion

A total of 28 articles that did not meet this minimum criterion were removed. For example, from five workshop-related contributions, the use of eudaimonia or eudaimonic were found but no interpretation of the term [31, 134, 169, 431, 524]. Other candidates for exclusion were contributions with only mentions in author details [205, 301], a reference to a software security technique called “Eudaemon” [257, 490] or a single hit in the references [504].

Final Corpus

The final coding and theme development took place with the help of a Miro Board[1]. Only certain aspects such as “value” [345] or “wittiness” [274] have been more difficult to assign.

Unique Interpretations of Eudaimonia in HCI

Some interpretations of eudaimonic well-being have only been identified once.

1. **Prosperity**: One contribution equating eudaimonia with “prosperity” [24, p. 63] can be found.

[1] https://miro.com/

2. **The Thriving Life**: Wilson et al. refer to eudaimonia as "the thriving life" [544, p. 286].

3. **Balance between deficiency and opulence of one's personality**: Robbins et al. describe finding the balance between deficiency and opulence of one's personality characteristics as activity towards eudaimonia [396].

4. **A state of well-being**: Another singular definition of eudaimonia is that of a "state of well-being, adaptation, self-acceptance, and positivity toward the others and toward life in general" [499, p. 2]. These would help the individual to develop a "positive, warm, self-confident, purposeful, open yet challenging frame of mind" [499, p. 2].

5. **A combination of activities**: Somanath et al. define eudaimonic happiness as a combination of activities that lead to high life satisfaction, high positive affect, and low negative effect [467].

6. **Hierarchical model**: The most detailed conceptualization of eudaimonia was presented by Ardagh [21]. In his article on the significance of public education in computer usage, Ardagh attempts to conceptualize a "happy life", which he links synonymously with the "Greek" concept of eudaimonia [21]. He illustrates a hierarchical model for eudaimonia, which is divided into two levels, the level of "specific criteria or marks of happiness" [21, p. 82], and operational needs: personal, social, and physical. Within the first level, Ardagh illustrates several critiques such as self-sufficiency, autonomy, the ultimate goods, and leisure-relatedness.

A.2 Study B: Scoping Review

All supplementary material has been uploaded on OSF:
https://osf.io/td2sx/?view_only=c26ce86c89d84ad488c1b0ceff308acb. Furthermore, a scoping review protocol has been crafted and uploaded.

Reference	Article type	Domain	Research Aim	Conceptualization	Measurement Method
[51]	Research Article	Education (Collaborative learning)	Measurement of eudaimonic learning outcomes through design artifacts in collaborative learning among pupils	Derivation of the items through several preliminary works, e.g. [248] and [521]	Four custom items regarding a sense of accomplishment, self-confidence, curiosity, and interest generated during and after the activity (4-point Likert scale)
[241]	Research Article	Not Specified	Comparison of two web prototypes for the formulation of "eudaimonic user experience (EUX)" principles	Reference to several theoretical considerations ([102, 417, 522])	Custom items for causality perception, deep involvement, growth perception, and self-determination, no indication of scale points
[445]	Research Article	Games	Effects of maldaimonic gaming experiences on long-term eudaimonic well-being, but also measurement of gaming experience as related to eudaimonic orientation in activities	Extensive theoretical background on eudaimonia, including work by [118, 224, 532]	Japanese version of the HEMA Scale and an additional item to measure a long-term meaning potential for the player ("If you consider your life one year from now, how important will you find this experience?")
[386]	Research Article	Social Technology; Work Technology	Impact of the use and frequency of video-conferencing on eudaimonic well-being	No explicit explanation of an understanding of eudaimonia	5-item measure of life satisfaction ([129])
[559]	Research Article	Social Technology	Measuring the influence of social media on the eudaimonic approach of well-being (psychological well-being)	Reference to psychological well-being as the concept of eudaimonic well-being ([420])	Chinese version of PWBS ([420])
[550]	Research Article	Not Specified	Development of the Eudaimonic Technology Experience Scale	Detailed theoretical background, explicit derivation by [226] and the elements growth, authenticity, meaning, and excellence	2 subscales (eudaimonic goals and self-knowledge), 3 items each (five-point Likert scale)
[429]	Research Article	Work Technology	Analysis of the effect of an email application extension to the definition of focus time in the work context	Recourse to eudaimonic well-being and workplace engagement theory (e.g. [7] and [65])	Mixture of several scales: Items from the Utrecht Job Engagement Scale ([437]), Work and Meaning Inventory ([474]), and Job-related Affective Wellbeing scale ([512])
[508]	Research Article	Games	Investigation of the relationship between learning outcomes, gameplay motives (eudaimonic), and well-being outcomes of gaming	Theoretical background available (e.g. [411] and mention of Self-Determination Theory)	Motives for Autonomous Player (MAP) inventory (four motives: immersive agency, competitive mastery, social, and utility) (reference to a submitted manuscript by Vahlo and Tuuri)
[68]	Research Article	Smartphone Technology	Influence of smartphone use on eudaimonic well-being ('worthwhileness') in certain contexts	Reference to a distinction between hedonic- and eudaimonic-oriented individuals (e.g. [48])	Single-item (10-point Likert Scale) ([68])

[541]	Research Article	Smart Home Technology	Effects of perceived friendship in the context of intelligent voice assistants, eudaimonic motives, and eudaimonic experience	Refer to the paper by Seaborn et al. [446] and differentiate between eudaimonic goal and eudaimonic user motives	4 adapted items of HEMA scale ([220]) and subscales for sense value, implication, awe, inspiration, transcendence, and carefreeness (with reference to [224])
[434]	Research Article	Mental Health	Investigation of the influence on psychological well-being (associated with the idea of eudaimonia) by an automated therapy application “Happiness Mom”	Reference to the psychological well-being variables of [416], i.e., embodiment of the idea of eudaimonic well-being	Ryff’s Psychological Well-being Scale (PWBS) (42 items, 6 dimensions, 7-point Likert scale)
[269]	Research Article	Smartphone Technology	Identification of a relationship between problematic smartphone use and well-being motives	Extensive theoretical background on eudaimonia with mentions of [118, 220, 532]	HEMA-R Scale (revised) ([220])
[286]	Research Article	Mobile Technology	Investigation of the relationship between smartphone screen time, flow perceptions, and also in particular eudaimonic well-being	Theoretical background with reference to three distinct components of well-being (evaluative, eudaimonic, and hedonic) (e.g. [420])	Two items of [420] (7-point Likert scale)
[282]	Research Article	Virtual Technology	Analysis of superhero abilities and their stimulation of eudaimonic orientations in interaction	Existence of hedonic and eudaimonic orientations ([224])	HEMA scale ([224])
[12]	Research Article	Virtual Technology	Prolonging the effects on eudaimonic well-being by using virtual reality technology of vacation experiences in a lab-based experiment over four time points	Reference to hedonic and eudaimonic separation ([482, 507])	6 items on eudaimonic well-being of a scale of [482]
[367]	Research Article	Social Technology	Analysis of the degree of interactivity and social interactions in virtual communities for medical tourism	References in the literature review section on eudaimonic well-being, e.g. [321]	Adapted item version of a well-being scale by [215]: “purposeful and meaningful life in the V-MTC”, 7-point Likert scale
[555]	Research Article	Education	Evaluation of three eudaimonic use concerns (perceived utility, curiosity, and superior influence) as stimuli on the use of a virtual learning environment	Theoretical background available (e. g. [477] and [118]); S-O-R framework ([323])	3 different scales for perceived utility, curiosity, and superior influence ([310, 517, 559])
[525]	Research Article	Virtual Technology	Analysis of long-term effects on eudaimonic well-being through virtual technology called “Mood Worlds”	Reference to work by [121]; Understanding of eudaimonic technology to promote self-growth	Oxford Happiness Questionnaire ([204])
[455]	Research Article	E-Commerce	Influence of perceived connectivity, personalization, controllability, and responsiveness on eudaimonic well-being in the course of online shopping	Extensive related work ([374, 411, 532])	Ten custom items for eudaimonic well-being (7-point Likert Scale) ([455])

[390]	Research Article	Smartphone Technology	Analysis of smartphone applications with regard to hedonic, pragmatic, and eudaimonic experiences	Extensive theoretical background (e.g. [224, 303, 324])	HEMA-Scale ([224])
[208]	Research Article	Care Technology	Differences in well-being orientations regarding the use of acute care technologies	Theoretical background available (e.g. [224, 324]), orientation towards the methodology of [324]	HEEMA Scale (alternative version of HEMA ([224]))
[366]	Research Article	Hospitality	The research aim was to show how IoT in hotels can stimulate the five senses and have an impact on guests' eudaimonic well-being	Reference to [411] and the distinction between hedonic and eudaimonic well-being orientation	Questionnaire for Eudaimonic Well-Being (QEWB) (21 items, 5-point Likert scale) ([535])
[297]	Research Article	Internet Technology	Influence of Internet use on the hedonic and eudaimonic well being of Chinese older adults	Theoretical considerations of [477] and [423]	Single item ("the participant's confidence towards him/herself in the future") (5-point Likert Scale)
[404]	Research Article	Mental Health	Influence of an online brain training on well-being (hedonic and eudaimonic aspects considered)	Derivation from the scale directly ([166]), no related work to eudaimonia explicitly	COMPAS-W measure ([166]), e.g. item for mastery (self-confidence and perceived control over one's environment)
[253]	Research Article	Music Technology	Differentiation of motives when using two different prototypes to augment a piano keyboard	Existence of hedonic and eudaimonic orientations ([224])	HEMA scale ([224])
[88]	Research Article	Mental Health	Measuring the influence of a mindful practice app "Calm" on hedonic and eudaimonic well-being of users	No theoretical interpretation of eudaimonia, understood more as a state-level, but which recognizes a distinction between hedonic and eudaimonic well-being	Short Warwick-Edinburgh Mental Well-Being Scale (SWEMWBS)
[294]	Research Article	Mobile Technology	Analysis of differences between hedonic and eudaimonic behavior when using smartphones	Reference to theoretical work by [357] and [403]	14 items for 3 dimensions (sociability, information seeking, and utilities) (5-point Likert scale)
[466]	Research Article	Games	Influence of passionate video games on the sympathetic nervous system and eudaimonic (mental) well-being	Comprehensive theoretical background with references to [411] and [477]	11 items (5 items for social and 6 items for psychological well being) of the Health Continuum-Short Form (MHC-SF) ([260, 284])
[162]	Research Article	Automotive Technology	Analysis of eudaimonic experience in manual, semi-automated, and fully automated constellation driving in a virtual environment (special issue publication of the results of [163] below)	Existence of hedonic and eudaimonic orientations ([224]), modification to investigate eudaimonic experience (in accordance with [324]), not orientation	(Modified) HEMA scale ([224])

[446]	Research Article	Games	Investigation in the context of an experiment of a game for people with reduced mobility	Extensively reported on related work (e.g. [220, 224, 414, 416, 532])	HEMA Scale ([224]), Flourishing Scale (FS) ([128])
[303]	Research Article	Mobile Technology	Investigation of experience of meaningfulness as the key component of the eudaimonic conception of well-being	References to the theoretical background, especially to [118]	Single-item: "How much do you feel like you have spent your time on something meaningful?" (7-point Likert scale)
[163]	Research Article	Automotive Technology	Analysis of eudaimonic experience in manual, semi-automated, and fully automated constellation driving in a virtual environment	Existence of hedonic and eudaimonic orientations ([224]), modification to investigate eudaimonic experience (in accordance with [324]), not orientation	(Modified) HEMA scale ([224])
[354]	Research Article	Recommender Systems	Analysis of certain preferences of life orientations (eudaimonia, engagement, hedonia) in leisure activity recommender systems	Orientations to Happiness (OTH) ([380])	Orientations to Happiness measure (6 items each, 5-point Likert scale) ([374]); an item for meaning perception ([180])
[329]	Research Article	Mental Health	Measuring increasing effect on eudaimonic well-being through self-managed genuine smiling over an app	Assumption of long-term happiness and overall feeling as "eudaemonic well-being"	Single-item scale: "Do you feel happy?" (11-point Likert scale)
[483]	Research Article	Not Specified	Development of a scale to measure an aesthetic experience in interaction with technology characterized as the eudaimonic motivation of use	Extensive theoretical work available in the paper (e.g. [7, 416, 420])	9 items to capture the three experience dimensions of eudaimonic motivation in interaction with technology (sense of self-expansion, meaningfulness, and active discovery) ([483])
[212]	Research Article	Mental Health	Investigation of "Echo", a technology for reflecting on one's own life, and its influence on eudaimonic well-being after use	Mentions of works on eudaimonia by e.g. [118], but also use of psychological well-being variables as indicators of eudaimonic well-being ([420])	Ryff's Scales of Psychological Well-Being (54-item version, [420])
[443]	Research Article	Games	Investigation in the context of an experiment of a game for people with reduced mobility (first study, the full study above ([446])	Related work is outlined (e.g. [118, 422, 532])	HEMA Scale ([224])
[324]	Research Article	Not Specified	Perceptions of hedonic and eudaimonic experience and correlations with other interaction qualities in interaction with technology	Modification of HEMA scale items to investigate eudaimonic experience not orientation (assuming hedonic and eudaimonic experiences)	(Modified) HEMA scale ([224])
[170]	Research Article	Social Technology	Measuring the impact on eudaimonic well-being of Facebook use in the context of social comparison needs	Reference to Waterman's definition of eudaimonia [535, p. 41]	Questionnaire for Eudaimonic Well-Being (QEWB) (21 items, 5-point Likert scale)

[85]	Research Article	Social Technology	Investigation of social network services and their influence on psychological well-being which is understood as a basic concept of eudaimonic well-being	Reference to [416] and the connection of psychological well-being and eudaimonic well-being	Rosenberg Self-Esteem Scale ([400])
[278]	Research Report	Work Technology	Analysis of interaction frequencies in emails and its impact on aspects of eudaimonic well-being	Importance of considering different well-being orientations with reference to some sources (e.g. [52, 416])	Different measurement methods (day-level and week-level): Subscale for environmental mastery ([420]), meaning in life questionnaire(s) ([279, 474]), 2 items of the social connectedness scale ([292])

Table A.1: Included studies on eudaimonic-well-being aspects in interaction with technology

A.3 Study 1

A.3.1 Appreciation of Variety

Collection of comments on the positive perception of the variety of perspectives.

1. Participant no. 4: "*I really appreciated the variety of sentences selected and the possibility of giving my point of view too. I think it's something that makes you think*"
2. Participant no. 21: "*I really liked that many quotes were presented, so we could tune in to the topic and learn from those who figured it out in their way*"
3. Participant no. 17: "*I found it interesting to read all of the different ideas that where being put forward*"
4. Participant no. 6: "*I really enjoyed the simplicity of the visuals and how the screen was organized to provide all different perspectives while not being visually overwhelming*"
5. Participant no. 3: "*I really appreciated the variety of sentences selected and the possibility of giving my point of view too*"

A.3.2 Customization Options

1. Participant no. 18: "*felt that the overall 'atmosphere' was a little too unserious and overly 'spiritualistic' for my tastes, which mainly regards the particular way the content was presented (e.g. floaty animated UI, walking android in the backdrop), and not the content itself*"
2. Participant no. 13: "*I found the theme (the color mostly) set a particular mood, about which I wasn't sure how to feel. It made me a little pensive, but in a "gloomy" sense (similar to how rainy weather may trigger a particular kind of atmosphere). Overall, I found it a bit distracting and would prefer the option to choose a theme*"
3. Participant no. 12: "*ambient music should be used to enhance the aspect of focus*"

4. Participant no. 15: "*For improvements, I think having some fitting ambience music in the background would further enhance the experience*"

5. Participant no. 13 (again, referring to a selection of topics): "*At the outset, I would have preferred an option that listed how many topics there were from which to choose - I did want to explore others, [...]*"

A.3.3 Variety of Interactions

1. Participant no. 10: "*maybe you should find a way for the user to be able to 'paint' the concept without actually having to draw,- maybe write a description? explain their feelings regarding the concept? [...]*".

2. Participant no. 21: "*However, I missed having to write more on the topic in my own words. Making a quote makes you want to think philosophically and therefore you miss the important part of self-reflection. Furthermore the artistic part is very controversial in my opinion because it's the kind of thing that only works for some people*".

A.3.4 Informative Feedback

1. Participant no. 19: "*And as for the project itself in general I would add a bit of an introduction, a really easy task to get me comfortable or something like that*".

2. Participant no. 4: "*I think It could be improved by adding questions. What I mean is, instead of just having the quotes, also having questions that make people reflect and think by themselves about the topic*".

3. Participant no. 1: "*I would probably add further explanation if I where you*".

A.4 Study 2

A.4.1 Demographic Data

Not all participants consented to release demographic information (n = 6), thus demographic data refers to all but them.

1. $\overline{x}$ (age of participants): 30.18.
2. Age range: 18-72.
3. 64.75% of participants were between 20 and 30 years old.
4. 50.51% of participants were female, 49.49% were male.
5. 62.73% of participants identified themselves as white, 60 participants (20.24%) as black, 20 participants (6.80%) as mixed, 15 as Asian (5.08%), and 12 participants as others (4.07%).
6. The countries of origin of the participants were as follows: Europe (56.27%), Africa (26.10%), America (12.20%), and Asia (2.71%).
7. A total of 171 participants stated that they were in part-time or full-time employment (57.97%). 47 participants (15.93%) stated that they were unemployed, not in paid employment, or would soon be starting a new job.
8. 77 participants indicated “Others” as their occupation (2.61%).
9. Finally, 37.63% of participants stated that they are students currently (n = 111).

A.4.2 AI Usage

1. OpenAI’s ChatGPT: n = 229
2. Google Services such as Gemini, Bard, or Translate: n = 16
3. Microsoft’s Copilot: n = 8
4. Amazon’s Alexa: n = 7
5. Grammalry: n = 4
6. AI-empowered Bing Services: n = 3
7. Github’s Copilot: n = 2
8. Adobe’s Firefly: n = 2
9. Invideo: n = 2

10. Individual mentions: run.ai (n = 1), alpha.bot (n = 1), Scite (n = 1), Leonardo (n = 1), Creative Fabrica (n = 1), Midjourney (n = 1), and Microsoft Azure (n = 1).

A.4.3 Cronbach's alpha

Structure: Cronbach's α, min, max

1. ETES EG values:
   Cronbachs Alpha: (0.7876635225215947, 0.742000, 0.826000)
2. ETES SK values:
   Cronbachs Alpha: (0.9250557921198438, 0.909000, 0.939000)
3. UMI AM values:
   Cronbachs Alpha: (0.8748928706313008, 0.848000, 0.898000)
4. UMI ER values:
   Cronbachs Alpha: (0.7597521232470874, 0.709000, 0.803000)
5. UMI InjR values:
   Cronbachs Alpha: (0.8955326593884378, 0.873000, 0.914000)
6. UMI IdenR values:
   Cronbachs Alpha: (0.820563504193008, 0.782000, 0.853000)
7. UMI InteR values:
   Cronbachs Alpha: (0.9346133884305695, 0.921000, 0.946000)
8. UMI IntrinR values:
   Cronbachs Alpha: (0.9260335388968817, 0.910000, 0.939000)
9. UES FA values:
   Cronbachs Alpha: (0.721125285876514, 0.662000, 0.772000)
10. UES PU values:
    Cronbachs Alpha: (0.6217497578748326, 0.541000, 0.690000)
11. UES AE values:
    Cronbachs Alpha: (0.7045503255016473, 0.642000, 0.758000)
12. UES RW values:
    Cronbachs Alpha: (0.7857828204082612, 0.740000, 0.825000)

13. TENS Set Interface Auto Support values:
    Cronbachs Alpha: (0.8190352443089367, 0.781000, 0.852000)
14. TENS Set Interface Auto Frustration values:
    Cronbachs Alpha: (0.7985809218611928, 0.756000, 0.835000)
15. TENS Set Interface Comp Support values:
    Cronbachs Alpha: (0.8951919454813193, 0.873000, 0.914000)
16. TENS Set Interface Comp Frustration values:
    Cronbachs Alpha: (0.894569851853666, 0.872000, 0.914000)
17. TENS Set Task Auto Support values:
    Cronbachs Alpha: (0.8788580109016175, 0.853000, 0.901000)
18. TENS Set Task Auto Frustration values:
    Cronbachs Alpha: (0.8712708196251688, 0.844000, 0.895000)
19. TENS Set Task Comp Support values:
    Cronbachs Alpha: (0.8910913098095709, 0.868000, 0.911000)
20. TENS Set Task Comp Frustration values:
    Cronbachs Alpha: (0.7925813060280342, 0.748000, 0.830000)
21. TENS Set Life Auto Support values:
    Cronbachs Alpha: (0.8863688540512998, 0.862000, 0.907000)
22. TENS Set Life Auto Frustration values:
    Cronbachs Alpha: (0.7589985032192663, 0.708000, 0.803000)
23. TENS Set Life Comp Support values:
    Cronbachs Alpha: (0.9254398954259044, 0.910000, 0.939000)
24. TENS Set Life Comp Frustration values:
    Cronbachs Alpha: (0.8724445040959834, 0.845000, 0.896000)

A.5 Study 3

A.5.1 Introduction Text for HEMA-R Scale

To what degree do you typically approach your activities with each of the following intentions, whether or not you actually achieve your aim?.

Scale A	Scale B	Pearson Coefficient	95%-C.I.
TENS-Task (Competence Support)	TENS-Life (Competence Support)	0.75***	[0.7-0.8]
ETES (Self-Knowledge)	UMI (Integrated)	0.74***	[0.68-0.78]
UES (Reward)	TENS-Task (Competence Support)	0.68**	[0.62-0.74]
TENS-Life (Autonomy Support)	TENS-Life (Competence Support)	0.67**	[0.6-0.73]
TENS-Task (Autonomy Support)	TENS-Task (Competence Support)	0.67**	[0.6-0.72]
UMI (Intrinsic)	UES (Reward)	0.63**	[0.55-0.69]
ETES (Self-Knowledge)	TENS-Life (Autonomy Support)	0.63**	[0.55-0.69]
UMI (Integrated)	TENS-Life (Autonomy Support)	0.62**	[0.55-0.69]
UMI (Identified)	TENS-Life (Competence Support)	0.62**	[0.55-0.69]
UES (Reward)	TENS-Life (Competence Support)	0.61**	[0.54-0.68]
UMI (Identified)	UES (Reward)	0.61**	[0.54-0.68]

Table A.2: Results of correlation analysis with a correlation of at least >50% (***p < 0.001)

(Sub-)Scale	Group A	Group B	Mean Diff.	Lower CI	Upper CI	*p*
TENS (Interface-Autonomy-Support)	Eudaimonia	Extrinsic	0.7417	0.1249	1.3584	.0136*
ETES (Self-Knowledge)	Eudaimonia	Extrinsic	2.1426	0.7016	3.5836	.0015**
ETES (Eudaimonic Goals)	Eudaimonia	Extrinsic	1.8075	0.453	3.1619	.0052**
ETES (Eudaimonic Goals)	Eudaimonia	Hedonia	-1.4488	-2.7564	-0.1413	.0257*
UMI (Integrated)	Eudaimonia	Extrinsic	1.1636	0.4594	1.8679	.0004**
UMI (Integrated)	Eudaimonia	Hedonia	-0.7241	-1.404	-0.0443	.0337*
UMI (Intrinsic)	Eudaimonic	Extrinsic	0.7477	0.0985	1.3968	.00193*
TENS (Task-Competence-Support)	Eudaimonia	Extrinsic	0.5955	0.0542	1.1369	.027*
UES (Focused Attention)	Eudaimonia	Extrinsic	0.4432	0.0441	0.8422	.0253*
TENS (Task-Competence-Frustration)	Eudaimonia	Hedonia	0.7988	0.3173	1.2802	.0003**
TENS (Task-Competence-Frustration)	Eudaimonia	Extrinsic	-0.723	-1.2218	-0.2243	.0021**
TENS (Life-Autonomy-Support)	Eudaimonia	Extrinsic	1.142	0.376	1.908	.0015**
TENS (Life-Autonomy-Frustration)	Eudaimonia	Hedonia	0.5929	0.1079	1.0779	.0119*
TENS (Life-Competence-Support)	Eudaimonia	Extrinsic	0.7965	0.1308	1.4621	.0142*
TENS (Life-Competence-Frustration)	Eudaimonia	Hedonia	0.5994	0.1587	1.04	.0043**
TENS (Life-Competence-Frustration)	Eudaimonia	Extrinsic	-0.4909	-0.9474	-0.0345	.0316*
TENS (Life-Autonomy-Support)	Hedonia	Extrinsic	0.5233	0.032	1.0146	.0337*
ETES (Self-Knowledge)	Hedonia	Extrinsic	1.0099	0.0856	1.9341	.0284*

Table A.3: Significant results of the post hoc Tukey's HSD tests (*=p<0.05,**=p<0.01). In all but the last two cases, significant differences were found between the group of eudaimonia-oriented individuals and the other groups.

A.5.2 Demographics

Some participants did not tell us their gender, but their age, so the denominator of the proportions is always to be understood in relation to the frequency of statements for each attribute.

1. Among the participants who shared their gender with us, there were 46.36% female participants and 53.63% male participants.
2. Age range from 18 to 72 ($\overline{x}$ (average age): 32.88).
3. In total, 220 participants shared their nationality with us: we collected results from 48.18% European participants, 31.82% of the participants were Africans, 13.18% of participants were Americans, 5% were Asians and 1.82% were Oceanians (New Zealand and Australia).
4. 33.16% of participants stated that they currently have student status.

A.5.3 Eudaimonic-oriented Individuals and AI Use

A.5.4 Cronbach's alpha

Structure: Cronbach's α, min, max

1. ETES EG values:
   Cronbachs Alpha: (0.8546377254662177,0.819, 0.885)
2. ETES SK values:
   Cronbachs Alpha: (0.9402828281718613, 0.925, 0.953)
3. TENS Set Interface Auto Support values:
   Cronbachs Alpha: (0.8722164748258305, 0.841, 0.898)
4. TENS Set Interface Auto Frustration values:
   Cronbachs Alpha: (0.9024995229917953, 0.878, 0.923)
5. TENS Set Interface Comp Support values:
   Cronbachs Alpha: (0.916673395236173, 0.896, 0.934)
6. TENS Set Interface Comp Frustration values:
   Cronbachs Alpha: (0.9345859516269217, 0.918, 0.948)

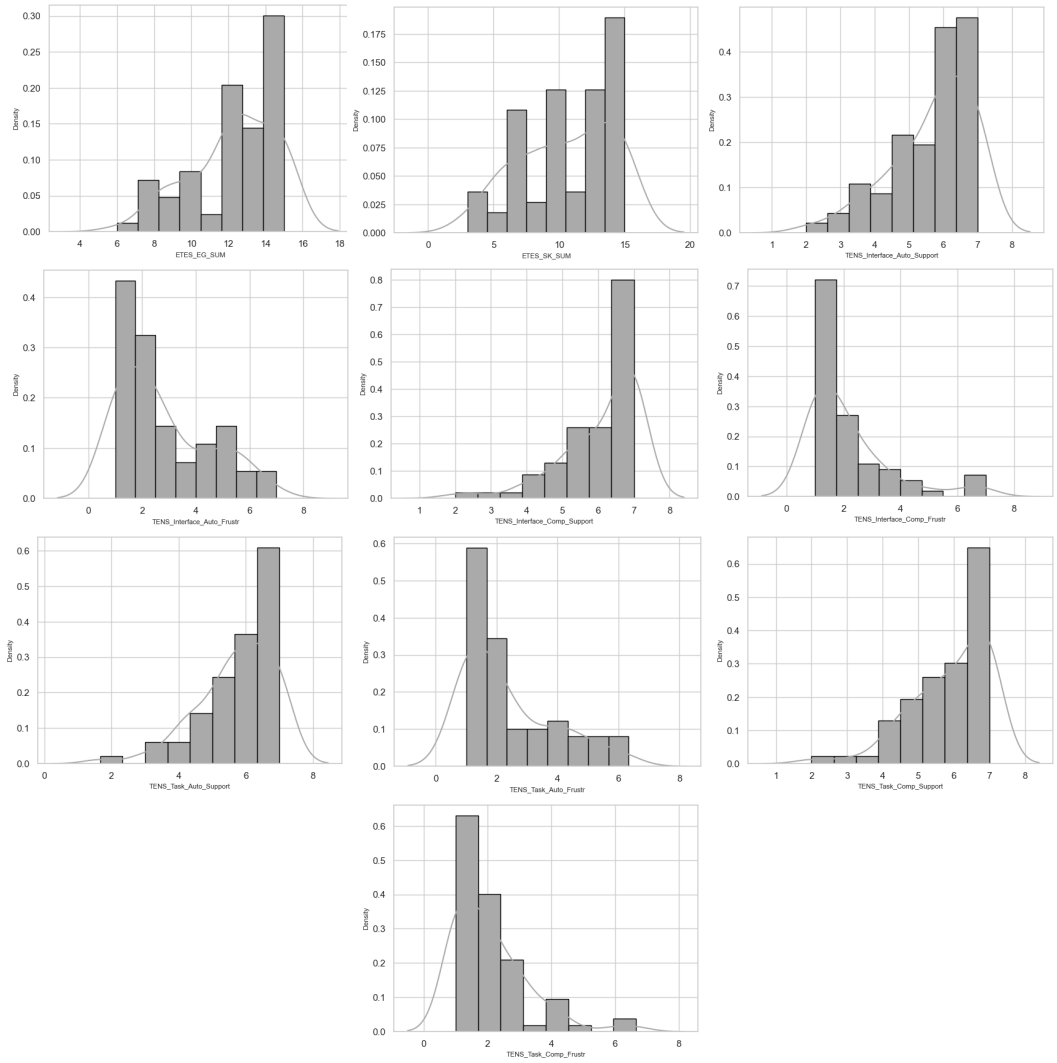

Figure A.1: Eudaimonic-Oriented Individuals within the AI Group.

7. TENS Set Task Auto Support values:
   Cronbachs Alpha: (0.8987140228861932, 0.874, 0.92)

8. TENS Set Task Auto Frustration values:
   Cronbachs Alpha: (0.9197107148556993, 0.9 , 0.936)

9. TENS Set Task Comp Support values:
   Cronbachs Alpha: (0.9431594135980608, 0.929, 0.955)

10. TENS Set Task Comp Frustration values:
    Cronbachs Alpha: (0.9025017250509489, 0.878, 0.923)

A.6 Study 4

A.6.1 Selecting Valid Participants

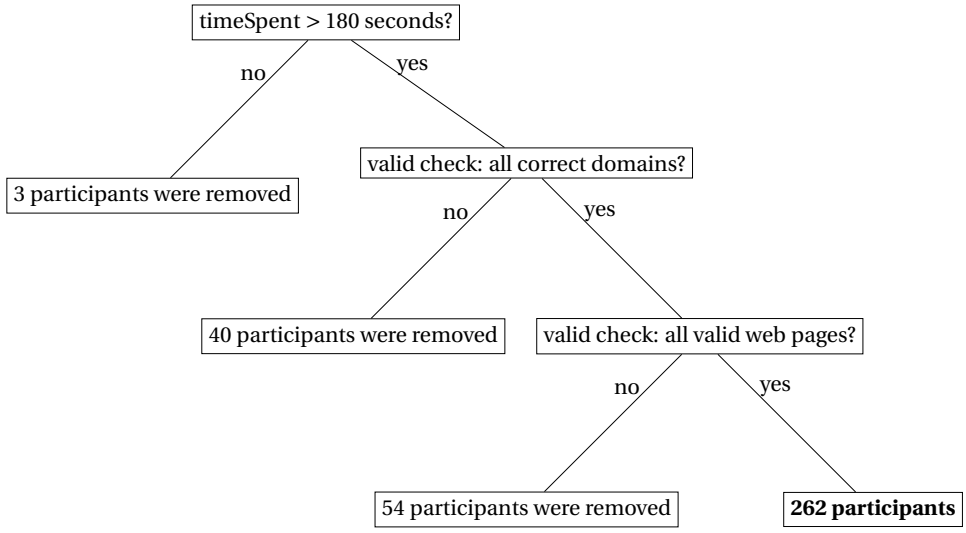

Figure A.2: The process of identifying valid participants, shown in a decision tree.

At first, 349 participants were recruited. Completed tests had to be removed for specific reasons, which will be explained in the following. Any participation under 180 seconds was removed from the valid test set (n = 3). Furthermore, 40 participants didn't pass the automatic check for 3 valid URLs from each domain (second step). In the second evaluation step, one noticed that people did not use the right web page from the website to prepare themselves. Thus, 54 participants from these errors possibly biasing the results. To understand and document the cleaning process we illustrate the cleaning process in Figure A.2.

A.6.2 Demographic Data

1. In general, some test participants refused to provide demographic information about themselves via Prolific.

2. In addition, certain information such as country of origin or student status was not provided by individual participants.

3. Complete or partially complete information could be evaluated for 97.33% (n = 255) of the 262 valid test subjects.

4. 51.76% (n = 132) of the participants are male, 48.24% (n = 123) of the participants are female.

5. All participants are aged between 18 and 77 (M = 27.45, SD = 7.66).

6. The nationalities of the participants can be analyzed as follows: 63.14% (n = 161) of the participants are of European origin, 25.10% (n = 64) are from Africa, 10.98% (n = 28) are of American origin, 1 participant is of Oceanic origin (Australia). One person has removed the information from their profile.

7. 49.80% (n = 127) of the participants have a student status, 41.96% (n = 107) have no student status, and 21 people (8.24%) have removed this information from their profile.

A.6.3 Detailed Results

Average Scores (Topics)

1. Inflation: an average of 46.02% points was achieved (2.76 out of 6 on average)

2. Autism: an average of 45.52% of the answers were correct (2.73 out of 6 questions answered correctly)

3. Photosynthesis: an average of 42.17% of the questions were answered correctly, which in turn means 2.53 out of 6 questions.

A.6.4 Notes Regarding URL Use

Compared to the original experiment of Fisher et al. [318], the validation check did not work optimally to the same extent, on the contrary: the second cleaning process was necessary to remove several non-valid participations. As previously explained in the methodology, the wrong URLs were used. One potential explanation for this discrepancy lies in the varying search results experienced by participants in this international approach. These differences can be attributed to various factors, including past search

behavior and the physical location of the searcher, as evidenced by Bennett et al. [46, 47], and are currently incorporated into advanced search engine systems. This probably resulted in biases. The experiments of Fisher et al. [318] were carried out exclusively by participants from the United States. In addition, some of the URLs had to be changed as they were no longer available. One press article from the original experiment was no longer accessible to participants due to a paywall. Another link was no longer available on the server of the external source. This may have resulted in different conditions compared to the original experiments.

A.7 Study 5

A.7.1 Demographics and Technology Use

1. The age range was 18 to 68 years with a gender proportion of 50.99% (n = 103) women and 49.01% men (n = 99).
2. 137 people defined themselves as white, 46 as black, and 19 were subsumed as others.
3. In total, 31% of participants were students.
4. A total of 35 nationalities participated.
5. The five most frequently mentioned technologies were Microsoft Word (10.40%, n = 21), Instagram (7.92%, n = 16), ChatGPT (6.93%, n = 14), Facebook (5.94%, n = 12), and Netflix (5.94%, n = 12).

A.7.2 Demographics for CFA

When providing demographic data, a small number of participants refused to provide demographic data and have therefore been anonymized.

1. The age range was 18-69 (stated by 290 participants), including 143 women (49.65%) and 145 men (50.35%) (stated by 288 participants).
2. In terms of ethnicity, 184 people described themselves as white (63.89%) and 67 as black (23.26%). 37 participants were subsumed under *others* as in the first study.

3. A total of 43 nationalities were involved in the study.
4. 32% of the participants were students.

A.7.3 Demographics for Third Study

1. The age range was 18 to 71.
2. 41 women (47.67%) and 45 men (52.23%) took part in the study.
3. Information on ethnicity shows that 63 participants identified as white and 10 as black. We summarized 13 statements on ethnicity under *others*.
4. In total, 22 nationalities took part.
5. 33% of the participants were students.

A.7.4 Discriminant Validity

All negative correlations that were significant are shown. Structure: pearson correlation coefficient, minimum - maximum, p-value.

1. EII CP - TENS Interface Auto Frustration values (-0.55, -0.68, -0.38, 4.937158171204095e-08***)
2. EII CP - TENS Interface Comp Frustration values (-0.22, -0.41, -0.0, 0.045170472555208924**)
3. EII CP - TENS Behavior Auto Frustration values (-0.53, -0.67, -0.36, 1.7300543083986197e-07***)
4. EII CP - TENS Behavior Comp Frustration values (-0.35, -0.52, -0.15, 0.0009493441195516064***)
5. EII DI - TENS Behavior Auto Frustration values (-0.27, -0.46, -0.06, 0.011409356879106743**)
6. EII DI - TENS Behavior Comp Frustration values (-0.23, -0.42, -0.02, 0.035371926856024805**)
7. EII GP - TENS Interface Auto Frustration values (-0.52, -0.66, -0.35, 2.3743722453892678e-07***)

8. EII GP - TENS Behavior Auto Frustration values (-0.5, -0.64, -0.32, 1.197551056913022e-06***)
9. EII GP - TENS Behavior Comp Frustration values (-0.3, -0.48, -0.09, 0.0057244092469273394***)
10. EII SD - TENS Interface Auto Frustration values (-0.42, -0.58, -0.23, 5.478024951224186e-05***)
11. EII SD - TENS Interface Comp Frustration values (-0.36, -0.53, -0.16, 0.0006037910107419587***)
12. EII SD - TENS Behavior Auto Frustration values (-0.46, -0.61, -0.27, 1.010087839641031e-05***)
13. EII SD - TENS Behavior Comp Frustration values (-0.44, -0.59, -0.25, 2.6443832596312936e-05***)-05***)

B

Abbreviations

Acronym	Meaning
ACM	Association for Computing Machinery
AI	Artificial Intelligence
BPNT	Basic Psychological Needs Theory
BCT	Behavior Change Technology
CET	Cognitive Evaluation Theory
HCAI	Human-Centered Artificial Intelligence
HCI	Human-Computer Interaction
HCD	Human-Centered Design
HCI	Human-Computer Interaction
EII	Eudaimonic Interaction Inventory
EUX	Eudaimonic User Experience
EWB	Eudaimonic Well-Being
HEEMA	Hedonic, Eudaimonic, and Extrinsic Motives for Activities
HEMA	Hedonic and Eudaimonic Motives for Activities
HEMA-R	Hedonic and Eudaimonic Motives for Activities (Revised)
IEEE	Institute of Electrical and Electronics Engineers
IoT	Internet of Things
IT	Information Technology
IVA	Intelligent Voice Assistant
LaLaMoSuLe	Large Language Model Supported Learning tool
MAP	Motives of the Autonomous Player
METUX	Motivation, Engagement and Thriving in User Experience
OECD	Organisation for Economic Co-operation and Development
OIT	Organismic Integration Theory
OSF	Open Science Framework
PLoC	Perceived Locus of Causality
PXI	Player Experience Inventory
PWBS	Psychological Well-Being Scale
QEES	Questionnaire for measuring Eudaimonic Experiences in School
RS	Recommender System
R2T2	Reflection, Rumination and Thought in Technology
SDG	Sustainable Development Goal
SDT	Self-Determination Theory
SWB	Subjective Well-Being
SWEMWBS	Short Warwick-Edinburgh Mental Well-Being Scale
TENS	Technology-based Experience of Need Satisfaction scales
UI	User Interface
V-MTC	Virtual Medical Tourism Community

C

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