

Trust in Voice-Based Assistants:
Developing and Testing a Model of Hybrid Trust
Across Technical, Social, and Media Dimensions

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Overview of the Cumulus

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- Paper 5: **Frehmann, K.** (2023). “Buckets of rain!” - Effects of colloquial and formal speech style of a voice assistant on humanness, competence, trust, and intentions to use. In M. Ziegele, A. Kümpel, & T. Dienlin (Eds.), *Beiträge zur Jahrestagung der Fachgruppe Rezeptions- und Wirkungsforschung 2022* (pp. 41–57). DGPK e.V. <https://doi.org/10.21241/ssoar.87698>

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Abstract

Voice-based assistants (VBAs) are a popular form of conversational artificial intelligence (AI) that interact verbally with users and exhibit anthropomorphic traits. Users rely on them for diverse service tasks as well as for information retrieval. Studying trust in VBAs is essential to understanding why users engage with them despite limited control and notable risks related to data privacy, misinterpretations, and unverifiable information. However, existing research lacks consensus on how to define and operationalize trust in VBAs. Given their hybrid character as both technical tools and social interactors, studies have so far applied either technical or interpersonal trust frameworks. A third relevant role, reflecting their role as information intermediaries, has not yet been addressed. This dissertation therefore investigates the central research question:

What is trust in voice-based assistants, and how does it shape user interactions?

Following a literature-based analysis of the technical and social roles of VBAs, the third role of information intermediary is introduced, and a first quantitative content analysis (*Paper 1*) evaluates how VBAs performed in this regard during the Covid-19 pandemic. Based on this, a theoretical model of hybrid trust is developed by integrating technical, interpersonal, and media trust frameworks (*Paper 3*). After outlining methodological considerations for research on Human-Machine Communication (*Paper 2*), the model is empirically tested and refined through three studies: a qualitative content analysis of user comments (*Paper 3*), a qualitative interview study with observed interactions (*Paper 4*), and an experimental online survey using a simulated VBA interaction (*Paper 5*). The dissertation contributes to theory and practice by providing an empirically enriched model of hybrid trust in VBAs, which can inform future research on conversational AI. It also offers implications for theoretical development, empirical measurement, the design of VBAs, and policymaking regarding AI regulation and education.

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List of Abbreviations

AI	Artificial intelligence
CASA	Computers as social actors
Covid-19	Coronavirus Disease 2019
GA	Google Assistant
HMC	Human-Machine Communication
LLM	Large language model
RQ	Research question
SEM	Structural equation model
VBA	Voice-based assistant

1. Introduction

1.1 Background, Goals, and Research Question

Artificial Intelligence (AI) has become an integral part of everyday life. People encounter it in various forms, such as algorithmic recommendations for entertainment content, autonomous modes of transportation, or conversational AI agents that users can interact with directly (Mishra, 2024). Voice-based assistants (VBAs) are a prominent example of conversational AI: they are software agents that receive verbal input and respond with spoken language (Hoy, 2018). Based on machine learning and rule-based processes, they typically have human-sounding names and engage in social interactions (Schaber et al., 2019). Siri, Alexa, and Google Assistant are the most widely known and used VBAs globally. Since the introduction of Siri in 2010 and the emergence of smart speakers in the late 2010s, these assistants have been adopted by a substantial portion of the population (Kinsella & Mutchler, 2020; Taş et al., 2019).

VBAs are used for a variety of functions, most of which relate to service tasks such as controlling smart home devices, but also include retrieving information and news (Kinsella & Mutchler, 2020). Several studies suggest that users perceive VBAs as social entities (e.g., Gao et al., 2018) and integrate them into their daily routines, household practices, and even family structures (Beirl et al., 2019; Foehr & Germelmann, 2020; Sciuto et al., 2018). These findings are unexpected considering the well-documented disadvantages of VBAs. After all, they are products of commercial companies with self-serving interests and have frequently been criticized for their handling of user data and associated privacy concerns (Bolton et al., 2021). Moreover, VBAs are largely opaque technology that provide little transparency regarding their inner workings and use of AI—specifically, how they collect and store user data, learn from it, and generate responses (Schaber et al., 2019). Their reliance on verbal interaction also restricts users’

ability to choose sources or review information independently, in contrast to traditional search engines (Natale & Cooke, 2021). In sum, users have limited control over these assistants and face considerable risks when engaging with them.

The concept of trust may be central to explaining VBA usage despite these risks: trust refers to a person's reliance on an external performance without the ability to ensure or control it, and accounts for why individuals engage in interactions despite the risk of being disappointed (Luhmann, 2014; Mayer et al., 1995). It can be conceptualized as a set of interdependent components, including indicators, consequences, external factors, and a temporal process of developing a trust relationship over time (McKnight et al., 1998). Trust has been studied across various disciplines and is used to explain why individuals engage with other humans, technology, or media (e.g., Lyu & Ferrin, 2018; Pavlou, 2003; Tsfaty & Ariely, 2014). As interactions with VBAs also entail risks rooted in a lack of privacy, transparency, and control over their performance, users may place their trust in VBAs to mitigate these risks and render interactions more acceptable.

Prior research on trust in VBAs has already provided insights into predictors of trust (e.g., Baughan et al., 2023) and its potential consequences (e.g., Acikgoz & Vega, 2022). However, these studies rarely offer a comprehensive conceptualization of trust that captures its multiple components. More importantly, an emerging debate about which perspective on trust is most appropriate for VBAs further challenges existing approaches. VBAs are particularly relevant to the field of Human-Machine Communication (HMC), an interdisciplinary domain concerned with communicative interactions involving technology (Etzrodt et al., 2022; Hepp & Loosen, 2023). Within HMC, conversational agents such as VBAs are understood not merely as media channels, but as active communicators, that are perceived as hybrid entities, unifying a technical and a so-

cial dimension (Etzrodt & Engesser, 2021; Guzman & Lewis, 2020). Accordingly, a hybrid combination of trust frameworks reflecting these dual roles appears particularly suitable, which has already shown empirical relevance in an initial study (Weidmüller, 2022). However, given that VBAs are increasingly used as information providers, a third trust framework rooted in communication science and oriented toward media trust also demands attention, as it may explain why users engage with and rely on information provided by VBAs (Natale & Cooke, 2021; Weidmüller, 2022).

Until now, no theoretical or empirical efforts have been made to integrate the three perspectives on trust in VBAs or to examine the interrelations between the corresponding trust frameworks. However, the theoretical advancement of hybrid approaches to conversational AI such as VBAs and their empirical validation are essential for understanding how users engage in interactions and build relationships with these emerging AI agents (Etzrodt et al., 2022; Greussing et al., 2022). This dissertation addresses that research gap by pursuing three key goals: (1) to determine what VBAs are and which of their roles are relevant for their investigation; (2) to develop a theoretical model of trust in VBAs that accounts for these roles and integrates relevant interdisciplinary trust research; and (3) to empirically investigate and refine this model. To do so, the dissertation addresses the central research question:

What is trust in voice-based assistants and how does it shape user interactions?

1.2 Research Program and Relevance

To answer this question, five papers have been written as part of a specific research program. This program includes both theoretical and empirical work, employing a methodological triangulation of various quantitative and qualitative methods to approach and examine trust in VBAs from multiple perspectives. The five papers are ei-

ther published or have been submitted to academic journals and address specific research questions derived from the central question. The research questions (RQs) are as follows:

- 1 *What are voice-based assistants, and what roles do they fulfill?*
- 2 *How can trust in voice-based assistants be theoretically conceptualized?*
- 3 *What empirical evidence supports the theoretical model of trust in voice-based assistants?*
 - 3a *Which methods are best suited for examining trust in voice-based assistants?*
 - 3b *What indicators of trustworthiness influence the formation of trust in voice-based assistants?*
 - 3c *How is trust in voice-based assistants developed over time?*
 - 3d *What are the consequences of trust in voice-based assistants?*

The research program begins with an introduction to the *research subject* of VBAs and defines the roles they take on (RQ1). To achieve this, a literature review on research concerning VBAs is provided in order to derive their three roles, which correspond to a technical, social, and media dimension. As research on their performance in this latter dimension remains limited, particularly from the perspective of communication science, a quantitative content analysis of various VBAs' answers was conducted, focusing on questions related to the Covid-19 pandemic. The results are presented in *Paper 1* and offer valuable insights into this under-researched role.

Building on the identification of these three roles, a first *theoretical model of hybrid trust* in VBAs was developed (RQ2). An interdisciplinary literature review and theoretical considerations from three distinct trust frameworks form the basis of the model, integrating perspectives from social and technical sciences, as well as communication science. The model not only addresses trust itself, but also incorporates trustworthiness indicators, trust's consequences, additional external factors, and the temporal process of

developing a trust relationship. This model serves as the foundation for the subsequent empirical investigations. Its development and various components are documented in the theory section of *Paper 3* and elaborated upon in this synopsis.

To investigate and refine the model (RQ3), firstly, the *methodological specifics* of studying interactions between humans and socially acting technology are examined and systematized in *Paper 2* to design a triangulation of qualitative and quantitative methods. Next, *empirical investigations* of the model's components and their interrelations were carried out: A *qualitative content analysis of online comments* on VBAs was conducted to examine signs of trust in user statements and further refine the model. The results are presented in *Paper 3*. Findings were extended through qualitative interviews with users of VBAs in domestic settings including observations of interaction tasks, to gain additional insights into the applicability of the model and users' concepts of trust in VBAs. The results are presented in *Paper 4*. Finally, a *quantitative experimental survey* was conducted to investigate causal relationships between VBA features, indicators of trustworthiness, trust, and consequences. The results are presented in *Paper 5*. Figure 1 illustrates the research program and indicates which paper corresponds to each step.

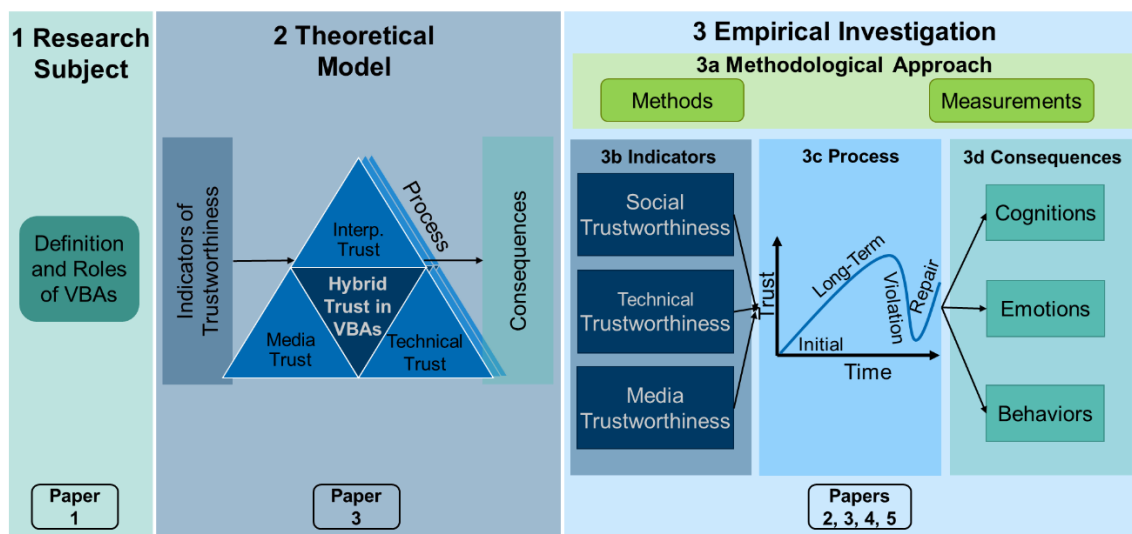


Figure 1. Research Program

The relevance of this dissertation can be outlined across four distinct dimensions: From a *theoretical* perspective, it offers a novel contribution to the understanding of trust in VBAs as new conversational partners based on AI. For the first time in research on conversational AI, this project integrates a media trust approach with social and technical trust frameworks. In doing so, the dissertation directly responds to calls for further theoretical advancement in HMC, advancing research that fully accounts for the hybrid nature of communicating technology and moves beyond constructs drawn exclusively from interpersonal or technical contexts (e.g., Etzrodt et al., 2022).

Communication science equally benefits from this work, as it contributes its own theoretical perspective to a multidimensional conceptual framework of trust, thereby enhancing the discipline's relevance in interdisciplinary research on AI, while generating empirical insights that can be transferred back to journalistic media, which itself increasingly faces AI-driven transformations (Lewis & Simon, 2023; Thurman et al., 2019). Finally, this dissertation advances the general understanding of human relationships with socially acting technology that serves as information provider, using VBAs as a concrete empirical case. As such agents continue to gain relevance in everyday life, multiple disciplines within the social sciences will increasingly focus on them as research objects to explore how users build trust and relationships with AI.

Empirically, the dissertation holds particular relevance, as it not only proposes a theoretical model but systematically develops and refines it through empirical investigation and testing of the proposed relationships. The resulting revised model, along with its underlying assumptions, provides a foundation for future research to further explore trust in VBAs and to extend these insights to upcoming developments. Given the volatility of current products and rapid pace of technological progress (Etzrodt et al., 2024;

Frehmann et al., 2023), with significant capability leaps already forecast for 2025 (Kotajlo et al., 2025), it is likely that new AI assistants relevant to trust research will emerge in the near future. This dissertation offers initial considerations regarding the transferability of the model to future agents—particularly in light of a new generation of voice assistants beginning to take shape (Frehmann et al., 2026).

In addition, the dissertation makes important *methodological* contributions by addressing the specific opportunities and challenges of conducting HMC research on VBAs. The mixed-methods design developed here, incorporating methodological triangulation, offers a first systematic approach to studying trust in VBAs and can serve as a blueprint for future investigations. Limitations and recommendations for future empirical work are discussed and offers guidance in this growing field.

The dissertation’s *practical relevance* arises from both its theoretical framework and empirical findings, which offer direction for *providers* of VBAs in the design and development of their products. Since trust is assumed to be a central factor in product use and relationship development, providers will be interested in actionable insights on how to foster and strengthen trust among potential users. At the same time, the work carries *political relevance*, as it underlines the importance of users making informed decisions about their use of VBAs and to build trust based on factual information rather than on unintended persuasive effects. This is particularly significant for VBAs, whose voice interaction is known to be more persuasive and influential on users’ social perceptions than text-based chatbots (e.g., Anderl et al., 2024; Cho et al., 2019), introducing emotional elements to information retrieval that may undermine users’ autonomy and control (Natale & Cooke, 2021). Regulatory interventions to protect and educate users might therefore be considered, and can be informed by the theoretical and empirical insights offered in this dissertation.

1.3 Structure of Synopsis

The dissertation consists of this synopsis and the five research papers. To answer the research questions, the synopsis closely follows the research program and summarizes the five papers (corresponding chapters indicated in parentheses), while also reviewing current research and theory on the respective topics:

- *Research subject*: The synopsis begins with an introduction to the research subject of VBAs, deriving the three relevant roles of technical tool, social interactor, and information intermediary, and discusses the state of research on all three roles. This is followed by the summary of *Paper 1*, which provides specific new insights into VBAs' role as information intermediary (Chapter 2.4.2).
- *Theoretical model*: The synopsis then introduces the concept of trust and three trust frameworks corresponding to the roles of VBAs, before deriving the theoretical model of hybrid trust in VBAs in accordance to *Paper 3* (Chapter 3.3). It is supplemented by a review of the current state of research on trust in VBAs.
- *Empirical investigation*: The synopsis then summarizes the empirical investigation of the theoretical model. After discussing possible methodological approaches to the topic, as systemized in *Paper 2* (Chapter 4.1.1), and the chosen method-mix of the dissertation, the results of a qualitative content analysis in *Paper 3*, qualitative interviews in *Paper 4*, and quantitative experimental survey in *Paper 5* are presented (Chapter 4.2).
- *Discussion, Implications, and Conclusion*: Finally, the dissertation presents a detailed discussion of the empirical findings and outlines limitations. It further identifies implications for refining the theoretical model, discusses additional considerations for research on a new generation of voice assistants, and summarizes the project's central contributions before drawing a final conclusion.

2. Voice-Based Assistants

This chapter provides the conceptual foundation for answering RQ1 by defining what voice-based assistants (VBAs) are and outlining how they are used and perceived by users. Based on this, three central roles—VBAs as technical tools, social interactors, and information intermediaries—are derived and examined through a review of interdisciplinary research. To address a notable gap concerning the third role, the chapter also includes an empirical study conducted in *Paper 1* that systematically evaluates how VBAs perform as information providers during the Covid-19 pandemic (Chapter 2.4.2).

2.1 Research Subject

Voice-based assistants (VBAs) are software agents designed for verbal interaction with their users and can be installed on mobile or stationary devices, such as smartphones or smart speakers (Schaber et al., 2019). They are particularly known for their anthropomorphism, meaning their presentation of social cues that imitate humans, including human names, voices, and behaviors (Mou & Wu, 2023; Wagner & Schramm-Klein, 2019). Because they are based on various (early) artificial intelligence (AI) processes and interact primarily in a dialogic manner, they are categorized as communicative or *conversational AI agents* (Guzman & Lewis, 2020; Hepp et al., 2023; Mou & Wu, 2023; Natale & Depounti, 2024).

Prior studies have also referred to them as intelligent personal assistants (e.g., Ki et al., 2020), conversational agents (e.g., Resendez et al., 2023), mobile virtual assistants (e.g., Guzman, 2019) or simply voice assistants (e.g., Natale & Cooke, 2021)—a term that earlier papers of this dissertation also used (*Papers 1, 2, 5*). In this synopsis however, the more specific term *voice-based assistant* will be used, as recent work in the field of HMC research has settled on this terminology (e.g., Etzrodt et al., 2022;

Fortunati et al., 2024; Rijhwani & Edwards, 2023; Vitak et al., 2023). The term emphasizes that these assistants' primary interaction mode with users is voice-based, thereby distinguishing them from a new generation of originally *text-based* chatbots built on more advanced AI processes such as large language models (LLM), which only recently began to offer voice interaction as well, for example ChatGPT's voice mode or Gemini Live (Hsiao, 2024; OpenAI, 2023). This dissertation project focuses primarily on the first generation of traditional *voice-based* assistants and uses the term VBA exclusively to refer to these agents.

The most popular VBAs in Germany and worldwide are Amazon Alexa, Apple Siri and Google Assistant (ARD & ZDF, 2020; Kinsella & Mutchler, 2020), all operated by three of the five Big Tech companies dominating the digital market (Birch & Bronson, 2022). Approximately 30% of worldwide internet users engage with VBAs at least weekly (We are social & Meltwater, 2024). Due to the widespread use of smartphones, VBAs are accessible to the majority of people in Germany (Arnold et al., 2019), although only around 25% of the German population actively use them on these devices (ARD & ZDF, 2020). VBAs are also commonly used in stationary form via smart speakers, such as Amazon Echo or Google Home. Adoption rates are similar to the mobile figures, with different studies reporting ownership rates between 15% and 26% among German adults (Hölig et al., 2022; Kinsella, 2021b). These figures are lower compared to English-speaking countries such as the US or UK, where 24% to 38% of the adult population are reported to own a smart speaker (Kinsella, 2021a, 2021b, 2021c; Newman et al., 2022), or compared to European countries such as the Netherlands, where 34% of Dutch families are reported to own one (Wald et al., 2024).

VBAs are primarily used as voice interfaces for assistance tasks that could also be performed manually, such as playing music, controlling smart home devices, or setting timers and alarms (Arnold et al., 2019; Kinsella & Mutchler, 2020). However, more interactive tasks such as requesting information are also common. Users frequently ask general questions, request information on specific topics, or inquire about current news, which accounts for a considerable share of total usage (Arnold et al., 2019; Newman, 2018; Newman et al., 2019, 2020; Taş et al., 2019). Especially during the Covid-19 pandemic, VBAs were used to stay informed about the evolving situation (NPR & Edison Research, 2020; Strathmann et al., 2021; Viehmann et al., 2022).

Summarizing the defining features and use cases of VBAs, three distinct roles emerge as particularly relevant. First, they serve as technical tools, grounded in AI technology and functioning as interfaces for general assistance tasks. Second, they act as social interactors, engaging users through dialogic interaction and employing anthropomorphic features. Third, they function as information intermediaries, delivering news and providing information on various topics independently. The following chapters offer an overview of the existing research on each of these roles and summarize *Paper 1*, which addresses a research gap concerning the information intermediary role.

2.2 VBAs as Technical Tools

VBAs' role as technical tools is grounded in their fundamentally technical nature. As a software application presented as conversational AI agents, VBAs rely heavily on *technical infrastructure*: For one, each assistant is bound to a physical device that delivers its voice output, such as a smart speaker or a smartphone (Schaber et al., 2019). While VBAs can perform functions embedded in their own software, they often serve as interfaces to control the device or its connected services. For example, smart speakers are frequently integrated into smart home systems, which digitize home appliances and

utilities. In such cases, the VBA functions as a voice-controlled interface for operating these appliances (Krol & Boßow-Thies, 2020). As mobile applications, VBAs may also be integrated into the operating systems of smartphones or other mobile devices, where they are often pre-installed and available without requiring additional downloads (Arnold et al., 2019). Users can then employ these app-based VBAs to operate the device or control other applications via voice (Taş et al., 2019).

The technical nature of VBAs also lies in their reliance on various *automation processes*, classifying them as AI (Kaplan & Haenlein, 2019). To enable voice interaction, VBAs utilize *natural language processing* (NLP). A VBA constantly listens for a “wake word” to activate recording of the user’s voice input (Polyakov et al., 2018). Using speech recognition, this input is converted into digital text, which is subsequently analyzed through natural language understanding to identify the user’s actual request (Schaber et al., 2019). For instance, the command “Hey Alexa, should I take an umbrella with me today?” is interpreted as a request for the current weather forecast, even though the word “weather” is not explicitly mentioned. The agent then processes this request by retrieving weather information for the user’s location and generates an appropriate response. Through text-to-speech and speech synthesis, this text-based response is converted back into audio and delivered to the user (Schaber et al., 2019; Solaimalai et al., 2024). All NLP processes—speech recognition, natural language understanding, and natural language generation—are executed online on the providers’ servers and cloud infrastructures (Polyakov et al., 2018; Schaber et al., 2019), which is why VBAs require an active internet connection to operate.

Machine learning is another crucial technology that VBAs employ to enhance both NLP and the personalization of responses. VBAs learn from prior input to develop

an understanding of their users, their voices, and their interests, allowing for more personalized interactions and more satisfying answers (Kaplan & Haenlein, 2019). However, the ways in which VBAs learn, store, and use user data, as well as how they retrieve and process information to generate responses, largely remain opaque to users (Natale, 2021). As a result, VBAs function as black boxes that do not disclose their AI decision-making processes (Pieters, 2011).

Research addressing the technical role of VBAs is primarily situated within *technical disciplines* such as engineering and computer science. For instance, NLP is continually being refined to address persistent challenges, including interpreting vague expressions, tonal variations, and diverse phrasings (Solaimalai et al., 2024) as well as improving the accuracy of NLP models in specific contexts such as fast-food ordering (e.g., Uke et al., 2024). In general, the AI capabilities of traditional VBAs are still considered error-prone, heavily reliant on users mentioning specific keywords, and in need of further advancement regarding context memory and personalization efforts (Johri et al., 2021; Mahmood et al., 2025).

The technical nature of VBAs is also relevant in studies examining factors that drive user *acceptance and adoption* of these assistants. Many of these studies are grounded in the Technology Adoption Model (TAM) or the Unified Theory of Acceptance and Use of Technology (UTAUT). The scope of these investigations varies considerably, focusing on different devices such as smart speakers (e.g., Kim et al., 2024), specific application contexts such as education (e.g., Octavia & Nugraha, 2024), or particular user groups such as individuals with disabilities (e.g., Hwan Jin et al., 2025) or various age groups (Zhong et al., 2024). Across these studies, typical technology adoption drivers are consistently found to apply to VBAs and positively influence

users' acceptance and use of these assistants, including ease of use, perceived usefulness, expected performance, social influence, and trust (Acikgoz & Vega, 2022; Hwan Jin et al., 2025; McLean & Osei-Frimpong, 2019; Octavia & Nugraha, 2024; Xiong et al., 2024; Zhong et al., 2024).

2.3 VBAs as Social Interactors

VBAs are typically designed with *anthropomorphic features*, imitating human behavior and communication. Providers market them as personas with human-sounding names such as Alexa or Siri and assign them personalities, emotions, and behaviors: “Alexa lives in the cloud and is happy to help anywhere there’s internet access [...]” (Amazon, n.d.). Through NLP, VBAs simulate human language, speech styles, and voices, and they are programmed to engage in social behaviors such as being polite, making small talk, or telling jokes (Hoy, 2018; Mou & Wu, 2023; Wagner & Schramm-Klein, 2019). Users respond accordingly: consciously they personify VBAs and compare their relationships with them to friendships or family bonds (Foehr & Germelmann, 2020; Gao et al., 2018; Purington et al., 2017). Subconsciously users adapt their own communication style to that of the VBA (Horstmann et al., 2024) or spontaneously respond with insults or expressions of frustration when irritated, also known as “blurting” (Rijhwani & Edwards, 2023).

Nevertheless, users generally remain aware that they are not interacting with a real person when communicating with a VBA (Etzrodt & Engesser, 2021; Guzman, 2019). Most people perceive VBAs as a *hybrid category* of “personified things” (Etzrodt & Engesser, 2021, p. 73) that are neither fully human nor fully inanimate. This perceived hybridity makes VBAs particularly relevant subjects in the interdisciplinary field of Human-Machine Communication (HMC), rooted in communication science, and shaped by contributions from different social sciences, humanities, and engineering

disciplines (Etzrodt et al., 2022; Hepp & Loosen, 2023). HMC focuses on communicative interactions between humans and agents and understands technology not merely as a channel facilitating communication between humans—as is the case in Computer-Mediated Communication—but as active communicators that users deliberately address and engage in conversation with (Etzrodt et al., 2022; Guzman & Lewis, 2020).

HMC research on communicative interactions with VBAs is typically grounded in the *computers as social actors (CASA)* paradigm. According to CASA, people perceive technology that presents anthropomorphism and social cues as social actors and treat them with according social norms (Nass & Brave, 2005; Nass et al., 1994). Originally investigated in the 1990s, researchers found evidence that social norms such as politeness or gender stereotypes apply to interactions with computers when these exhibit human-like characteristics (Nass et al., 1994). This phenomenon may be explained by the notion that people react mindlessly to socially acting technology (Nass & Moon, 2000) or by the assumption that such behavior is an automatic response rooted in humanity’s evolutionary “old brains” confronted with “new media” and technology (Reeves & Nass, 1996). However, no definitive explanation for this behavior has yet been established.

CASA has been extensively investigated and confirmed for VBAs. Users perceive VBAs as social actors and develop evaluations, emotions, behaviors, and even relationships toward them due to their anthropomorphism. In particular, the human-like qualities of VBAs’ voices influence user evaluations: users tend to evaluate VBAs more positively when they communicate via voice rather than text (Cho et al., 2019; Rzepka et al., 2022), when they use human-sounding voices instead of artificial ones (Chérif & Lemoine, 2019), or when they employ an emotionally engaged, “smiling” tone rather

than a neutral tone (Torre et al., 2020). Gender stereotypes have also been found to apply to gendered and pitched voices of VBAs (Tolmeijer et al., 2021). Regarding VBAs' social behavior, users tend to approve and reciprocate socially appropriate behaviors and disapprove of inappropriate ones. For instance, users give more favorable evaluations to polite VBAs compared to impolite ones (e.g., Carolus et al., 2019), to VBAs that adapt their communication style to the user's needs compared to non-accommodating ones (Craig et al., 2024), and to VBAs that employ a relational communication style compared to those that focus solely on functional interaction (Kim et al., 2021).

Behaviors and emotions are also influenced by social cues. Users, for example, are more likely to offer help to a VBA that has previously assisted them (e.g., Schneider & Hagmann, 2022), evaluate a product recommendation more favorably when the suggestion is personalized (Rhee & Choi, 2020), and respond positively to VBAs' self-disclosure and social support, which can strengthen feelings of friendship toward the assistant (Ki et al., 2020). The effects of social cues are often mediated by users' perceptions of human-likeness or social presence in the VBA (Chérif & Lemoine, 2019; Cho et al., 2019; Ki et al., 2020; Kim et al., 2021). These perceptions can, in turn, influence both usage intentions (Han & Yang, 2018; Hsieh & Lee, 2021; Jang, 2020; Ki et al., 2020) and trust in the VBA (Chérif & Lemoine, 2019; Hsieh & Lee, 2021; Torre et al., 2020).

However, not all social features in VBAs elicit positive user responses. The *uncanny valley effect* suggests that there is a threshold to anthropomorphism in technology beyond which an agent appears overly human-like, resulting in feelings of discomfort or eeriness (Stein & Ohler, 2017). In addition, inconsistent findings regarding CASA and conversational AI point to further complexities. In certain contexts, text-based agents are perceived as more human-like or natural than voice agents (e.g., Etzrodt et al., 2019; Ischen et al., 2022), or as more persuasive (Voorveld & Araujo, 2020). Some effects

also appear to depend on individual differences, such as cognitive abilities or sensitivity to social cues (e.g., Chattaraman et al., 2019; Lee, 2010).

Recently, debates in HMC have emerged advocating for an *expansion of the CASA paradigm* to better reflect current technological realities (Gambino et al., 2020; Gambino & Liu, 2022). As interactions between humans and conversational agents have become increasingly common in everyday life and technology has advanced substantially, users seem to have adapted to these developments. The assumption of mindless social responses to agents may therefore no longer fully apply. Instead, it is suggested that humans have developed new interaction scripts for engaging with conversational AI agents that differ from human-human interaction while still acknowledging the hybrid nature of these agents, including their social and technical elements (Gambino et al., 2020). As a result, new theoretical approaches and empirical measures are essential to fully capture interactions between humans and conversational AI within the field of HMC (Etzrodt et al., 2022; Guzman et al., 2023). These approaches must move beyond concepts borrowed from interpersonal communication or technology adoption research and explicitly reflect users' evolving knowledge and behaviors when engaging with hybrid agents—yet such approaches are still lacking (Greussing et al., 2022).

2.4 VBAs as Information Intermediaries

2.4.1 State of Research

VBAs also assume the role of information intermediaries, as they can either play back content from online sources and provide updates on current news or answer general and specific questions in their own words. In the UK and the US, over two-thirds of smart speaker users regularly retrieve information via their VBA, and around 20% access news daily through their speakers (Kinsella & Mutchler, 2020; Newman, 2018). In Germany, these figures are somewhat lower but have remained stable over recent years

(Hölig et al., 2020; 2021; 2022). The Covid-19 pandemic further increased information retrieval via VBAs in high-adoption countries such as the US (NPR & Edison Research, 2020), as well as in Germany (Viehmann et al., 2022).

This makes VBAs a relevant research subject for both communication studies and HMC research. As they are not simply media channels that enable users to access online content through verbal interfaces, but rather *active communicators* acting with a degree of autonomy (Guzman & Lewis, 2020), they also take on an active role in providing information: when asked general or specific questions, VBAs formulate responses in their own words, actively selecting, processing, and presenting information (Frehmann et al., 2022). They also independently determine which sources to play when users request news content (Newman, 2018; Pedrero-Esteban & Gas-Gozalbo, 2021). Prior studies have described them as gatekeepers (Arnold et al., 2019, Fortunati et al., 2024), information intermediaries (Frehmann et al., 2022; Weidmüller et al., 2021, 2022), mediators (Natale & Guzman, 2022), or artificial news anchors (Weidmüller, 2022), highlighting their parallels to journalistic roles and their potential influence over which information is disseminated to users and how.

However, similar to the general opaqueness surrounding the AI decision-making processes of VBAs, there is *little transparency* regarding how VBAs search for, select, and organize information to generate an answer (Natale & Cooke, 2021). However, several *problematic practices* can be observed. For instance, some providers rely on user comments as information sources without clarifying whether or how these comments are reviewed or edited (Amazon, 2022). When users request VBAs to play “the news” without specifying a preferred source, VBAs typically select content from a limited set of pre-connected sources or apps, which has been found to lack diversity (Newman, 2018; Pedrero-Esteban & Gas-Gozalbo, 2021; Weidmüller et al., 2021). Concerns about

the quality of information provided by VBAs have also emerged, particularly in studies originating from health research. These studies identified shortcomings in the information VBAs deliver on topics such as mental health (Miner et al., 2016), smoking (Boyd & Wilson, 2018), and vaccinations (Alagha & Helbing, 2019). However, a systematic evaluation of VBA performances on a current and broadly relevant topic assessed through journalistic quality standards has been lacking so far.

Although the use of VBAs for information retrieval and news consumption has been observed for several years, research gaps remain concerning usage patterns and potential effects. For example, it is still unclear which topics or content users actually seek when requesting information from VBAs (Frehmann et al., 2022). A first survey study investigating user expectations toward Alexa as an information provider, conducted among students from the US and Italy, offers initial insights. Participants expected (1) a *personalized* information experience in which Alexa would select information, news, and service content relevant to the individual user; (2) the ability to multitask while receiving information in *audio form*; and (3) *conversational interaction* that allows for deeper engagement with topics of interest (Fortunati et al., 2024).

Whether VBAs are actually able to fulfill these services in line with user expectations remains largely unanswered. However, specific concerns have been raised regarding each of these aspects. First, the *personalization* of VBA information has sparked concerns about the influence that economically driven companies such as Amazon and Google may exert on users' information-seeking and processing behaviors (Pedrero-Esteban & Gas-Gozalbo, 2021), potentially steering them toward specific topics, attitudes, or even products. Research has further shown that reliance on personalized information provided by VBAs may reduce the likelihood of achieving societal consensus on important issues compared to traditional mass media (Resendez et al.,

2023). Second, delivering information solely in *auditory form* limits both the amount and diversity of information VBAs can present (Weidmüller et al., 2021). Auditory information tends to be processed with less attention than written text, making it more difficult for users to detect errors, while simultaneously being perceived as more credible—even when accuracy is low and sources are missing (Anderl et al., 2024; Gaiser & Utz, 2024). In fact, a significant proportion of VBA news users struggle to recall or recognize the sources of the news they received verbally (Newman, 2018).

Third, research on the effects of VBAs' *conversational* information delivery remains scarce. Yet, it is likely that information curated to individual interests and delivered through personalized, anthropomorphic dialogue is processed differently than information received via one-way channels such as journalistic mass media or search engines. Dialogically delivered information may be retained longer due to the interactive nature of the exchange, but may also be remembered selectively and incompletely, emphasizing the personally relevant aspects highlighted by the VBA.

2.4.2 Evaluation of VBAs' Performance as Information Intermediaries (Paper 1)

To date, it remains unclear how and how effectively VBAs function as information intermediaries when addressing timely, pressing, and universally relevant topics evaluated from the perspective of communication science and journalistic quality standards. As one-fifth of the German population regularly used VBAs to stay informed during the Covid-19 pandemic (Viehmann et al., 2022), this crisis offers a highly relevant context to examine both societal information needs and the performance of VBAs in meeting them. Therefore, in *Paper 1*, we investigated how three different VBAs responded to various questions related to the Covid-19 pandemic.

The study provides an important contribution for three key reasons. First, to the best of our knowledge, no prior research grounded in communication science theories

and methods has examined VBA information performance using journalistic quality standards. While a body of studies rooted in health research has previously assessed the content of VBA responses—finding questionable or non-expert sources and incomplete or absent answers (Alagha & Helbing, 2019; Boyd & Wilson, 2018; Goh et al., 2021; Miner et al., 2016; Wilson et al., 2017)—these studies did not apply differentiated journalistic assessments of information quality. Second, the Covid-19 pandemic allowed for the evaluation of VBAs' performance not in the context of a narrowly defined niche topic, but rather within a dynamic, developing societal crisis that spanned multiple sub-topics, including health, politics, and everyday life. Third, prior evaluations have predominantly focused on English-language content, leaving the performance of VBAs in other widely used languages, such as German, largely unexplored. Taken together, this study addresses the question of whether German-speaking VBAs can serve as reliable information sources during a general societal crisis such as the Covid-19 pandemic.

We conducted a quantitative content analysis of VBA responses to investigate three central aspects: (1) the assistants' ability to answer Covid-related questions, (2) the answer strategies employed, and (3) the quality of the answers assessed according to journalistic standards. To this end, the three most widely used VBAs in Germany—Alexa, Google Assistant (GA), and Siri—were tested weekly over a period of nine weeks between March and May 2020. Two interviewers asked 25 questions covering various crisis-related topics (e.g., transmission, diagnosis, social regulations, misinformation) to newly installed mobile versions of each assistant, recorded the answers, and transcribed them. In total, 603 question-answer sets were collected and systematically analyzed according to: (1) the relevance of the answer to the question, (2) the type of answer provided, and (3) the quality of the response, assessed based on prior medical studies and journalistic quality standards (e.g., Urban & Schweiger, 2014). Quality was

differentiated into four subcategories: (a) detail (response length), (b) transparency (referenced sources), (c) expertise (source reliability), and (d) accuracy (completeness and correctness of facts compared to FAQs of expert sources at the time).

The results showed that, across all VBAs, most questions could be answered with a fitting response (80%). However, a portion of these responses referred only to the general context of the crisis (15%) rather than directly addressing the specific question topic (65%). In 15% of cases, the VBAs failed to provide any answer (“I am sorry, I don’t know”), while 6% of the questions were misinterpreted and elicited an incorrect or irrelevant response. Failure rates were particularly high for questions related to misinformation, behavioral recommendations, or those requiring contextual information such as the user’s location.

Analysis of the answer strategies for all broadly fitting responses ($n = 478$) revealed clear differences among the assistants: Alexa consistently acted as a voice-based assistant, presenting each answer as a fully spoken response. In contrast, GA and Siri primarily displayed lists of search results on the screen, accompanied by brief spoken introductions. Siri also frequently referred users directly to the Ministry of Health instead of answering a question.

Regarding the quality of the spoken answers ($n = 180$), 83% were transparent about the sources used, and all sources demonstrated high expertise. Each VBA typically relied on different sources, with only Alexa occasionally citing multiple sources within a single answer. Significant differences emerged in terms of detail and accuracy: Siri provided shorter responses compared to its competitors, while Alexa outperformed both other VBAs in accurately defining the virus and describing its symptoms. Siri demonstrated only moderate accuracy, and GA consistently failed to provide a complete list of definition criteria and symptoms.

Overall, the study offers a more nuanced and differentiated picture of VBA performance in their role as information intermediaries. For a substantial portion of questions, the mobile versions of GA and Siri functioned more as voice-activated search engines rather than as active communicators. Nevertheless, all three VBAs demonstrated elements of active *information intermediation* by providing spoken answers on various pandemic-related subtopics. The quality of these responses, however, suggests that none of the VBAs can be considered fully reliable intermediaries. Alexa answered only a small proportion of questions but provided spoken answers with transparent expert sources, sufficient detail, and generally higher accuracy, thus adhering most closely to journalistic quality standards. In contrast, GA often failed to deliver complete information, while Siri's answers lacked both detail and consistency in accuracy.

2.5 Answer to RQ1: VBAs and Their Roles

To answer RQ1, VBAs are conversational AI agents embedded as software applications on various devices that interact verbally with their users. They fulfil three central roles: As technical tools, they are integrated into technical infrastructures, function as interfaces, and rely on AI processes to understand, process, and execute user requests. As social interactors, they display anthropomorphic features and engage in social behaviors, eliciting corresponding social reactions and emotional responses from users. Finally, VBAs act as information intermediaries, answering questions, providing information on a variety of topics, and playing news—a function that was heavily utilized during the Covid-19 pandemic.

This last role is under-researched, with limited insight into how VBAs search for and construct their answers, how users engage with them for information purposes, and how dialogical interaction shapes information processing. Existing research has identi-

fied quality shortcomings in VBA content related to medical topics, which were confirmed and extended in *Paper 1* for the specific case of the Covid-19 pandemic. The study demonstrated that VBAs are capable of producing autonomous answers to questions addressing various societal dimensions of the crisis, while answer quality varied, with several responses lacking sufficient detail, completeness, or transparent sourcing.

VBAs thus possess the capabilities to act in all three identified roles and are perceived and used by users accordingly (e.g., Arnold et al., 2019; Mou & Wu, 2023). They can therefore be understood as hybrid agents—not only combining technical and social dimensions (Etzrodt & Engesser, 2021), but also incorporating a media dimension. Because VBAs operate as inherently opaque technology that lacks transparency in both AI decision-making and information processing (e.g., Natale & Cooke, 2021), user interactions with them are characterized by low control and elevated risk. To explain why users nonetheless engage with these agents and rely on their performance despite these uncertainties, the concept of trust becomes central.

3. Theoretical Perspectives on Trust in VBAs

This chapter provides the theoretical foundation for answering RQ2 by conceptualizing trust in VBAs. It defines the concept of trust and outlines key elements of trust formation, before reviewing three trust frameworks that correspond to the roles previously identified for VBAs. This review serves as the basis for developing a theoretical model of hybrid trust in VBAs (Chapter 3.3), which was used for the qualitative studies presented in *Papers 3* and *4* and is further elaborated in the Theory section of *Paper 3*. In this synopsis, the model is presented independently of study-specific methodologies and is complemented by an updated overview of current research on trust in VBAs.

3.1 Trust Definition and its Relevance for VBAs

Trust can be defined as a willingness to be vulnerable toward another party that is expected to perform in a certain way but cannot be controlled in its actions (Mayer et al., 1995; Rousseau et al., 1998). Trust thus becomes relevant in any interaction that involves expectations and risk: when a person expects a performance but cannot control it, there is always a risk that expectations may not be met (Mayer et al., 1995). To manage this risk and allow the interaction to proceed despite the lack of control, the person can evaluate the other party and decide to place trust in them, thereby relying on their actions. In this process, the person assumes the role of the *trustor* and accepts vulnerability toward the other party, the *trustee* (Rousseau et al., 1998).

Trust serves as a strategy to reduce social complexity, enabling individuals to enter and sustain interactions (Luhmann, 2014), and is often described as a ‘social glue’ that facilitates relationships (Lewicki, 2006). It is not limited to interpersonal interactions but can involve a wide range of trustees, including animals (e.g., Caddiell et al., 2023), cooperate organizations (e.g., Guinot & Chiva, 2019), or abstract constructs such as science (e.g., Reif & Guenther, 2021). As these examples illustrate, trustees may vary

not only in type but also across different levels: trust can form on a micro-level between individuals, on a meso-level between a person and a group or organization, and on a macro-level between a person and a system (Rousseau et al., 1998). Trust across these levels and contexts can be interconnected in the so-called “trust nexus”, where different forms of trust influence each other reciprocally (Blöbaum, 2014; Hanitzsch et al., 2018).

To fully understand how trust develops and functions, it can be broken down into several components that are often investigated separately as predictors, conditions, and effects of the central variable trust (Rousseau et al., 1998). However, these elements should be understood as interrelated components of a holistic concept that together constitute trust (McKnight et al., 1998). Trust involves more than a single positive attitude toward the trustee; rather, it reflects an internalized process of evaluating the trustee, accepting vulnerability, forming trust, and relying on the trustee—a chain of steps that the trustor (often subconsciously) undergoes (McKnight et al., 1998; Siau & Wang, 2018; Vidotto et al., 2012). In the following, the concept of trust will therefore be discussed and modeled along its central *components*, marked in italics.

The first component involves the trustor evaluating the trustee based on *indicators of trustworthiness*. To assess whether the trustee is indeed worthy of trust, the trustor considers previous experiences as well as directly observable characteristics and behaviors that indicate their trustworthiness. These evaluations form beliefs about the trustee and influence the formation of trust (Boon & Holmes, 1991; Mayer et al., 1995; McKnight et al., 1998). If the trustee is evaluated positively, *trust* will be formed. As the central component of the concept, it represents a positive attitude toward the trustee, involving a willingness to be vulnerable and dependent on them (Mayer et al., 1995). However, trust often forms subconsciously and automatically, without deliberate reflec-

tion (Hill & O'Hara O'Connor, 2005). For this reason, research frequently relies on indicators of trustworthiness as proxies to measure trust as a latent construct, rather than asking directly about it (e.g., Lankton et al., 2015; Reif & Guenther, 2021). Consequently, the terms “trust” and “trustworthiness” are sometimes used interchangeably (e.g., Strömbäck et al., 2020), although they refer to two distinct components of trust formation in this synopsis.

When trust is established, *consequences* emerge and mark a third component of trust, often referred to as trusting intentions and trusting behaviors (McKnight et al., 1998). Typically, trust leads to increased engagement with the trustee, as well as positive cognitions, emotions, and behaviors toward them (e.g., Caddiell et al., 2023; Colquitt et al., 2007; Singh et al., 2015; Wang et al., 2016). These interactions can, in turn, reinforce trust (e.g., Lee & See, 2004; Lyu & Ferrin, 2018), creating a self-reinforcing cycle of interaction and trust that mutually strengthen each other.

In parallel to these three central components, trust formation is shaped by *external factors* that influence the trustor-trustee relationship, such as situational conditions or individual predispositions to trust, so-called trait trust (Lewicki, 2006; Mayer et al., 1995). Finally, trust is not static but rather a dynamic *temporal process* of developing a long-term relationship. It often originates from an initial trust based on rational calculations of potential losses and gains, heavily influenced by observable cues from the trustee (Rousseau et al., 1998). Over time, trust may solidify into a stable relationship grounded in emotions and repeated experiences. However, trust can also be disrupted by violations and may require repair (Lewicki & Bunker, 1996; Rousseau et al., 1998).

Applying this concept to VBAs, trust becomes a central factor for understanding interactions with them, as such interactions are inherently uncontrollable, involve risks, and require the user's vulnerability. When users approach VBAs with a request, they

have *no control* over how the assistant processes the request or how it generates a response, nor can they trace how the answer was derived due to the lack of transparency of the underlying AI processes (Natale, 2021). The *risks* associated with interacting with VBAs are multifaceted: privacy concerns arise because VBAs are known to violate privacy policies (Bolton et al., 2021), have been found recording private conversations (Ford & Palmer, 2019), and have even been hacked to infiltrate private devices and networks (Kumar et al., 2018). In addition, VBAs' natural language processing remains error-prone and requires further advancement (Solaimalai et al., 2024), exposing users to the risk of misunderstandings and unsatisfactory communication outcomes. The risk of misinformation is equally significant: due to the opaque nature of information compilation within VBAs, users are often unable to verify sources, assess accuracy, or identify fictitious information (Fui-Hoon Nah et al., 2023; Mahmood et al., 2025).

In light of this substantial lack of control over the assistants' actions, and considering the risks such as security breaches, misinterpretations, and unverifiable information, users may choose to place their trust in the VBA. By relying on the assistant to meet their expectations despite these uncertainties, users are able to simplify the interaction, reduce cognitive complexity, and proceed with the interaction while assuming a positive outcome without needing to intervene or verify every detail. Trust thus plays a key role in explaining why users continue to engage with VBAs despite known limitations, potential errors, and considerable risks (Frehmann & Peters, in press).

3.2 Relevant Trust Frameworks

As determined in RQ1, VBAs are hybrid agents that operate simultaneously as technical tools, social interactors, and information intermediaries. Each of these roles introduces distinct risks that users must navigate: technical vulnerabilities, social misin-

terpretations, and lack of information transparency. Consequently, trust becomes essential across all three dimensions to enable interactions with VBAs. In order to conceptualize trust in VBAs comprehensively and to accurately reflect both user perceptions and real-world usage, all three roles must be taken into account. This can be achieved by drawing on three distinct trust frameworks and their corresponding empirical insights, each originating from research fields that align with the specific roles of VBAs. The following literature review therefore begins with the traditional perspective, interpersonal trust, rooted in social psychology and management studies, then introduces technical trust, originating from computer science and human-computer interaction, and finally discusses media trust, drawn from communication science. Each framework is introduced with its own conceptualization of trust, and the review organizes key findings using the previously introduced components of trust formation.

3.2.1 Interpersonal Trust Framework

Traditionally, trust has primarily been studied as *interpersonal trust* between humans who rely on one another, often in contexts such as the workplace or personal relationships (e.g., Lewicki & Bunker, 1996; Mayer et al., 1995). Empirical research has identified three central indicators that determine *interpersonal trustworthiness*: ability, benevolence, and integrity (Lewicki & Bunker, 1996; Mayer et al., 1995; McKnight et al., 1998). The trustor must therefore have confidence in the trustee's ability to successfully fulfill expected tasks, often later referred to as competence (Colquitt et al., 2007; Di Battista et al., 2020). Benevolence reflects the perception that the trustee prioritizes the trustor's well-being. Integrity refers to shared values and ethical alignment between trustor and trustee. A positive assessment of these characteristics marks a trustee as trustworthy and increases the likelihood that the trustor will form trust and rely on the trustee (Lewicki & Bunker, 1996; Mayer et al., 1995; McKnight et al., 1998).

Interpersonal trust has been associated with various positive *consequences*, including attraction, commitment, cooperation, and enhanced performance (Lyu & Ferrin, 2018; Singh et al., 2015). A key *external factor* influencing interpersonal trust formation is an individual's predisposition to trust or trait trust (Hill & O'Hara O'Connor, 2005; Lewicki, 2006; Mayer et al., 1995). Trust develops through different *temporal processes* depending on the nature of the relationship. Initially, trust may be established either rationally, based on cost-benefit considerations, or emotionally, through an idealized perception of the trustee. Over time, repeated interactions provide the trustor with experience that leads to a stable trust relationship, justified both cognitively and emotionally, and primarily grounded in accumulated knowledge about the trustee (Boon & Holmes, 1991; Koller, 1997; Lewicki, 2006; Lewicki & Bunker, 1996).

3.2.2 Technical Trust Framework

Technical trust refers to a human trustor and a technical trustee, and involves users accepting the risk of malfunctions or failures and relying on technology to perform tasks (McKnight et al., 2011). Studies on technical trust typically focus on specific technologies, such as workplace software, mobile applications, or trust in technology brands or general automation (e.g., Blut et al., 2018; Chien et al., 2014). Although interpersonal trustworthiness indicators have previously been applied to technology (e.g., Benbasat & Wang, 2005; Muir & Moray, 1996), these indicators require adjustments because technology lacks agency or free will. Instead, *technical trustworthiness* is commonly assessed through functionality, helpfulness, and reliability (Lankton et al., 2015; Lee & Moray, 1992; Lee & See, 2004; McKnight et al., 2011). Functionality refers to a technology's ability to fulfill user expectations, paralleling competence in interpersonal trust. Helpfulness is similar to benevolence, as it describes how technology supports users through its programmed features, even though it lacks intentionality. Reliability,

similar to integrity in human trustees, reflects consistency and predictability in performance (Lankton et al., 2015; McKnight et al., 2011).

When these aspects are positively evaluated, the technology is perceived as trustworthy, and trust can form. As a *consequence*, technology acceptance, usage intentions, and actual user behaviors follow (Jarvenpaa et al., 1998; Ki et al., 2020; Pavlou, 2003). A self-reinforcing cycle of trust and use may emerge, in which trust enables usage episodes that, in turn, strengthen trust and further increase use (Lee & See, 2004). *External factors*, such as the specific use scenario, also influence trust formation (e.g., Aoki, 2020). Trust in technology, particularly in AI-based technology, also follows a *temporal process* consisting of multiple phases: initial trust based on observable trustworthiness indicators transitions into ongoing trust shaped by experience with actual performance. Violations of trust may occur and require repair strategies (Andras et al., 2018; Lee & See, 2004; Siau & Wang, 2018; Tschopp, 2018).

3.2.3 Media Trust Framework

In communication science, trust is applied to news media and journalism in the form of *media trust*. It describes audiences relying on media-provided information despite being unable to independently verify its correctness (Hanitzsch et al., 2018). Media trust can apply to various trustees, including entire media systems, specific media brands, particular pieces of content, or individual journalists (Blöbaum, 2018; Hanitzsch et al., 2018; Strömbäck et al., 2020). Similar to other trust frameworks, recipients assess media trustworthiness prior to trust formation, often referred to as credibility in this context (Engelke et al., 2019; Fawzi et al., 2021; Strömbäck et al., 2020; van Dalen, 2019). According to established media trust measurements, indicators of *media trustworthiness* include the selectivity of topics and facts, the accuracy of reporting, and its journalistic assessment (Kohring & Matthes, 2007). Selectivity refers to the relevance of

reported facts and topics for both the audience and the context. Accuracy is assessed based on the truthfulness of reporting and its alignment with reality. Journalistic assessments reflect whether reporting is objective, unbiased, and appropriately framed (Knudsen et al., 2022; Kohring & Matthes, 2007; Prochazka & Schweiger, 2019).

When these indicators of trustworthiness are positively evaluated, recipients can form media trust toward the trustee. As *consequences*, trusted media are more likely to be used, and media trust may enhance political trust and related knowledge and behaviors, although it is still unclear whether these outcomes are actual consequences of trust, antecedents to trust, or interrelated components that mutually reinforce one another (Fawzi et al., 2021; Hanitzsch et al., 2018; Ladd, 2010; Tsfatı & Ariely, 2014; Wang et al., 2016; Ziegele, 2022). *External factors* primarily include dispositional trait trust (Tsfatı & Ariely, 2014; Ziegele, 2022), and the political environment in which media operate (Fawzi et al., 2021; Hanitzsch et al., 2018). While the *temporal process* of media trust has not been systematically studied, it is assumed that an initial state based on socialization and habitual media use evolves through accumulated experiences over time, similar to other trust frameworks and trustees (Jackob, 2012; Ziegele, 2022).

3.3 A New Model of Hybrid Trust in VBAs (Paper 3)

To illustrate how expectations, risks and trust relate to the three roles of VBAs and how they interact, an example may be helpful. When requesting a VBA to recommend a nearby restaurant, users hold multiple expectations simultaneously. Technically, they expect the NLP processes to function correctly so that the VBA accurately understands both the spoken words and the intended request, which may include not only suggesting a restaurant but also providing navigation to it. Given the well-documented error-proneness of NLP and VBAs in general, users face the risk of technical failures that may prevent them from receiving useful or complete information. On the social level,

users may expect the VBA to “know” them and take into account personal background information, such as their location, preferences, or dietary restrictions, which the assistant should benevolently consider. If this information has not been correctly learned or is not integrated into the response, users risk social disappointment and may receive irrelevant or impractical recommendations. As information intermediaries, users expect VBAs to research information reliably and provide truthful answers that are relevant both to the topic and to users as recipients. However, since AI assistants are known to give incomplete, irrelevant or even incorrect information, users face the risk of receiving misleading or false content.

To engage in interaction with VBAs despite the awareness of these risks, users may place their trust in the assistants. How trust in VBAs and their three roles is formed, which factors are influential, and which questions remain unanswered can be derived from the interdisciplinary review of trust research presented in the previous chapters. Since all three frameworks reflect consistent conceptualizations of trust that differ only in relation to the trustee, and each framework contributes empirical insights into the distinct components of the trust concept, they can be integrated into a comprehensive model. In this model, the previously introduced trust components provide the structural framework (Fig. 2). Trust formation begins with (A) the evaluation of the trustee’s trustworthiness, which may lead to (B) the actual formation of trust as the core component of the model, (C) resulting in consequences. Trust formation is further understood as (D) a temporal process of developing a trust relationship over time and is influenced by (E) additional external factors.

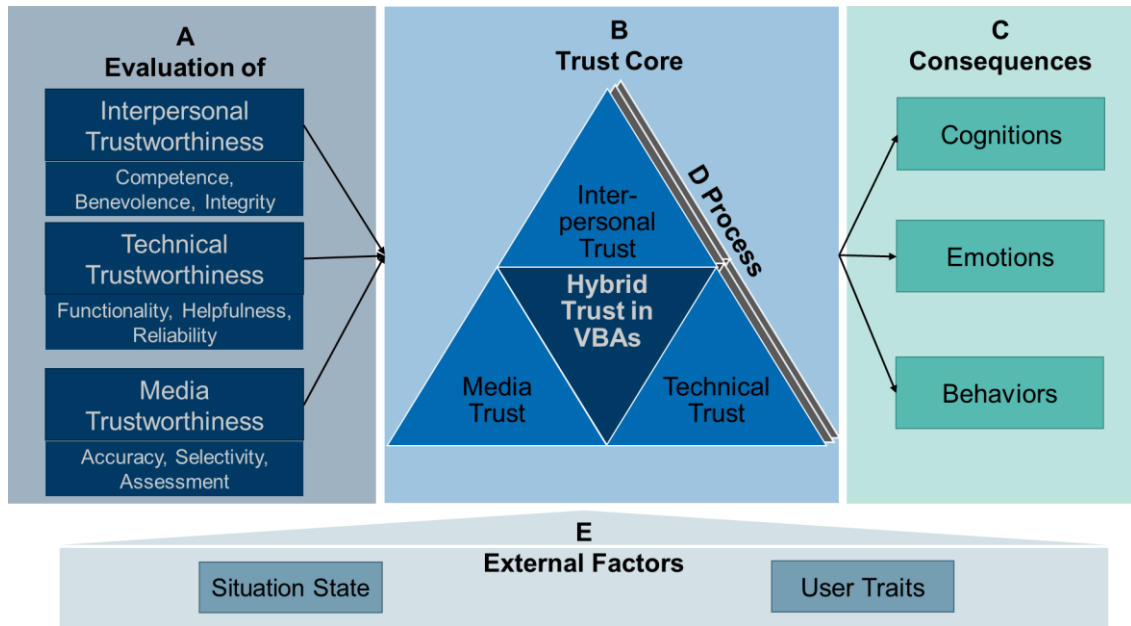


Figure 2. Theoretical model of hybrid trust in VBAs (Frehmann & Peters, in press, p. 73)

To effectively describe the model, the central component (B), the *trust core*, serves as a starting point. The literature review demonstrated that the three frameworks of interpersonal, technical, and media trust converge in their fundamental understanding of trust as a willingness to rely on an interpersonal, technical, or media trustee despite the risk that expectations may not be met. A VBA represents a trustee that unifies all three roles, as users perceive and engage with VBAs as technical tools, social interactors, and information intermediaries. Accordingly, users are likely to form expectations regarding the assistant’s performance in each of these domains—or in a multidimensional combination of them: For example, in the previously discussed scenario of a restaurant recommendation, the social and media roles may combine to create a hybrid expectation for added benevolent, personalized information, not only suggesting a restaurant but also recommending specific dishes based on the user’s preferences. Similarly, a combination of technical and informational expectations may involve integrating estimated travel time into navigation guidance while also providing information on whether

the restaurant will remain open upon arrival. Incorporating the interpersonal dimension further, the VBA may be expected to personalize the travel time based on the user's preferred mode of transportation, such as car, bike, or train. Consequently, trust in the VBA's performance may not form exclusively within a single role but can take on a hybrid, multidimensional form that reflects multiple roles simultaneously. The specific form and dynamics of such hybrid trust, as compared to unidimensional trust in a single role, remains an open empirical question that requires further investigation (Fig. 2, B).

All three trust frameworks and related empirical work consistently suggest that whether trust is ultimately formed depends primarily on (A) the evaluation of *indicators of trustworthiness*. Across all three frameworks, three fundamental trustworthiness dimensions emerge that closely correspond in meaning. The trustee's ability to fulfill their role is reflected in the indicators of interpersonal competence, technical functionality, and media-related accuracy. Prioritizing the trustor's interests over self-interest is captured by benevolence, helpfulness, and the selectivity of relevant information according to audience needs and topic. Finally, the demand for a morally sound and predictable trustee is reflected in integrity, reliability, and the appropriate journalistic assessment of information. While these indicators exhibit strong conceptual parallels, nuances remain, shaped by differing levels of agency between humans and technology and by varying degrees of professionalization between laypersons and journalists. The proposed model therefore integrates all nine trustworthiness indicators as predictors of trust formation in VBAs (Fig. 2, A). Whether and how these indicators influence trust formation in practice, and whether additional or alternative characteristics are necessary to fully capture the hybrid trustworthiness of VBAs, remains subject to empirical investigation.

When trust is established in VBAs, it leads to (C) *consequences*. Across all three trust frameworks, research consistently identifies increased engagement with the trustee

as a typical behavioral consequence, which in turn may reinforce trust and contribute to a self-reinforcing cycle of interaction. Additionally, interpersonal and technical trust have been shown to elicit positive cognitions and emotions toward the trustee, which are likely transferable to trust in VBAs as well. Therefore, the model assumes that trust affects cognitions, emotions, and behaviors (Fig. 2, C). Which specific cognitions and emotions are influenced by trust in VBAs, and whether additional behavioral consequences beyond engagement emerge, remain open questions for empirical investigation.

The model further incorporates the (D) *temporal process* of developing a trust relationship, recognizing that trust in VBAs evolves over time. Initial trust may gradually develop into a more stable trust relationship, but may also be disrupted by trust violations. The model does not presume a specific development of this temporal process (Fig. 2, D), as the available research across the three trust frameworks varies substantially. While various processes have been empirically identified for interpersonal trust, there is little empirical research addressing the temporal development of media trust relationships. In the context of VBAs, it remains to be explored whether trust formation begins with a more technical, rational phase of cost-benefit considerations or with an interpersonal idealization based on emotional responses. Across all three frameworks, however, it is assumed that ongoing experiences contribute to trust formation over time. Yet, the specific dynamics of this development, including key events that may strengthen or hinder relationship development, require further empirical examination.

Finally, the model highlights the role of (E) *external factors*, which may influence all components of trust formation. The literature review suggests that these external factors can be categorized as either contextual state factors, such as the use scenario or political environment, or individual trait factors, such as a person's predisposition to trust (Fig. 2, E). It is also conceivable that additional factors exist that fall within these

two categories or reflect entirely new, theoretically unexplored aspects that may emerge as users develop new interaction patterns with conversational AI (Gambino et al., 2020).

Taken together, the model proposes causal relationships from (A) indicators of trustworthiness to (B) trust, and from (B) trust to (C) consequences, with all relationships potentially moderated by (E) external factors and shaped by (D) the temporal process of developing a trust relationship. Since a hybrid trust involving multiple VBA roles is assumed, it is also possible that trustworthiness indicators, consequences, and external factors originating from separate trust frameworks may interact with one another or reveal previously unexplored relationships. Empirical research testing the proposed model of hybrid trust may identify additional variables and interconnections beyond those theoretically derived and thereby refine and further develop the model.

3.4 State of Research

Trust in VBAs has been studied across various disciplines, including HMC, human computer interaction, marketing, social psychology, ergonomics, education or information systems. Many of these studies focus on isolated aspects of trust, examining it either as a predictor or an outcome variable, or investigating its role within broader frameworks such as CASA, technology adoption, or privacy concerns (e.g., Acikgoz & Vega, 2022; Craig et al., 2024). However, a comprehensive investigation of the full trust concept and its components, as theorized in the presented model, remains absent—along with a theoretical foundation that systematically integrates multiple trust frameworks. To provide an overview of the existing research landscape, the following chapter organizes prior findings according to the previously introduced components of trust. The trust core (Fig. 2, B) is addressed last, as it presents the greatest degree of inconsistency and requires further discussion.

With respect to *indicators of trustworthiness* that influence trust formation in VBAs, research has primarily identified technical characteristics of VBAs as relevant predictors. These include positive expectations and evaluations of VBA abilities and performances (Baughan et al., 2023; Etzrodt et al., 2019; Foehr & Germelmann, 2020; Lee et al., 2021; Pitardi & Marriott, 2021; Rheu et al., 2021), as well as perceptions of ease of use, usability, and customization options available to users (Cho et al., 2020; Lee et al., 2021; Octavia & Nugraha, 2024; Pitardi & Marriott, 2021). In addition, numerous studies have identified social features acting as trustworthiness indicators, suggesting that anthropomorphic characteristics of VBAs positively influence trust. These include the general anthropomorphism of the agent (Seymour & Van Kleek, 2021; Weidmüller et al., 2022), perceived human intelligence or human-like emotional responses (Etzrodt et al., 2019; Pitardi & Marriott, 2021; Rheu et al., 2021), and especially human features expressed through voice and communication style (Chérif & Lemoine, 2019; Rheu et al., 2021; Torre et al., 2020). Several studies further suggest that perceived social presence mediates the positive effects of these human-like features on trust (e.g., Chérif & Lemoine, 2019; Pitardi & Marriott, 2021) while parasocial perceptions of the interaction may additionally strengthen trust (Hsieh & Lee, 2021).

When trust in VBAs forms, it leads to positive *consequences* on users' attitudes toward the assistant (Pitardi & Marriott, 2021; Xiong et al., 2024), on emotional responses and relationships with the agent (Foehr & Germelmann, 2020; Seymour & Van Kleek, 2021), and ultimately on use intentions (Acikgoz & Vega, 2022; Baughan et al., 2023; Lee et al., 2021; Nasirian et al., 2017; Octavia & Nugraha, 2024; Xiong et al., 2024). Consequences may also extend to attitudes and behavioral intentions toward products and services recommended by the assistant (Chérif & Lemoine, 2019; Hsieh & Lee, 2021; Lee, 2010). However, the causal nature of these relationships is often only

assumed, as many of the cited studies rely on cross-sectional designs, and few have examined multiple potential consequences across different categories simultaneously.

External factors influencing trust formation include user-related variables such as demographics and personality traits (Lee, 2010; Weidmüller et al., 2022), as well as trust in related trustees. These related trust forms contain institutional trust in the parent company, general trust in technology, and the trustor's trait trust (Schadelbauer et al., 2023; Weidmüller et al., 2022). Privacy concerns, particularly in relation to the parent company, represent another frequently studied external factor that has been shown to significantly affect trust (Foehr & Germelmann, 2020; Lau et al., 2018; Pitardi & Marriott, 2021; Seymour & Van Kleek, 2021; Vitak et al., 2023; Weidmüller et al., 2022).

The *temporal process* of developing a trust relationship with VBAs has received limited empirical attention so far. However, one qualitative study conducted by Foehr and Germelmann (2020) suggests that users initially form trust based on trustworthiness evaluations of the assistant's abilities and performance. In this early phase, external factors such as trust in the parent company, recommendations from others, or the purchasing decision of a partner may influence the initial trust state. As users accumulate experience, they appear to follow different developmental trust paths: some engage in interpersonal trust evaluations that foster emotionally grounded trust and interpersonal relationships, while others evaluate costs and benefits, leading them to limit usage to functions they trust their VBA to fulfill (Foehr & Germelmann, 2020).

Concerning the *trust core* itself, it remains difficult to determine the general level of trust in VBAs, as measurement approaches vary considerably across studies. Many studies directly assess trust by asking participants to evaluate their trust in VBAs using single- or multi-item scales (e.g., Craig et al., 2024; Hsieh & Lee, 2021), while others employ newly developed instruments that measure trust in specific aspects of the

assistant, such as its honesty (e.g., Pitardi & Marriott, 2021; Torre et al., 2020), underlying processes (e.g., Lee et al., 2021), or privacy practices (e.g., Acikgoz & Vega, 2022). Other studies avoid the term “trust” altogether and instead operationalize trust as a latent construct based on evaluations of trustworthiness indicators. However, studies diverge considerably regarding which indicators are most appropriate. Some focus primarily on technical trustworthiness indicators (e.g., Schadelbauer et al., 2023; Seymour & Van Kleek, 2021; Xiong et al., 2024), while others adopt an interpersonal perspective to capture the social nature of VBAs (e.g., Baughan et al., 2023; Chattaraman et al., 2019; Cho et al., 2020; Foehr & Germelmann, 2020; Tolmeijer et al., 2021). Although combining indicators from both domains appears theoretically well-justified, this multidimensional approach has only been applied once to date (Weidmüller, 2022).

Strikingly, no existing study has yet incorporated trustworthiness indicators rooted in media trust frameworks. This is particularly noteworthy given that some studies already acknowledge the influence of information quality on trust in VBAs (Lee et al., 2021; Nasirian et al., 2017). Similarly, Weidmüller et al. (2022) demonstrated that information credibility can function as a context-specific predictor of interpersonal trustworthiness when VBAs present news content. Nevertheless, trust frameworks originating from communication science—with their well-established components of indicators of trustworthiness, consequences, and external factors—have not yet been systematically applied to VBAs. Given that VBAs regularly serve as information intermediaries for a substantial portion of users and, in certain cases, even partially adhere to journalistic standards (Frehmann et al., 2022), this represents a *significant gap* in the empirical literature that urgently requires attention. To fully understand trust and its critical role in shaping interactions with VBAs as conversational AI agents, it is essential to consider their three central roles and the hybrid interrelations between them.

3.5 Answer to RQ2: Theoretical Model of Trust in VBAs

To answer RQ2, trust in VBAs is defined as users' willingness to depend on the VBA to perform in a certain way while accepting their vulnerability due to a lack of control over the assistant's actions and the risks involved. Considering the three central roles of technical tool, social interactor, and information intermediary, trust frameworks addressing technical, interpersonal, and media trustees are relevant for conceptualizing trust in VBAs. A holistic model of hybrid trust in VBAs was developed through an interdisciplinary literature review that incorporates the evaluation of trustworthiness indicators, the formation of (hybrid) trust, consequences, external factors, and the temporal process of developing a trust relationship over time. By integrating findings from all trust frameworks, the model accounts for expectations related to each of the three roles, while also allowing for hybrid expectations and hybrid trust that simultaneously reflect two or all three roles. Although previous studies have investigated trust in VBAs, none has examined it comprehensively across all components of trust formation nor incorporated media trust frameworks that address VBAs' role as information intermediaries.

As this model is theoretically derived, empirical validation is required to examine whether its assumptions hold true (RQ3). A key question concerns which *trustworthiness indicators* actually predict trust in VBAs (RQ3b). While previous research has identified both technical and interpersonal trustworthiness indicators as influential, these have rarely been combined within a single measurement approach, and media trustworthiness has not yet been included. Empirically investigating trustworthiness across all three roles will therefore provide new insights into the applicability of media trust frameworks compared to previously established technical and interpersonal approaches as well as whether users evaluate trustworthiness hierarchically, prioritize one role over another, or combine multiple roles when forming trust in VBAs.

Secondly, the *temporal process* of developing trust in VBAs remains largely unexplored (RQ3c). While both technical and interpersonal trust frameworks suggest distinct developmental pathways, empirical studies addressing temporal trust development in VBAs are scarce, and media trust lacks empirical research in this regard altogether. Investigating this process can contribute important insights into how trust relationships with VBAs evolve over time and under which conditions users develop deeper and more stable relationships, integrating VBAs into family life and everyday routines (e.g., Beirl et al., 2019). Such an understanding is crucial, as long-term trust may shape not only usage patterns but also broader social implications of AI integration into private spheres—potentially influencing users’ general attitudes and behaviors in everyday life.

Thirdly, the *consequences* of trust in VBAs remain insufficiently understood (RQ3d). While increased engagement and usage intentions are consistently reported across trust frameworks and previous research, potential behavioral consequences beyond usage have rarely been addressed. In addition, possible cognitive and emotional consequences have not yet been systematically examined or categorized for VBAs. Moreover, the causal relationship between trust and its consequences remains unclear, as most existing studies rely on cross-sectional designs.

Finally, determining the *best suited methods* for studying trust in VBAs constitutes a necessary first step for addressing these empirical questions (RQ3a). Comprehensive investigations of the proposed model, including examinations of assumed causal relationships across multiple variables, entail specific methodological requirements. In addition, general challenges must be addressed that characterize the field of HMC, which focuses on researching interactions with conversational AI agents such as VBAs. The resulting methodological discussion offers important guidance for future studies in this emerging area of research.

4. Empirical Evidence for the Theoretical Model

This chapter addresses RQ3 by presenting the empirical investigation of trust in VBAs. It begins with a discussion of the methodological approach, which provides the foundation for presenting the results of three empirical studies, each examining different aspects of the theoretical model.

4.1 Methodological Approach

To answer RQ3a, this section examines the methodological foundations necessary for studying trust in VBAs. It begins by situating the dissertation within broader methodological debates in HMC research, highlighting both general approaches and specific challenges in studying interactions with socially acting technologies like VBAs, as discussed in *Paper 2* (Chapter 4.1.1). Building on these insights, the section then presents the mixed-methods design developed for this dissertation and details the methodological implementation across *Papers 3, 4, and 5*.

4.1.1 Methodological Approaches and Challenges in HMC (Paper 2)

The investigation of communicative interactions between humans and technology, such as chatbots, VBAs and social robots, lies at the core of Human-Machine Communication (HMC). This field views such technologies as active communicators with whom humans interact and form relationships (Etzrodt et al., 2022; Guzman & Lewis, 2020). Because conversational agents are perceived as hybrid entities, both novel theoretical approaches as well as adapted methodological frameworks are required to fully capture these interactions. *Paper 2* provides a structured overview of the methods used to study interactions with such agents, discusses their advantages and challenges, and offers recommendations to address these issues. It contributes to communication science in general and HMC in particular by first raising awareness of the methodological challenges in studying conversational agents and offering guidance, especially for

new scholars in the field. Second, it integrates previously fragmented methodological discussions across disciplines, agent types, and methods. Third, it encourages methodological innovation by adapting established approaches to the evolving nature of communication between humans and conversational AI. The following synopsis of *Paper 2* focusses on methodological designs and challenges in researching interactions with VBAs, laying the foundation for the methodological choices presented in Chapter 4.1.2.

Before selecting specific methods, HMC research faces several *general challenges* due to its relative youth. First, researchers often employ small sample sizes due to a limited number of available experienced users of an agent under study, leading some studies to rely on non-users who evaluate agents unfamiliar to them, which can bias results (e.g., Weidmüller et al., 2022). Such participants are easily influenced by how the agent is introduced, including the metaphors used to describe its abilities or whether it is assigned a name (e.g., Voorveld & Araujo, 2020). Careful consideration is therefore required when presenting unknown agents to participants. Second, there is a lack of theoretically grounded and validated scales for core HMC constructs. For example, trust is often measured using scales from interpersonal (e.g., Cho et al., 2020) or technical research (e.g., Pitardi & Marriott, 2021), which do not fully account for the hybrid nature of agents like VBAs. Theoretical advancements are needed to develop new, validated instruments that reflect users' perceptions of VBAs as neither human nor object (Etzrodt & Engesser, 2021, p. 73), and to capture potentially new interaction protocols that users may have adapted to the agents' perceived hybrid character (Gambino et al., 2020).

Experimental designs are the most common approach for studying interactions with conversational agents in general, and with VBAs in particular, within HMC research. Experiments allow researchers to examine causal effects using objective

measures (e.g., tracking, task completion, e.g., Schneider & Hagmann, 2022) or subjective measures (e.g., self-reports, e.g., Ischen et al., 2022), while controlling for potential confounding variables. However, the high degree of control limits external validity and generalizability. Experimental designs require a decision on which VBA to use as a stimulus. Well-known products such as Alexa may trigger prior attitudes and experiences (e.g., Weidmüller, 2022), while unfamiliar devices or voices may evoke skepticism (e.g., Yuan et al., 2019). A further challenge is defining an appropriate control group. Comparing technology-based interactions to human face-to-face communication as a “gold standard” is not always meaningful in HMC. Therefore, comparisons between different VBA features (e.g., Cho et al., 2019; Ischen et al., 2022) or between VBAs and other media such as search engines (e.g., Gaiser & Utz, 2024) offer more informative alternatives.

Many VBA experiments rely on *simulated interactions*. In *vignette studies*, a “demonstrational approach” is used, where participants imagine interaction scenarios while listening to prerecorded audio or video files. For example, Gaiser and Utz (2024) introduced participants to a fictional smart speaker for information search and asked them to read questions and listen to recorded answers in an imagined interaction. Such answers can be created using programmable VBAs like Alexa (e.g., Gaiser & Utz, 2024) or lesser-known text-to-speech interfaces (e.g., Rhee & Choi, 2020). While these designs are cost-efficient and useful for larger samples and online surveys, they omit the core element of actual interaction.

In contrast, the *Wizard of Oz (WoZ) technique* allows participants to interact with a seemingly real agent that is covertly controlled by a human operator (“wizard”). Although the interaction appears authentic, it remains simulated and follows a strict

script to ensure comparability. WoZ studies are resource-intensive and typically conducted in lab settings, but they are well-suited for investigating actual interaction behaviors while maintaining control over features that exceed current VBA capabilities. For example, early WoZ studies introduced personalization at a time when VBAs had limited abilities in this area. Background information was collected in advance and integrated into live conversations by the wizard to deliver tailored recommendations (Rhee & Choi, 2020; Yuan et al., 2019). While WoZ designs are highly standardized and reproducible, they do not capture genuine interactions with fully autonomous VBAs and raise ethical concerns regarding participant deception and potential influence on expectations toward real agents.

As an alternative to simulations, experiments can also rely on *non-simulated interactions*. These designs increase external validity and are typically conducted in laboratory settings using reliable technical equipment. Researchers may use *self-created agents* to maintain control over the stimulus, but this requires programming skills (e.g., Tolmeijer et al., 2021) or collaboration with companies that can support the development, particularly for the complex NLP processes (e.g., Chérif & Lemoine, 2019). Alternatively, *commercially available agents* may be used, as they are easier to access and technically reliable. However, they offer less control over their behavior, and unanticipated errors may influence outcomes (e.g., Cho et al., 2020). Although using existing VBAs increases authenticity, laboratory settings outside participants' usual home environments may still limit external validity.

Field studies represent a second approach for studying interactions with VBAs. They offer deeper insights into natural, authentic interactions and can be conducted quantitatively, qualitatively, or through mixed-methods designs that balance the

strengths of both. Various data collection methods are available, such as direct observation of live or recorded interactions (e.g., Foehr & Germelmann, 2020) or indirect methods like diary studies and experience sampling (e.g., Lau et al., 2018). Longitudinal designs are particularly suited for investigating long-term relationships, though maintaining participant engagement and consistent data collection can be challenging. Field studies also have high organizational demands regarding time, reliable agents, technical support, and analytical expertise to handle unstructured data such as log files. Collaborations with companies offering prototype agents may be helpful but can involve competing scientific and commercial interests that must be considered.

Field studies are mostly conducted in *private settings*, involving either new users provided with an agent (e.g., Beirl et al., 2019) or existing users (e.g., Bentley et al., 2018). Providing VBAs to new users may indirectly promote commercial products and data collection by companies, which raises ethical concerns. As a result, studies frequently focus on established users who have already chosen to adopt a VBA and can voluntarily share log data via apps and tools (e.g., Sciuto et al., 2018). Privacy remains a central issue, as sensitive personal data and private conversations may be included. A key limitation of this approach is that it excludes conscious non-users and their reasons for discontinuing or avoiding interaction with VBAs altogether. Alternatively, field studies can be conducted in *public settings*, such as educational contexts (Lopatovska & Oropeza, 2018) or exhibitions (Siegert, 2020) where interactions with students or visitors are observed. However, participants may feel reluctant to interact publicly, and video recordings require permissions from both authorities and participants.

Ultimately, when selecting a methodological design for investigating interactions with conversational agents, researchers must align their approach with the specific research objective, choosing between experimental designs for causal analyses and field

studies for more holistic insights into interaction processes. Mixed-methods approaches offer a valuable way to balance the strengths of different designs, but remain rare. Key methodological challenges in HMC include questions of sample populations, operationalizations of variables, validity, interaction quality, resource intensity, privacy concerns, and further ethical considerations.

4.1.2 Methodological Approach of the Dissertation (Papers 3, 4, 5)

The research program underlying this dissertation follows a *mixed-methods design*, combining quantitative and qualitative approaches to address the empirical questions RQs 3b, 3c, and 3d. To empirically support the theoretical model and balance the strengths and limitations of common HMC methods, the dissertation employs both an experimental design and two field studies. This results in a *triangulation* of data collection methods, data types, and analytical techniques (Flick, 2014): the studies draw on online comments, semi-structured interviews combined with observations, and survey data, which are analyzed through qualitative content analysis and quantitative statistical procedures. This methodological combination enables a comprehensive examination of trust as a complex phenomenon emerging in interactions with a novel and hybrid communicator (Denzin, 2012). Specifically, the qualitative studies aim to deepen the understanding of trust from the user perspective, allowing for the identification of additional variables and relationships not yet captured by the theoretical model (Leavy, 2014). The quantitative study complements these insights by testing selected causal relationships and estimating their strength under controlled conditions. The specific methodological designs of each study are described in the following sections.

Paper 3 aimed to explore how users express trust in VBAs unprompted, searching for explicit and implicit signs of trust in user-generated content online. It was the first study to introduce the integration of all three trust frameworks for VBAs, providing

an initial empirical examination of the hybrid trust model based on field data and refining the model inductively through the results. To achieve this, we conducted a *qualitative content analysis* following Kuckartz's (2018) approach. In contrast to previous quantitative studies, this research deliberately employed a qualitative design and examined "naturally" occurring online comments to gain a deeper understanding of how users evaluate VBAs on of their own initiative and how trust emerges in these evaluations.

The analysis included German comments on Alexa, Siri, and Google Assistant posted between 2019 and 2023 across marketplaces, media coverage, and discussion platforms. A selective heterogeneity sample ensured diversity in the data (Patton, 2002). Only comments that reflected personal experiences with one or more VBAs were included to ensure that commenters were actual users. In total, 169 postings were collected and analyzed by two researchers using MAXQDA. The analysis was guided by the main categories derived from the theoretical model, with categories refined iteratively and subcategories developed inductively (Mayring, 2014).

As a follow-up study, *Paper 4* investigated users' trust in VBAs in home settings by combining *qualitative semi-structured interviews* with *user observations during interactions* with agents. This mixed approach offered a comprehensive understanding of users' subjective concepts of trust, which have received limited attention in trust research, as well as insights into their natural interaction behaviors. Conducting the field study in the homes of 22 participants and incorporating two distinct data sources strengthened external validity (Brinkmann et al., 2020). While the interviews captured participants' perspectives on trust, its influencing factors, formation, and consequences, the observed interactions provided behavioral data and reference points for subsequent evaluations. This design also enabled a comparison of trust in two distinct phases: par-

ticipants first interacted with their own VBA, representing an established trust relationship, and later with the (at that time) new voice mode of ChatGPT on a newly set-up smartphone, representing an initial trust phase with a relatively unfamiliar agent. The study thus contributes to understanding trust in VBAs by exploring users' personal definitions of trust, its relevance for their relationships, and its variation across trust phases.

The interviews followed a guideline based on the theoretical trust model and were further informed by insights from *Paper 3*. After introductory questions on general usage, participants performed typical tasks with both their own VBA and ChatGPT voice mode. Following the interactions, participants evaluated and reflected on their experiences with both assistants, before discussing usage development, effects of usage, personal concepts of trust, and indicators of trustworthiness. A total of 22 regular VBA users that engaged them for diverse tasks were recruited via snowball sampling. Each interview was conducted by two researchers, who shared moderation duties and observed the interactions. The recorded interviews were transcribed, anonymized, and analyzed by four researchers using MAXQDA. The coding scheme, originally developed in *Paper 3*, was inductively refined and continuously discussed in team meetings to ensure consistency and capture emerging themes.

In *Paper 5*, an *experimental online survey* using a 2x2 between-subjects vignette design with a demonstrational approach was conducted. Recordings of a VBA were manipulated in two dimensions: speech style (formal vs. colloquial) and topical context (informal everyday topics vs. formal political topics). The study was designed collaboratively with university students and was loosely based on the theoretical model of trust in VBAs, while also drawing on CASA and general trust research. At the time, colloquial speech in VBAs represented a novel feature, leading to the assumption that, in line with CASA, a more human-like speech style could enhance perceived humanness and

thereby trust (Cho et al., 2019; Lee & Nass, 2010). However, prior research on human communication suggests that non-standard language can reduce perceived competence (Blair & Conner, 1978; Cuddy et al., 2008). Lower competence, as an indicator of interpersonal trustworthiness, could negatively affect trust formation (Mayer et al., 1995). In addition, trust was expected to increase use intention (e.g., Chérif & Lemoine, 2019).

The experiment contributes to trust research in VBAs by examining a novel anthropomorphic cue and its impact on trust formation. It further replicates parts of the proposed trust model and tests its causal assumptions: an assistant feature (speech style) may influence the evaluation of a trustworthiness indicator (competence), which affects trust, leads to consequences (use intentions), and may be moderated by an external factor (context of information search). While additional hypotheses were tested, this synopsis reports only on the results directly relevant to the dissertation.

Given limited resources in the university context, the novelty of the speech feature, and the need for strict control over external variables to isolate causal effects, a vignette study based on prerecorded material was chosen as the most suitable design. The vignette introduced a fictitious VBA named “Q” and asked participants to imagine interacting with it. Q’s responses were prerecorded using the free version of the text-to-speech solution Readspeak (Greussing et al., 2022) and modified to create a gender-neutral and unfamiliar voice, minimizing prior attitudes linked to existing VBAs. A total of 244 participants, recruited through student networks and an online panel provider, were randomly assigned to one of the four experimental conditions. Participants imagined asking Q either informal everyday questions (e.g., about the weather) or formal political questions (e.g., about party programs), while hearing answers in either a colloquial or formal speech style. After listening to the responses, participants evaluated the assistant’s perceived humanness, competence, trust, and use intentions.

4.1.3 Answer to RQ3a: Methodological Approach to Trust in VBAs

HMC research on communicative interactions with conversational agents such as VBAs primarily relies on experimental designs to examine causal effects, while field studies are used to explore interactions in natural settings. Although both approaches offer distinct advantages, each also presents specific challenges. Therefore, combining methods is highly recommended to fully capture the complexity of these interactions, yet mixed-methods designs remain rare in this field. In answering RQ3a, this dissertation applies a mixed-methods approach that triangulates (1) a qualitative content analysis of online comments, (2) qualitative user interviews combined with observations, and (3) a quantitative experimental survey. This combination offers the most comprehensive empirical foundation to assess the proposed model of hybrid trust in VBAs.

The chosen design enables both exploratory and confirmatory research logic: qualitative methods capture authentic user perspectives, subjective trust definitions, and previously unexamined components of trust formation, while the experimental study systematically tests key causal relationships assumed in the model. In doing so, the approach addresses all key components of trust to be examined in RQ3b (trustworthiness indicators), RQ3c (temporal process of trust development), and RQ3d (trust consequences). This dissertation thus represents the first systematic empirical assessment of hybrid trust in VBAs based on multiple data sources, data types, and analytical procedures. In doing so, it directly responds to recent calls for methodological innovation in studying emerging hybrid conversational agents within HMC (Guzman et al., 2023; Greussing et al., 2022) and offers orientation for future endeavors.

4.2 Results (Papers 3, 4, 5)

This section presents the empirical findings of the dissertation in response to RQs 3b, 3c, and 3d. Rather than reporting the results of *Papers 3, 4, and 5* separately, the findings are synthesized to provide an integrated understanding of how trust in VBAs is formed, develops over time, and influences users. The presentation begins with exploratory insights that offer a general perspective on users' concepts of trust, followed by focused analyses of trustworthiness indicators, the temporal process, and consequences. Exemplary quotations from online comments (OC, *Paper 3*) and interviews (IV, *Paper 4*) are included to illustrate key results.

4.2.1 Exploratory Insights

Before examining the results for the specific components of the theoretical trust model, general exploratory insights offer an initial understanding of how users perceive and define trust in VBAs. The online comments analyzed in *Paper 3* revealed that users rarely refer to trust explicitly when evaluating VBAs. When the term was mentioned, it was typically in connection with either the *parent company* in general or specifically in relation to *data privacy policies* (OC1). A similar pattern emerged in the interviews of *Paper 4*: when participants were asked whether their general definitions of trust—which were mostly aligned with an interpersonal trust understanding—could be applied to VBAs, many rejected the idea. Some argued that a VBA could not serve as a trustee in a relationship; others clarified that trust could instead be placed in the parent company, particularly regarding its data privacy practices (IV1). Many interviewees instead described trust primarily as (technical) *reliability* (IV2), often restricting this trust to specific *functions* or tasks performed by the VBA (IV3).

- (OC1) “I trust Apple’s data privacy much more than Amazon’s or Google’s” (Siri_42)
- (IV1) “[...] I trust Amazon. [...] I wouldn’t know what kind of trust I could actually give the VBA” (P05, 489)
- (IV2) “Yes, I find it reliable in the sense that I know it works, and then I trust that it will work” (P17, 795)
- (IV3) “I trust my voice assistant to be able to play the songs I want it to play, to a large extent” (P21, 866)

In summary, users do not seem to form a broad or generalized trust in VBAs but rather a task-specific trust, largely focused on reliability and tied to particular contexts of use. At the same time, trust in the parent company and its privacy policies appears to play a role in shaping trust in VBAs.

4.2.2 Answer to RQ3b: Indicators of Trustworthiness

To assess which indicators of trustworthiness influence the formation of trust, we explored online comments for evaluations of VBAs in any of their three roles that were either explicitly linked to trust or implicitly reflected typical indicators of trustworthiness (*Paper 3*). In the interviews, participants were asked directly which factors influenced their trust in VBAs in general and with respect to each of the three roles (*Paper 4*). We specifically examined whether participants independently referred to theoretically established indicators, while also considering any additional factors that emerged naturally. The findings from both qualitative studies are presented jointly, before turning to the assumed causal relationships tested in the experimental survey (*Paper 5*).

In both qualitative studies, statements concerning VBAs as technical tools reflected typical *technical trustworthiness*: Commenters frequently praised VBAs for their technical *reliability*, particularly in relation to voice control and NLP performance (OC2). Similarly, interviewees emphasized reliably working functions (IV4). *Functionality* was often implicitly embedded in participants’ statements, and could also be identified in online comments where users discussed which functions VBAs were capable of

performing, which apps operated reliably, and where their expectations were not met (OC3). Thus, both reliability and functionality emerged as indicators of technical trustworthiness, consistent with prior research (Lankton et al., 2015; McKnight et al., 2011).

(OC2) “The speech recognition works very well and reliably” (GA_36)

(IV4) “So I rely on it working, but I’m not that annoyed when it doesn’t work, because I usually find out why. That’s why it’s basically a reliable device or a reliable tool, yes” (P16, 746)

(OC3) “Originally, my little one was supposed to be able to listen to his audio books independently with his new Alexa Kids ... it doesn’t work” (Alexa_44)

Many comments also addressed VBAs as social interactors and evaluated their *interpersonal trustworthiness*, often in connection to praise for their *anthropomorphic* voices and behaviors or through descriptions of human-like roles and relationships (OC4). This may represent a potential new indicator of trustworthiness for conversational AI, reflecting users’ perceptions of VBAs as humanized agents (Etzrodt & Engesser, 2021). However, the interviews revealed a somewhat different perspective: participants often expressed skepticism or rejection regarding the relevance of anthropomorphism for their own trust, sometimes indicating third-person effects, where they acknowledged possible influences on others but denied such effects for themselves (IV5). Social desirability may have played a role here, as participants may have sought to avoid appearing naïve or easily influenced by the technology, particularly in a face-to-face interview context. Both the online comments and the interviews also revealed some signs of theoretically established interpersonal trustworthiness. Commenters frequently discussed the VBA’s (lack of) intelligence, which can be interpreted as an assessment of its *competence* to understand and fulfill user requests (OC5). Although mentioned less frequently, both data sources included occasional references to the expectation that VBAs act with *integrity*, particularly in terms of honesty (OC6, IV6).

Overall, these findings support the relevance of the interpersonal trustworthiness indicators competence and integrity for VBAs (Mayer et al., 1995).

- (OC4) “Alexa... somehow a typical woman” (Alexa_38)
- (IV5) “So [...] if, for example, other people [...] see this human aspect more, [...] then I can understand that they naturally have much more trust in Alexa” (P12)
- (OC5) “The *intelligent* version of Siri” (GA_6)
- (OC6) “I could have accepted the incompetence if the assistant had answered honestly ‘I have no idea what you want’” (GA_1)
- (IV6) “But one of the personality traits of this technical component is that Siri always admits her failures. So, she simply points out her limitations, whereas with ChatGPT we’ve seen that he doesn’t do that” (P17, 838)

In relation to VBAs’ role as information intermediaries, users in both studies addressed indicators of *media trustworthiness* as defined in the media trust framework. In both online comments and interviews, participants emphasized the importance of receiving correct information, expressing expectations that VBAs provide accurate and truthful answers (IV7), thus evaluating the indicator of *accuracy*. Additionally, the *selection* of information was frequently discussed, particularly in terms of timeliness and “up-to-dateness” (OC7), as well as relevance to the individual user (IV8). Accuracy and selectivity of information are established indicators of media trustworthiness (Kohring & Matthes, 2007), and thus confirm the relevance of applying a media trust framework to the context of VBAs. Further aspects were discussed in both studies. Commenters often addressed the *presentation mode* of information, distinguishing whether content was displayed visually or spoken aloud, with a clear preference for spoken output (OC8). In contrast, interview participants focused less on presentation but frequently highlighted the importance of *source transparency*: VBAs that disclosed their sources were viewed more favorably, while a lack of source references was criticized (IV9).

- (IV7) “I actually think the information is always very valid and correct” (P14, 587)
- (OC7) “All requested information is up to date” (Alexa_39)
- (IV8) “So I want Siri to know me better. I wish Siri could do more for me” (P08, 1230)
- (OC8) “90% of the questions result in pointless Google searches... I don’t need a smart speaker for that...” (Siri_13)
- (IV9) “And I also think it’s pretty good that she also says where she got her information from” (P12, 849)

Interestingly, some comments reflected a *hybrid trustworthiness* by combining elements from different roles. Users often linked social anthropomorphism with media-related information performance (OC9) or with technical abilities, attributing knowledge or even a form of independent “mind” to the assistant (OC10). Similarly, interview participants also evaluated such combinations of anthropomorphism and media-related performance, but this only occurred in relation to their experience with the newly tested voice mode of ChatGPT (IV10). However, when interviewees were asked to identify which aspects were most important for their trust in their own VBA, they primarily referred to the technical or media-related role and corresponding indicators of trustworthiness, while explicitly ranking the interpersonal role as least relevant (IV11).

- (OC9) “The assistant has great answers and logical ideas” (GA_16)
- (OC10) “When asking questions, it is really noticeable that she has an American mind-set and was programmed there. Often, she does not understand what I want” (Alexa_4)
- (IV10) “But I felt more like I was talking to a person, probably also because she went into so much detail and said so much in response to my questions” (P15, 317)
- (IV11) “Even if it has such a nice voice, if it doesn’t work technically or just spits out un-truths, then I wouldn’t have anything to gain from it sounding nice” (P14, 643)

To further examine the assumed *causal relationships* between trustworthiness indicators and trust, the quantitative experimental study tested whether an anthropomorphic feature (colloquial speech style) affected trust indirectly via an interpersonal indicator of trustworthiness (competence). Since the qualitative studies revealed only limited indications of competence influencing trust, and interview participants often denied any effect of VBAs' social nature on their trust, more detailed insights into these relationships are needed.

The results of a structural equation model (SEM), incorporating all hypothesized relationships (Frehmann, 2023, p. 49) showed that the colloquially speaking VBA Q was perceived as less competent than the formally speaking one ($\beta = -.143$, $p = .033$), confirming the hypothesis based on the CASA paradigm. Competence demonstrated a strong positive effect on trust ($\beta = .768$, $p < .001$), and the indirect effect of colloquialism on trust via competence was also significant and negative ($B = -.315$, $p = .034$, 95% CI [-0.600; -0.025]). These results indicate that competence is indeed an influential indicator of trustworthiness that directly affects trust formation. At the same time, competence itself is shaped by anthropomorphic features in a manner similar to interpersonal evaluations of humans. However, no direct effect of the stimulus on trust was found ($\beta = .02$), suggesting that anthropomorphic cues such as colloquialism do not serve as independent indicators of interpersonal trustworthiness, but rather influence users' assessments of trustworthiness indicators such as competence, which then affect trust.

In summary, across both qualitative studies, typical indicators of trustworthiness for each role of VBAs were identified, with some being combined, supporting the assumption of hybrid trust in VBAs. Competence, as an example of an interpersonal trustworthiness indicator, was confirmed to positively affect trust and is itself influenced by anthropomorphic features such as colloquialism, which impact trust only indirectly.

4.2.3 Answer to RQ3c: Temporal Process

To investigate the temporal process of developing a trust relationship—specifically, the progression from an initial phase to a stable long-term phase—we analyzed descriptions of such developments in online comments (*Paper 3*) and asked interview participants directly about changes in their relationships with VBAs over time (*Paper 4*). We also compared user interactions and evaluations across various typical tasks between participants’ own VBA and the newly introduced LLM-based ChatGPT voice mode, assuming these represented a stable trust phase and an initial trust phase respectively, as ChatGPT’s voice mode was new to all interviewees except one.

In the online comments, we found no explicit reflections on relational development, but rather descriptions of *changed evaluations* linked to improved or deteriorated functions of VBAs (OC11). Similarly, interview participants described *changed attitudes* toward the VBA over time, either moving from initial skepticism to acceptance, or from early curiosity to a more moderate, matter-of-fact perception, often depending on who originally introduced the device into the household (participant or another person). Regardless of the starting point, most participants reported having become accustomed to the presence of their VBA over time, eventually perceiving it as a given and unquestioned part of daily life (IV12). Learning the assistant’s capabilities and limitations appeared to facilitate this adjustment. However, participants did not recall specific changes in trust itself, nor distinct events that would have triggered increases or decreases in trust.

(OC11) “Nothing works properly anymore. Connecting with devices as Wi-Fi speakers do not work. Simple routines that worked great last year no longer work [...] I was such a big fan and recommended Alexa to everyone. That’s over!”

(Alexa_34)

(IV12) “First a bit of skepticism, then simply an everyday object, it’s there, it’s used. A minimal change in the sense that it is simply there and has become an everyday device” (P09, 372)

When observing interactions with both assistants and collecting evaluations of their task performance, we identified differences corresponding to the *different phases* of trust. When evaluating ChatGPT’s voice mode, participants—similar to their evaluations of their own VBA—assessed both its role as a technical tool and as an information intermediary. Technical advancements were particularly praised (IV13), while aspects related to app handling were criticized. Regarding its role as an information intermediary, some interviewees appreciated the breadth of information provided, while others criticized excessive detail and especially the lack of source transparency (IV14). However, unlike with their own VBA in an established trust relationship (see Chapter 4.2.2), ChatGPT’s role as a social interactor received more frequent positive evaluations after initial interactions. Yet, these social aspects were almost always mentioned in conjunction with either technical or media-related performance (IV15).

(IV13) “I think ChatGPT is really good. I think it’s crazy well implemented and I find the possibilities behind it fascinating” (P06, 441)

(IV14) “The problem with ChatGPT for me is still this source handling, that you don’t know where from... Exactly. Where does the information come from?” (P21, 1146-1148)

(IV15) “I think it’s the type of voice output, the mix of information and human voice. That’s where you think ‘Yes, someone has just looked something up for you and is now answering you’. It’s the mix, yes” (P06, 1189)

When determining which assistant participants trusted more, one additional factor emerged as particularly influential: *experience*. Although many participants rated

ChatGPT's observed performance and appearance more positively than that of their own VBA, trust was generally higher for the traditional VBA, as users felt that their accumulated experience with it outweighed these initial impressions (IV16). This experience also extended to familiarity and experience with the often-cited or indirectly implied parent company, including attitudes toward its reputation and data privacy policies (IV17). A small number of participants expressed greater trust in ChatGPT; in all cases, their reasoning was linked to its media-related performance and prior hands-on experience with ChatGPT as a chatbot (IV18).

(IV16) "ChatGPT, for sure [is more] trustworthy, in the sense that the results are delivered, [...] in the overall context. In terms of my needs, I trust Siri. Now we come to trust. I trust Siri, yes" [Interviewer 1] "So, Siri is more trustworthy than ChatGPT?" [Interviewee] "Yes, completely, because I haven't used ChatGPT to that extent yet. And because what I need can be done by Siri. So, alarms, Spotify, calls, reminders, exactly" (P13, 1231).

(IV17) "I trust Siri much more than ChatGPT because I'm pretty sure that my data is protected there, whereas with ChatGPT I know that it's just being processed openly on the internet and that it's also being used for other requests in order to optimize them. Well, I'm safer with Siri in terms of security" (P14, 675)

(IV18) "[...] while Alexa is more of a help, ChatGPT is almost like a tool. So, I have more trust in it because it's more reliable. It's just much more reliable and helps me more" (P11, 1061).

It can therefore be concluded that the temporal process of developing a trust relationship with a VBA initially relies on perceivable characteristics across all three roles: technical tool, social interactor, and information intermediary. As users gain experience and become familiar with the assistant, initial curiosity or skepticism diminishes, technical and media-related performance aspects become more central compared to interpersonal ones, and trust increasingly builds on accumulated experience. However, specific key events that may trigger changes in trust remain open.

4.2.4 Answer to RQ3d: Consequences

To assess the consequences of trust, we analyzed references to outcomes of VBA evaluations in the online comments (*Paper 3*) and asked interview participants whether and how trust in the VBA influences their perceptions, cognitions, and emotions (*Paper 4*). Additionally, usage intention was included as a typical consequence of trust and measured in the experimental survey (*Paper 5*).

In the online comments, *emotional consequences* emerged as the most frequent outcome of VBA interactions. A range of emotions was expressed, including excitement, amusement, and affection, as well as disappointment, frustration, fear, or jealousy (OC12, OC13). In contrast, interview participants largely denied experiencing emotional consequences related to their VBA usage or trust (IV19). Nevertheless, emotional reactions such as annoyance or amusement were observed during the interactions, along with personifications of the assistants. Interviewees also described short-term emotions and acknowledged that the sophistication of socially acting technology may inherently trigger some degree of emotional response in users (IV20). However, in both studies, no indications of deeper emotional bonds were reported.

(OC12) “I already love her” (Alexa_55)

(OC13) “But my girlfriend is already starting to get jealous” (GA_10)

(IV19) “No. In that respect, I’m also pretty factual [...] Nope, why should I be annoyed by that device?” (P07, 698-702)

(IV20) “From a purely perceptual point of view, I would deny it now. But it’s probably the case that you’re a bit emotional about it, it’s just this use, [the phrase] ‘can you please’ alone is confirmation that you deal with it differently” (P22, 423)

Commenters also showed *cognitive consequences* by expressing how recommendable they perceived a VBA to be, which is typical for marketplace reviews written to guide other potential buyers (e.g., Chen & Xie, 2008; Zhang et al., 2010). Such explicit recommendations were not found in the interviews; however, most interviewees

described long-term shifts in their perceptions and attitudes toward VBAs. These developments typically moved from initial skepticism or curiosity toward acclimatization and comfort, which can also be understood as part of the general temporal process of developing a trust relationship (see Chapter 4.2.3).

Both studies revealed various *behavioral consequences* of trust, including changes in usage patterns, accommodation to VBA phrasing and keywords, increased engagement with VBA functions, and intentions to purchase additional related products (OC14). The interviews provided more detailed insights into how this increased engagement is connected to trust. Consistent with the temporal process, experience emerged as significant and acted as both a consequence and a predictor of trust: users primarily trust functions with which they have had positive experiences, leading to more frequent use and further reinforcing trust (IV21). Conversely, functions associated with negative experiences are not trusted and therefore avoided (IV22).

(OC14) “I’m even thinking about buying matching light bulbs to be able to control them with Alexa” (Alexa_53)

(IV21) “The simpler the tasks are, the more reliably they are performed, of course. And that’s why I only use them for simple tasks” (P05, 561)

(IV22) “Yes, I trust that I don’t need to trust it. I just know that it somehow doesn’t work in many aspects and then I don’t even try it, which is of course a pity in some cases, but I don’t even try it and yes, I have trust that it won’t work anyway” (P17, 791).

This trust in specific functions can result in broader *habitual consequences*, leading to changes in routines and daily practices. Such developments were observed in the online comments (OC15), and discussed in more depth during the interviews. Some users described how family routines and dynamics had adapted around the use of the

VBA, or how it served as a resource for altered media consumption habits and new family rituals (IV23). A few interviewees even mentioned the integration of the VBA into the family itself (IV24).

(OC15) “[...] our new ritual ‘audio book at breakfast’” (Alexa_51)

(IV23) “Yes, I think this evening ritual with the lights and the music in the evening, the sounds to fall asleep to, that’s definitely a ritual that has only come about thanks to the voice assistant” (P17, 619)

(IV24) “Yes, well, as I said earlier, sometimes my father and I get angry with her, but she’s just part of it now, isn’t she? [...] But yes, she has already been integrated with us, yes” (P03, 465)

The quantitative experimental survey also examined a potential *causal relationship* between trust and an exemplary consequence. Specifically, it tested whether the manipulated speech style would influence use intentions via competence and trust as mediators. The SEM revealed a positive correlation between trust and use intentions, but this effect narrowly missed conventional significance levels ($\beta = .191, p = .079$). Similarly, no significant indirect effect of speech style on use intentions was found ($B = -.070, p = .085; 95\% \text{ CI } [-0.261; 0.008]$). Thus, for the participants of this experimental survey, trust did not significantly influence behavioral intentions. However, the effect trend suggests that the small sample size may have limited the statistical power to detect an effect reliably.

Summarizing the results, trust appears to lead primarily to behavioral consequences related to the adaption to and usage of VBAs and the integration of VBAs into everyday routines. Although the experimental survey could not reliably confirm a causal link between trust and behavior, qualitative findings consistently revealed such patterns. Emotional consequences were diverse but limited to short-term reactions rather than deeper emotional bonds grounded in trust. Interviewees also described shifts in attitudes

driven by accumulated experience, which seems particularly relevant in determining which functions users feel confident relying on and continue to use in the future.

4.2.5 Answer to RQ3: Empirical Evidence of Trust in VBAs

The empirical investigation of the theoretical model of hybrid trust in VBAs largely confirms the model's assumptions while adding important nuance. The qualitative findings show that users' trust in VBAs is not general or fundamental but task-specific, focused on functions perceived as reliable. Users actively limit their interactions to trusted tasks and factor in trust toward the parent company and its data policies. Across the components of trust, indicators of trustworthiness for all three roles—technical, interpersonal, and media-related—proved relevant for trust formation and were sometimes combined, with consequences emerging on behavioral, habitual, cognitive, and short-term emotional levels. The experimental study confirmed a causal effect of an interpersonal trustworthiness indicator on trust, though no significant effect was found for trust on behavioral intentions.

Regarding the temporal process, users initially evaluate technical, media-related, and interpersonal trustworthiness. As they gain experience, trust shifts from being based on these indicators to being anchored in personal experience with specific functions, which then drives continued trust and usage. In this stable phase, interpersonal aspects become less influential, while technical reliability and functionality and media-related accuracy, selectivity, and source transparency remain central to sustaining trust.

5. Discussion and Limitations

5.1 Discussion of the Empirical Results

This section discusses the empirical findings from *Papers 3, 4, and 5* in light of RQ3 and the central aim of understanding trust in VBAs and its influence on user interactions. The discussion moves beyond the structure of Chapter 4 and instead focuses on central insights across the studies to connect them back to the theoretical foundations established earlier in the dissertation.

5.1.1 Users' Narrow Definition of Trust

A central insight of the qualitative studies was the users' narrower understanding of trust compared to earlier theoretical assumptions. Trust in the VBA was described primarily as task-specific reliability rather than a broad, general trust encompassing all potential interactions. Users did not fully relinquish control or accept risks across the entire range of VBA functions, as a more universal understanding of trust would suggest (Rousseau et al., 1998). Instead, they selectively engaged with tasks and functions they had previously experienced as reliable. This indicates that users consciously regulate trust by limiting it to familiar contexts.

Such behavior likely serves as a *risk management* strategy: by restricting interactions to well-known functions, users maintain a greater sense of control and minimize the likelihood of disappointment. In this way, trust becomes conditional on accumulated experience and knowledge of prior performance, resembling knowledge-based trust as described in interpersonal contexts (Lewicki & Bunker, 1996), but further narrowed by its task-specific application. Thus, trust in VBAs emerges as a more cautious, experience-driven process than originally theorized, reflecting users' active management of vulnerability in interactions with socially acting technology.

This limitation of trust to specific functions signifies a deviation from theoretically broader conceptualizations and thus represents a novel finding in trust and VBA research. While similar notions of “domain-specific trust” (Foehr & Germelmann, 2020, p. 196), restricted to repeated actions, have been observed previously, this dissertation is the first to directly link such limitations to users’ conscious strategies of risk management. The findings show that users actively manage their trust by selectively engaging with functions they feel confident using, thereby maintaining a sense of control over interactions that inherently involve technological uncertainty. This insight may serve as a valuable starting point for refining theoretical definitions of trust in conversational AI agents from the user perspective and for assessing how users adapt their perceptions and behavioral scripts to new communicative interaction partners (Gambino et al., 2020).

5.1.2 Institutional Trust as an External Influence

Despite the narrowness of trust in VBAs, both qualitative studies revealed that trust operates on a broader level as well: the parent company emerged as an additional trustee, introducing institutional trust at the meso-level. Trust in the VBA appeared to be deeply embedded in this institutional trust, as users generally became adopters only if they already trusted the company behind the product. If concerns existed about the company or its data practices—such as with ChatGPT’s parent company OpenAI—usage was often limited or avoided entirely (see IV17).

This trickle-down effect, in which trust in an organization translates into trust in its products (e.g., Blöbaum, 2014; Seymour & Van Kleek, 2021), appears to be more influential than previously acknowledged. It sets the stage for interaction by legitimizing the assistant as a trustworthy actor endorsed by the company itself. While prior VBA research has often emphasized privacy concerns related to the parent company (e.g., Vitak et al., 2023), the findings here demonstrate that institutional trust is shaped not only by

data practices, but by additional broader positive experiences with the brand and its societal reputation. This underlines that trust in the parent company is a complex and multi-faceted construct, warranting further investigation. As such, it should be understood as a central external factor in trust formation processes surrounding VBAs.

5.1.3 The Relevance of Media Trust

One of the central theoretical advancements of this dissertation was the integration of a media trust framework alongside the established interpersonal and technical frameworks, in order to reflect VBAs' role as new intermediaries of information and their multidimensional, hybrid nature. The findings confirm that this media-related role is highly relevant for users' trust in VBAs. Indicators of trustworthiness related to all three roles were independently evaluated in the online comments and identified as influential in the interviews, with technical and media-related trustworthiness even outweighing interpersonal trustworthiness in importance. Moreover, several instances showed users blending the roles in their assessments, suggesting that hybrid trustworthiness can foster hybrid trust, for example when users evaluate an anthropomorphic agent providing personalized information (see IV15).

The relevance of media trust for VBAs represents a new empirical insight. While VBAs have long been used for information retrieval and news consumption (e.g., Hölig et al., 2022; Newman, 2018), prior research has not systematically measured the role of media trust indicators in this context (e.g., Weidmüller, 2022). This dissertation demonstrates that users do apply typical journalistic trustworthiness criteria when evaluating VBA information. At the same time, the actual information quality of VBAs remains limited, as seen for questions concerning the Covid-19 pandemic (Frehmann et al., 2022) and health-related topics (e.g., Miner et al., 2016). It is therefore encouraging

that users do not engage in blind trust but critically assess information provided by VBAs, focusing on accuracy and selectivity.

The findings also suggest that users may apply even *stricter expectations* to VBAs compared to traditional news media, as aspects like information presentation and source transparency were frequently mentioned. While these two aspects are not part of conventional media trust frameworks (e.g., Kohring & Matthes, 2007), (source) transparency in particular has been increasingly discussed in the context of AI-generated information and incorporated as a relevant evaluation aspect in prior studies (e.g., Alagha & Helbing, 2019; Frehmann et al., 2022; Goh et al., 2021). These aspects likely do not function as distinct trustworthiness indicators but may instead shape how users assess established indicators such as accuracy and selectivity, thereby influencing trust indirectly—similar to the indirect influence of anthropomorphism on trust via interpersonal trustworthiness (Frehmann, 2023).

As conversational AI continues to evolve and AI information search expands into broader usage contexts such as education (e.g., Hoy, 2018; Karunaratne & Adesina, 2023; Zhang & Yang, 2025), media trust will likely become even more central for understanding user trust in AI-driven information performances. Incorporating established media trust indicators (e.g., Kohring & Matthes, 2007; Prochazka & Schweiger, 2019), particularly in quantitative studies, offers a valuable way forward for capturing trust in this emerging area of information interaction.

5.1.4 The Decreasing Relevance of Interpersonal Trust with Growing Experience

Regarding VBAs' role as social interactors, the studies revealed inconsistent evidence on how influential interpersonal trustworthiness is, and whether emotional consequences and affective bonds—typical outcomes of interpersonal trust (e.g., Lewicki, 2006; Lyu & Ferrin, 2018)—actually occur. While interpersonal trustworthiness was

discussed in online comments and interpersonal competence was found to influence trust in the experiment, interviewees largely rejected the relevance of the social interaction role, and none of the studies identified clear signs of emotional bonding. These inconsistencies become more understandable when considering a potential confounding variable across studies: *different phases* in trust development.

A comparison of the study samples suggests that unintentionally different user populations have been examined. The experimental survey, conducted in July 2021 with a convenience sample, confronted participants with a new VBA with which they had no prior experience. Similarly, the qualitative content analysis of online comments, covering posts from 2019 to 2023, included a substantial proportion of reviews on marketplaces (51%) and forum discussions (18%), many of which were written by new users. Online reviews are typically written shortly after first experiences with a product or service, when users are still motivated to reflect on their initial impressions (Li et al., 2019, 2020), and the forum posts often reflected early user questions or first reflections. Thus, both studies largely captured trust in an *initial phase*—either after a very first (simulated) interaction in the experiment or during an early trial phase in the content analysis.

In contrast, the interviews specifically recruited users with over one year of experience with VBAs, yielding an average of 4.9 years of usage across the 22 participants. These interviews, conducted in 2024, represent users in a more *stable phase* of trust relationships with traditional VBAs, after years of product establishment and widespread adoption of smart speakers in Germany (Taş et al., 2019). Additionally, interviewees were temporarily placed into a new *initial phase* of trust when interacting with ChatGPT’s newly introduced voice mode (OpenAI, 2023).

When interpreting the findings across the different trust phases, a clear pattern emerges regarding the role of the interpersonal dimension within the trust relationship.

In all examined *initial phases*, the social interactor role was noticeably present. In the online comments, users evaluated anthropomorphism as well as competence and integrity—classic indicators of interpersonal trustworthiness (e.g., Mayer et al., 1995)—and competence was shown to causally influence trust in the fictive VBA Q in the experimental study. Commenters also expressed expectations that future AI-powered assistants would exhibit even greater interpersonal intelligence, often blending this with technical and informational capabilities. Similarly, interviewees evaluating their first interactions with ChatGPT’s voice mode, several years later and in a new initial phase, commented on its interpersonal competence and again combined this with evaluations of technical and media-related performance in relation to their trust.

In contrast, for their own established VBAs in a *stable phase* of trust, interviewees strongly dismissed the relevance of the social interactor role for their trust and rejected any emotional attachments or consequences. Thus, VBAs appear to trigger evaluations of interpersonal trustworthiness primarily during an initial phase of trying out and assessing the assistant’s capabilities. In these early stages, a hybrid trust incorporating all three roles may be especially prominent. However, as the trust relationship steadies in a stable phase and users accumulate experience, the significance of the interpersonal role diminishes. Experienced users consciously prioritized technical reliability and media-related accuracy over social behaviors when describing what underpins their trust.

This development aligns logically with the earlier finding that users form task-specific trust: most tasks that users delegate to their assistants are either technical in nature or involve information retrieval (Arnold et al., 2019; Kinsella & Mutchler, 2020). Consequently, trustworthiness indicators relevant to these domains drive user trust. At present, there are no social tasks that users regularly perform with their VBAs, rendering interpersonal trust unnecessary in the current task landscape. However, with the

rapid advancement of LLM-based assistants and their expanding capabilities (Kokotajlo et al., 2025), it is conceivable that new social use cases may emerge.

5.1.5 The Temporal Process of Developing Trust and Experience's Twofold Role

Although participants were unable to recall precisely how their trust changed over time, they were able to describe how their overall relationship with the agent evolved. This relationship is assumed to be based on interactions entered through task-specific trust and therefore their descriptions offer indirect but fruitful insights into the temporal process of trust development. Two primary *trajectories* emerged: (1) Some participants experienced disenchantment as they gradually recognized the VBA's actual capabilities and learned how to adapt to its vocabulary and operational logic; (2) others described an evolution from initial skepticism toward greater acceptance and comfort. In both cases, experience played a central role in facilitating these adjustments. This developmental path bears resemblance to typical interpersonal trust trajectories, where initial emotional idealization transitions into a more stable trust based on knowledge (Boon & Holmes, 1991). In some cases, however, early skepticism suggests a reversed—but still emotional—entry point into the trust relationship, which eventually stabilizes into an experience-based trust (Lewicki & Bunker, 1996).

Experience thus plays a profoundly significant role in the formation of trust and its development over time. While prior research has acknowledged the influence of (in)experience with VBAs on trust (e.g., Foehr & Germelmann, 2020; Weidmüller, 2022; Weidmüller et al., 2022), the present findings suggest a twofold function that has not been articulated before. First, experience operates as a *consequence* of initial trust and subsequent engagement: only after trust is initially established do users accumulate hands-on experience with the VBA and learn which functions they consider reliable for continued trust-based interactions. Second, experience becomes a *predictor* of trust in

the stable phase of the relationship, where trust is grounded in accumulated positive experiences and correspondingly adapted expectations.

As also seen in previous research, users often described this interplay between trust and experience as a *reinforcing cycle* (e.g., Lee & See, 2004; Lyu & Ferrin, 2018; Tsfati & Ariely, 2014), but struggled to disentangle which element precedes the other. It appears plausible that meso-level experience or trust may function as an initial external factor influencing early trust: trust in the parent company (see Chapter 5.1.2), as well as second-hand experiences shared by peers, may contribute to an initial baseline trust. This initial foundation is then supplemented by evaluations of trustworthiness through direct observations once users engage with the agent. Such initial influences were visible, for example, in participants' statements about ChatGPT, where trust assessments were informed by prior knowledge of the parent company, even before any personal interactions had occurred (see IV17). Experience and trust subsequently reinforce one another in the ongoing development of the trust relationship.

The trajectory of trust development in VBAs remains a relatively underexplored area. To date, only one previous study has explicitly examined this temporal process, suggesting that users develop either a rational or an emotional form of trust depending on their experiences (Foehr & Germelmann, 2020). However, that study was limited to interpersonal trust frameworks and included users with minimal experience, often as little as one week. In contrast, the present dissertation's findings suggest that emotionally based interpersonal trust likely characterizes an early phase of trust development that later transitions into a more experience-based, task-specific trust. Rather than reflecting two distinct developmental paths, these trajectories may instead represent different stages within a common trust development process. Future research should employ longitudinal panel designs that follow new VBA users over extended periods, capturing the

development of trust, identifying key events and experiences that shape its evolution, and confirming the found transition from an emotionally- to an experience-based trust.

5.1.6 Consequences of Trust and How VBAs Influence Users

The investigation of specific consequences of trust in VBAs—separate from the general process of relationship development—revealed primarily behavioral effects related to usage, along with some cognitive, emotional, and habitual consequences. Overall, it proved challenging to collect statements from commenters and interviewees, as users often struggled to reflect consciously on the effects of trust. Consequences appeared to unfold gradually and implicitly, making them difficult to articulate. Nevertheless, the behaviors observed and described, particularly at the emotional and habitual levels, suggest that VBAs do influence their users—though this influence requires further investigation using more objective methods beyond self-reported reflections.

While few participants explicitly described fully integrating VBAs in core aspects of private or family life, both qualitative studies provided clear evidence of VBAs becoming embedded in daily rituals and routines. In many cases, these routines emerged organically through the simple presence of the device in users' homes, without users being able to fully retrace how this deeper integration evolved over time. For instance, simple tasks such as playing music or providing information eventually extended into broader contexts like elaborate nighttime routines or radio consumption habits both based on the VBA (see IV23).

This observation indicates that trust in VBAs may affect a *gradual mechanism of behavioral expansion*: as users develop trust in basic functions, they become increasingly open to relying on the VBA for adjacent or more complex tasks, thereby reinforcing and broadening their reliance on the agent. Each positive experience with a trusted function may lower users' psychological barriers, making them more receptive to VBAs

suggestions in related areas. In this way, trust may act as a behavioral gateway, where successful task-specific experiences create stepping stones toward more expansive and diversified usage patterns.

When users begin to move beyond task-specific trust and explore new, untested functions, they implicitly accept higher levels of risk and correspondingly place greater trust in the VBA. This gradual broadening of interaction contexts may signal the emergence of a more holistic form of trust and increasingly *meaningful relationships* with VBAs—although these relationships differ fundamentally from interpersonal ones, as they are not rooted in affectionate attachment, but primarily in functional and informational reliability. The significance of such relationships thus lies not in emotional bonding, but in the role of the VBA as a practical tool and information provider with the potential to exert a fundamental influence in these areas.

However, if future generations of voice assistants succeed in continuously learning from prior interactions and mastering increasingly complex tasks, trust may gradually evolve through positive experiences and expanding interaction patterns. It may eventually develop into a form of generalized trust that is no longer limited to narrowly defined tasks but extends across multiple areas of interaction. Such generalized trust would imply that users increasingly relinquish active control over interactions and accept greater vulnerability in the face of uncertainty, risk, and limited experience with new application contexts. This form of trust then could have consequences on a broader and more generalized level, signifying a fundamental influence of VBAs on users' behaviors, knowledge, and opinions. Whether users will indeed be willing to take this step of accepting greater risks and reduced control, or whether the need for control and risk management will remain relevant even as AI capabilities advance, remains an open question for future research.

5.2 Limitations

Overall, the research program conducted in this dissertation provided valuable and multidimensional insights into the subject of trust in VBAs. Nonetheless, this work is not without limitations. Several *important issues* that emerged across the individual studies could *not be explored* in greater depth. For example, the concept of trust in the parent company remained somewhat undefined, and it could not be determined at which point in time this institutional trust influences trust at the individual level. Similarly, experience was found to be highly relevant for users in deciding which functions to use and trust in a stable trust phase—yet it remained unclear which specific experiences and key events contribute to this process. Furthermore, insights regarding the effects of individuals' characteristics, such as demographics, personality traits, or general technology attitudes, remained rather superficial. An extensive analysis of the observational data concerning users' nonverbal reactions to VBA answers, separate from the combined interviews, also remains outstanding.

Most importantly, a *quantitative validation* of the theoretical model of hybrid trust in VBAs is still lacking. Although the experimental survey offered some insights into selected causal relationships, a survey of a representative sample of VBA users investigating the full model would have provided more certainty about the relevance of all variables and their interrelations. In particular, a *longitudinal design* following the temporal process from initial to stable trust and monitoring external factors alongside the growth of experience would have been especially informative. Likewise, it was not possible to develop and validate a *standardized trust scale* for VBAs based on the central findings regarding the three roles and corresponding trust frameworks, which is urgently needed to improve comparability across future studies in the HMC field (Greussing et al., 2022). Finally, specifically targeting conscious *VBA non-users* and ex-

users could have offered important insights into how a lack of trust emerges and what consequences it entails—a population often neglected in HMC research (Greussing et al., 2022). Due to the limited timeframe and available resources, these aspects could not be addressed within the scope of this dissertation project.

Moreover, the individual empirical papers contain limitations that contribute to the overall boundaries of the dissertation. A general limitation is that all research was conducted with German-speaking participants or based on German online comments. German online users are known for their strong privacy sensitivity (Ilhan & Fietkiewicz, 2020; Krasnova & Veltri, 2010). In fact, the adoption of VBAs and smart speakers has been slower and more hesitant compared to more technology-open countries like the US or the UK (Hölig et al., 2022; Newman et al., 2022), possibly due to privacy concerns. It is likely, that the *cultural context of German technology skepticism* (Rath & Delere, 2020) influenced the empirical studies, particularly with regard to social desirability effects in both the interviews (*Paper 4*) and the experimental online survey (*Paper 5*): social pressure may have led participants to emphasize their privacy awareness and controlled use of VBAs. Conducting similar studies in less privacy-concerned cultures may reveal different relevant external factors, especially regarding the parent company, and may even uncover a less task-specific form of trust rooted in less need for control. Future studies should therefore pursue cross-national designs to compare trust, its influences, and its consequences across different cultural contexts.

Concerning the qualitative content analysis (*Paper 3*), a first central limitation concerns the *non-representative sample*. We consciously collected comments that had a minimum interpretable length and contained evaluations of at least one of VBAs' roles, while attempting to balance the platforms, products, ratings, and time periods represented. However, the comments likely reflect perspectives of particularly opinionated or

tech-savvy users, while more moderate or undecided voices may be underrepresented, as such users tend to be less vocal online (Hu et al., 2017). Therefore, the findings cannot be generalized to all VBA users. Second, the frequent *absence of explicit trust statements* required us to assume trust indirectly, based on the theoretical assumption that any evaluation of a VBA's performance reflects aspects relevant for its use—and that use itself implies that at least some level of trust has already been granted. While we argue that the presence of evaluations of typical trustworthiness indicators suggests that a form of subconscious trust is present, this interpretation could not be directly validated within the available material. However, the follow-up interviews later confirmed that trust predicts interaction (Frehmann et al., 2026).

The interviews combined with observations of interactions tasks (*Paper 4*) also contain several limitations. First, while we intentionally recruited a diverse sample regarding demographics, products, and years of prior use, the exploratory nature of the study and the participants' self-selection again *prevent generalizability* to the full VBA user population. Second, despite using open-ended, narrative prompts to minimize response bias, it remains possible that participants' rejection of VBAs' social characteristics reflects a form of *social reactance* towards persuasive agents. Privacy norms specific to the German context may have further amplified socially desirable responses on this issue. Nevertheless, as participants simultaneously expressed appreciation for social features when interacting with ChatGPT, we believe our interpretation of differences between agents and trust phases remains valid, even if some answers may have been dampened by social desirability. Third, since trust often forms subconsciously and automatically (Hill & O'Hara O'Connor, 2005), participants may *not have been fully able to reflect* on or reconstruct the development of trust over time, the role of key experiences,

or the consequences of trust. This highlights, once again, the need for longitudinal designs that track such developments independently of participants' retrospections.

The experimental online survey (*Paper 5*) is subject to several additional limitations. First, the sample was *not representative*, but consisted of a mixture of self-selected university contacts and participants from a commercial online panel. Moreover, the *sample size* may have been insufficient to reliably detect effects, as no a-priori power analysis was conducted, and the hypothesized effect of trust on usage intentions only emerged as a trend approaching significance. Second, while the fictional voice assistant "Q" was intentionally designed as gender-neutral and distinct from existing products, some participants found the voice style unappealing, which may have reduced *external validity* and unintentionally influenced perceptions of the agent. Third, the vignette-based design asked participants to imagine interactions rather than experience them directly, which likely *limited interactivity* and the perceived realism of the scenario—a common shortcoming of HMC research (Greussing et al., 2022). More immersive or lab-based methods could better address this in future research.

Fourth, the study focused on *selected components* of the theoretical model: only competence was measured as an interpersonal trustworthiness indicator predicting trust, while benevolence and integrity—as well as indicators of technical and media trust—were omitted. Finally, the study employed a *newly constructed trust scale* derived from prior instruments (Burgoon et al., 2000; Lee, 2003), which showed excellent reliability (Cronbach's $\alpha = .92$), but focused primarily on broad trustworthiness and reliability rather than capturing VBAs' hybrid nature as technical tools, social interactors, and information intermediaries. Future studies should incorporate all relevant trustworthiness indicators and develop trust measurements that fully reflect the hybrid role of VBAs to more comprehensively capture the multidimensional nature of trust in these agents.

6. Implications and Contributions

This chapter outlines specific implications and general contributions derived from the results discussion and the overall dissertation project. It first offers implications for a refined model of hybrid trust in VBAs (RQ2), then reflects on directions for future research on a new generation of voice assistants (RQ1), and concludes by summarizing the central contributions to theory, empirics, methodology, and practice.

6.1 Refinement of the Theoretical Model of Hybrid Trust

Despite its limitations, the findings of the dissertation provide extensive insights into trust in VBAs and allow for a revision and refinement of the theoretically derived model of hybrid trust developed for RQ2. For each component of trust, the results offer additions and refinements that inform the revised model, which is depicted in Figure 3 and explained in the following paragraphs.

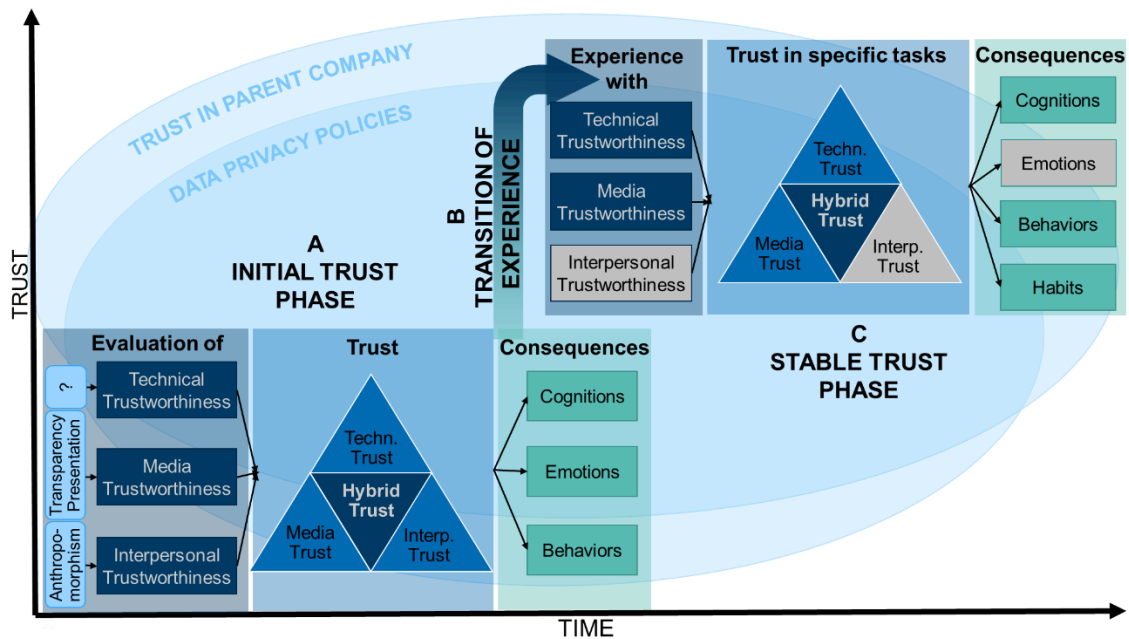


Figure 3. Revised model of hybrid trust in VBAs according to empirical findings

The model now integrates the *temporal process* of trust development more centrally by distinguishing between two phases: an initial trust phase and a stable trust phase. These phases are situated in a matrix, with time on the x-axis and trust level on

the y-axis, assuming that trust increases as time progresses. The model further separates *external factors* from the trust formation process itself, placing them in the background as stable influences (blue ellipses): currently, these include trust in the parent company and the subdimension of its data privacy policies. Further subdimensions of institutional trust such as company experience and reputation, as well as independent factors like individual predispositions to trust, may be added by future research. Further work should also examine whether these external factors exert a constant influence throughout the trust process or whether their impact varies at specific stages, for instance prior to the first interaction or during later stages of relationship development.

The process of trust formation and its consequences differ across the two phases. In the (A) *initial trust phase*, observable characteristics of the VBA—such as anthropomorphism or source transparency—influence users’ evaluations of technical, interpersonal, and media trustworthiness. Users assess trustworthiness based on these initial impressions, forming trust that may reflect one or multiple roles simultaneously, resulting in a singular or hybrid trust. This trust formation then leads to cognitive, emotional, and behavioral consequences, such as satisfaction, recommendations, and intentions to use or purchase related products.

A central consequence of initial trust is the gaining of experience with the VBA’s functions and performance. Over time, this experience shifts from being a consequence of trust to becoming its primary predictor, marking the (B) *transition of experiences*. At this point, users no longer rely solely on observable characteristics but instead evaluate trustworthiness based on accumulated knowledge. While the model allows for the possibility that this transition may occur after a single interaction, it is equally plausible that a certain threshold of experience must be reached for stable trust

to emerge. Future research will need to examine whether such a threshold reflects quantity or quality of experience, possibly tied to key events of learning abilities and limits of VBAs or experiencing satisfying or disappointing interactions, which may even vary depending on the role involved.

In the (C) *stable trust phase*, users primarily assess technical and media trustworthiness based on their personal experience with the assistant, while interpersonal trustworthiness becomes less relevant. Hence, technical and media trust is formed, or a hybrid trust in multiple roles. Trust in the VBA is now higher, but becomes increasingly task-specific, focusing on technical and media-related performances. Cognitive and behavioral consequences continue to occur, while emotional consequences were mostly denied, and habitual consequences emerged. Although participants largely dismissed interpersonal trust and emotional consequences in this phase, the model retains greyed-out interpersonal components to acknowledge the possibility of subconscious social influences that cannot be entirely ruled out.

The revised model thus offers a more detailed depiction of the temporal dynamics of trust development, the differentiated relevance of the three roles across trust phases, and the shifting role of experience over time. It provides a foundation for future studies to address open questions identified in the limitations (Chapter 5.2) and, in particular, to further investigate the hybridity of trust in VBAs. Although the studies confirm that hybrid trust can emerge from hybrid trustworthiness, it remains unclear to what extent trust in VBAs can be considered hybrid. The model can serve as a basis for developing quantitative measures of hybrid trust in VBAs, enabling research of the hybrid nature of trust in different use cases. For example, measuring trust directly before and after specific usage episodes can clarify which use contexts activate hybrid trust,

which indicators of trustworthiness are most relevant in these tasks, and how these experiences feed back into hybrid trust development over time.

6.2 Research Perspectives on a New Generation of Voice Assistants

Looking back on the definition of VBAs developed in RQ1 and considering the current emergence of a new generation of voice assistants, additional reflections are necessary to guide future research. As this dissertation is finalized, traditional VBAs are losing significance in comparison to newly emerging voice assistants, such as Microsoft's Copilot Voice, xAI's Grok voice, Google's Gemini Live or ChatGPT's voice mode (Hsiao, 2024; Musk, 2025; OpenAI, 2023; Suleyman, 2024). These assistants are largely extensions of existing text-based chatbots that now offer the additional capability of voice-based interaction, sometimes even replacing earlier VBAs entirely, such as the discontinued Google Assistant (Marquardt, 2025). Rather than relying on rule-based processes and keyword-dependent NLP, these new agents are based on large language models (LLMs) employing advanced AI technologies like deep learning and neural networks to generate responses (Fui-Hoon Nah et al., 2023; Mahmood et al., 2025; Polyakov et al., 2018).

Consequently, these new voice assistants continue to function as conversational AI agents intended for communicative interaction with users and, like their predecessors, rely on AI processes (e.g., Hepp et al., 2023). However, they are considerably more advanced and capable of generating highly natural, back-and-forth dialogue (Mahmood et al., 2025). By incorporating context memory from both current and previous interactions, they personalize conversations more effectively (Dong et al., 2023). LLMs also provide access to vast amounts of information across multiple languages and display more sophisticated anthropomorphic behaviors and conversational markers (Deng & Lin, 2022; Fui-Hoon Nah et al., 2023). At the same time, they are particular

prone to factual inaccuracies through so-called “AI hallucinations”, faulty generated information that is non-factual but can seem correct (Fui-Hoon Nah et al., 2023).

To date, it remains unclear how widely these new voice assistants are used and what their dominant use cases will be. While some applications may mirror those of traditional VBAs, new patterns are likely to emerge due to the assistants’ expanded capabilities. Text-based LLMs have already been adopted for professional tasks in workplaces (e.g., Bankins et al., 2024; Zirar et al., 2023) and academic information search (e.g., Karunaratne & Adesina, 2023; Zhang & Yang, 2025), suggesting these domains may also extend to their voice-driven counterparts. Initial anecdotal evidence also points toward additional socially relevant uses: Some users report feeling comfortable sharing personal and even psychological issues with ChatGPT’s voice mode (Pirnay, 2023; Shipper, 2024), while first studies have successfully tested these assistants as conversation partners to reduce driver fatigue during long car rides (Huang et al., 2024). These emerging use cases may be particularly driven by more natural dialogues, empathetic voices, and vocal markers such as comforting filler sounds (Shipper, 2024; Zeff, 2024).

Whether these new use cases introduce genuinely new trust-relevant roles, or whether trust remains structured around the previously established technical, interpersonal, and media-related dimensions, remains an open question for future research. However, first insights from this dissertation’s investigation of ChatGPT’s voice mode suggest that all three trust frameworks remain relevant, and their ongoing applicability appears plausible. For instance, when users discuss psychological problems, both interpersonal and media-related dimensions may be involved: users may assess the assistant’s competence, benevolence, and integrity to handle such sensitive topics related to psychological distress, while simultaneously evaluating the accuracy, selectivity, and

assessment of given therapeutic information and recommended resources. In such sensitive contexts involving highly personalized data and therefore high risks, trust becomes particularly important—especially considering that trust is foundational to traditional therapeutic relationships as well (Krupnik, 2023).

Future research will need to closely examine trust in this new generation of assistants to fully understand how users initiate interactions, develop trust relationships over time, and are influenced by them. As an initial step, representative studies assessing user numbers and application contexts will be valuable to map emerging usage patterns. However, because adoption is still in its early stages, studies capturing the development of trust trajectories are particularly urgent. The development of trust—from its initial emergence to more stable phases—can now be observed by studying new user populations. Longitudinal panel designs that track the development of trust over extended periods will be especially informative. By employing a method-mix of combining users' self-reported evaluations of trustworthiness, trust, and consequences with interaction data collected through assistant log files, researchers can directly link actual usage episodes and patterns to changes in trust, experience, and behavior over time.

Particular attention should be paid to potential differences in the trust development process compared to traditional VBAs, due to these assistants' new capabilities. Interpersonal trust may remain important even as experience grows, given the increasingly convincing anthropomorphic cues and possible expansion into social use cases. At the same time, the heightened risk of misinformation caused by AI hallucinations may alter how users evaluate (media) trustworthiness, increasing demands for transparency, integrity and more comprehensive disclosure of how information was researched and compiled. The revised model developed in this dissertation offers a theoretically and

empirically grounded foundation for these future investigations and can be further adapted as both AI assistant technologies and user behaviors evolve.

6.3 Central Theoretical, Empirical, and Practical Contributions

In addition to the specific implications for the theoretical model of hybrid trust and a new generation of voice assistants, this dissertation offers several broader contributions for both researchers and practitioners—advancing theory, empirical research, methodology, and practice.

As its first *theoretical contribution*, the dissertation delivers a comprehensive examination of VBAs and their core roles, a thorough theoretical analysis of three trust frameworks from different disciplines, and their integration into a new theoretical model of hybrid trust in VBAs. The developed model incorporates the distinct components involved in trust formation and relationship development, thus conceptualizing trust as a dynamic and complex process. In doing so, the dissertation provides the field of Human-Machine Communication (HMC) with a long-needed theoretical advancement that moves beyond the previously dominant interpersonal or technical perspectives to reflect the hybrid nature of new conversational agents (Etzrodt & Engesser, 2021; Etzrodt et al., 2022). Moreover, the interdisciplinary foundation and model can serve as a valuable starting point for future theoretical advancements across multiple fields of the social sciences, such as political science, sociology, and social psychology, as trust in AI agents increasingly becomes a central research topic related to individual, organizational, and societal developments.

A second theoretical contribution is provided to the field of communication science. By integrating theoretical and empirical insights from communication science, the dissertation not only strengthens its interdisciplinary relevance in the field of HMC research, but also highlights the valuable contributions that communication science can

offer to general interdisciplinary debates on AI and trust. Theoretical concepts like media trust or journalistic quality, and empirical approaches like content analyses provide important perspectives that have so far been underrepresented in much of the predominantly technical or interpersonal trust research on AI. By systematically incorporating these perspectives, the dissertation demonstrates that communication science has a central role to play in shaping how trust in new AI-based communicators is conceptualized, measured, and understood.

At the same time, this interdisciplinary engagement allows communication science itself to reflect critically on its established trust concept previously defined for human journalism, and to reconsider how such concepts may evolve as AI becomes increasingly embedded in how media contents are produced, distributed, and consumed by audiences (Lewis & Simon, 2023; Thurman et al., 2019). As AI increasingly enters newsrooms and editorial processes, recipients may form trust in news media differently than before—just as journalists and media institutions themselves must renegotiate their roles in an AI-transformed profession (Lewis et al., 2025). The dissertation and its findings can give guidance in these processes.

An additional theoretical contribution relates to the computers as social actors (CASA) paradigm. The findings of this dissertation support the core CASA assumption that social cues displayed by VBAs can activate social responses in users and shape their trust (Nass et al., 1994). However, these responses are not static; rather, they evolve dynamically. As users gain experience, they increasingly recalibrate their perceptions of the assistant's social role and focus their interactions on specific, task-oriented functions. These findings suggest that CASA's original framework requires refinement to reflect that users are not merely passive recipients of social cues but actively develop new interaction protocols for engaging with socially behaving AI agents—an

interpretation that aligns with recent suggestions from other researchers (Gambino et al., 2020; Gambino & Liu, 2022). Such adaptive strategies may serve to preserve a sense of self-efficacy, risk management and control in interactions with opaque and complex agents. Rather than contradicting CASA's foundational premises, the results point to the need for an expanded concept—one that integrates both the automatic activation of social heuristics and users' conscious efforts to regulate and contain these influences.

The dissertation also makes several *empirical contributions*. First, it offers an empirically refined and validated model of hybrid trust formation in VBAs that can serve as a foundation for future research. By integrating users' narrow definitions of trust, the central role of experience, and the distinction between trust phases, the model reflects the social reality of VBA interactions more accurately than previous theoretical approaches. It allows HMC and trust research to measure distinct components of trust, and can guide the development of standardized trust scales, survey instruments, and experimental stimuli reflecting the three identified roles. By outlining first considerations regarding a new generation of voice assistants, the dissertation further provides initial impulses and guidance for future empirical research building on the revised model.

Second, the content analysis (*Paper 3*) provides new insights into how users genuinely and without being prompted evaluate VBAs and relevant aspects to their usage. It reveals that trust is often directed more towards the parent company and only implicitly evaluated for VBAs when discussing typical indicators of trustworthiness. It also showed for the first time in VBA research, that users evaluate VBAs' role of information intermediaries and according trustworthiness. The interviews and observed interactions (*Paper 4*) further advanced the understanding of trust in VBAs by capturing users' own trust definitions. It revealed how media trust is combined with technical and

interpersonal trust in practice, how trust plays into developing a relationship with a VBA and how deeply it is intertwined with experience.

Third, the experimental survey (*Paper 5*) contributed causal evidence for relationships identified qualitatively. It is also among the first studies to examine colloquial speech in VBAs—a feature that has since gained relevance with the rise of LLM-based voice assistants (Shipper, 2024; Zeff, 2024). Finally, the quantitative content analysis (*Paper 1*) offers communication science novel insights into VBAs as information intermediaries by objectively assessing how well they meet journalistic standards when asked about a current socio-political issue. In addition, it offers a first methodological approach for analyzing the momentary outputs of conversational AI such as VBAs.

This dissertation further offers *methodological contributions* that may guide future research. It represents one of the few mixed-method designs addressing the complex concept of trust in VBAs by triangulating quantitative and qualitative methods. This design, developed from the methodological analysis of HMC research, proved highly effective and can be applied to other conversational AI agents, hybrid trust, or related concepts such as institutional trust or experience. Triangulation allows to exploratory identify relevant variables and quantitatively test their relationships.

For quantitative research, a comprehensive investigation of all theoretically derived variables—rather than selective testing—is recommended to fully capture the complexity of a concept like trust, as well as pre-study power analyses. As experience plays a central role in HMC, it should be either controlled through randomization in experimental designs or integrated as an independent variable to assess its effects on trust and related outcomes.

For qualitative research, combining methods with varying degrees of researcher intervention is especially valuable. Online comments provide rich, naturalistic data to

explore users' perspectives without external influence. Follow-up interviews allow for a deeper examination of emerging themes, while integrating observations of interaction tasks can help to create talking points for the ongoing interviews and lighten the atmosphere. In general, combining multiple data sources enables researchers to syndicate subjective perceptions with objective interactions.

Lastly, the dissertation offers *practical implications*. For *providers* of VBAs, the findings emphasize the central role of their corporate image and reputation. Trust in a VBA is heavily influenced by institutional trust in the parent company—particularly in contexts where sensitive data and privacy concerns are involved. Therefore, the branding and positioning of VBAs with regard to privacy policies represent a critical starting point for fostering user trust. Moreover, the studies highlight that reliable task performance from the very first interaction is essential for trust and continued usage. A role that providers may not have fully considered to date concerns VBAs' growing function as intermediaries of information. Aligning information practices with journalistic standards and additional transparency efforts may therefore serve as an effective trust-building strategy that strengthens both users' trust and their long-term engagement.

The findings also offer important implications for *policymakers*. Understanding how individuals form trust in conversational AI is increasingly relevant, especially given the influence these agents may wield on political opinions through everyday information exposure. In light of the findings from *Paper 1* and related studies on the quality of VBA information, concerns about the adequacy of conversational AI in politically sensitive contexts are valid. First studies investigating LLM-based chatbots' performances on political topics already reveal substantial shortcomings, especially outside of English-language contexts and regarding misinformation (Finn et al., 2024; Kuznetsova

et al., 2024). As such assistants gain further adoption, regulatory measures may be necessary to safeguard users from mis- and disinformation. Potential strategies could include mandatory source transparency or automated reminders encouraging users to verify received information. However, recent research suggests that such interventions may not always have the intended effect (Lermann Henestrosa & Kimmerle, 2025), and regulations of rapidly evolving AI will be difficult to enforce.

Rather than relying solely on restrictive regulations, empowering users in their own interactions with conversational AI appears even more crucial. Media literacy and AI-related education should be promoted from an early age and integrated into school curricula to equip future users with the critical skills necessary to navigate these technologies. This includes fostering awareness of how algorithmically generated content may contain AI hallucinations (Fui-Hoon Nah et al., 2023) and presents personalized, and thereby potentially distorted, representations of reality (Resendez et al., 2023). Furthermore, users must be made aware of their own susceptibility to social cues—particularly the human-like qualities of friendly, natural-sounding voices (e.g., Rzepka et al., 2022; Torre et al., 2020)—to reduce stigma around the social component of communication with AI and enable more conscious management of their own reactions and behaviors. Fostering an informed public through education, transparency, and self-awareness may serve as an effective counterweight to the risks posed by unregulated, socially behaving and potentially misleading conversational AI.

7. Conclusion

The starting point of this dissertation was the observed popularity of voice-based assistants (VBAs) and the need to better understand how trust in such technology emerges—despite their known lack of transparency and proneness to error. Research in the field of Human-Machine Communication (HMC) has called for theoretical innovation in response to increasingly socially behaving technologies. To address this, the dissertation first explored the roles of VBAs and found them to act not only as technical tools and social interactors, but also as information intermediaries—used in current events like the Covid-19 pandemic, though only partly adhering to journalistic standards (*Paper 1*). In response, the dissertation integrated technical, interpersonal, and media trust frameworks into a new theoretical model of hybrid trust (*Paper 3*). Based on this model and methodological considerations for research in HMC (*Paper 2*), three empirical studies were conducted using a mixed-methods design (*Papers 3, 4, 5*) to answer the central research question:

What is trust in voice-based assistants and how does it shape user interactions?

The studies show that trust is formed through evaluations of technical, interpersonal, and media trustworthiness—or a hybrid of these. Users selectively trust VBAs in task-specific contexts, based on prior positive experience. While trust is broader in an initial phase of trust relationships, it narrows in stable phases to reliable and familiar functions. Thus, trust helps explain usage despite known weaknesses of VBAs—because users manage risk through selective interaction. The findings further show that trust is closely intertwined with experience: successful interactions reinforce trust, deepen engagement, and lead to new habits and routines—effects users are not always fully aware of. To trust a VBA, then, means not only entering a controlled relationship

in specific usage contexts, but also becoming gradually more open to VBAs' suggestions and influences in the long term through sustained interaction.

The dissertation offers theoretical, empirical, and methodological contributions to communication science, HMC, and related disciplines. It provides an empirically refined model for future research and practical insights for providers and policymakers. As outlined in the recent "AI 2027" report (Kokotajlo et al., 2025), rapid advances in AI in general—and conversational AI in particular—are expected to create agents that exceed human performance in complex tasks and offer near-human social interactions. However, these agents will not be infallible and may pose greater risks to user autonomy than ever before. Against this backdrop, understanding how users form trust in such increasingly powerful and human-like assistants becomes not just relevant—but urgent. Communication science and HMC share a responsibility to study these agents as communicators and information providers, and to educate the public on their role and potential influences. Future research in both fields should work together in theory, methods, and findings, to build a comprehensive understanding of conversational AI, user perceptions and trust, and the evolving relationships between the two.

Declaration on the Use of Generative AI and AI-Assisted Technologies

During the preparation of this dissertation, the author used the generative AI tools DeepL Write and ChatGPT for the following purposes: (1) to check grammar and spelling and improve the overall language quality of the synopsis, (2) to translate German study materials as well as interview and comment quotations, and (3) to shorten selected sections of the text for clarity and conciseness, without altering their original content or argumentation. After using these tools, the author reviewed and edited all AI-assisted outputs and takes full responsibility for the final version of the synopsis.

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Appendix

The Appendix contains:

Curriculum Vitae

Curriculum Vitae
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Akademische Ausbildung

11/2019 – 12/2025	Promotion Kommunikations- und Medienwissenschaft Heinrich-Heine-Universität Düsseldorf Abschlussnote magna cum laude
10/2016 – 09/2019	Master of Arts Kommunikationswissenschaften mit Schwerpunkt Kommunikations- und Medienforschung Johannes Gutenberg-Universität Mainz Abschlussnote 1,2
10/2012 – 09/2016	Bachelor of Arts Publizistik und Audiovisuelles Publizieren Johannes Gutenberg-Universität Mainz Abschlussnote 1,5

Berufliche Tätigkeiten

Seit 11/2019	Wissenschaftliche Mitarbeiterin Heinrich-Heine-Universität Düsseldorf, Institut für Sozialwissenschaften, Abteilung Kommunikations- und Medienwissenschaft
11/2015 – 06/2019	Werkstudentin Markt- und Medienforschung Dentsu Aegis Resolutions Wiesbaden
11/2013 – 01/2019	Wissenschaftliche Hilfskraft Institut für Publizistik, Universität Mainz Journalistisches Seminar, Universität Mainz

Publikationen

- Frehmann, K., & Ziegele, M.** (2026). Trust in voice-based assistants: a multidimensional conceptualization based on in-home user interviews. *Frontiers in Human Dynamics*, 8, 1941118. <https://doi.org/10.3389/fhumd.2026.1941118>
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- Frehmann, K., & Ziegele, M. (2026).** *From Social Actors to Information Intermediaries: Rethinking Trust in Voice-Based Assistants.* Vortrag auf der Jahrestagung der International Association for Media and Communication Research (IAMCR, 28.06.-02.07.2026).
- Frehmann, K., & Ziegele, M. (2025).** *Trust in Voice-Based Assistants: A User-Centered Perspective.* Vortrag auf der Jahrestagung der Fachgruppe Digitale Kommunikation der Deutschen Gesellschaft für Publizistik und Kommunikationswissenschaft (DGPUK) und der Interest Group Human Machine Communication der International Communication Association (ICA) (DigiKomm & HMC, 15.-17.09.2025).
- Frehmann, K., Leuders, L., Ziegele, M., Mütschele, H. (2025).** *Fake Interactions With Fake Influencers? Effects of a Human and a Virtual Influencer on Parasocial Interactions and the Mediating Effect of Attractiveness.* Vortrag auf der 74. Jahreskonferenz der International Communication Association (ICA, Denver, USA, 12.-16.6.2025).
- Frehmann, K., Ziegele, M., Arkian, S., Melzer, M., Nagel, J., & Yakin, B. (2024).** *"Hey Voice Assistant, tell me about your privacy policy!" The influence of privacy policies presented by voice vs. text on trust and use intentions in a voice-based assistant.* Vortrag auf der European Communication Research and Education Association (ECREA, Ljubljana, Slowenien, 24.-27.09.2024).
- Frehmann, K., Peters, J., & Ziegele, M. (2024).** *"I wouldn't trust her with my life but..." - Identifying explicit and indirect signs of trust in voice-based-assistants in user-generated-content online.* Vortrag auf der European Communication Research and Education Association (ECREA, Ljubljana, Slowenien, 24.-27.09.2024).

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- Frehmann, K.**, & Schäfer, M. (2021). *Journalistic footnotes in German suicide coverage - supplement or substitute for sticking to media guidelines?* Vortrag auf der 8th European Communication Conference der European Communication Research and Education Association (ECREA, Braga, Portugal, online, 06.-09.09.2021).
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- Frehmann, K.**, Ziegele, M., & Peters, J. (2021). *Alexa hält Vorträge und Siri fühlt sich nicht zuständig - Der Umgang von Sprachassistenten mit Fragen zur Corona-Krise*. Vortrag auf der Dreiländertagung der DG PuK, ÖGH und SGKM (DACH, Zürich, Schweiz, online, 7.-9. 4.2021)
- Frehmann, K.**, & Schäfer, M. (2020). *Die journalistische Perspektive auf Suizide: Einflussfaktoren auf die journalistische Nachrichtenentscheidung im Zuge der Suizidberichterstattung*. Vortrag auf der Jahrestagung der Fachgruppe Gesundheitskommunikation der Deutschen Gesellschaft für Publizistik- und Kommunikationswissenschaft (DG PuK GesKom, online, 11.-13.11.2020).
- Frehmann, K.**, & Schäfer, M. (2020). *Suizide in den Medien: Die Alltagsberichterstattung über Suizide in Deutschland*. Vortrag auf der Jahrestagung der Fachgruppe Gesundheitskommunikation der Deutschen Gesellschaft für Publizistik- und Kommunikationswissenschaft (DG PuK GesKom, online, 11.-13.11.2020).
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- Frehmann, K.**, & Schäfer, M. (2020). *Machen Werther und Papageno im deutschen Journalismus Schule? Der Stellenwert suizidfördernder und suizidpräventiver Medieneffekte in der deutschen Journalistenausbildung*. Vortrag auf der Jahrestagung der Fachgruppe Gesundheitskommunikation der Deutschen Gesellschaft für Publizistik- und Kommunikationswissenschaft (DG PuK GesKom, online, 11.-13.11.2020).

Weitere akademische Tätigkeiten

Engagement	- Mittelbausprecherin der Fachgruppe Digitale Kommunikation DGpuK (seit 2024) - Vertreterin der Promovierenden der philosophischen Fakultät im Wissenschaftlichen Beirat von philGRAD (2024-2026) - Mitglied der Jury Heinrich-Heine-Journalismuspreis des Verein Düsseldorfer Journalisten und der Heinrich-Heine-Universität (seit 2024) - Kursleiterin bei der Deutschen Schülerakademie (seit 2019)
Veranstaltungsorganisation	- Promotionskolloquium der Abteilung Kommunikations- und Medienwissenschaft der HHU (2022-2023) - Mitorganisation der Jahrestagung der Fachgruppe Rezeptions- und Wirkungsforschung DGpuK (07.-09.2022)
Weiterbildungen	- Produktives Schreiben im Wissenschaftsalltag (philGRAD, HHU, 2025) - Eintauchen in den Flow. Denk- und Schreibretreat für Wissenschaftler*innen (philGRAD, HHU, 2024) - Zertifikatsprogramm „Professionelle Lehrkompetenz für die Hochschule“, Basis-, Erweiterungs- und Vertiefungsmodul (Sell, HHU, 2020-2024) - Gute Wissenschaftliche Praxis (philGRAD, HHU, 2020) - From idea to project – how to finance research projects by third leg funding (JUNO, HHU, 2019)
Lehrtätigkeit	- Betreuung von Abschlussarbeiten (B.A., M.A.) - Lehre von eigens konzipierten Seminaren zu persönlichen Forschungsschwerpunkten - Lehre von Lehrforschungsprojekten - Lehre von standardisierten Basisübungen
Reviews	- Computers in Human Behavior - International Journal of Communication - DGpuK - ECREA - ICA

Mitgliedschaften

- Deutsche Gesellschaft für Publizistik- und Kommunikationswissenschaft (DGPuK)
- European Communication Research and Education Association (ECREA)
- International Communication Association (ICA)
- Düsseldorf Institute for Internet and Democracy (DIID)
- Graduiertenakademie der Philosophischen Fakultät der Heinrich-Heine-Universität Düsseldorf (philGRAD)