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Persuasive Technologies: On Behavior Modification and Affordances of Digital Objects in Virtual Environments

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Persuasive Technologies: On Behavior Modification and Affordances of Digital Objects in Virtual Environments

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Erklärung der Autorin

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Summary of the Results (English)

Virtual environments, also referred to as online social spaces, are artificially constructed and allow users to sense a space and artifacts or others in that space apart from the physical environment they are in. This cumulative dissertation explores human interaction with technological artifacts in virtual environments. Specifically, persuasive technologies, which are interactive systems that can influence human attitude or behavior through inscribed cues by reinforcing or changing a target behavior are in the focus of this dissertation. Whether inscribed cues for action are correctly perceived and used by humans, depends on the real (designed) as well as the correctly perceived technology action potentials. In this dissertation, both aspects of persuasive technologies, their capacity to influence behavior and their requirement to be correctly perceived by users are explored in a series of qualitative studies. Accordingly, this dissertation is structured in two research streams, which focus on 1) the influence of digital nudges on user decision-making (research stream one) and 2) aspects influencing user perception of technology action potentials in socio-technical relationships (research stream two).

Therefore, two theories, the digital nudging, and affordance theory are used to provide theoretical backgrounds for the empirical observations and explanations for the different forms of influence on human decision-making and perception in virtual environments. In general, digital nudging can be understood as user-interface design elements that influence humans towards a target behavior, while affordances likewise present the material aspects of a technology that offer action potentials to users.

Research stream one presents status quo analyses, theoretical discussions, and an empirical assessment of interactive digital nudge design in dynamic virtual choice environments. The digital nudging research conducted in this dissertation contributes to the conceptual clarity of digital nudging, integrates ethical considerations in the design of digital nudges, and explores potentials of digital nudges in dynamic choice environments. While digital nudging research (rooted in behavioral economics) shows a long history of research and empirical observations on cognitive aspects of human-artifact interaction in virtual environments, affordance research (rooted in ecological psychology) is largely missing conclusive explanations of changes and factors influencing perception and consequent behavior. Therefore, existing conceptual boundaries of affordance perception are extended in this dissertation to include cognitive aspects of perception in affordance research. Accordingly, research stream two presents theoretical discussions and empirical assessments of the role of in-built IT artifacts as facilitators of affordance perception and the potential of integrating cognition to extend the understanding of perception and consequent behavior in affordance contexts.

Kurzfassung der Ergebnisse (Deutsch)

Virtuelle Umgebungen, synonym betrachtet also soziale online Räume, sind künstlich konstruiert. Sie erlauben Nutzer:innen einen Raum und Artefakte oder andere Nutzer:innen in diesem Raum wahrzunehmen, der neben der physischen Umgebung besteht in dem sie sich befinden. Diese kumulative Dissertation untersucht menschliche Interaktion mit technologischen Artefakten in virtuellen Umgebungen. Insbesondere persuasive Technologien, die als interaktive Systeme menschliches Verhalten oder Wahrnehmung durch eingeschriebene (visuelle) Reize beeinflussen, indem sie menschliches Verhalten und Einstellungen gezielt verstärken oder verändern, sind im Fokus dieser Dissertation. Ob die eingeschriebenen (visuellen) Reize und intendierten Handlungsaufforderungen die gewünschte Wirkung entfalten, hängt oft von dem Design der Technologien und Nutzer:innenwahrnehmung der Aktionspotentiale ab. In dieser Dissertation werden beide Aspekte persuasiver Technologien, sowohl ihr Potential menschliches Verhalten zu beeinflussen als auch ihre Anforderung, dass Nutzer:innen die eingeschriebenen Handlungsaufforderungen wahrnehmen können, in einer Reihe von qualitativen Studien untersucht. Demnach ist diese Dissertation in zwei Forschungssträngen strukturiert, um 1) den Einfluss von *digital nudging* auf das Entscheidungsverhalten von Nutzer:innen (Forschungsstrang eins) und 2) Einflussfaktoren auf die Wahrnehmung der Aktionspotentiale von Technologien (Forschungsstrang zwei) zu untersuchen.

Zwei Theorien, die *Digital Nudging* und die *Affordance* Theorie, liefern das theoretische Fundament für die empirischen Beobachtungen und Erklärungen der unterschiedlichen Formen des Einflusses auf menschliches Entscheidungsverhaltung und menschliche Wahrnehmung in virtuellen Umgebungen. Generell kann *digital nudging* als Design Element verstanden werden, das ein bestimmtes Zielverhalten der Nutzer:innen beeinflusst, während *affordances* die materiellen Aspekte einer Technologie meint, die durch die Wahrnehmung von Nutzer:innen als Aktionspotentiale erkannt werden müssen.

Forschungsstrang eins präsentiert insgesamt Status Quo Analysen, theoretische Diskussionen und eine empirische Bewertung eines interaktiven *digital nudging* Designs in einer virtuellen Entscheidungsumgebung. Der wissenschaftliche Beitrag der *digital nudging* Forschung in dieser Dissertation umfasst eine erhöhte konzeptuelle Klarheit der *digital nudging* Theorie, die Integration ethischer Erwägungen in dem Design von *digital nudges* und die Verdeutlichung der Potentiale interaktiver *digital nudges* in dynamischen Entscheidungsumgebungen. Während *digital nudging* Forschung (Ursprung in der Verhaltensökonomie) eine lange Forschungshistorie und empirische Beobachtungen der kognitiven Aspekte in der Beziehung zwischen Menschen und Artefakten in virtuellen Umgebungen vorzuweisen hat, fehlen schlüssige Erklärungen für die Veränderung von und Einflüsse auf Wahrnehmung und daraus resultierendem Verhalten in der Forschung zu *Affordance* Theorie (Ursprung in der Ökologischen Psychologie). Daher werden in dieser Dissertation die existierenden konzeptuellen Einschränkungen bezüglich der Wahrnehmung von Aktionspotentialen von Technologien in der Forschung erweitert, indem kognitive Aspekte der Wahrnehmung berücksichtigt werden. Der wissenschaftliche Beitrag der Forschung zu dem Angebotscharakter von Technologien in dieser Dissertation umfasst insgesamt eine dynamische Perspektive auf die Wahrnehmung der Aktionspotentiale von Technologien sowie deren Nutzung und erweitert das bestehende Verständnis der Zusammenhänge von Kognition und Wahrnehmung sowie Verhaltensänderung im Kontext der *Affordance* Theorie.

Table of Contents

List of Figures

List of Tables

Abbreviations

A	Article
App	Application
CAIS	Communications of the Association for Information System
cf.	Latin: confer/conferatur; English: compare
CNF	Conference
e.g.	Latin: exempli gratia; English: for example
GQ	Guiding Questions
HCI	Human-Computer-Interaction
HICSS	Hawaii International Conference on Systems Sciences
ICIS	International Conference on Information Systems
i.e.	Latin: id est; English: that is (to specify something)
ESB	Enterprise Social Bot
IJIM	International Journal of Information Management
IS	Information Systems
IT	Information Technology
JNL	Journal
PACIS	Pacific Asia Conference on Information Systems
PhD.	Doctor of Philosophy
RS	Research Stream
VHB JQ 3	Verband der Hochschullehrer für Betriebswirtschaft Jourqual 3[1]

[1] The VHB JQ3 ranking is a quality rating of relevant Information Systems Research journals and conferences by the members of the Association of University Lecturers for Business Administration (German: VHB).

1 Introduction

1.1 Research Motivation

1.1.1 Persuasive Technologies

Natural environments are full of cues and objects to which animals, humans included, instinctively respond. Virtual environments are artificially constructed and therefore inherently different from natural environments. However, they are likewise full of cues and (digital) objects that can trigger (social) responses. In general, virtual environments can be understood as a "*sensory experience*" or online social space that allows users to sense a place, space, or other users in an environment other than the one they are physically in (Schroeder, 2006, p. 439). Virtual environments are intentionally, unintentionally or even unknowingly designed into e.g., technological artifacts, which constitute "*material and cultural properties packaged in some socially recognizable form such as hardware and/or software"* (Orlikowski and Iacono, 2001, p.121). Accordingly, the study of human interaction in virtual environments and on technological artifacts offers a unique field of study for researchers interested in socio-technical phenomena.

The ability of technological artifacts to offer inscribed (social) cues, which can elicit (social) responses or user interaction is what Fogg (2002) calls persuasion. Specifically, persuasive technologies are defined as interactive systems that are intentionally designed and have the capacity to influence attitude and/ or behavioral change (Fogg, 1998). Hereby, persuasive technologies aim to reinforce, change, and shape attitudes or target behavior through task support, dialogue support, system credibility or social support (Oinas-Kukkonen and Harjumaa, 2009). The influence of persuasive technologies on attitudes or behavior has been well researched (Oinas-Kukkonen, 2013). It has been argued that the perceived usability of technology features is not only based on the intended design but rather emerges through artifact use and action (Thapa and Sein, 2018). This indicates that human behavior in virtual environments likewise depends on real as well as perceived and actionable artifact properties. In virtual environments, designers only influence how users perceive the action possibilities of artifacts (Norman, 1999), whereas individuals must be able to perceive the built-in physical properties of an app to use it at all (Parchoma, 2014). In summary, whether individuals can perceive the 'clickability' of icons or the 'touchability' of a screen to select items, therefore depends on the visual feedback implemented by designers as well as users' mental and physical capacity to use a technological artifact (Bernhard et al., 2013).

Based on a thorough literature review on empirical persuasive technology research, Hamari et al. (2014) argue that both, intentionality (i.e., intended outcomes, changes in attitude or behavior) and the event or context of persuasion (i.e., persuasive technology use in specific environments) must be considered in research. Hamari et al. (2014) add that empirical persuasive technology studies often lack, among other things, conclusive presentations of results. Distinguished assessments between potential and actual effects of persuasive technologies on attitudes or artifact design are needed (Volkoff and Strong, 2018). In addition, open questions remain regarding when and why some technological artifacts successfully influence a targeted behavior while others do not (Schneider et al., 2016). Addressing these gaps is relevant given the pervasiveness and influence of persuasive technologies in the everyday lives of individuals (Oinas-Kukkonen, 2013). Technologies are oftentimes intentionally designed to influence and guide choices on the Internet, facilitate interaction and behavior in the virtual workspace or elicit emotional responses during mundane human-artifact interactions. Users' capability to perceive technology materiality can influence when and why

they make use of action potentials (Normann, 1999). However, how designers evaluate the capabilities of potential users to derive implications for the artifact design remains a challenge. One approach taken in this dissertation to answers this question, is to explore preferred design elements among different user groups or within specific contexts. Another approach is to address users' individual characteristics and goals for using or not using persuasive technologies, which according to Alshawmar et al. (2021) needs more attention in research.

In summary, this dissertation explores contingencies between artifact design and perception in persuasive technology contexts to draw conclusions how and when technology is used or not. Different aspects of persuasive technology such as intentional design and contexts of persuasive technology use, where guidance is wanted or needed to achieve some target behavior, are considered. By addressing design aspects of persuasive technologies, such as design for task support, this dissertation aims to understand the influence design can have on attitude or behavior. Thereby, the importance of design standards and ethical aspects that need consideration will also be explored. In addition, the exploration of perception in persuasive technology contexts has also raised questions regarding current understandings of perception. Therefore, contingencies between cognition and perception are likewise addressed in this dissertation. The human elements in human-artifact relations that influence interaction such as e.g., individual user backgrounds, goals, or contexts of technology use will be analyzed. By addressing the human elements, this dissertation aims to understand cognitive aspects of perception and use of persuasive technologies.

Research on persuasive technologies and their influence on human behavior and/ or attitudes is often conducted within the field of Human Computer Interaction (Fogg, 1998). The Information Systems (IS) research discipline provides overlapping research interests with Human Computer Interaction as an interdisciplinary approach to studying human behavior, attitudes, and artifact design (Oinas-Kukkonen and Harujumaa, 2008). This makes persuasive technologies a relevant IS research topic for the purpose of this dissertation. Within the IS research context, two suitable theories are used to study persuasive technologies in this dissertation, which will be introduced in the following.

1.1.2 Decision-Making and Perception in Persuasive Technology Contexts

Decision-making and perceiving are rather broad research topics, not only applicable in persuasive technology contexts. Therefore, two IS theories were identified, which provide adequate methodological approaches and are fitting to address the mentioned research gaps. In the context of persuasion, which, by the definition of Fogg (1998) is "*an attempt to shape, reinforce, or change behaviors, feelings, or thoughts about an issue, object, or action*," (p. 225), both digital nudging and affordance theory assess the influence persuasive technologies have in shaping attitude or behavior during user interaction with objects and vice versa. Specifically, digital nudging uses intentionally designed choice architectures to shape or reinforce behavior, whereas affordances asses the material aspects (i.e., features) of intentionally or unintentionally designed artifacts that influence attitude or behavior (Volkoff and Strong, 2018). In addition, affordance theory assesses the human elements that shape, reinforce, or change attitudes, behavior, or action (Alshawmar et al., 2021).

For one, digital nudging elicits behavioral responses from users in virtual environments, which emphasizes artifact design with intention to guide individuals toward sound and conscious decision-making in their own best interest. Accordingly, empirical digital nudging research is suitable to show that behavior was modified. Even more so, digital nudging studies are helpful to isolate which aspects of persuasive technology design modified behavior in what contexts. In IS contexts, digital nudging explains how human decision-making can be influenced by user-interface design elements in virtual choice environments (cf. Weinmann et al., 2016). Digital nudging research draws on insights from cognitive psychology to make human perception and

consequent decision-making more explicit. Finding the most effective ways to influence individuals in virtual choice environments involves careful consideration as "*predicting consequences of implementing certain* [interventions] *is not always possible*" (Schneider et al., 2018, p. 7).

In digital nudging research, gaps remain regarding clear conceptual boundaries between digital nudging and persuasion as well as putting relevant ethical considerations of digital nudging into practice (see e.g., Cohen, 2013). Digital nudging conceptually provides a stricter understanding of the legitimizing conditions to influence decision-making than persuasion (Lembcke et al., 2019). In line with that, scholars call for more research on theory and practice of digital nudging in recognition of ethical implications for influencing human behavior in virtual environments (Lembcke et al., 2019). Ethical considerations are increasingly important and require renewed attention given that there is no objective way to influence human agents or present choices in virtual environments, while at the same time, many everyday life decisions are made online (Schneider et al., 2018). Based on the current status quo in digital nudging research, this dissertation contributes to the conceptual boundaries and ethical considerations in digital nudging as well as assessments of the potentials of conversation-driven digital nudges.

Secondly, affordances assess how technology materiality (i.e., features) can influence user perception and consequent behavior. Learning how material aspects of a technology are afforded requires scrutiny of user-artifact interaction in specific contexts. At the same time, affordance theory provides a focus on the event of persuasion along with the design. Affordances exist at the intersection of artifacts, actors, and situations (Hutchby, 2001). They provide a socio-technical perspective on human-artifact relations, which focus on the social elements or contexts of technology feature use (Faraj and Azad, 2012). Simplified, affordances present an artifact's action potential that exists independent of user perception, while user perception is influenced by individual abilities or skills to perceive action potentials in specific situations (Parchoma, 2014).

To this day, IS affordance scholars only implicitly provide explanations for perception in virtual environments. Further, the significance of perception in virtual environments as well as explanations regarding the change of perception during continued artifact use are still limited in IS research (Warren, 2006). However, understanding why and how users perceive technology action potentials is key to learning which aspects of persuasive technology design are relevant. Scholars argue that a degree of cognition is necessary for the perception of artifact action potentials (Normann, 1988). Likewise, temporal changes in perceiving and sensing action possibilities need further exploration to understand when and how an affordance is actualized for what reason (cf. Tim et al., 2017). In line with that, this dissertation explores potentials of conversational agents as facilitators (interventions) of user perception to make artifact action potentials better perceivable. Moreover, the concept of mental models (MM) will be introduced as an additional aspect of the human elements that influence human-artifact relations in affordance research. Thereby, the aim is to make nuances of perception and affordance actualizations during continued artifact use more explicit.

In summary, both decision-making and perception are central to persuasion in human-artifact relations observed in IS research contexts. At the same time, conceptual boundaries largely remain, which motivated this dissertation to conduct a series of research projects in both areas. Addressing current shortcomings in both, digital nudging and affordance research will also contribute to discussions on intentionality of design and contextual use of persuasive technologies. Figure 1 on the next page summarizes the identified research gaps in persuasive technology contexts as well as digital nudging and affordances.

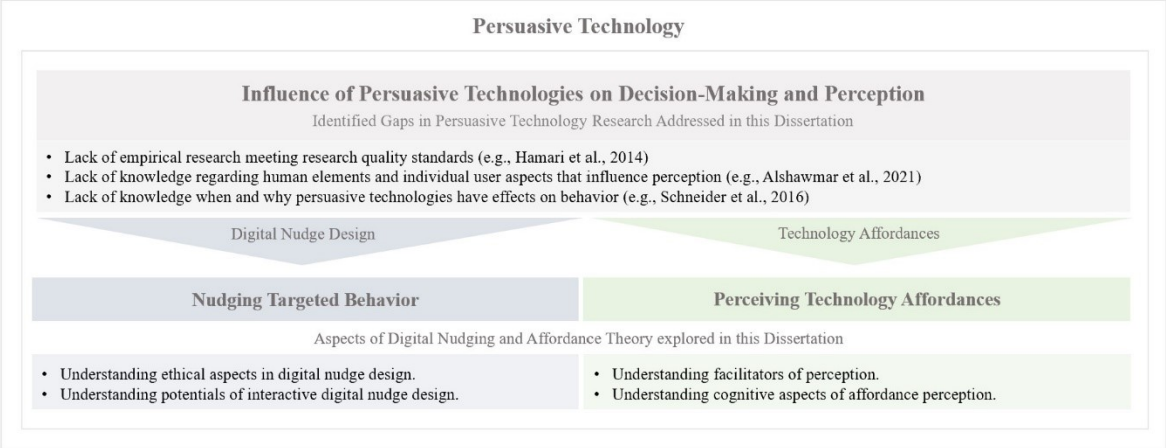

Figure 1. Summary of Identified Persuasive Technology Research Gaps in IS Research

In the following, a detailed presentation of the research streams and expected contributions will be presented. Thereafter, the overall structure of this dissertation will be introduced.

1.2 Research Streams and Expected Contributions

1.2.1 Research Streams and Corresponding Research Questions

This dissertation is structured in two research streams (RS) and corresponding guiding questions (GQ). Each RS formulates a proposition, which narrows the scope and reveals what can be expected of the research conducted in each stream. The GQs present the relevant questions that are expected to be answered by the conducted research. Altogether RS and GQs constitute the structure of this dissertation.

Overall, RS1 addresses challenges and opportunities in the application of digital nudges to understand and guide decision-making in virtual choice environments. Discussions regarding the conceptual understanding and development of the nudging theory will be provided. Further, nudge designs and their effectiveness will be assessed in different contexts. Research stream 1.1 presents status quo on digital nudging research and revisits current discussions on the conceptual distinction of digital nudging to related research fields. Based on that, ethical discussions on the effects of digital nudging to influence decision-making are also presented. Research stream 1.2 presents an assessment of digital nudges to influence predefined behavior and explore new perspectives in digital nudging research towards conversation-driven artifacts and their influence on behavior. In summary, the two RS and corresponding GQs read as follows:

RS1.1: Precise conceptualizations of digital nudging as a subfield of persuasion are scarce.

- GQ1.1: How can definitory and ethical aspects of digital nudging be conceptualized?

RS1.2: Digital nudges can use interactive designs to elicit user engagement and change decision-making.

- GQ1.2: What are potentials of conversation-driven and consecutive digital nudges to influence decision-making?

Overall, RS2 applies the affordance theory to assess the influence technology materiality (i.e., features) can have on user perception and consequent behavior. Moreover, RS2 addresses facilitators of perception in virtual environments as well as changes in perception and feedback during continued user-artifact interaction. Research stream 2.1 addresses potentials of built-in

IS artifacts as technology-mediated facilitators of user perception. Specifically, the use of conversational agents to influence human perception in socio-technical relationships will be explored. Research stream 2.2 focuses on the human elements that influence perception and actualization in dynamic socio-technical relationships. This will be accomplished by integrating MMs as an additional human element (besides individual user backgrounds, goals, or contexts of technology use) to make nuances of perception as well as adjustments of perception and actualization from feedback more explicit. In summary, the two RS and corresponding GQs suggest:

RS2.1: Technology-mediated interaction with users can influence their perception of artifact action potentials.

- GQ2.1: How can built-in IT artifacts such as chatbots facilitate affordance perception?

RS2.2: Conceptualizations of affordance perception and feedback can be more nuanced by integrating cognitive aspects.

- GQ2.2: How can mental models extend conceptualizations of perception and feedback?

Figure 2 builds on Figure 1 by presenting both RS and corresponding GQs, which will be addressed in this dissertation to close the mentioned research gaps. Each GQ will be answered by the research articles that have been published in this dissertation. Lastly, Figure 2 presents the overall expected contributions of this dissertation, which will be presented in detail in the following.

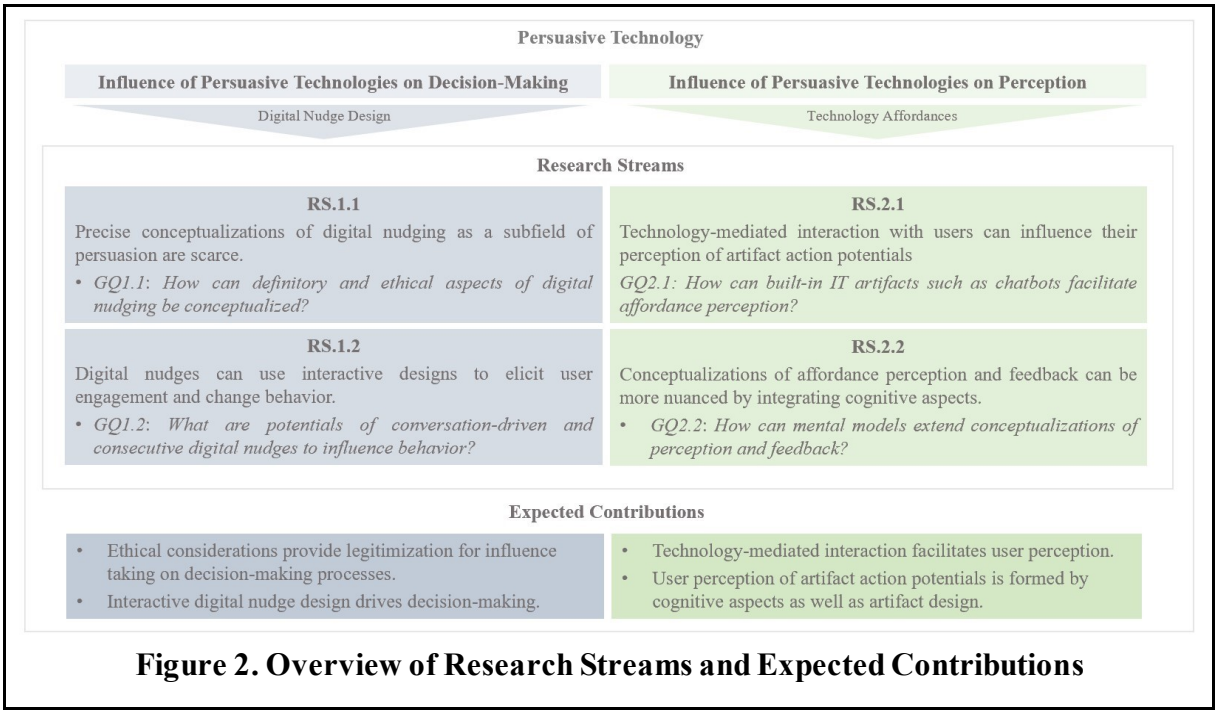

Figure 2. Overview of Research Streams and Expected Contributions

1.2.2 Expected Research Contributions

The research contributions of this dissertation are developed within both RS in digital nudging and affordance research. The conducted digital nudging research is expected to contribute knowledge on the conceptual boundaries and influence persuasive artifact design can have on human behavior and attitudes. Based on calls for research to put digital nudging to practice and provide ethical implications for influence taking on decision-making processes in virtual environments (cf., Lembcke et al., 2019), this dissertation expects to contribute an improved conceptual understanding of digital nudging, especially in consideration of ethical aspects. Further, case study research is expected to provide implications and examples for the hands-on

implementation of digital nudges in relevant practice-oriented contexts. Hereby, this dissertation will explore conversation-driven digital nudges as a form of dynamic user interaction in virtual environments. The aim is to explore a dynamic digital nudging research perspective close to the reality of social interaction in virtual environments users are confronted with today (cf., Stoeckli et al., 2018).

Further, the conducted affordance research is expected to contribute an understanding of the influence of technology materiality and the role of human elements on perception in virtual environments. This dissertation seeks to extend existing affordance conceptualization by making the nuances of perception during continuous socio-technical relationships explicable. Namely, potentials of conversational agents as facilitators of user perception will be explored to make artifact action potentials better perceivable. Moreover, the concept of MMs will be introduced in affordance research to understand and explore their potentials. Thereby, this dissertation expects to establish a nuanced explanation of perception and affordance actualizations during continued artifact use in contribution to affordance research.

The overall observation of this dissertation is that persuasive technologies are omnipresent. Accordingly, the research conducted on digital nudging and affordances is expected to explicate when and why some artifacts successfully influence decision-making as well as when and why technology action potentials are correctly perceived. Addressing both, decision-making and perception in the context of persuasive technologies is expected to close existing gaps and remaining questions on human-artifact interaction in virtual environments as well as provide outlooks for future developments in IS research. Lastly, the used epistemologies reflect descriptions and explanations of observed real-world phenomena (Guba and Lincoln, 1994). By contributing a detailed understanding and precise conceptualization of digital nudging and affordance theory in this dissertation, practical implications can likewise be derived for e.g., artifact designers who aim to 1) steer decision-making using ethical digital nudges or 2) design artifacts in consideration of human elements that influence perception. In the following, the cumulative dissertation structure will be presented in detail.

1.3 Cumulative Dissertation Structure

Chapter 1, “Introduction”, is divided in “Research Motivation” (1.1), “Research Streams and Expected Contributions” (1.2), “Cumulative Dissertation Structure” (1.3), and the “List of Publications” (1.4), which constitutes the published research articles in the context of this dissertation. The first sub-chapter research motivation is further divided in “Persuasive Technologies” (1.1.1) and “Decision-Making and Perception in Persuasive Technology Contexts” (1.1.2). The second sub-chapter 1.2 is further divided in “Research Streams and Corresponding Research Questions” (1.2.1) and “Expected Research Contributions” (1.2.2).

Following that, chapter 2, “Research Background”, presents relevant definitions and theoretical concepts, which provides a well-rounded background and basis for understanding the digital nudging and affordance research implications presented in this dissertation. In line with RS1, chapter 2.1, “Behavioral Choice Environments and Digital Nudging”, is further divided in “Human Behavior and Decision-Making in Behavioral Economics” (2.1.1) and “Human Behavior and Decision-Making in Virtual Choice Environments” (2.1.2). Both sub-chapters provide relevant background on the status quo of digital nudging in persuasive technology contexts in response to RS1.1. Building on that, practical examples of digital nudges in specific contexts are explored in correspondence to RS1.2. In line with RS2, chapter 2.2, “Affordances and the Perception of Action Potentials”, provides relevant background on perception, actualizations, and feedback loops. This chapter is further divided in “Action Potentials of Physical Objects in Ecological Psychology” (2.2.1) and “Action Potentials of Digital Objects in Virtual Environments” (2.2.2) as well as “Understanding Nuances of Perception and

Affordance Actualizations" (2.2.3). The sub-chapters provide relevant background on the status quo of human perception and the potentials of IS artifacts as facilitators of perception in correspondence with RS2.1. Further, different aspects of perception and actualizations during continued artifact use are explored in correspondence to RS2.2. Finally, chapter 2.3, "Compatibility of Digital Nudging and Affordance Theory" presents arguments for the synthesis of digital nudging and affordance theory as done in this dissertation.

Thereafter, chapter 3, "Research Design", is further divided in the chapters "Research Approach" (3.1) and "Research Methodology" (3.2). Chapter 3.1 provides a detailed presentation of the step-by-step approach taken to conduct the published research articles according to the RS pursued in this dissertation. This provides a more detailed understanding how each research article provides individual implications to research and practice in the corresponding research streams. The individual research articles stand in context to each other and therefore provide an overall contribution to persuasive technology research. The overall research contributions will be addressed in detail in the Conclusion. The sub-chapter 3.2 is further divided in "Research Methods" (3.2.1) and "Data Collection and Data Analyses Methods" (3.2.2). The research methods chapter contains descriptions of the non-empirical literature reviews and conceptual research as well as the empirical digital nudging design and case study research applied in this cumulative dissertation. The data collection and data analyses methods chapters elaborate the (systematic) literature reviews for status quo analyses, as well as qualitative analyses, and online experiments, which were applied in the individual research articles.

Chapter 4, "Results", then presents the results of the research articles in response to each RS and corresponding GQ. The sub-chapters are structured in "Summary of the Findings" (4.1), "Digital Nudging and Ethical Design" (4.2), "Towards Conversation-Driven Digital Nudge Perspectives" (4.3), "IS Artifacts as Facilitators of Affordance Perception" (4.4), and finally "Unboxing Nuances of Affordance Perception and Feedback" (4.5).

In chapter 5, "Discussion", the research results are discussed and split in two different sub-chapters. The first sub-chapter, "Behavior Modification on Persuasive Technologies" (5.1) is further divided in the sub-chapter "Conceptual Clarity and Ethical Aspects" (5.1.1) and "Interactive Digital Nudge Design" (5.1.2). The second sub-chapter, "Affordance Perception of Persuasive Technologies" is further divided in "Facilitating Affordance Perception" (5.2.1) and "Cognitive Aspects of Affordance Perception and Feedback" (5.2.2).

Finally, chapter 6, "Conclusion", is further divided in "Summary of Contribution to Knowledge" (6.1), "Implications for Research and Practice" (6.2), and "Limitations, Critical Reflection, and Opportunities for Further Research" (6.3). An overview of the structure of this cumulative dissertation is summarized in Table 1 below.

Table 1. Dissertation Thesis Structure

1 Introduction	**1.1** Research Motivation	**1.1.1** Persuasive Technologies
		1.1.2 Decision-Making and Perception in Persuasive Technology Contexts
	1.2 Research Streams and Expected Contributions	**1.2.1** Research Streams and Corresponding Research Questions
		1.2.2 Expected Research Contributions
	1.3 Cumulative Dissertation Structure	
	1.4 List of Publications	

2	Research Background	**2.1** Behavioral Choice Environments and Digital Nudging	**2.1.1** Human Behavior and Decision-Making in Behavioral Economics
			2.1.2 Human Behavior and Decision-Making in Virtual Choice Environments
		2.2 Affordances and the Perception of Action Potentials	**2.2.1** Action Potentials of Physical Objects in Ecological Psychology
			2.2.2 Action Potentials of Digital Objects in Virtual Environments
			2.2.3 Understanding Nuances of Perception and Affordance Actualizations
		2.3 Compatibility of Digital Nudging and Affordance Theory	
3	Research Design	**3.1** Research Approach	
		3.2 Methodology	**3.2.1** Research Methods
			3.2.2 Data Collection and Data Analyses Methods
4	Results	**4.1** Summary of the Findings	
		4.2 Digital Nudging and Ethical Design	
		4.3 Towards Conversation-Driven Digital Nudge Perspectives	
		4.4 IS Artifacts as Facilitators of Affordance Perception	
		4.5 Unboxing Nuances of Affordance Perception and Feedback	
5	Discussion	**5.1** Behavior Modification on Persuasive Technologies	**5.1.1** Conceptual Clarity and Ethical Aspects
			5.1.2 Interactive Digital Nudge Design
		5.2 Affordance Perception of Persuasive Technologies	**5.2.1** Facilitating Affordance Perception
			5.2.2 Cognitive Aspects of Affordance Perception and Feedback
6	Conclusion	**6.1** Summary of Contribution to Knowledge	
		6.2 Implications for Research and Practice	
		6.3 Limitations, Critical Reflection, and Opportunities for Further Research	

1.4 List of Publications

This dissertation constitutes a cumulative PhD thesis, that consists of six published research articles between the years 2020 and 2022. The research articles were published in international IS research journals (JNL) and conferences (CNF), which adhere to the *Verband der Hochschullehrer für Betriebswirtschaft Jourqual 3* (VHB JQ 3) ranking standards. One JNL article was published in the Communications of the Association for Information Systems (CAIS) and one JNL article was submitted to the International Journal of Information Management (IJIM). Corresponding CNF articles were published in the proceedings of the Pacific Asia Conference on Information Systems (PACIS), the International Conference on Information Systems (ICIS), and the Hawaii International Conference on Systems Sciences (HICSS). Collaborations and co-authorships for the published articles in this

dissertation were formed at the Freie Universität Berlin, Germany as well as Ruhr Universität Bochum, Germany, and the University of Agder, Norway.

Table 2 presents the list of published JNL and CNF in this cumulative dissertation according to their publication date in chronological order from oldest to youngest. The full research articles can be found in Chapter 8.2, Appendix. More specifically, Table 2 provides information about the authors, the year of publication, the title, and publisher of each research article. Further, the VHB JQ 3 rankings and corresponding publication credit points achieved for each research article are indicated. The credit points vary depending on the publisher and their individual ranking standards as well as the number of authors involved.

Overall, this cumulative dissertation satisfies the formal requirement (at least two credit points) of Freie Universität Berlin, School of Business and Economics by compiling 2.83 VHB JQ 3 points. In detail, this dissertation brings forward a single author research article published at a peer reviewed conference (PACIS), and five co-authored research articles. Two of the articles included in this dissertation have been submitted to ranked IS journals, of which one has been published while the other is under review (second round, major revision). Further, this cumulative dissertation includes four publications in conference proceedings of which one short paper and one full research article were published at an A-ranked conference (Table 2). The short paper that was published at ICIS (Article 4) also received the "Best Short Paper in Track Award" (see Chapter 8.2, Appendix). It focuses on designers' intended affordances of a mobile app and was extended into a full journal article (Article 6, IJIM, major revision under review) focusing on users' perceived affordances of the same mobile app. While the analyzed artifact is the same for both articles, the empirical base (survey of designers in the short paper; survey of users in the full journal article) and hence the contributions differ. The short paper does not contribute to the overall dissertation score (required: 2.0).

Table 2. List of Publications Included in the Cumulative Dissertation

	Publication		Type	VHB JQ 3	Credit Points
1	Authors: Year: Title: Publisher:	Christian Meske Ireti Amojo 2020 Ethical Guidelines for the Construction of Digital Nudges. In Proceedings of the 53rd Hawaii International Conference on Systems Sciences (HICSS)	CNF	C	0.5
2	Author: Year: Title: Publisher:	Christian Meske Ireti Amojo 2020 Status Quo, Critical Reflection and Road Ahead of Digital Nudging in Information Systems Research A Discussion with Markus Weinmann and Alexey Voinov. Communications of the Association for Information Systems (CAIS)	JNL	C	0.5
3	Author: Year: Title: Publisher:	Christian Meske, Ireti Amojo 2020 Enterprise Social Bots as Perception-Benefactors of Social Network Affordances In Proceedings of the 41st International Conference on Information Systems (ICIS)	CNF	A	0.5
	Publication		**Type**	**VHB JQ 3**	**Credit Points**

4	Author: Year: Title: Publisher:	Christian Meske Ireti Amojo Devinder Thapa 2020 Understanding the Affordances of Conversational Agents in Mental Mobile Health Services. In Proceedings of the 41st International Conference on Information Systems (ICIS)	Best Short Paper in Track Award (no dissertation points)		
5	Author: Year: Title: Publisher:	Ireti Amojo 2021 Working from Home During a Pandemic Crisis: The Potential of Conversation-Driven Nudges to Manage Work and Non-Work Domain Boundaries. In Proceedings of the 25th Pacific Asia Conference on Information Systems (PACIS)	CNF	C	1
6	Author: Year: Title: Publisher:	Christian Meske Ireti Amojo Devinder Thapa 2022 A Conceptual Model of Feedback Mechanisms in Adjusted Affordances – Insights from Usage of a Mental Mobile Health Application. International Journal of Information Management (IJIM) *(major revision)*	JNL	C	0.33
				Sum: 2.83	
				(Required: 2.0)	

A list of all articles published until now is presented in the Appendix (Chapter 8.1) according to their publication date in chronological order from oldest to youngest.

2 Research Background

To understand the implications made in this cumulative dissertation, a brief review of digital nudging and affordances will be presented in this chapter. This provides a thorough background and foundation in both theories. Based on a detailed description of the past and present scholarly discussions on decision-making and perception, existing research gaps will be presented. The end of this chapter summarizes the similarities between both theories and explains why they are compatible and how they were used to derive contributions in the context of persuasive technologies.

2.1 Behavioral Choice Environments and Digital Nudging

2.1.1 Human Behavior and Decision-Making in Behavioral Economics

Humans make a complexity of decisions every day. Given the amount of information they receive daily, research on behavior and decision-making assumes that individuals can lack rational thinking to handle the number of decisions, which may lead to bad or nonreflective decision-making (Parsons and Browne, 2012). This is based on insights from cognitive psychology and knowledge from the dual-process theory according to which humans deviate from their normative behavior and rational thinking due to their bounded rationality (cf. Stanovich and West, 2000). According to Butterfield (1998), "*by using bounded rationality, humans attempt to create a more manageable mental representation or model of the problem before attempting to solve it"* (p. 35). This suggests that humans are prone to irrational thinking and behavior based on inadequate MMs of reality and information about systems in their environment.

There are two cognitive processes involved in decision-making. They are referred to as system one, which entails quick and automatic cognition without conscious reflection, and system two, which entails slow, deliberate cognition using conscious reflection (Stanovich and West, 2000). The duality of cognitive thinking further describes fluent transitions from one system to the other. The scholar Kahneman (2002) explains that decisions, which require reflective thinking are usually not made based on intuition. Routine or affective decision-making is usually represented in system one. At the same time, system one also contextualizes information for cognitive processing in system two, meaning that it provides impressions of any given situation to inform the reflective thinking in system two (Kahneman, 2002).

Building on the idea of bounded rationality, nudging has shown to be especially effective when decision-making is based on heuristics and biases (Stanovich and West, 2000). Heuristics can be specific to individuals. They are universally applicable and generally improve as individuals train their MMs in terms of gaining experience with certain decisions or developing expertise over time (Tversky and Kahneman, 1974). Biases constitute systematic derivation (errors) from standard behavior or otherwise normative decision-making in choice environments (Parsons and Browne, 2012). More specifically, heuristics and biases are understood as mental shortcuts, which enable intuitive decision-making by reducing the amount of information to enable quicker decision-making at a low cognitive effort (Thaler and Sunstein, 2008). At the same time, mental shortcuts increase the likeliness of unreliable judgements, cognitive errors, or even bias (Parsons and Browne, 2012).

To overcome or utilize system one constraints, the behavioral economics scholars Thaler and Sunstein (2003) proposed the use of choice architects to facilitate and guide (system one) decision-making towards users' preferential choices. They defined nudges as "*any aspect of the choice architecture that alters people's behavior in a predictable way without forbidding any options or significantly changing their economic incentives*", which is "*easy and cheap to avoid*" (Thaler and Sunstein, 2008; p. 6). Thereby, the idea is that every decision is embedded in a context specific environment, also called choice architecture, in which nudges (i.e., choice architects) can be used as interventions to influence the way choices are presented to individuals (Barton and Grüne-Yanoff, 2015). Research shows that nudging interventions can successfully influence decision-making even on a low threshold such as e.g., default settings or adding descriptions in form of additional information (Thaler, 2016). In doing so, nudging interventions can exploit system one constraints by using bias in the choice architecture or animate individuals' system two thinking by stimulating their reflective thinking (Michalek et al., 2016). While nudging based on individuals' cognitive limitations has shown high effectiveness, scholars have more recently emphasized the importance of using nudges to empower individuals and boost their reflective thinking (Sunsetin, 2016; Hertwig and Grüne-Yanoff, 2017). Accordingly, nudges can be categorized as non-educative when their primary goal is to influence non-reflective, intuitive decision-making or educative, when their primary goal is to help individuals overcome their bias by providing information (Sunstein, 2016). Research on human behavior and decision-making has a long history in IS and Human-Computer-Interaction (HCI) research with the focus cognitive structures (Greeno, 1983) and respective influences of cognition on behavior and outcomes of behavior for instance (Davern et al., 2012). Accordingly, nudging is of interest in IS and HCI research, given its focus on guiding behavior and decision-making in virtual environments by influencing cognitive structures such as reflective and unreflective thinking.

2.1.2 Human Behavior and Decision-Making in Virtual Choice Environments

As pointed out, nudging theory originated in behavioral economics and was based on social and cognitive psychology. Therefore, nudging provides an alternative way of influencing behavior as opposed to more intrusive and commonly used measures such as e.g., fines, bans, or

mandates (Thaler and Sunstein, 2008). Both, IS and HCI research communities have established a rich body of knowledge regarding the use of nudging for behavioral modification in the respective disciplines. Virtual choice environments play an important role in shaping and influencing human behavior as they are never neutral and always designed with a (latent) purpose (Burr et al., 2018). In HCI research, nudging is understood as a form of persuasion. The scholar Fogg (2002) defines a persuasive technology as an "*interactive computer system designed to change people's attitude or behaviors"* (p. 1), which may have prompted HCI scholars to position nudging within persuasion research. More specifically, HCI scholars commonly understand nudging as a libertarian form of modifying behavior in virtual environments (Burr et al., 2018). In IS research, nudging was introduced as digital nudging and first defined by Weinmann et al. (2016) as "*the use of user-interface design elements to guide people's behavior in digital choice environments*" (p. 433). To this day critical scholarly discussions revolve around the delineation of IS specific digital nudging and HCI specific persuasive technologies.

The importance of the critical discussions regarding the delineation and ethical aspects of digital nudging in IS research becomes apparent in the empirical domain. Here, design mechanisms to influence decision-making are often mistaken as nudging despite their use of mandates or manipulation. Information Systems scholars emphasize that virtual choice environments are never neutral, given that the way choices are presented can either deliberately or accidentally influence and modify human decision-making (Mandel and Johnson, 2002; Weinmann et al., 2016). This emphasizes the importance of understanding the effects of deliberate digital nudges in virtual environments and avoid accidental influence on human decision-making as a way of reducing freedom of choice. Accordingly, empirical IS research on digital nudging focuses on assessments of the effectiveness of digital nudging mechanisms to influence targeted behavior outcomes such as for instance to improve decision-making about the disclosure of private information on social networks (cf. Kroll and Stieglitz, 2019) or increase online verification conversion rates (cf. Schneider et al., 2017) on platforms. Hereby, research contributions are commonly twofold: namely, (1) designing IT artifacts following IS specific design science research paradigms, and (2) evaluating the effectiveness of IT artifacts. Accordingly, the design as well as potentials of digital nudges to steer decision-making will be explored in this dissertation.

Moreover, while many empirical studies focus on the design and influence of static IS artifacts on (human) decision-making, recent studies also address the ontological reversal of more dynamic relationships between agentic IS artifacts and human agents. The significance of these relationships lies in the distribution of agency towards the IS artifact, which is no longer passive and reactive to the human agent and instead disposes of a set of capabilities (Baird and Maruping, 2021). Such capabilities allow IS artifacts, on a spectrum of agency, to e.g., extend functionalities of enterprise systems through enterprise social bots (ESBs), which proactively engage users to complete certain tasks (Stoeckli et al., 2018). As Burr et al. (2018) point out, interaction in virtual environments oftentimes requires some form of interaction with software agents as facilitators of socio-technical relationships. The authors briefly conceptualize that the "*environment of an intelligent software agent includes the behavior of a human user, and the intelligent agent's goals depend on whether the interacting user performs certain actions*" (Burr et al., 2018, p. 736). While some form of ontological reversal and artifact agency is required to trigger a behavioral response, the level of intelligence can greatly vary between software agents depending on the inscribed autonomy and roles within a given system. Accordingly, potentials of the combination of digital nudges and conversational elements to guide decision-making more interactively in dynamic virtual choice environments will be explored in this dissertation.

As pointed out, a brief review of the relevant theories is necessary to provide a well-grounded background on digital nudging and affordance research, which constitute the core of the two RS presented in this dissertation. Accordingly, the background on affordance theory and its developments in IS research will be presented in the following. First, the focus will be on presenting relevant background on traditional affordance perspectives. This provides a foundation for following discussions on the human elements of perception (i.e., cognition) in affordance research and the actualization of action potentials during continuous socio-technical interaction.

2.2 Affordances and the Perception of Action Potentials

2.2.1 Action Potentials of Physical Objects in Ecological Psychology

The Affordance Theory was originally developed by the ecological psychologist J. J. Gibson (1904-1979) to conceptualize interactions between physical environments and subjects. Taking a closer look at ecological psychology, which was likewise coined by J. J. Gibson and influenced by developmental psychologist E. J. Gibson (1910-2002), is helpful, to understand existing challenges for affordance theory application in other disciplines (Lobo et al., 2018). The basic principles of ecological psychology epistemology can be traced back to four areas of influence being: pragmatism (i.e., radical empiricism, neutral monism), behaviorism, gestalt psychology, and phenomenology (Lobo et al., 2018). For a more detailed description on the mentioned influences see Lobo et al. (2018). In its essence, ecological psychology provides an alternative way of looking at distinct visual perception of individuals. Namely, J. J. Gibson understood visual perception as a process, which does not involve cognition but rather holds a conceptual middle ground between cognitivism and behaviorism (Lobo et al., 2018). In these situations, humans are capable of directly perceiving what physical objects afford them to do in specific environments. Gibson (1979) believed that cues (i.e., information) can be directly perceived in the (physical) environment, which constitutes affordances as only related, and not dependent, on the perception of the subject. Yet affordances are always existing independent of whether they are perceived or not. Gibson (1979) originally defined affordances of the environment as "*what it offers the animal, what it provides or furnishes*" (p. 127) and further indicates that affordances "*have to be measured relative to the animal. They are unique for that animal. They have unity relative to the posture and behavior of the animal being considered*" (pp. 127-128). Both J. J. and E. J. Gibson viewed perception as a dynamic and action-oriented process, based on the idea that perception (vision) and action (haptic space) are interdependent (Gibson, 1966). Further, ecological information perceived in the individuals' environment simply resonates with the individuals' neural organization of the visual input, as Gibson (1966) explains: "*instead of postulating that the brain constructs information from the input of a sensory nerve, we can suppose that the centers of the nervous system, including the brain, resonate to information*" (p. 267).

J. J. Gibson's notions of purposive behavior and characteristics in the environment, which guide the individual's behavior are assumed to have been influenced, among others, by the behaviorism scholar Tolman (1932) (in Lobo et al., 2018). More specifically, the notion of manipulanda in behaviorisms, which is understood as *"visual and tactual size and shape and number and pressure* […] *uniformly indicative of specific sizes and shapes and weights as supporters of motor-possibilities"* (Tolman, 1932, p. 90), is similar to the notion of action-possibilities ascribed in the physical properties of objects or environments (Gibson, 1979). Moreover, Tolman (1932) identifies different characteristics in the environment, which provide behavior-support mechanisms for individuals, if they have the "*capacity for being endowed with, or for acquiring, the correct expectational relationships (perceptual or memorial) between the given sets of immediately presented stimuli and the to-be-expected discriminanda*

(i.e. any set of stimuli the individual has to discriminate before responding) *and manipulanda* (i.e. presented manipulation-possibilities which support motor activities)*"* (p. 91). Further, Tolman (1932) distinguished perceptual from memorial expectations. Namely, in a series of experiments it was shown that there is a difference between perceptual expectation in response to "*goal-stimuli*" and memorial expectation in response to changed environments in which subjects (i.e., rats) were still able to achieve their goal based on preceding stimuli (Tolman, 1932, p. 77). The idea that manipulation-possibilities will always be subjective to the individual in a specific environment strongly aligns with J. J. Gibson, who only adopted the notion of manipulanda in his development of the affordance theory and otherwise developed his own notion of direct stimuli (i.e., ecological information) (Lobo et al., 2018).

The experimental psychologist Greeno (1994) criticized Gibson's sole focus on perceptual information that could directly be perceived and argued for a more holistic view regarding recognized perception as well as direct visual perception. He points out that when analyzing relations between individuals and other systems, naturally, some aspects will "*factor into aspects that can be attributed to the environment and aspects that can be attributed to individual minds*" (Greeno, 1994, p. 337), which does not mean that scholars should disregard one or the other but rather analyze both to provide useful and worthwhile results. This notion has been largely excluded from scholarly discussion in the more recent extensions of the original affordance theory. What has been focused on instead is the notion of action-possibilities ascribed in the material properties of objects. Action-perception describes a reciprocal relationship between an individual and the related environment that dictates the resources or information available for the individual's perception and intentional use (Warren, 2006). Accordingly, in affordances, ecological information in the environment related to the individual is always "*sufficient information of the affordances of the environment as for guiding the behavior of the agents itself*", which also explains "*the rejection of cognitive processing*" (Lobo et al., 2018, p. 6).

While reconstructing the historical influence on and the development of affordance theory even further is not within the scope of this dissertation, a closer look at the scholars who influenced J. J. Gibson in his development of the affordance theory provides interesting fruit for thought. Regarding the schools of thinking, which informed and nourished the grounding concepts of affordances also explains why the affordance theory has been so widely adopted in different disciplines. Lastly, looking at the origin of Gibson's affordance theory also helps to understand perception from an ecological psychology perspective and further informs the importance of extending the concept of perception in virtual environments, where the stimulus always comes from an intentionally designed environment and may require the individual's memorial expectation (cf. Tolman, 1932). As Gibson's ecological approach to perception caught the attention of scholars from many different research fields of psychology, HCI, and design (Wang et al., 2018), affordance theory has been extended in many different areas of research, which likewise introduced different, sometimes even contradicting definitions and inconsistent use of the theory (Lanamäki et al., 2016). Overall, affordance theory is helpful to understand action possibilities of physical objects; however, the original theory was not as easily transferred to virtual environments to provide knowledge about the nuances of perception of action possibilities of digital objects.

2.2.2 Action Potentials of Digital Objects in Virtual Environments

According to the authors Thapa and Sein (2018) affordance theory receives rightful attention in digital contexts, as J. J. Gibson himself developed interests in the research of artificial affordances of objects, which he regarded no differently than affordances of physical objects in the (natural) environment. The transition of affordance theory from physical to digital objects was notably coined by Gaver (1991), a designer who was situated within the HCI research

community and used the affordance theory to understand designs of interactive technologies. He identified four affordance categories to make the design of action possibilities and corresponding existence of perceptual information more explicit (Gaver, 1991). Accordingly, while Gibson (1979) pointed out that affordances are only related to and not dependent on users' perception, Gaver (1991) specified that the design of action possibilities constitutes whether users can perceive affordances or not, and that wrong interpretation of action potentials or lack of perceptual information about existing action potentials can lead to false or hidden affordances. Namely, the existence of perceptual information as designed material properties of an IT artifact can be 1) perceptible affordances (i.e., affordance is there and relevant information about it exists), 2) false affordance (i.e., affordance is not there but information implies it exists), 3) hidden affordance (i.e., affordance is there but information about it does not exist), and 4) correctly rejected affordances (i.e., both affordance and information about it does not exist) (cf. Gaver, 1991).

The cognitive psychologist Norman (1999), also borrowed from affordance theory and applied it to the HCI community to describe affordances as designed properties of a technological artifact in form of real affordances (i.e., built-in physical affordances of an artifact) and perceived affordances (i.e., visual feedback announcing the affordance). Norman (1988) further stated: "*I believe that affordances result from the mental interpretation of things, based on our past knowledge and experience applied to our perception of the things about us*" (p. 219). The scholar Parchoma (2014) specified that users' ability, skills, or capacity influence how they perceive and interpret action potentials; making affordances dynamic structures that only emerge from the relationship between actors and their perception of IT artifacts. Based on a systematic literature review on the affordance theory development in academic manuscripts from Gibson until applications of affordance theory in 2018, the authors Wang et al. (2018) identified Hutchby (2001) as the first scholar who coined the understanding of relational affordances as occupying the middle ground between technological determinism (i.e., technology is only given meaning through an individual's interpretation) and social constructivism (i.e., an individual's behavior is determined by technology). Namely, that affordances are situated in the relationship between actors, material properties of an IT artifact, and contextual artifact use (cf. Hutchby, 2001). In other words, applying an affordance perspective to socio-technical phenomena implies that artifact materiality determines the boundaries of users' action possibilities, while at the same time, affordances exist independent of whether users perceive and actualize them or not.

Eventually, the theory of affordances was also adopted by IS scholars, where it provides a socio-technical view on how technology-mediated environments are perceived and actualized by their users. Compared to HCI, IS scholars only started borrowing from affordance theory in 2005 (Wang et al. 2018). The use of affordance theory in IS covers a variety of different research contexts including e.g., enterprises (cf. Leonardi, 2011), social media (cf. O'Riordan et al., 2012) or public health (cf. Thapa and Sein, 2018). Here, affordances are defined as "*the possibilities for goal-oriented action afforded to specified user groups by technical objects*" (Markus and Silver 2008, p. 622), and the authors' ability to utilize action possibilities is dependent on their individual capabilities or skills (Parchoma, 2014). In other words, possibilities for action depend on the relationship between the individual user and the digital object in the context of IT artifact use to accomplish specific user goals (Thapa and Sein, 2018).

In their assessment of telemedicine use in public health contexts, the authors Thapa and Sein (2018) used an affordance perspective to make IT artifact use patterns more explicit. They identified what they called a trajectory of affordances, which best describes their recollection of the dynamic process from affordance perception, actualization, and adjusted affordances. Additionally, the authors were interested in learning about the ways information about affordances is made available to artifact users, given that affordances exist independent of user

perception and can only lead to targeted outcomes based on their actualization (Pentland et al. 2015). The potential of facilitating conditions in form of any resources to support technology users in their perception and actualization of action potentials was first latently suggested by Strong et al. (2014) and then explicitly addressed in Thapa and Sein (2018). In the process of evaluating the data, Thapa and Sein (2018) identified facilitating conditions (e.g., resources in form of social actors or networks), which users relied on to make IT artifact actualizations possible in the first place. They further specified, that facilitating conditions for the perception of affordances were necessary even in goal-oriented, capable user groups (Thapa and Sein, 2018). This aligns with García et al. (2021), who show that facilitating conditions (i.e., visual animation cues) can positively influence users' perception of smart system performance. In response to Thapa and Sein (2018), who call for more research on the *"forms and roles of facilitating conditions*" to make information about affordances available to users (p. 813), this dissertation explores the potential role of conversational agents (CAs) or enterprise social bots (ESBs) as facilitators of technology affordances. Conversational agents are understood as behavioral intervention technologies, and more specifically as automatic or semi-automatic (rule-based) computer programs, which mimic human behavior in speech and writing (Miner et al., 2016). At the same time, ESBs are understood as automated services that allow casual interactions with complex enterprise systems and processes (Stieglitz et al. 2018).

2.2.3 Understanding Nuances of Perception and Affordance Actualizations

Despite the potential of inbuilt IT artifacts as facilitators of technology action potentials, questions remain regarding explicit conceptualizations of perception in "artificial" affordance contexts as well as factors influencing perception prior to artifact use. The scholar Norman (1988) first suggested that mental interpretations of things, which may influence how things are perceived, are based on knowledge and past experiences. In addition, Greeno (1994) pointed out that recognition processes should be included as a form of direct perception in affordance research. These ideas were picked up by Bernhard et al. (2013) who argue that the perception of affordances is determined by the information individuals are provided with; however, the ability to understand perceptible information of digital objects may require a degree of (mental) effort. Nevertheless, no further information is provided regarding cognitive elements involved in perception. Building on that, in their research in progress, Pozzi et al. (2014) distinguish affordance perception as a process of recognition, in contrast to affordances as a cognitive process of perceiving action potentials from the relationship between actors and other systems. However, Pozzi et al. (2014) do not provide empirical assessments showing how to make affordance perception more explicit. Existing empirical studies on affordances and conceptual articles oftentimes only implicitly address affordance perception. Based on that, new affordance perspectives on affordance perception and actualizations are needed to provide more explicit understandings of adjustments of perception and actualizations from feedback during continued artifact use.

As Warren (2006) states, understanding perception as direct visual cues constitutes boundaries of understanding internal representations of information and cognitive behavior during e.g., continuous action sequences in virtual environments. Given that research is often interested in the reciprocal effects of perception and action in affordance contexts, a more detailed assessment of perception of digital objects in virtual environments is needed. The authors García et al. (2021) present a direct connection between (visually) seeing and (cognitively) perceiving. They show that information presented to individuals can lead to cognitive bias as a form of mental representation of reality, which in consequence influences the perception of how smart systems work. This aligns with knowledge from cognitive research, which establishes that human agents possess mental models (MMs) of reality and physical systems in their environment (Carroll and Olson, 1987; Ramalingam et al., 2004). Mental models can be further distinguished in (1) internal mental representations of information about artifacts as a

way of understanding and making sense of how they work (Yang et al., 2003) or (2) as external representations of information about a system presented to users (Davern et al., 2012). In response to that, MMs are explored in this dissertation to make affordance perception and actualizations in fluid socio-technical relationships more explicit. This will address existing affordance perception gaps in continuous socio-technical relationships.

Mental Models are addressed in e.g., Information Systems Management or Social and Behavior Sciences research to understand and improve, among other aspects, decision-making (cf. Ramakrishnan et al., 2012) or how humans perceive systems in their environment (Butterfield, 1998). In IS research, MMs can be used as a concept for the (internally) constructed representations of relationships, symbols as well as systems (Greeno, 1994). The idea of MM use in IS research is that knowledge representations in systems must be contextualized in the users own MMs based on background and experience first, before they can be used to make sense of the system (Ltifi et al., 2020). In other words, while all users of systems possess some form of MM about a system, the accuracy of these MMs is dependent on e.g., the users' knowledge, level of experience or goals in relation to the system (Bourmistrov, 2017). Accordingly, MMs represent users' understanding of reality and artifacts in that reality even before they are interacting with the artifact. Therefore, MMs are even broader in the sense that they make cognitive processes more explicit regarding the internal mental representation of information as well as external representations or information provided about systems (Davern et al., 2012). Accordingly, the use of MMs in affordance contexts can provide a more explicit understanding of nuances of perception, adjustments of perception and actualization during continued artifact use.

2.3 Compatibility of Digital Nudging and Affordance Theory

Rooting scientific research in theories can provide guidance on how to interpret and explain empirical results as well as give explanations, make predictions, provide design, and action guidelines (Gregor, 2006). Both, digital nudging, and affordance theory provide a lens for viewing and explanting forms of influence on human decision-making and perception in virtual choice environments (cf. Gregor, 2006). While digital nudging describes and predicts how and why users (inter)act with artifacts in socio-technical relationships, it also provides interventions based on cognitive heuristics and biases to change predicted behavior (Combs and Brown, 2018). Digital nudges describe choice architectures designed to influence decision-making. In digital nudging, the presumption is that synthetically designed features are perceivable, which is why the focus lies on guiding users' preferential decision-making during their interaction with digital objects. Affordances are likewise based on descriptions and predictions how people interact with digital objects in socio-technical relationships. Affordance theory describes action potentials digital objects offer to users. In affordances, the focus is on the synthetic cues designed into digital objects to influence perception of action potentials. However, explanations of cognitive aspects of perception to predict or describe changed behavior are still largely missing.

Digital nudging stands on the shoulders of a long history of research on psychology and decision-making, for which Richard Thaler received a Nobel Prize in 2017 to honor his work in behavioral economics. Digital nudging provides a systematic approach based on empirical observations and experiments. The explanations how and why people behave the way they do are based on profound research in psychology, neuroscience, and behavioral economics. While affordance theory has historically been more influenced by varying research streams, such as sociomaterial [imbrication] perspectives (cf. Leonardi, 2011) and socio-technical [generative mechanisms] perspectives (Volkoff and Strong, 2013), it still uses systematic research approaches, which are based on profound research in (ecological) psychology and behaviorism.

This shows that digital nudging and affordances both evolved from aspects of 1) psychology research, which explores (mental) thought processes and their influence on behavior; and aspects of 2) behavioral research, which explores influences on action based on external environments (cf. behaviorism, behavioral economics). Moreover, digital nudging and affordances are about persuasion. In digital nudging, scientific evidence on cognition and brain cycles involved in decision-making processes show how users can be persuaded (not forced or coerced) towards a target behavior. Depending on the context of change, specific interventions techniques are further identified (e.g., timing, reminder, trigger, etc.). Likewise, affordances are focused on how aspects of technology materiality influence perception and persuade artifact use.

The scholar Bunge (1983) explains that the synthesis of two theories can be realized if both study the same system or if one studies a component of the other (in Nevo and Wade, 2010). The rich history of knowledge on cognition and brain cycles in digital nudging research provides a contribution to affordance research, in that digital nudging is a similar but more conceptually stable research field that provides important lessons for affordance research in the aspects of 1) contingencies between cognition and perception as well as 2) contingencies between cognition and behavioral change. Based on the compatibility of digital nudging and affordance theory in the persuasive technology contexts of this dissertation, knowledge from digital nudging is used to highlight potentials for the conceptual extension of perception in affordance theory.

In the following, the research design will be presented in detail.

3 Research Design

Overall, the research design consists of the research approach (3.1) and the methodology (3.2). The latter is further divided in the applied research methods (3.2.1) and data collection and analyses methods (3.2.2). The findings of each research article will be presented in detail in Chapter 4.

3.1 Research Approach

This cumulative dissertation uses a step-by-step approach to direct the focus and structure of its published research articles. As pointed out before, this cumulative dissertation provides status quo analyses, theoretical discussions, and empirical assessments of choice architectures in virtual choice environments (RS1) as well as assessments of perception-actualizations and feedback in socio-technical relationships (RS2). Within these streams individual research articles were planned and carried out. The conducted research articles either build on or extend the findings of previous articles or explore different questions and research gaps within the same research context. The RS and corresponding research articles will be presented in the following.

The first RS consists of two sub-streams, each addressing decision-making in virtual choice environments from a human user-oriented perspective. To begin with RS1.1 establishes the current status quo in digital nudging research and practice. Both A1 and A2 present an overview of digital nudging in IS and HCI. A thorough literature review in A1 combined with a double interview, with the renowned IS scholar Markus Weinmann and HCI scholar Alexey Voinov, provides knowledge about digital nudging and potentials for future developments in each discipline. Additionally, A2 explores ethical considerations that a relevant for the modification of virtual choice environments. The focus of A2 is specially to enrich existing theoretical debates on digital nudging in distinction to persuasion and manipulation. Thereby, A2 contributes calls to action in an IS research field with growing importance and further proposes

that the delineation between digital nudging and persuasion lies in the ethical aspects of nudging.

Building on the established ethical considerations, RS1.2 contributes a digital nudging case study, which addresses user interaction and contact initiation in the context of dynamic socio-technical relationships. In A3, a digital nudge combined with conversational elements was assessed to understand potentials of dynamic socio-technical relationships between IS artifacts and human agents. In a first step A3 asks what technology-sided strategies interview participants use to manage their work and non-work domain boundaries in the homeoffice. In a second step A3 further observes whether conversation-driven digital nudges can guide boundary management strategies on participants mobile devices in the homeoffice. The observation of user interaction with conversation-driven digital nudges provides insights on their potential to influence increased user engagement during continuous artifact interaction. In summary, A3 contributes insights on the dynamic interaction between human users and interactive technological artifacts.

The second RS also consists of two sub-streams, which address perception in virtual choice environments. Accordingly, RS2.1 addresses potentials of built-in IS artifacts to influence affordance perception. Two research articles are published in RS2.1. Both A4 and A5 provide an overview of the status quo on affordance research to highlight existing gaps and motivate empirical scrutiny. The articles contribute first insights on the potentials of conversational agents (in A4) or enterprise social bots (in A5) to facilitate interaction in socio-technical relationships. In A4, a CA is used as an onboarding mechanism to initiate user engagement and their perception of technology action potentials. In A5, potentials of an ESB to mediate communication between enterprise social network users and provide a resource to activate users on the network are identified. Overall, in RS2.1, first insights on the value of dynamic perspectives on sequences of affordance perception, actualization, and feedback processes are gathered.

Building on that, R2.2 focuses on understanding the cognitive aspects of perception to make nuances of affordance perception and adjustments as well as actualization from feedback more visible. Thereby, A6 contributes the concept of MMs to ongoing affordance research discourses and shows that cognitive processes contribute sound explanations for internal (mental) or external information that can influence user perception of digital objects. This builds on Mesgari and Okoli (2019) who find that cognition begins where direct perception of action potentials end, when individuals begin to "*make inferences, and build mental categories and models based on what they initially discover directly about the affordances"* (p. 218). Further, the introduction of cognitive processes in affordance contexts also helps explain changes in perception during continuous user-artifact interaction, when technology action potentials are not directly perceivable, and no other external forces are present. Mental models are an actor-centric concept. However, the value of introducing MMs to affordance research lies in the improved explainability of affordance perception and adjustments and actualizations from feedback to close existing gaps in research. Table 3 on the next page summarizes the published research articles and the corresponding research streams.

Table 3. Published Articles and Corresponding Research Streams

Article	Title	RS1		RS2	
		RS1.1	RS1.2	RS2.1	RS2.2
A1	Status Quo, Critical Reflection and Road Ahead of Digital Nudging in Information Systems Research - A Discussion with Markus Weinmann and Alexey Voinov.	x			
A2	Ethical Guidelines for the Construction of Digital Nudges.	x			
A3	Working from Home During a Pandemic Crisis: The Potential of Conversation-Driven Nudges to Manage Work and Non-Work Domain Boundaries.		x		
A4	Understanding the Affordances of Conversational Agents in Mental Mobile Health Services.			x	
A5	Enterprise Social Bots as Perception-Benefactors of Social Network Affordances.			x	
A6	A Conceptual Model of Feedback Mechanisms in Adjusted Affordances – Insights from Usage of a Mental Mobile Health Application.				x

3.2 Methodology

To begin with, some clarifications are necessary to explain the underlying paradigm, i.e., the concepts and patterns of thought, used to make contributions in this dissertation. The term paradigm is understood as the adopted "*belief system or worldview* [that] *guides the investigator, not only in choices of method but in ontologically and epistemologically fundamental ways*" (Guba and Lincoln, 1994, p. 105). Epistemologies are theories of knowledge used to make sense of the world, whereas ontologies describe how things are and how they work (Guba and Lincoln, 1994) in terms of e.g., structures or properties of objects, which can be used to classify or structure different entities. The paradigm adopted in this dissertation substantiates the proposed research questions and conducted research. Highlighting the paradigm is important to make sense of the research approach and put the findings into context. Most notably, any paradigm will affect the way research is conducted. Accordingly, the underlaying assumption of research conducted in this dissertation is that realities always exist outside of an individual's knowledge and respective perception (Thapa and Haj-Bolouri, 2020). Likewise, knowledge is bias and always bound by the individual's perception of reality as well as observed events in that reality (Thapa and Haj-Bolouri, 2020). Therefore, in the context of perception and behavior in virtual environments the research findings present only snapshots of time and fragments of reality in terms of observable structures.

All research articles in this dissertation are based on a qualitative research methodology, which focuses on exploring or explaining real-world mechanisms or observations (Thapa and Haj-Bolouri, 2020). In qualitative methodology knowledge is intersubjective (i.e., subjective experiences between individuals), meaning that contextualized interpretation of phenomena are at the core of qualitative research (Thapa and Haj-Bolouri, 2020). Table 4 on the next page provides an overview of the used research and data collection methods in the individual research articles. The corresponding theories (Table 4) were explained in detail in Chapter 2. The order of articles presented in Table 4 corresponds to the order of research streams. Articles one through three were conducted as part of RS1 to observe and address challenges and opportunities regarding decision-making in virtual choice environments. Meanwhile, A4 through A6 were conducted as part of RS2 to observe and address perception-actualizations and feedback in socio-technical relationships between human agents and IS artifacts.

Table 4. Overview of Used Research and Data Collection Methods

Article	Research Method	Data Collection Method	Theory
A1	Combination of Literature Review and Interview	Systematic Literature Review	Nudging Theory
A2	Conceptual Research	Systematic Literature Review	Nudging Theory
A3	Case Study Research	Interviews	Nudging Theory
A4	Case Study Research	Interviews	Affordance Theory
A5	Case Study Research	Interviews	Affordance Theory
A6	Case Study Research	Interviews	Affordance Theory

3.2.1 Research Methods

The purpose of this dissertation is to observe when and why some artifacts successfully influence a targeted behavior and understand the influence of human elements on perception and behavior in virtual environments. Therefore, behavioral research was used to conduct the studies. The paradigm adopted in this dissertation does not provide boundaries regarding the types of knowledge addressed in research (Mingers et al., 2013). This grants the freedom to observe knowledge derived from empirical findings of social interaction, physical and virtual environments and (digital) objects in those environments as well as from conceptual research in the IS research discipline.

Non-empirical research is provided by A1, which is based on a combination of a literature review and an interview, as well as A2, which is based on conceptual research. Literature research can contribute a critical review of existing literature on a specific topic and at the same time also reveal new perspectives and opportunities to extend the existing body of knowledge (Boell and Cecez-Kecmanovic, 2014). This was done in A1 titled "Status Quo, Critical Reflection and Road Ahead of Digital Nudging in Information Systems Research - A Discussion with Markus Weinmann and Alexey Voinov", by presenting the status quo of digital nudging research in addition to an interview with relevant scholars to explore future developments in the field. Conceptual research was conducted in A2, titled "Ethical Guidelines for the Construction of Digital Nudges". This article is based on conceptual and analytical reasoning to categorize the existing body of knowledge rather than directly observed events (cf. Dibbern et al., 2004). Here, the existing body of knowledge in IS research served as a foundation to analyze new research objectives (i.e., limitations and ethical concerns) in digital nudging to derive ethical guidelines (A2). In general, non-empirical studies are often focused on descriptive or abstract narratives, however, they can provide theoretical foundations and perspectives (Ji et al., 2007). Both A1 and A2 are focused on rich theoretical discussions and suggestions for the development of the digital nudging definition, based on which conceptual extensions to include ethical considerations are proposed.

In addition to non-empirical digital nudging research, empirical studies were also conducted. Namely, in A3 titled "Working from Home During a Pandemic Crisis: The Potential of Conversation-Driven Nudges to Manage Work and Non-Work Domain Boundaries". The article derives knowledge about the potential of more conversation-driven and interactive IS artifacts to guide decision-making in virtual environments. Here, qualitative interviews were conducted in a case study, followed by an online questionnaire to further explore the case study results. As a research method, case studies are generally conducted in the empirical domain from a behavioral IS research perspective in real-life contexts (Yin, 2002). According to Benbasat et al. (1987), case studies examine a phenomenon "*in its natural setting, employing multiple methods of data collection to gather information from one of a few entities*" (p. 370).

Further, case studies enable state of the art research by exploring "*how*" and "*why*" questions in the context of IS artifacts in the real world (Benbasat et al., 1987, p. 370). Accordingly, case studies are suitable methods to explore open questions and gaps in research and practice, which was the purpose they served in this dissertation. Here, the overall goal was to conduct data on "*specific research issues as well as capturing the contextual complexity"* regarding the phenomena in its real-life environment without any manipulation (Benbasat et al., 1987, p. 374).

To derive knowledge from perception of digital objects in virtual environments and further provide a dynamic perspective and understanding of perception, case study research was also applied in the remaining research articles. Namely in, A4 ("Understanding the Affordances of Conversational Agents in Mental Mobile Health Services"), A5 ("Enterprise Social Bots as Perception-Benefactors of Social Network Affordances"), and A6 ("A Conceptual Model of Feedback Mechanisms in Adjusted Affordances – Insights from Usage of a Mental Mobile Health Application."). In general, case study research needs to address concerns of rigour (transparency), reliability as well as theoretical validity and generalizability (Yin, 1984; Saxena, 2019). Rigour was provided in the conducted research articles through the precision of planning the individual studies and the thorough documentation and interpretation of the collected data. Based on the multiple eye principle, every research article was either carefully discussed and feedbacked among the co-authors or with other researchers. Further, reliability (i.e., consistency or stability of the analysis method) was also provided. As Benbasat et al. (1987) point out, *"the chain of evidence will improve the reliability of the data"* (p. 383). Accordingly, the case studies conducted in this dissertation provide detailed descriptions of the research methods and results, which in turn makes the authors' critical reflections more transparent and improves the readers' understanding of the (subjective) lines of argumentation in a comprehensive way. To ensure theoretical validity and generalizability in the individual research articles, the arguments derived from the data were critically reflected regarding their logical consistency as well as the empirical evidence and their support in relevant literature (Saxena, 2019).

In line with the explorative character of case study research, instead of only focusing on inductive (i.e., developing a theory) or deductive reasoning (i.e., testing an existing theory); retroduction (i.e., sound reasoning about why something happens) and improving the knowledge derived from the observed phenomena based on collected data is the focus of this dissertation (Saxena, 2019). In retroductive reasoning the analysis moves from the empirical observation to drawing plausible explanations in terms of conceptualized statements about the outcomes of events (Saxena, 2019). The research articles (A4 - A6) describe in multiple coding cycles how the results were derived to improve the explanations and theoretical consistency (Saxena, 2019). To control for researcher subjectivity, retroductive reasoning was used either with researchers who co-authored the individual research articles (cf. Frederiksen and Kringelum, 2021) or colleagues who provided joint reflection and thorough discussions about the empirical observations. Furthermore, as shown in one research article (A6), retroductive reasoning can also lead to the development of a new conceptual model or theoretical statements (Saxena, 2019).

3.2.2 Data Collection and Data Analyses Methods

Literature reviews are part of the craft any scholar relies on for the development of a well-rounded research article. Namely, the existing body of knowledge in the literature must be addressed first before new contributions to knowledge can be derived based on what is already known about some phenomenon in research and practice. All published articles in this dissertation initially provided general or systematic literature reviews to understand the status

quo on digital nudging and affordance research and identify adequate gaps to motivate the research. Specifically, A1 and A2 used Systematic Literature Reviews as their data collection method. Article one used the literature review to present the current status quo on digital nudging as the basis to assess arguments made in an expert interview. Article two based the literature review on the framework by Vom Brocke et al. (2009) to examine the status quo of digital nudging research in ethics. The applied framework provides rigor by establishing a structured approach for the identification of the goal and the specification of the keywords and relevant databases for the literature search (Vom Brocke et al., 2009). During the analysis of the identified literature, which usually entails reading the identified literature to learn more about common themes or gaps, categories are used classify the literature. In A2 the identified articles were classified according to the ethical aspects they discussed.

Interviews are a form of data collection commonly used in qualitative research (Jansen, 2010). In this dissertation, qualitative interviews were the most frequently applied data collection method. Specifically, A3 through A6 used interviews as a method to learn about the diversity of member characteristics of a sample in a population (Jansen, 2010). According to Jansen (2010), diversity can either be pre-defined or developed through an open-coding process. In A4, A5 and A6, knowledge was derived using a stepwise approach of 1) getting familiarized with the data and observations during the interviews, before 2) using an open-coding processes to identify relevant aspects of reality, in form of e.g., reoccurring topics or themes pointed out by the participants in the context of each research article. Here the open-coding process structured multiple cycles of interpreting the interview transcripts (unstructured data) and discussing and comparing the identified topics, concepts, or dimensions among the group of authors to make sense of the data (Jansen, 2010). Reliability was provided by thorough documentation and use of multiple coding cycles to provide transparency of the data analysis (Yin, 2014). Further, during the analysis, relationships between different characteristics in the data or patterns could be identified such as e.g., the influence of feedback from IS artifacts on perception and continued artifact use (in A6). Article one consisted of an expert interview on a controversial topic in digital nudging research. The analysis of the interview was part of the discussion of the research article, which is also how reliability of the analysis process was provided.

In A3 qualitative interviews were conducted using the repertory grid method, which is a pre-defined coding approach to elicit the personal mental constructs of reality from the sample (i.e., opinions and attitudes towards work and non-work domain separation strategies). The method consists of the following key aspects: elements, constructs, and links. Elements present the entities on which the interview is based on, and respondents have the freedom to determine similarities and differences between the elements by comparing three elements at a time (triads) (Tan and Tung, 2003). The researcher selects triads during each round and presents them to the respondents, which are then asked to compare the triads by pairing two similar elements in contrast to the third (Latta and Swigger, 1992). In the last step, elements are linked by the respondents on a seven-point Likert scale, which indicates each respondents' interpretation of the similarities or differences between elements and constructs (Tan and Hunter, 2002). This process is continued until no new constructs can be identified. In the case of the repertory grid method, pre-defining the elements provides an interview structure and control in terms of the aspects of reality that are subject of the study. At the same time, the method grants participants the freedom to determine the similarities and differences between the elements based on their personal constructs (Tan and Tung, 2003). During the analysis, the derived constructs from the interviews are used to build meta-categories, which reflect the strategies participants use to manage their work and non-work domain boundaries in the homeoffice. The repertory grid interviews were then followed by a two-week online questionnaire to put the identified strategies and recommendation for action to practice.

The two-week online questionnaire was administered with mostly close-ended questions for the analysis of the structured data provided by participants (Floyd and Fowler, 2002). A digital nudge combined with conversation-driven elements was used as a form of an agentic IS artifact on participants mobile devices to reinforce their individual boundary management strategies. The close-ended questions provided knowledge about the frequency of characteristics (here: frequency of improved boundary management during artifact use) in the sample. Further, the online questionnaire also used open questions and unstructured data, which provided insights about the diversity of characteristics in the sample (here: reasons for bypassing the artifact). While the relatively small sample size in A3 provides limitations in generalizability for a larger population, the results of the descriptive data, which focused on the frequencies of the demographic characteristics as well as context specific information, provided first insights future studies can build on.

4 Results

The results of the published research articles in the cumulative dissertation will be presented in this chapter. First, a summary of the findings in each research article and corresponding research stream will be presented in chapter 4.1. Following that, in chapters 4.2 through 4.5 the key findings in each research stream will be presented in detail. More specifically, 4.2. will present the findings regarding conceptual and ethical discussions on digital nudging. Chapter 4.3 presents the findings on digital nudging towards conversation-driven IS artifact perspectives. Chapter 4.4 presents the findings regarding IS artifacts as facilitators of perception in socio-technical relationships. And finally, chapter 4.5 presents the findings regarding perception and feedback in continuous socio-technical relationships.

4.1 Summary of Findings

Overall, six research articles are included in this cumulative dissertation. Table 5 provides a summary of the findings in each research article. The full research articles presented in Table 5 can be found in the same order in Chapter 8.2, Appendix of this Dissertation. Table 5 also indicates that A1 and A2 correspond to RS1.1 and A3 corresponds to RS1.2. Further, A4 and A5 correspond to RS2.1 while A6 corresponds to RS2.2.

Table 5. Overview of Findings in the Individual Articles

	Title	Article Focus / Main Findings	RS
A1	Status Quo, Critical Reflection and Road Ahead of Digital Nudging in Information Systems Research - A Discussion with Markus Weinmann and Alexey Voinov.	A critical reflection of the status quo on empirical and non-empirical digital nudging research and outlook to future developments. This article identifies existing gaps in digital nudging research and practice such as e.g., instruments and guidelines to put digital nudging to practice.	RS1.1
A2	Ethical Guidelines for the Construction of Digital Nudges	A critical reflection of the status quo on ethical discussions in digital nudging research. This article presents a distinction between libertarian nudges, non-libertarian nudges, and manipulation; and a checklist for ethical considerations to improve conceptual clarity and nudge ethically sound design.	RS1.1

A3	Working from Home During a Pandemic Crisis: The Potential of Conversation-Driven Nudges to Manage Work and Non-Work Domain Boundaries.	An empirical assessment of strategies and challenges to separate work and non-work domains in the homeoffice and potentials for conversation driven nudges as facilitators of boundary management strategies in the homeoffice. This article reveals that conversation driven nudges provide a dynamic and effective way to support individuals in their self-developed boundary management strategies in the homeoffice.	RS1.2
A4	Understanding the Affordances of Conversational Agents in Mental Mobile Health Services.	An empirical assessment of the features and corresponding affordances of a mobile health app from the designers' perspective, which aims to empower teenagers to self-help. This research-in-progress article assesses a mobile health app to identify the designed features and targeted outcome (building user capacity to self-help) users can achieve through perceiving and actualizing the features.	RS2.1
A5	Enterprise Social Bots as Perception-Benefactors of Social Network Affordances.	An empirical assessment of enterprise social bots as built-in IT artifacts on social networks in enterprise contexts. This article reveals that enterprise social bots can act as perception-benefactors, which activate users and influence their affordance perception and consequent actualizations.	RS2.1
A6	A Conceptual Model of Feedback Mechanisms in Adjusted Affordances – Insights from Usage of a Mental Mobile Health Application.	An empirical assessment of user perception and actualizations of a mobile health app to address current limitations in affordance research. This article reveals how nuances of perception and feedback can be made more explicit to improve the understanding of affordance perception especially in continuous socio-technical relationships.	RS2.2

4.2 Digital Nudging and Ethical Design

The critical reflection on the status quo on both empirical and non-empirical digital nudging research in A1 sets a baseline for the remaining digital nudging articles in RS1.1 and RS1.2. Article one highlights the importance of digital nudging in the IS research field given its utilization as a persuasive technology, which aims to increase human welfare based on libertarian paternalistic values. In addition, the interview with the scholars Markus Weinmann and Alexey Voinov enriched the findings by providing outlooks and relevant suggestions on how to close identified gaps in future research. The proposed ideas on how to put digital nudging theory to practice also inform the direction and focus of both empirical and non-empirical digital nudging research in this dissertation. Namely, A1 finds that the development of more concrete design principles will increase the originality of digital nudging as an IS research specific topic. Moreover, A1 suggests the need for more conceptual as well as empirical digital nudging research, which recognizes the definitory aspects of digital nudging in distinction to related research areas in the context of persuasive technology. Lastly, A1 provides concrete examples of how to respond to the proposed ideas in future research, such as for instance the integration of user-centered or participatory digital nudge design models or the development of concrete legitimizing conditions for the design of digital nudges. The latter directly motivated the development of A2.

Namely, A2 focuses on the critical reflection of the status quo on ethical discussions in digital nudging contexts and presents a guideline for ethical digital nudge design in consideration of legitimizing conditions. Altogether, A2 establishes a kind of taxonomy for the distinction between libertarian nudges, non-libertarian nudges, and manipulation. This taxonomy helps improve conceptual clarity of what is considered a digital nudge in IS research in distinction to other forms of persuasion strategies such as e.g., manipulation. Further, A2 highlights the importance of transparency of any digital nudge during influence taking on human behavior. The guideline presents easy resistibility and non-controlling mechanisms, which allow users to opt-out of the modified choice environment, as necessary requirements for digital nudge designs. The guideline also presents legitimizing conditions in cases where non-transparent nudges are implemented during unreflective thinking processes (intuition, impulsive decision-making) of the target audience. Suggested legitimizing conditions require a justification for non-transparency, the disclosure of information as well as requesting user consent for the implementation of nudges. Lastly, A2 identifies non-transparent nudges during reflective thinking processes as manipulative and not permissible for digital nudging implementation in IS research.

As pointed out, more empirical digital nudging research is needed to further reflect on and improve the digital nudging definition and application in IS research contexts. This is accomplished in RS1.2. Article three provides an example of how (ethical) nudge design can be put into practice in response to the call for research proposed in A1.

4.3 Towards Conversation-Driven Digital Nudge Perspectives

Article three first provides an empirical assessment of the challenges and strategies of interview participants to separate their work and non-work domains during the ad hoc homeoffice implementation in the wake of the Covid-19 pandemic. In line with the goal of RS1.2 to address user engagement and persuasion through conversation-driven IS artifacts, A3 then presents an example of an interactive digital nudge design aimed at supporting users in their domain separation strategies.

The interviews revealed that most respondents had difficulty separating domains especially when they used the same technology in both domains. This motivated a follow-up study during which the usability of a self-monitoring software (i.e., Downtime), which uses digital nudging mechanisms and conversational elements to support users in their target behavior, was assessed. Altogether, the Downtime feature explored in A3 integrated a default-setting nudge, label nudges, conversation-driven warning nudges, and decision-staging nudges to support users in their target behavior. The complexity of integrated nudging mechanisms provided a dynamic persuasive system, which influences decision-making at multiple points in time. Further, A3 reveals the potential of conversation-driven nudges as technology-sided tools to support participants in their efforts to manage domains.

More interestingly, the conversation driven nudge successfully engaged users and assisted in the temporal separation of work and non-work domains. The conversation-driven nudge further decreased the non-work domain related disruptions in the work domain, which prompted users to have an increased focus for short periods of time. Lastly, the possibilities to modify the conversation driven nudge based on individualized needs, supported users to establish individualized rules of psychological separation or integration according to personal preferences. Altogether, A3 contributes a practice-oriented example of how to extend traditional digital nudging into more agentic IS design. This provides insights on dynamic socio-technical relationships and digital nudge designs, which are closer to the reality of complex choice environments of today.

4.4 IS Artifacts as Facilitators of Affordance Perception

There are several high-ranking journals (i.e., Journal of the Association for Information Systems, Information Systems Journal), which published affordance theory frameworks based on the critical realist perspective. The focus of existing frameworks, such as e.g., Strong et al. (2014) or Tim et al. (2017) lies on affordance actualizations and feedback rather than perception. While the application of affordance theory to artifact design in the HCI community laid important groundwork for further discussions on the importance of designing artifacts that offer perceptual information to users, to this day, more explicit affordance discourses on perception fall rather short.

In line with the goal of RS2.1 to address affordance perception and actualizations in socio-technical relationships, A4 provides an empirical assessment of the designed features and corresponding affordances of a mental mHealth app from the designers' perspective, which aim to empower teenagers who struggle with mental health related issues to build self-help capacities. Hereby, the mHealth app provides a common example of the use of persuasive design elements to influence users' behavior and attitudes. Article four presents a detailed account of what affordances are and how they are distinguished from features or targeted outcomes of an IS artifact. Altogether, four designed app features (Dashboard, Institutions, Testimonials, Conversational Agent) and one targeted outcome (building user capacity to self-help) were identified in the study. Further, A4 identifies the CA as an in-built facilitator of user interaction and other affordances. Further, A4 provides a brief introduction of the theoretical shortcomings in mHealth adoption research, such as for instance low interaction quality and a missing understanding of user needs and personalized interaction. Additionally, A4 proposes the affordance lens and use of the CA as a facilitator of app affordances in response to existing gaps. Thereby the existing adoption gaps in mHealth research can be addressed by implementing a CA to facilitate the onboarding process during which e.g., the age and the problem identification are assessed to provide individualized information on the app and improve user engagement.

The assessment of app features, affordances, and targeted outcomes presents a static assessment of the IT artifact. Article four does not contribute to the overall dissertation score, however, it provides a baseline for the extension of the short paper in A6, which reveals insights about user perception of the same mHealth app and provides a more dynamic perspective on perception and feedback during continued artifact use. Figure 3 on the next page summarizes the general understanding of affordances in the mental mHealth context on the individual user level, which is also applicable to all other affordance contexts presented in this dissertation.

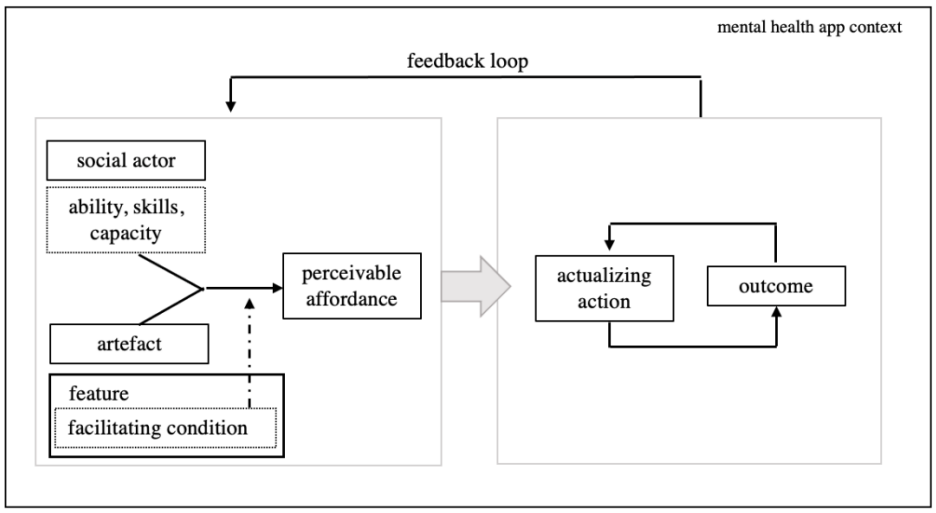

Figure 3. Excerpt A5: Affordance-Perception Framework Based on Evans et al. (2016) and Du et al. (2019)

In the case of A5 a conversational agent (CA) is introduced as a built-in facilitating condition to increase user interaction and actualization of other perceived affordances. Likewise, A5 finds that enterprise social bots (ESBs) can act as perception-benefactors in enterprise social networks to activate and influence user perception and consequent actualizations. In the case of A5, an ESB was implemented as a built-in IT artifact on an enterprise social network to initiate a companywide socializing initiative. More specifically, the ESB mediated lunch dates between employees from different hierarchies or peer groups, which consequently provoked offline interaction between employees. This afforded employees to build second base (social) relationships with their colleagues in a neutral environment, which in turn encouraged an increased post-lunch date familiarity and interaction on the enterprise social network. This effect of ESB mediated offline interaction on the enterprise social network could be identified in the participants changed perception of enterprise social network affordances (e.g., using the network to ask for support) and changed enterprise social network user behavior (e.g., use of new communication channels). Most importantly, A5 reveals a dynamic perspective on affordance perception, actualizations, and feedback, which motivated the following affordance research articles presented in this dissertation. Namely, based on established affordance research by IS scholars (cf. Leidner et al., 2018), A5 reveals affordances in sequence, which can be identified as first- and second-order affordances. The concept of first- and second-order affordances draws on the knowledge that ontologies of human agents and (agentic) IS artifacts constitute dynamic "*multifaceted relational structures*" (Faraj and Azad 2012, p. 254). The ESB and consequent offline networking outcomes identified in A5 constitutes the first-order affordance. The first order outcome influenced user perception and enterprise social network user behavior, which led to second-order affordances. Accordingly, by applying the affordances in sequence perspective, A5 presents a detailed assessment and understanding of dynamic socio-technical relationships as a baseline for the following research in RS2.2.

4.5 Unboxing Nuances of Affordance Perception and Feedback

In line with the goal of RS2.2 to understand the nuances of perception that influence interaction with and use of (persuasive) technologies, A6 addresses affordance perception and adjustments of perception and actualization from feedback in continuous socio-technical relationships. First, A6 finds that the concept of MMs needs consideration as part of the user background in affordance contexts. This enables more detailed explanations of the internal (mental) as well as

external information that can influence affordance perception even prior to user-artifact interaction or when action potentials are not directly perceivable. Further, A6 also introduces the generative base as a concept that grasps the complexity of in-situ conditions necessary for the emergence of affordances at the intersection of an artifact, an actor with a user background, and a specific context of artifact use. Thereby, A6 finds that the generative base provides a more comprehensive understanding of how initial user perception or previous expectations can be adjusted or reinforced during continuous user artifact interaction. More specifically, during continuous cycles of affordance perception, actualization, and feedback, all aspects of the generative base may be adjusted or reinforced. Figure 4 presents the conceptual model, which was developed in A6.

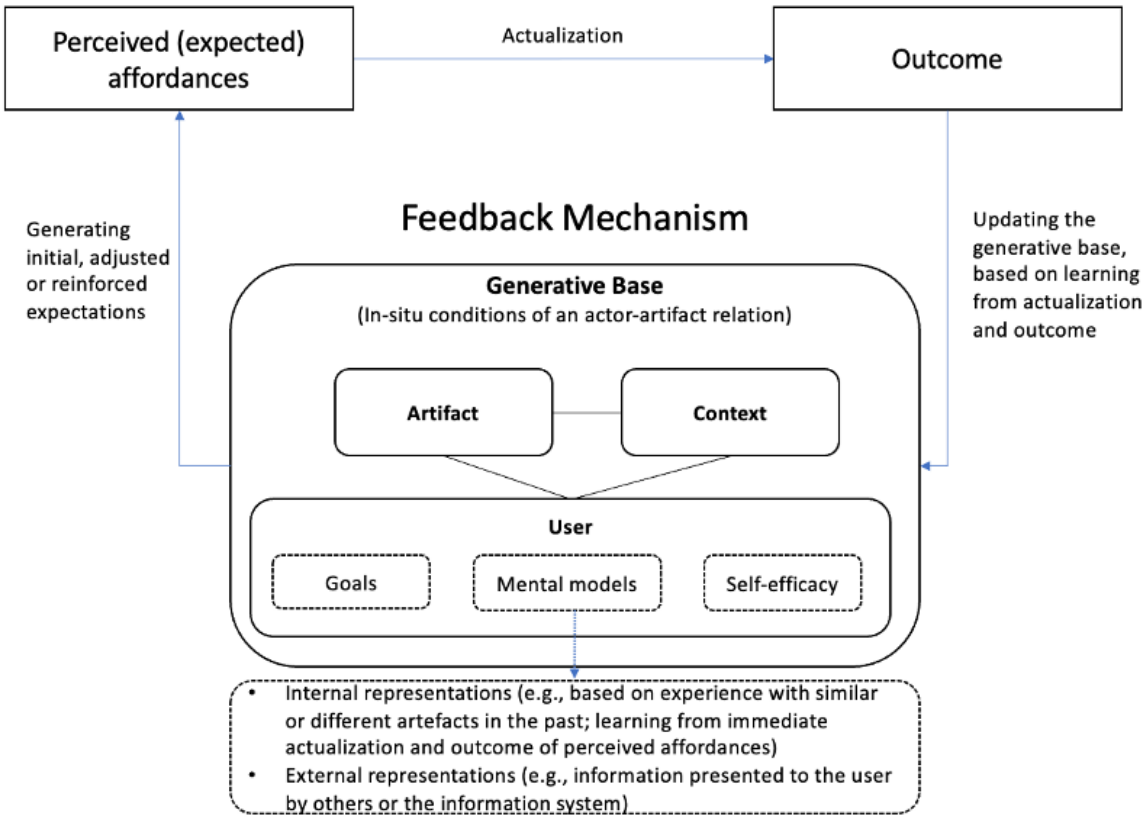

Figure 4. Excerpt A6: Conceptual Model

The conceptual model in Figure 4 presents an extension of the general affordance framework presented in Figure 3. Based on the core principles of affordances, the conceptual model presents perception, actualizations, and outcomes of affordances as the foundation. The conceptual model extends existing affordance models (see e.g., Strong et al., 2014; Tim et al., 2017) by suggesting that the user background includes MMs as a concept in addition to goals and self-efficacy. Additionally, the conceptual model extends existing affordance models by showing that the generative base, which is subject to change during affordance actualization and feedback cycles, encompasses the in-situ conditions required for the emergence of affordances.

5 Discussion

The results presented in the previous chapter will be discussed in the following. More specifically, the discussion will be structured in two sections. In line with RS1, section one focuses on behavior modification on persuasive technology. In line with RS2, section two

focuses on artifact affordances of persuasive technology. The discussion of the results is focused on the overall goal of this dissertation to explicate when and why artifacts successfully influence decision-making and perception. Especially, this chapter elaborates how knowledge from research on psychology and decision-making in digital nudging can influence ideas on psychology and perceiving in affordance research.

5.1 Behavior Modification on Persuasive Technologies

5.1.1 Conceptual Clarity and Ethical Aspects

The research on the conceptual clarity and ethical aspects of digital nudging lays the foundation for conducting research on the practical implementation of individual nudges to influence decision-making. In line with traditional IS research perspectives, the research articles conducted in the beginning of this dissertation addressed virtual choice environments and their influence on human decision-making. In line with IS traditions, these research interests focus on human agency and goal-oriented behavior in virtual environments. While technological advancements and corresponding research interests evolve consistently, A1 and A2 reveal the importance of addressing ethical aspects in the context of behavioral modification systems. To this day, ethical considerations adapt slower compared to the speed of technological advancements they aim to regulate.

First and foremost, A1 shows the need for more conceptual clarity within digital nudging research to improve its conceptual distinction from related research areas. Most importantly, A1 shows that ethical aspects of nudging are rarely mentioned nor considered in the design of digital nudges. At the same time, ethical aspects of digital nudging provide its most predominant distinction from persuasion. This underlines the relevance of considering ethical aspects in conceptual and digital nudging design research. For instance, A1 proposes ethical aspects such as an increased emphasis and explicit understanding of user preferences and transparency in digital nudging design processes to avoid manipulation of users in virtual choice environments.

On the basis thereof, A2 develops an ethical guideline for the design of digital nudges. This nudges designers to reflect and find arguments for their design choices. Further, A2 recommends designers to reflect on their intentions and goals for persuasive technologies and the cognitive thought process they aim to activate in their target group. In this context, cognition is understood as two distinct but interrelated systems of (1) unreflective thinking (intuition) at a low cognitive effort and (2) slow, reflective thinking at higher cognitive costs (Stanovich and West, 2000). While users in unreflective thinking stages tend to make intuitive and bad decisions (Parsons and Browne, 2012), digital nudges can be implemented to guide users through choice environments by engaging their reflective thinking. This can only be accomplished, if designers are mindful of the potential effects design can have on the cognition of users.

More specifically, the ethical guideline in A2 differentiates between the use of transparent and non-transparent digital nudges in regard of the cognitive thinking processes (unreflective, reflective) involved in the decision-making processes of users. Accordingly, users in an unreflective thinking state must always be presented with transparent nudges given their inability to engage in reasonable thinking and reflective decision-making. At the same time, users may be presented with non-transparent nudges during their reflective decision-making stages, if certain legitimizing conditions (e.g., consent, disclosure) are provided, enabling users to willingly resist or engage in the behavior modification. In summary, A2 provides an opportunity for this dissertation to explore different ways of integrating ethical aspects in digital nudging design. The developed ethical guideline provides general applicability and presents

one way of providing legitimization for the design and implementation of digital nudging in virtual choice environments.

5.1.2 Interactive Digital Nudge Design

Based on the ethical considerations and discussions, A3 provides an example of a practical implementation of digital nudges and highlights different aspects to consider when influencing behavior on persuasive technologies.

Along with technological advancements come, among other things, new dynamics and relationships between intelligent technology and human agents. Likewise, calls for research require more dynamic perspectives of agency (Baird and Maruping, 2021). In response to that, A3 sets out to explore conversation-driven digital nudges, which provides persuasive technologies closer to the interactive dynamic of real-life choice environments on the Internet. Namely, A3 shows how the use of multiple digital nudges in one choice environment as well as the consideration of conversational elements in digital nudging can provide an interactive persuasive system, which engages users at multiple points in time and creates a more dynamic way of supporting users in their desired behavior. In the choice environment of A3, users are presented with multiple digital nudging options to create their individualized behavior modification system. Users can opt-in a combination of conversation-driven warnings to impede an undesired behavior with the conversation-driven decision-staging to simplify the desired behavior. At the same time, the combination of the different persuasion strategies, such as making an undesired behavior harder for users while at the same time simplifying the desired behavior, enables users to make their preferential choices at a low cognitive effort. The perspective of conversation-driven digital nudges provided in A3, can support users during their decision-making according to their individual preferences even in dynamic choice environments. The default-setting nudge implemented in the beginning of A3 establishes individual user preferences to avoid manipulation. At the same time, the integration of conversation-driven elements and the use of multiple digital nudges to create a dynamic persuasive system, provides a new perspective that has not yet been addressed in digital nudging research. This shows that dynamic persuasive technologies, which engage and steer behavior at multiple points in time during human-artifact interaction can be effective. Such dynamic elements in persuasive technologies can provide decision-making environments closer to the velocity of decision-making users engage in when navigating the Internet.

To summarize, in response to GQ1.1 to address the scarcity of conceptualizations, A1 and A2 focus on digital nudging literature and conceptual research. In response to GQ1.2, A3 focuses on a practical example and explores the potential of interactive digital nudge design. More specifically, A3 addresses goal attainment through a conversation-driven IS artifact perspective to provide an assessment of digital nudging in dynamic environments. Finally, as RS1.1 and RS1.2 build on each other, Figure 5 on the next page summarizes the digital nudging articles and contribution of RS1. Specifically, Figure 5 highlights the overall contribution of RS1 to prompt user interaction through interactive IS artifacts and in consideration of ethical aspects in digital nudging research.

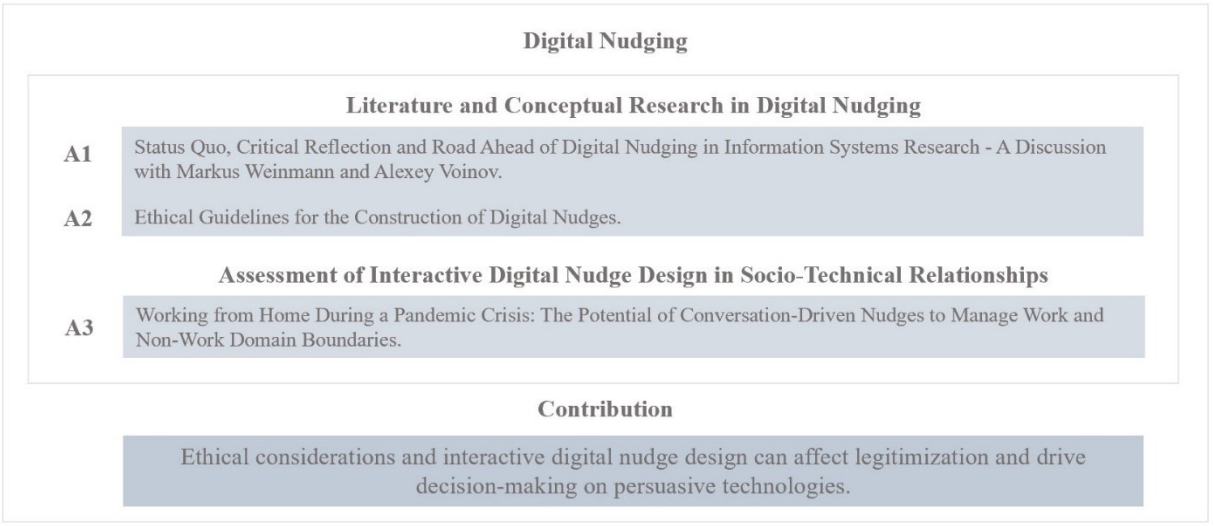

Figure 5. Summary of Digital Nudging Articles and Contributions in Persuasive Technology Research

The digital nudging stream (RS1) provides insights and fruit for thought on the contingencies between cognition and behavior, which also influenced the development of the affordance stream (RS2) in this dissertation. Digital nudging research and its profound empirical evidence show that the cognitive state (reflective, unreflective) a user is in will determine how potentials for artifact use (decision-making) are perceived. Digital nudging research realizes that users will respond differently to cues in their virtual environment if they are in an intuitive, unreflective state of mind than if they are in a reflective state of mind. Designers ought to use this knowledge to implement adequate design mechanisms that can be adequately perceived by users and consequently trigger the desired behaviors. In affordance research, the influence cognition plays on the perception of users, which in consequences influences actualization (behavior) is still a black box. Based on the learnings from digital nudging research in RS1, the affordance research conducted in RS2 addresses two specific aspects. Namely, as presented in the following, RS2 discusses how 1) interactive design can help facilitate affordance perception and 2) how the influence of cognition in affordance perception research can be unboxed.

5.2 Affordance Perception of Persuasive Technologies

5.2.1 Facilitating Affordance Perception

Affordance perception is often briefly described as a form of user awareness, which can be influenced by external information about technology affordances (i.e., signals) or internal information from the artifact itself (i.e., facilitating conditions) (Bernhard et al., 2013). Both, A4 and A5 provide examples of how in-built IT artifacts can be used, among other things, as facilitators to improve the perception of artifact action potentials and their consequent actualization. In alignment with RS2 and in response to calls for more research on the forms and roles of facilitating conditions (cf. Thapa and Sein, 2018), A4 and A5 explore the potentials of conversational agents (CAs) as well as enterprise social bots (ESBs) in different settings.

The assessment of a mental mHealth application for teenagers in A4 focuses on the design and use of a conversational agent (CA) as a facilitator of the app features and user perception. More specifically, in line with existing studies (cf. Thapa and Sein, 2018), A4 focuses on the design and integration of a CA to make app affordances more visible and better perceivable to app users. In general, A4 is more focused on providing a theoretical lens on the potential of affordances to explain and provide implications for mHealth adoption research. The affordance

lens provided in A4 shows that CAs can be used as facilitators of user interaction and perception on a push and pull principle in response to existing adoption gaps. Namely, A4 proposes that by making the app affordances better perceivable (push) and at the same time activating the user to engage with the app (pull), the CA can improve existing adoption gaps such as by improving the perceived interaction quality based on individual user needs and preferences as well as motivating user behavior. Despite the primary focus of A4 to contribute to mHealth adoption research, it also provides an interesting outlook for the practical implementation of mental mHealth adoption. Namely, the use of a CA for teenage users in A4 provides low barrier access to the already difficult subject of mental health, which has been met by an increasing demand especially during the recent Covid19 pandemic (Scarpetta et al., 2021). Here, the design of an artifact and the user engagement can mitigate the inhibition threshold of getting information or asking for help about stigmatized or tabooed topics. Article four provides an example of a persuasive technology that emphasizes artifact design, which utilizes a CA as a social companion and provides a personalized user experience on the app.

In addition to that, A5 likewise applies an affordance lens for the identification of an ESB as a facilitator (here: perception-benefactor) of enterprise social network affordances. More specifically, A5 provides a dynamic perspective of affordances perception, actualizations, and outcomes of affordances. Thereby, from a theoretical affordance lens, A5 focuses on a delineated assessment of affordance perception, actualizations, and outcomes of actualization with the focus on the role and potential of facilitating affordance perception on persuasive technologies through in-built IT artifacts. Moreover, the identification of the ESB as the initiator and facilitator of user interaction on the enterprise social network led to actualizations and consequent offline networking as a first order outcome of the affordance. First order outcomes in turn enabled new perception of enterprise social network affordances such as e.g., relationship building, which let to new actualizations and consequent network diversifications as second order outcomes. In addition, by applying the affordance sequence perspective, A5 provides a dynamic perspective of perception during continued artifact use. Thereby, from a practice-oriented perspective, A5 emphasizes the usability of ESBs on enterprise social networks to increase user interaction and engagement on the network. This can provide a variety of contexts in which ESB use can help facilitate perception of persuasive technology affordances or socializing initiatives in enterprise contexts.

In summary, the use of in-built IT artifacts in affordance context has similar effects like the use of conversation-driven modifications in digital nudging contexts. Namely, the implementation of in-built IT artifacts in A4 and A5 reveals the potentials of CAs or ESBs as facilitators of interaction with and use of persuasive technologies in different contexts. At the same time, A4 and A5 only implicitly provide an understanding of the nuances of user perception. Both articles also suggest that technology affordances and corresponding perception of action possibilities may not only be influenced by the material properties of the artifact but also by sequences of action and continued artifact use, which provides first insights on the mutual flows of action distributed to both material aspects of a technology and human agents. The following study in A6 can build on the suggested dynamics and further address factors influencing perception during or prior to artifact use to make nuances of perception of persuasive technologies more visible.

5.2.2 Cognitive Aspects of Affordance Perception and Feedback

In IS contexts, some aspects of affordance theory (i.e., actualizations, outcomes) have been prioritized, however, it is still not fully understood what constitutes perception of persuasive technologies in IS research and how perception evolves over time. Therefore, perception is rarely further scrutinized and only mentioned as a precondition for the actualization of artifact features in pursuit of specific goals (Bernhard et al., 2013). Virtual environments are designed

with purpose and intention, which generally provides some level of influence on user perception and therefore decreases the likeliness of direct perception (Schneider et al., 2018). Accordingly, especially in regard to the cognitive aspects of perception some questions remain regarding perception of action potentials in situations where (1) perceptual information of digital objects is not directly perceivable or (2) the technological artifact itself influences the perception of users as well as (3) perception can be influenced even before individuals interact with material aspects of a technological artifact or (4) feedback from artifact interaction influences perception and actualization during persuasive technology use.

The human elements that influence perception previously only focused on aspects like individual user backgrounds, goals, or contexts of technology use. Article six shows how mental models (MMs) can be used in affordance research as an additional human element to make nuances of perception more visible. This aligns with GQ2.2 to address cognitive aspects of perception and actualizations during continued artifact use.

In IS and HCI research, MMs are used as a concept of mental representations individuals develop (based on knowledge and experiences) to understand their reality (Greeno, 1994). Further, MMs also provide the understanding that individuals develop mental representations of artifacts as a way of understanding how technological artifacts can be used or how they work (Yang et al., 2003). Accordingly, MMs provide a fitting concept to understand nuances of affordance perception in terms of influence through prior experiences or knowledge from reality or artifacts in that reality. This can influence individual perception of persuasive technology action potentials even prior to artifact use as well as feedback from artifact interaction, which can change individuals' reality or understanding of the artifact.

At last, insights from IS use of the MM concept provides a suitable perspective to uncover underlying cognitive processes to make nuances of affordance perception of persuasive technologies more explicit. Accordingly, in A6 the MMs of mental mHealth app users were assessed during their continued app use. Hereby, A6 reveals the nuances of perception in form of user MMs (i.e., prior experiences with similar artifact, preconceived ideas of how the app works, expectations from prior information about the app), which are the human elements that influence the perception of the app. For instance, A6 highlights that, (false) expectations of the app (e.g., to help acquire psychotherapy) can be based on individual situations or prior information about the app. Prior expectations can be disappointed, if they do not align with the app features. This can have an influence on the overall perception of app features and action potentials during the first interaction with the app. At the same time, A6 shows the significance of adjustments and changes in perception through feedback from affordance actualizations during continued artifact use. Here, only the continued app use may help users overcome disappointment by learning about app features and perceiving new action potentials. Prior expectations can be exceeded, which in turn will have an influence on the satisfaction with the app and the perception of the app features. Both examples show that the use of MMs in the context of A6 reveals not only cognitive aspects that influence perception during persuasive technology use (e.g., confirmed, unconfirmed expectations) but also highlights other human elements, such as the importance of previous (mental) aspects that influence perception (e.g., prior information about the app, experience with similar apps).

Thereby, A6 underlines the importance of addressing cognitive processes during and prior to perception and actualization of technology affordances. This aligns with what is known about cognition in digital nudging research, where the cognitive state a user is in will determine the cognitive resources available to essentially perceive and react to implemented choice architectures. Namely, the mHealth app presented as the research object in A6 is intentionally designed to persuade users' behavior and attitude. However, full use potentials of the app to

help users achieve their targeted behavior may only be achieved if user MMs align with the persuasive technology design.

Figure 6 summarizes the focus of RS2. In response to GQ2.1, A4 and A5 focus on empirical assessments of IT artifacts as facilitators of affordance perception. In response to GQ2.2, A6 focuses on the human elements that influence perception and actualization of action potentials in continuous socio-technical relationships. Finally, as RS2.1 and RS2.2 build on each other, Figure 6 highlights the overall contribution of RS2 to make cognitive aspects and facilitators of perception and feedback more visible in continuous socio-technical relationships.

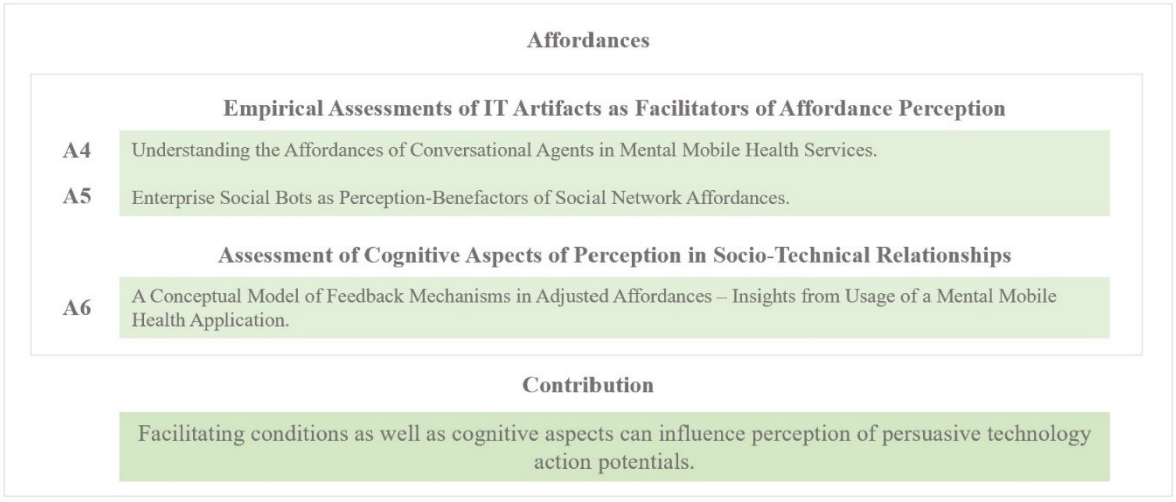

Figure 6. Summary of Affordance Articles and Contributions in Persuasive Technology Research

6 Conclusion

6.1 Summary and Contributions to Knowledge

The influence of persuasive technologies on perception or behavior is at the core of the research conducted in this dissertation. Both topics are explored in two research streams to identify different aspects of persuasive technologies such as (1) the influence of digital nudges on decision-making in RS1 and (2) unboxing different aspects of affordance perception of technology action potentials in socio-technical relationships in RS2. Further, similarities between both research streams were explored and presented as an argumentative base to use knowledge from cognition in digital nudging research to provide new perspectives in affordance research regarding contingencies between cognition and perception as well as behavioral change.

In summary, RS1 presented status quo analyses, theoretical discussions, and empirical assessments of interactive digital nudge design in virtual choice environments. Meanwhile, RS2 presented theoretical discussions and empirical assessments of the role of in-built IT artifacts as facilitators of affordance perception and the potential of MMs to extend the understanding of affordance perception and feedback from actualizations.

Table 6 on the next page summarizes the formulated research streams (RS) corresponding guiding questions (GQ) as well as the individual research questions (RQ) posed in the articles published in this dissertation.

Table 6. Summary of Research Streams, Guiding Questions and Corresponding Articles

Research Stream 1			
RS1.1:	Precise conceptualizations of digital nudging as a subfield of persuasion are scarce.		
	GQ1.1:	How can definitory and ethical aspects of digital nudging be conceptualized?	
		RQA1	What are the varying definitions, design models, and first empirical findings in digital nudging research and what are the potentials for future research in this context?
		RQA2	What is the current state of ethical discussions on nudging and how do the findings transfer to the digital context to provide corresponding guidelines for the design of digital nudges?
RS1.2:	Digital nudges can use interactive designs to elicit user engagement and change decision-making.		
	GQ1.2:	What are potentials of conversation-driven and consecutive digital nudges to influence decision-making?	
		RQA3	What technology-sided strategies do individual employees use to manage their work and non-work domain boundaries in the homeoffice; and can conversation-driven nudges guide boundary management strategies on mobile devices of employees in the homeoffice?
Research Stream 2			
RS2.1:	Technology-mediated interaction with users can influence their perception of artifact action potentials.		
	GQ2.1:	How can built-in IT artifacts such as chatbots facilitate affordance perception?	
		RQA4	What are the affordances of conversational agents in mental mobile Health services for teenagers?
		RQA5	How does enterprise social bot-induced human interaction lead to a change in perception of ESN affordances and actualizations?
RS2.2:	Conceptualizations of affordance perception and feedback can be more nuanced by integrating cognitive aspects.		
	GQ2.2:	How can mental models extend conceptualizations of perception and feedback?	
		RQA6	How can the emergence of affordance perceptions, actualizations, and outcomes be made more explicit to extend the current understanding of adjusted technological affordances?

Part of the overall goal of this dissertation in RS1 was to address the status quo on digital nudging regarding current discussions, the integration of ethical aspects, and conceptual clarity of existing definitions in RS1.1. Here, A1 and A2 contribute conceptual discussions and status quo analyses to address how definitory aspects of digital nudging can be improved in response to GQ1.1. Both articles build on each other. First, A1 provides an overview of the varying definitions and design models. Further, A1 highlights the potentials for future research to contribute more knowledge on ethical aspects of digital nudging to improve its conceptual clarity (RQA1). More specifically, A1 calls for research to develop ethical guidelines on which future conceptual research and digital nudging design research can build. Following that, A2 presents the status quo on ethical discussions in nudging research and shows how the findings transfer to digital nudging (RQA2). Further, A2 derives an ethical guideline for digital nudging, which provides a stepwise approach for designers to integrate ethical aspects in their design processes of digital nudges. In summary, the conducted research contributes to knowledge on

ethical considerations that are necessary when influencing decision-making (by design) on persuasive technologies.

In addition to the status quo analyses and conceptual discussions, the research conducted in RS1.2 contributes a practical example and assessment of digital nudges. Namely, A3 reveals the potentials of conversation-driven IS artifact perspectives towards more dynamic artifact interaction and goal attainment. The contribution of A3 is twofold. First, A3 reveals that blockers, personalized software configurations, separate devices, or spaces, avoiding images or messages, and using context specific software are the technology-sided strategies individual employees use to manage their work and non-work domain boundaries (RQA3). Secondly, A3 reveals the usability of conversation-driven digital nudges to guide employees' boundary management strategies on mobile devices (RQA3). The latter also reveals that conversation-driven digital nudges can engage users and guide their behavior at multiple points in time during the decision-making process, which is closer to the dynamic of everyday choice environments. In summary, this contributes a new perspective to research on dynamic behavior modification on persuasive technologies.

Part of the overall goal of this dissertation in RS2 was to address perception, actualizations, and consequent adjustments from feedback in RS2.1. First, in response to GQ2.1, A4 and A5 reveal the potentials and role of facilitating conditions to improve affordance perception. Both, conversational agents (CAs) and enterprise social bots (ESBs) provide usability as social companions and perception benefactors at low cost and time. They can function as in-built IT artifacts and act as social companions who board users on, in terms of actively engaging users and helping them perceive other technology features and action potentials on mobile applications (RQA4). Further, ESBs can increase peer-to-peer communication in enterprise social networks to support enterprise socializing initiatives (RQA5). Research conducted in RS2.1 reveals respondents' willingness to interact with in-built IT artifacts and their overall positive perception towards CAs and ESBs in persuasive systems. This contributes to knowledge on in-built IT artifacts as facilitators of technology affordances in research and shows their usability to improve user experience or accomplish enterprise goals in practice.

The research conducted in RS2.2 reveals the potential of mental models (MMs) to provide a dynamic perspective on interaction between technology materiality and human agents in persuasive systems. This also extends the understanding of affordance perception and actualization in continuous socio-technical relationships. The use of MMs in A6 integrates human elements in affordance contexts and shows that MMs allow a more nuanced understanding of affordance perception of digital objects in virtual environments prior to or after user-artifact interaction (RQA6). Namely, A6 reveals that MMs, such as prior knowledge about an artifact, information from others about the artifact or prior experiences using the same or similar artifacts, are factors influencing user perception of artifact action potentials. Further, A6 shows how material aspects of a technology can influence perception by making nuances of affordance perception and actualizations during continuous artifact use more visible. This responds to current shortcomings in affordance research and contributes an even more explicit understanding of what constitutes perception and how perception can change from feedback of technology use.

6.2 Implications for Research and Practice

The implications for research and practice elaborate the conclusions that can be drawn from the research results. The research conducted in this dissertation presents the current status quo on digital nudging to influence decision-making in virtual choice environments as well as affordance perception and actualization of digital objects in IS research. Both, decision-making and perception are inherent aspects to determine the effectiveness and influence persuasive

technologies can have in guiding users. The status quo analyses and conceptual discussions in both research streams establish a solid baseline to identify existing research gaps and potential implications for research and practice. The studies conducted on digital nudging improve conceptual clarity as an implication to research. Namely, based on thorough discussions and analyses, ethical guidelines for the design of digital nudges were derived. This provides conceptual clarity for digital nudging and guidance for the design and implementation of behavior modification in persuasive technology design. Moreover, designing and implementing digital nudges based on ethical considerations provides legitimacy for designers and practitioners as an implication to practice. This is especially helpful to close research gaps regarding digital nudging implementations in enterprise contexts (Stoeckli et al., 2018).

Information Systems research is traditionally focused on human-centered perspectives and goal-oriented relationships. As pointed out, more dynamic and technology centered research perspectives emerge given an ongoing automation and popularity of artificial intelligence. Agency is no longer addressed from a strictly human-centered perspective in IS research (Baird and Maruping, 2021). Likewise, behavior modification on persuasive technologies such as digital nudging needs consideration and implementation in more dynamic choice architectures. Based on that, the conducted research reveals the potential of conversation-driven nudges to engage users during their decision-making at multiple points in time. As an implication to digital nudging research, this provides a new perspective and shows how the combination of digital nudges and integration of conversational elements potentially improves the effectiveness of behavioral modification in persuasive systems. Likewise, as an implication to digital nudging practice, persuasive technology designers or decision-makers planning to implement digital nudges to increase public welfare in e.g., sustainability or charity contexts, can build on the conducted research. This can help them combine and develop interactive digital nudges closer to the dynamic character of everyday choice environments.

The practice-oriented implications to affordance research highlight the potential of in-built IT artifacts to facilitate affordance perception. This reveals, that conversational agents (CAs) and enterprise social bots (ESBs) can engage users successfully and help them perceive technology action potentials in pursuit of their individual goals. This improves the usability of apps or enterprise social networks through artifact design as an implication to practice. Further, the research articles also reveal that forms of interactive design through e.g., CAs can be especially helpful to engage younger user groups. The conducted affordance research shows that making affordance perception more explicit also contributes a dynamic perspective in affordance research. Even though the research was focused on the assessment of in-built IT artifacts as facilitators of affordance perception, the results provide research implications in form of detailed descriptions of how outcomes of first-order affordances can lead to second-order affordances. This provides the implication of an affordance in sequence perspective to existing research and presents a more conclusive research perspective on affordances.

Traditional affordance research perspectives focus on affordance actualizations and largely disregard affordance perception (cf., Strong et al., 2014). Consequently, an explicit understanding of affordance perception and the changes of affordance perception and actualizations during the continuous interplay between persuasive technology materiality and human agents is largely missing. In response to that, the research conducted in RS2 pursues the integration of cognitive processes in affordance research to improve the understanding and design of persuasive technology. Namely, concepts from cognitive psychology such as MMs add a new layer of analysis to provide more explicit explanations of factors influencing perception as well as changes of perception during continued artifact use. This provides new research implications to affordance theory, which currently falls short on coherent explanations of affordance perception prior to and during continuous persuasive technology use. In line with that, this dissertation further provides nuanced explanations of affordance perception and

adjustments or reinforcements of perception through feedback. This provides research implications of a more explicit and conclusive understanding of the entire affordance perception, actualization, and outcome cycle, rather than focusing on isolated aspects of affordance theory as often done in research. Hereby, the conducted research in this dissertation shows the interplay between the aspects of affordance theory (perception, actualization, outcome) also in consideration of the human elements that may influence when and how action potentials are perceived.

Providing empirical research to make nuances of perception visible also provides implications to current affordance theory discussions. Namely, scholars have emphasized and discussed the importance and underrepresentation of cognitive aspects of perception in affordance research (cf. Normann, 1988; Greeno, 1994). Especially in the contexts of persuasive technology, the research conducted in this dissertation provides implications for empirical affordance perception research in consideration of cognitive aspects. At the same time, the research conducted on cognitive aspects of perception also provides practical implications. Namely, it can help practitioners understand how users perceive information and how that affects their technology use and perception of situations. The conducted research also shows that e.g., prior knowledge, experiences with similar artifacts, or external information can influence perception. This provides practical implications and considerations for e.g., designers of persuasive technologies.

6.3 Limitations, Critical Reflection, and Opportunities for Further Research

The cumulative dissertation has some overall limitations, which will be pointed out in the following. For one, conversational agents (CAs), chatbots, and enterprise social bots (ESBs) are generally referred to as IT-artifacts in this dissertation. This does not correctly reflect the complexity in terms of taxonomies, definitions, and roles of CAs, chatbots, and ESBs within IS research. Further, the use of qualitative interviews as the data collection method is predominant in this dissertation. While case study research provides flexibility to the researcher, qualitative interviews can cause bias and are not generalizable due to the smaller sample size and the unknown numerical distribution in the population as compared to quantitative studies (Jansen, 2010). The use of quantitative research methods in the context of this dissertation could have addressed these limitations and provided further contributions to IS research. Nevertheless, the case study research conducted in this dissertation provided detailed and rich information about the diversity of the topics within the selected sample as well as the possibility to expand conceptual boundaries to extend existing research (Jansen, 2010).

Further, persuasive technologies are introduced as an aggregate research interest in this dissertation for which both RS set out to conduct relevant studies. The two RS presented in this dissertation predominantly discuss decision-making and perception on persuasive technologies distinct from each other. The use of in-built IT artifacts as facilitators of perception and behavior is the only phenomenon introduced and explored in both RS. More research could have been conducted regarding interconnections and epistemological similarities between digital nudging and affordances on persuasive technologies. For instance, the perception of presented choices in terms of the perceived action potentials a behavioral modification system presents to its users is oftentimes not specifically addressed in digital nudging research. Here, knowledge from affordance research could have been implemented in digital nudging design processes to learn about user perception prior to a behavior modification towards a targeted outcome. Likewise, the assessment of the perceptible, false, or hidden affordances digital nudges may present to users could have also been presented in this dissertation to strengthen the interconnectedness of both RS. Further, the two RS presented in this dissertation do not present a joint contribution

to IS research. Rather, knowledge from cognition in digital nudging research was presented and used to inspire research on cognition in affordance perception research. Thereby, each stream posed individual research questions that were answered during this dissertation project. The individual research articles and their corresponding contributions to research and practice have been thoroughly presented in the Discussion chapter. The critical reflection presented in the following, however, discusses the added value and boundaries of this dissertation as a cumulative work.

As pointed out, the role of in-built IT artifacts (i.e., chatbots) as facilitators of user perception and engagement with technology materiality in digital nudging or affordance contexts provides a similarity between both RS. In line with that, A3 presents the value of implementing conversation-driven elements in digital nudges to increase user engagement. Further, A4 and A5 present the value of in-built IT artifacts as facilitators of perceived technology action potentials. The articles underline the added value of in-built IT artifacts in both digital nudging and affordances to initiate user engagement with digital objects. This proves meaningful in virtual environments, where knowledge from decision-making or perception in analogue environments is not always directly applicable. Virtual environments are always designed with some intention, which is why the perception of choice architectures can vary greatly between individuals compared to regular environments. To this day, affordance literature only partially discusses these differences. Digital nudging research has fully adopted nudging in virtual environments, however conceptual boundaries (ethical considerations), which are predominant in virtual environments are only slowly adjusted. In both RS, these shortcomings have been used to motivate new research perspectives to scrutinize the complexity of (1) ethical aspects of digital nudging in virtual choice environments and (2) human elements of perception of digital objects in affordance contexts. Additionally, (3) chatbots were presented as benefactors or facilitators of how users engage or perceive action possibilities in socio-technical relationships. This can help persuasive technology designers of virtual environments to mitigate the uncertainty of user perception in complex choice environments.

Moreover, this dissertation provides a glance into the future of IS research and new perspectives in digital nudging. Research stream one focuses on decision-making in persuasive technology contexts. The conducted research provides new perspectives on the role of conversation-driven digital nudges in socio-technical relationships. As shown in the conducted research (A3), new perspectives in digital nudging research towards conversation-driven nudges who initiate user interaction potentially provide applicability in dynamic choice environments. Future studies can build on that and introduce artificial intelligence as a potential new actor in digital nudging research. For instance, more dynamic choices environments that learn from user choices and past behavior but at the same time provide conversational elements during which users can confirm their preferences or consent to the influence on their decision-making could be a valuable and promising new dimension in digital nudging research. This corresponds to artifact agency as the ability of technological artifacts to accept e.g., rights and responsibilities for certain tasks and act autonomously (cf. Baird and Maruping, 2021). This can be further explored in future studies based on research that calls for a change of the level of analysis from individual or collective goals to agentic IS artifact goal-orientation (cf. Baird and Maruping, 2021). In response to that, future research can explore potentials of intelligent agentic software to modify behavior based on learning from interaction with human agents. Such implementations require careful considerations to assure their conceptual alignment with digital nudging. This is important given the conceptual boundaries of digital nudging, which require consenting technology users and some form of identification of the user preferences and target behavior prior to the behavior modification. Future research regarding the implementation of intelligent behavioral modification technology can build on the ethical guidelines and legitimizing

conditions developed in the digital nudging stream to integrate ethical considerations in the design process and thereby avoid manipulation.

In addition, RS2 focuses on perception of digital objects in persuasive technology contexts. Traditional affordance research perspectives reveal limitations in the assessment of affordance perception, which in consequence reflects on the explainability of affordances in continuous technology use. While research focusing on affordance actualizations thoroughly explains how e.g., individual level actualizations can have impact on collective level actualizations is well established in this context, future use of the affordance theory may also have to provide even more detailed explanations and empirical evidence of factors influencing change. This dissertation argues that such explanations can be provided based on a nuanced and detailed assessment of perception, actualizations, and outcomes of affordances during continuous technology use. Accordingly, this dissertation proposes the integration of human elements (i.e., cognition) to improve the explanation and understanding of affordance perception. Future research can build on these findings to provide even more empirical evidence for the explainability of affordance perception based on e.g., MMs. The discussion on affordances in this dissertation tackles basic conceptual boundaries regarding perception and unfolding the feedback Blackbox. This provides well-researched groundwork for future discussions of complex affordance contexts in which users *"(or things) have the capacity to act"* and research aims to understand how they sense and actualize (Baygi et al., 2021, p.440). The results provided in this dissertation suggest conceptual extensions and detailed explanations of the reciprocal influence between material aspects of a technology and human elements during continuous interaction. In the future, it will be interesting and necessary to assess, how original affordance principles will too transform.

7 References

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8 Appendix

8.1 List of All Articles Published Until Now

Title and Year	Author(s)	Journal/ Conference	Included in the Dissertation
Social Bots as Initiators for Human Interaction in Enterprise Social Networks (2018).	Christian Meske, Ireti Amojo	Proceedings of the 29th Australasian Conference on Information Systems (ACIS) [short Paper]	no
The Potential Role of Digital Nudging in the Digital Transformation of the Healthcare Industry (2019).	Christian Meske, Ireti Amojo, Akira-Sebastian Poncette, Felix Balzer	Proceedings of the International Conference on Human-Computer Interaction (HCII)	no
Ethical Guidelines for the Construction of Digital Nudges (2020).	Christian Meske, Ireti Amojo	Proceedings of the 53rd Hawaii International Conference on Systems Sciences (HICSS)	yes
Status Quo, Critical Reflection and Road Ahead of Digital Nudging in Information Systems Research A Discussion with Markus Weinmann and Alexey Voinov (2020).	Christian Meske, Ireti Amojo	Communications of the Association for Information Systems (CAIS)	yes
Digital Nudging to Increase Usage of Charity Features on E-Commerce Platforms (2020).	Christian Meske, Ireti Amojo, Peter Mohr	Proceedings of the 15th Internationale Tagung Wirtschaftsinformatik (WI)	no
Enterprise Social Bots as Perception-Benefactors of Social Network Affordances (2020).	Christian Meske, Ireti Amojo	Proceedings of the 41st International Conference on Information Systems (ICIS)	yes
Understanding the Affordances of Conversational Agents in Mental Mobile Health Services (2020).	Christian Meske, Ireti Amojo, Devinder Thapa	Proceedings of the 41st International Conference on Information Systems (ICIS) [short Paper]	yes
Working from Home During a Pandemic Crisis: The Potential of Conversation-Driven Nudges to Manage Work and Non-Work Domain Boundaries (2021).	Ireti Amojo	Proceedings of the 25th Pacific Asia Conference on Information Systems (PACIS)	yes
Affording Twitter in Emergency Situations: The Occurrence of Rumor Sense-Making (2021).	Milad Mirbabaie, Ireti Amojo, Stefan Stieglitz	Journal of Database Management (JDM)	no

8.2 Articles Published in the Cumulative Dissertation (in Order of Research Streams)

Article 1: Status Quo, Critical Reflection and Road Ahead of Digital Nudging in Information Systems Research – A Discussion with Markus Weinmann and Alexey Voinov

Article Information

Title	Status Quo, Critical Reflection and Road Ahead of Digital Nudging in Information Systems Research – A Discussion with Markus Weinmann and Alexey Voinov
Year	2020
Outlet	*Communications of the Association for Information Systems (CAIS) (VHB: C)*
Type	Journal Article
Status	Published
Link	https://doi.org/10.17705/1CAIS.04617

Co-Authorship

Author	Location	Address	E-Mail	Contribution (CRediT)
Christian Meske	Ruhr-Universität Bochum	Universitätsstr. 150, 44801 Bochum, Germany	christian.meske@rub.de	Conceptualization (lead), Data Curation (support), Funding Acquisition (lead), Investigation (equal), Methodology (equal), Project Administration (lead), Supervision (lead), Writing – Original Draft Preparation (equal), Writing – Review & Editing (lead)
Ireti Amojo	Freie Universität Berlin	Garystr. 21, 14195 Berlin, Germany	ireti.amojo@gmail.com	Conceptualization (support), Data Curation (lead), Investigation (equal), Methodology (equal), Project Administration (support), Writing – Original Draft Preparation (equal), Writing – Review & Editing (support)

Alternative Usage

To the best of my knowledge, parts of this paper have not yet been used in other doctoral qualification procedures.

September 13th, 2022

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Date

Article 2: Ethical Guidelines for the Construction of Digital Nudges

Article Information

Title	Ethical Guidelines for the Construction of Digital Nudges
Year	2020
Outlet	*Proceedings of the 53rd Hawaii International Conference on Systems Sciences (HICSS) (VHB: C)*
Type	Conference Article, Full Paper
Status	Published
Link	https://doi.org/10.24251/HICSS.2020.480

Co-Authorship

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Christian Meske	Ruhr-Universität Bochum	Universitätsstr. 150, 44801 Bochum, Germany	christian.meske@rub.de	Conceptualization (equal), Funding Acquisition (lead), Investigation (support), Methodology (lead), Project Administration (lead), Supervision (lead), Writing – Original Draft Preparation (equal), Writing – Review & Editing (support)
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Alternative Usage

To the best of my knowledge, parts of this paper have not yet been used in other doctoral qualification procedures.

September 13th, 2022

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Date

Article 3: Working from Home During a Pandemic Crisis: The Potential of Conversation-Driven Nudges to Manage Work and Non-Work Domain Boundaries

Article Information

Title	Working from Home During a Pandemic Crisis: The Potential of Conversation-Driven Nudges to Manage Work and Non-Work Domain Boundaries
Year	2020
Outlet	*Proceedings of the 25th Pacific Asia Conference on Information Systems (PACIS) (VHB: C)*
Type	Conference Article, Full Paper
Status	Published
Link	https://aisel.aisnet.org/pacis2021/224

Authorship

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Alternative Usage

To the best of my knowledge, parts of this paper have not yet been used in other doctoral qualification procedures.

September 13th, 2022

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Date

Article 4: Understanding the Affordances of Conversational Agents in Mental Mobile Health Services

Article Information

Title	Understanding the Affordances of Conversational Agents in Mental Mobile Health Services
Year	2020
Outlet	*Proceedings of the 41st International Conference on Information Systems (ICIS) (VHB: A)*
Type	Conference Article, Short Paper
Status	Published
Link	https://aisel.aisnet.org/icis2020/is_health/is_health/9

Co-Authorship

Author	Location	Address	E-Mail	Contribution (CrediT)
Christian Meske	Ruhr-Universität Bochum	Universitätsstr. 150, 44801 Bochum, Germany	christian.meske@rub.de	Conceptualization (equal), Funding Acquisition (lead), Investigation (equal), Methodology (equal), Project Administration (equal), Supervision (lead), Writing – Original Draft Preparation (equal), Writing – Review & Editing (support)
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Devinder Thapa	University of Agder	Universitetsveien 25, 4630 Kristiansand, Norway	devinder.thapa@uia.no	Conceptualization (equal), Investigation (equal), Methodology (equal), Writing – Original Draft Preparation (equal), Writing – Review & Editing (support)

Alternative Usage

To the best of my knowledge, parts of this paper have not yet been used in other doctoral qualification procedures.

September 13th, 2022

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Date

Article 5: Enterprise Social Bots as Perception-Benefactors of Social Network Affordances

Article Information

Title	Enterprise Social Bots as Perception-Benefactors of Social Network Affordances
Year	2020
Outlet	*Proceedings of the 41st International Conference on Information Systems (ICIS) (VHB: A)*
Type	Conference Article, Full Paper
Status	Published
Link	https://aisel.aisnet.org/icis2020/social_media/social_media/5/

Co-Authorship

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Ireti Amojo	Freie Universität Berlin	Garystr. 21, 14195 Berlin, Germany	ireti.amojo@gmail.com	Conceptualization (lead), Data Curation (equal), Investigation (equal), Methodology (lead), Project Administration (equal), Writing – Original Draft Preparation (lead), Writing – Review & Editing (support)

Alternative Usage

To the best of my knowledge, parts of this paper have not yet been used in other doctoral qualification procedures.

September 13th, 2022

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Date

Article 6: A Conceptual Model of Feedback Mechanisms in Adjusted Affordances – Insights from Usage of a Mental Mobile Health Application

Article Information

Title	A Conceptual Model of Feedback Mechanisms in Adjusted Affordances – Insights from Usage of a Mental Mobile Health Application
Year	2022
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Alternative Usage

To the best of my knowledge, parts of this paper have not yet been used in other doctoral qualification procedures.

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Date