Technology Continuance in Health:
Development and Application of New Measurement Models

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“Fall seven times, stand up eight”

(Japanese Saying)

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Abstract

Healthcare systems worldwide are facing unprecedented challenges related to digitalizing patient care and treatment and rising consumer centricity. They increasingly revolve around sustaining well-being and prevention rather than treatment. The COVID-19 pandemic has heightened the urgency of digitalizing healthcare delivery, contributing momentum to existing technologies and generating disruptive new approaches. While greater attention is directed to the digital transformation of healthcare systems, research into digital health solutions post-pandemic is nascent and has resulted in inconsistent findings. Against the fragmented landscape of digitally mediated healthcare delivery and prevention, the current lack of research understanding about the post-adoption utility of healthcare technologies is troubling, especially concerning the changes in consumers' usage behaviors of digital health solutions propelled by the COVID-19 health crisis. Despite the experienced benefits of healthcare technologies during the pandemic, recent studies reveal an acceptance–discontinuance gap in user behavior: Users often abandon these technologies shortly after initial use. Digital health solutions' low retention rates impede the prevention and treatment of health risks and their associated reduction in healthcare expenditure, which, ultimately, cannot be reinvested in potential benefits to the broader population. Therefore, this thesis seeks to understand better the continued use of two selected core technologies—telemedicine and fitness apps—both of which gained acceptance during the pandemic. In this context, this thesis proposes solutional approaches for the continued use of these technologies.

Based on the expectation-confirmation model (ECM), the roles of the core variables proposed in the original model and additional influencing factors were examined. Part A of this thesis explores patient perspectives and use motives for the continued use of teleconsultations in non-pandemic situations. It stresses the role of technological factors and psychological aspects in determining post-adoption user behavior. Part B emphasizes the importance of a richer post-adoption model to explain the continued use of fitness apps. While general tendencies in continued use behaviors are evident, research and practice need to explore users' motives, demands, and needs more holistically. This thesis contributes to the literature by exploring the focal phenomena from a combination of theoretical approaches, illuminating the significance of integrating synergistic variables that are important in explaining the acceptance–discontinuance phenomenon.

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1. Introduction

1.1 Motivation

Healthcare systems have changed drastically in the past few years due to technological, regulatory, and socioeconomic disruptions. COVID-19 further aggravated and catalyzed the digitalization and automation of healthcare systems worldwide (Boston Consulting Group, 2024). During the COVID-19 crisis, digital health solutions and services offered new approaches to improve health outcomes and elevated consumers' awareness of the importance of health and wellness (Menhas et al., 2023). As a result, the demand for digitally assisted healthcare delivery and preventive care grew exceptionally. In the post-pandemic era, this unprecedented shift continues to evolve: Digital healthcare, artificial intelligence (AI), and new platform ecosystems are driving disruption, providing customized end-to-end solutions for users and patients, changing patients' needs and expectations, and demanding new capabilities from healthcare systems.

The digital transformation of healthcare delivery encompasses the development of technologies (i.e., digital solutions and services) and their relations to new therapies and best practices for better health outcomes (Stoumpos et al., 2023). Mobile health (mHealth), health informatics, and electronic health (eHealth) all result from emerging technologies to collect patient data and generate insights to facilitate patient care and preventative measures (Paul et al., 2023). Such digital health solutions and services demonstrate significant potential to improve patients' access to healthcare while decreasing healthcare system costs and enhancing their quality and effectiveness (Borges do Nascimento et al., 2023; Uncovska et al., 2023). The demand for digital tools in healthcare delivery is increasing, with a projected global digital health market revenue growth from 234 billion USD in 2022 to around 982 billion USD by 2032 (Global Market Insights, 2023a).

Spurred by those emerging technologies, patient-centric healthcare delivery is evolving into patient-led healthcare since technology increasingly creates information parity between patients and physicians (Gopal et al., 2019; Stoumpos et al., 2023). As a result, patients are demanding to take charge of their health by using digital tools, like ever-more-advanced remote diagnostic, delivery, and monitoring solutions, to connect to their care teams in unprecedented ways. This new wave of patient-led care requires great leaps in integrating personalized, digitalized, and preventative solutions into patients' and users' daily lives. Consumer centricity has only recently arrived in the healthcare industry (Buchter et al., 2023). Healthcare systems must now meet patients' evolving demands and expectations throughout their end-to-end healthcare

journey while mirroring the experiences consumers usually appreciate when they engage with other industries. Simultaneously, patients prioritize their well-being more than they used to and express continued frustration with the healthcare system (Buchter et al., 2023). According to Statista Market Insights (2024b), the market for digital health treatment solutions is achieving the most growth within one year in 2024. From 3.7 percent last year, the largest market segment jumped to 16.4 percent in 2024, possibly due to the shift toward an aging population in countries such as Germany and population growth in emerging countries. Overall, given the globally increasing costs for healthcare delivery and shifting demographics, the digitalization and automatization of healthcare systems and preventive measures offer tremendous potential for improving health outcomes.

Although digital transformation has attracted attention in many sectors, research on the topic in the healthcare sector is nascent and findings are fragmented (Liu & Avello, 2021; Massaro, 2023). The rapid developments in digital health solutions and services, the recent shift toward patient-led care, and the increasing importance of preventive measures and longevity have made findings from pre-pandemic studies potentially obsolete (Stoumpos et al., 2023). Moreover, against the known potential of digital health solutions and services, empirical evidence on how to reinforce their continued use after the pandemic and ensure loyalty is still narrow (Mumtaz et al., 2023; Peek et al., 2023). Despite the benefits, continued use behaviors are limited and have not been as common post-COVID-19 as expected. Recent findings confirm the existence of an acceptance–discontinuance gap in healthcare technologies (Grenier Ouimet et al., 2020; Le Lyu et al., 2024). Although adoption rates for healthcare technologies have been high, user actual use is often temporary, with relatively low retention rates. For example, according to AppsFlyer (2024), fitness and health apps worldwide show a 2.8% retention rate 30 days from installation.

To expedite patients' and users' post-adoption behaviors, a thorough understanding of the factors that influence their continuance intention regarding healthcare technologies is needed to design strategies that ensure user retention (Nabavi et al., 2016). So, this thesis focuses on two core technologies that gained momentum during the pandemic. Healthcare delivery will become progressively more holistic as practitioners leverage a broader range of health solutions, including hybrid models using digital solutions and in-person visits. Therefore, teleconsultation, representing one novel digital disease care and treatment option, will be explored. Teleconsultations offered convenience, increased accessibility, and improved care efficiency during the pandemic. Despite these advantages, patients' use rate is slowing in the aftermath of the COVID-19 crisis (Ernst & Young, 2024), possibly decelerating the much-

needed paradigm shift to digitalize treatment and care. The discontinued use of telemedical services represents lost opportunities to provide comprehensive cost- and time-efficient healthcare delivery and treatment solutions for acute and chronic conditions. This work addresses the factors influencing patients' decisions to continue or discontinue using teleconsultation and similar telemedical services in the post-pandemic era in Part A: Digitalization of disease care and treatments – patient perspectives.

Then, fitness apps, as one of the self-managed, digitized, preventative solutions offered by mHealth tools, are examined in Part B: Technologies in lifestyle and health promotion. Users' perspectives on healthcare self-management through informed lifestyle choices are explored. Propelled by the shift toward preventive medicine, the demand for products and services that support well-being is increasing. However, the low retention rates of mHealth technologies, such as fitness apps, impede their prevention of health risks and the associated reduction of healthcare expenditure, which cannot then be reinvested in potential improvements to healthcare systems. Therefore, an advanced understanding of users' fitness apps post-adoption behaviors is required to ensure user retention and materialize benefits.

The next section reviews this thesis' theoretical background on a meta level and describes the two core technologies identified above in greater detail.

1.2 Theoretical background

Considering the economic and societal relevance of digital healthcare solutions and the potentially positive behavioral changes that the increasing importance of prevention may foster, this thesis focuses on teleconsultation and fitness apps, recognizing their value to drive the digitalization of healthcare systems to improve health outcomes. Furthermore, this thesis illuminates the continued use of these technologies from the patient and user perspectives.

Previous studies have explored users' initial adoption of teleconsultation (Harst et al., 2019; Kamal et al., 2020; Mueller et al., 2020; Pang et al., 2022) and fitness apps (Baer et al., 2022; Dhiman et al., 2019; Wei et al., 2021) alike but have yet to provide comprehensive explanations of continued use behaviors post-pandemic. The lack of research into post-adoption behaviors is troubling because it limits the understanding of the actual effectiveness of these technologies and their potential to improve health outcomes. To embrace the potential of these emerging healthcare technologies, a combined analysis of theoretical frameworks is necessary to comprehend patients' and users' decision-making processes to realize associated benefits.

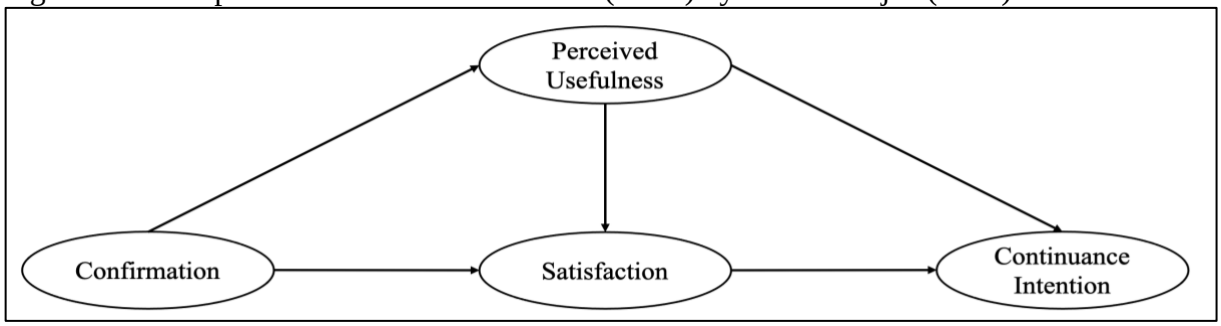
Therefore, this thesis draws on the core variables from Bhattacherjee's (2001) expectation-confirmation model (ECM), derived from expectation-confirmation theory (ECT) (Oliver, 1980), which is often used in marketing to explain how consumer satisfaction leads to repurchase intentions. The ECM extends traditional expectation-confirmation theory to propose a direct relationship between disconfirmation and post-usage benefit perception (i.e., perceived usefulness) (Bhattacherjee & Lin, 2015). While the ECT examines pre- and post-consumption variables and the effects of users' ex-ante but not ex-post expectations, the ECM adapted the ECT to apply mainly to an information system (IS) continuance use context, replacing expectation with post-usage perceived usefulness and repurchase intention with continuance intention.

The ECM thus estimates continued technology use after their initial acceptance (Bhattacherjee, 2001), contrary to the technology acceptance model (TAM) (Davis, 1989) or the unified theory of acceptance and use of technology (UTAUT) (Venkatesh et al., 2003), which understand continuance intentions as an extension of acceptance behavior. Yet, according to Bhattacherjee (2001), technology adoption and technology continuance intention are two different notions. Continuance intention seeks to explain continued use after the initial adoption of technology and thus aims to predict a distinct and temporally separate use behavior compared to technology adoption models (Bhattacherjee & Barfar, 2011). For this reason, Bhattacherjee and Barfar (2011) argued that models that were initially designed to explain technology acceptance are not appropriate for explaining technology continuance because this may generate misunderstandings and misapplications of the theories. Although psychology research provides elements for both acceptance and continuance research, these derive from different theoretical backgrounds: ECM is based on the expectation-confirmation-satisfaction paradigm, while, for instance, TAM pertains to the beliefs-attitudes-behavior paradigm proposed by theory of reasoned action (TRA) (Premkumar & Bhattacherjee, 2008). Therefore, the ECM, a process model, draws from actual usage experience (Premkumar & Bhattacherjee, 2008), unlike TAM, a static model, which is based on users' prospective usage experience of using a specific technology.

Conceptually, the ECM relies on the premise that users' technology continuance decisions are determined by the confirmation of their expectations, expectations of benefits, and emotional responses. The confirmation of prior expectations distinguishes the ECM from other models explaining IS use behaviors (Thong et al., 2006). Users' assessment of previous technology usage (i.e., satisfaction) and anticipation of the benefits of continued technology usage (i.e., perceived usefulness) determine their continuance intention. Satisfaction with prior technology

usage is affected by the confirmation or disconfirmation of users' initial expectations during technology usage (i.e., confirmation) and perceived usefulness (Bhattacherjee, 2001). Perceived usefulness is also positively influenced when users' expectations are confirmed. Figure 1 summarizes the core variables of the ECM and their relationships as proposed by Bhattacherjee (2001).

Figure 1. The expectation-confirmation model (ECM) by Bhattacherjee (2001).



Even though the utility of the ECM has been supported across various research fields (Ambalov, 2018; Franque et al., 2021), recent studies have criticized it for emphasizing the role of technology-related factors and disregarding the role of affective and social factors in determining continued use behaviors (Filieri et al., 2017; Guinea & Markus, 2009; Hossain, 2012; Yan, Filieri, & Gorton, 2021). Consequently, the mere analysis of functional experiences of users' long-term continued use may not be enough to explain users' continuance behaviors thoroughly. Furthermore, research on continuance intention highlights that the adoption or abandonment of digital health solutions and services may also be related to the user's hedonic and social experiences and psychological factors (Gómez-Rico et al., 2023; Yan, Filieri, Raguseo, & Gorton, 2021).

Therefore, this thesis addresses these shortcomings of the ECM by extending it with appropriate theories and psychological concepts and applying it to teleconsultation and fitness app continued use behaviors. Conceptually, this thesis aims to provide a more holistic explanation of continuance intentions regarding the two healthcare technologies by seeking to demonstrate that a combination of synergistic variables supports the value of a richer post-adoption model. This is vital in explaining the acceptance–discontinuance phenomenon observed in consumers' use of healthcare technologies and digital preventive solutions, especially in the aftermath of COVID-19. Table 1 summarizes current digital technologies in the healthcare sector.

The remainder of this section presents a detailed overview of the two core technologies discussed in this thesis. It also provides reasons for the importance of their continued use in driving the digital transformation of healthcare systems.

Table 1. Overview of current healthcare technologies.

Technology	Description	Aim	Features and Areas of Application
Artificial Intelligence	AI in healthcare is the use of machine learning (ML), natural language processing (NLP), deep learning (DL), and other AI-powered tools.	Support and, ideally, improve the patient experience, including diagnosis, treatment, and outcomes.	• Medical diagnostics, • Drug development, • Administration and process management (e.g., in hospitals or resource and capacity planning).
Blockchain	Platform for securing, capturing, updating, and storing medical data.	Encompasses medical applications that aim to improve and develop various aspects of healthcare, such as innovative data management, increased information security, and optimizing processes based on a decentralized and distributed ledger to manage information, transactions, and records.	• Drug authentication: tracking the delivery process and ensuring compliance and safety; • Patient records: Transfer patient records between different healthcare facilities; • Real-time insurance information: Ensuring the interoperability of real-time information between healthcare providers and insurance companies.
eHealth	Applications, aids, and services that use electronic information and communication technologies (ICT) for patient treatment and care.	Connect institutions and individuals in the healthcare sector via a secure and reliable platform (i.e., telematics infrastructure). The systems of outpatient medical practices, pharmacists, hospitals, health insurance companies, and other stakeholders are linked together on this technical basis.	• Electronic Health Records (HER): Patient data (diagnoses, therapy recommendations, incompatible medication, etc.) in electronic form; • Telehealth: Remote medical treatment through ICT (e.g. teleconsultation/ remote monitoring).
mHealth	Medical procedures and private and public healthcare measures that are offered on mobile devices.	Improve healthcare in various ways via mobile technologies, help users take responsibility for their own health, and increase health literacy by providing health information.	• End-to-end healthcare delivery: diagnostics, therapy/treatment and aftercare, • Prevention or fitness/wellness.
Robotics	Automation of routine tasks in healthcare.	Robots in the medical field are changing how operations are performed, optimizing the supply and disinfection of consumables, and allowing medical professionals to focus on patient care.	• Surgical Assistant Robots: Perform complex operations quickly and precisely; • Therapeutic Robots: Help with rehabilitation after, e.g., strokes or traumatic brain injuries; • Autonomous Mobile Robots: Assist with tasks such as disinfection or the administration of medication and medical supplies.
Wearable Devices	Wearables are worn directly on the body to measure, e.g., heart rate, blood pressure, sleep, or calorie consumption. Measurement results are then evaluated via apps.	Evaluating the collected data to provide behavioral tips to improve fitness levels.	• Fitness or activity tracking; • Smartwatch data collection.

1.2.1 Core technology I – Teleconsultation

The healthcare industry has increasingly been disrupted by technologies and innovations to deliver diagnoses and treatments in new, convenient, cost-effective ways, building care around the patient (Stoumpos et al., 2023). eHealth applications and services proved essential to maintain and complement health services during the COVID-19 pandemic (Bokolo, 2021a). eHealth has developed from web-based services to telemedicine applications and video consultations, allowing practitioners to reach patients and ensuring access to acute treatment and care. Post-pandemic telemedicine, a core eHealth technology, continues to be particularly helpful in redefining and digitalizing healthcare delivery (Grenier Ouimet et al., 2020). Telemedicine plays a critical role in making healthcare accessible and recent studies confirm that users seek platforms that holistically support their well-being (Miller, 2024). Unsurprisingly, the telemedicine market is projected to grow to around 244 billion USD by 2032 (Global Market Insights, 2023b).

As a health service system, telemedicine encompasses remote consultation, treatment, and diagnosis via information and communication technologies (Hartono et al., 2021). Remote consultations (i.e., teleconsultations) can bridge gaps in acute treatment by expanding access and enhancing healthcare delivery to underserved communities (Boston Consulting Group, 2023), as well as improving the treatment of chronic conditions via remote patient monitoring, all while reducing healthcare costs. This type of healthcare delivery is, therefore, often considered a time- and cost-efficient approach to increasing accessibility and patient satisfaction. Teleconsultations in this thesis refer to virtual exchanges between patients and physicians that allow healthcare providers to assess patients, make recommendations, and adjust treatments in real-time, similar to in-person appointments. Therefore, teleconsultations are considered comparable to in-person visits in the appropriate medical context and can boost patient autonomy in healthcare decisions.

Despite the increasing recognition and political and social adoption of teleconsultation throughout the pandemic, its adoption rate post-pandemic is limited. Whereas findings from PwC (2024) indicate that 57% of patients surveyed in Germany confirmed that they would use teleconsultations, a recent report by Ernst & Young (2024) indicates that only a few patients now use teleconsultations, although a total of 86% of respondents see the benefits of video consultations, for example, for writing prescriptions (53%), discussing lab results (49%), or getting a sick note (42%). Statista Consumer Insights (2023) furthermore confirms that only

7% of German respondents have used teleconsultations in the past 12 months, emphasizing the gap between acceptance and user discontinuance.

Continuous use is significant for telemedical applications (i.e., teleconsultations) and services, as short-term use is not conducive to the shift from sporadic acute to continuous, comprehensive healthcare. Due to the demographic changes of an increasingly aging society, the demand for healthcare staff continues to grow while healthcare systems are already overloaded. Not only does the discontinuance of teleconsultations and other telemedical services reduce opportunities to deliver comprehensive, cost- and time-efficient healthcare but it also burdens healthcare systems with reduced efficiency regarding in-person routine consultations and follow-up examinations.

1.2.2 Core technology II – Fitness apps

Alongside the increasing shift in focus toward well-being and prevention rather than acute treatment, the market for mHealth technologies has expanded rapidly in recent years. The World Health Organization (2011) defines mHealth as "medical and public health practice supported by mobile devices, such as mobile phones, patient monitoring devices, personal digital assistants, and other wireless devices." As consumer centricity increases, mHealth technologies present a novel approach to preventive care that allows users to make informed decisions, monitor their progress, and pursue healthy lifestyles (Menhas et al., 2023; Rivera-Romero et al., 2023). mHealth technologies include wearable devices, smartwatches, and health and fitness app-based interventions.

Fitness apps are among the most commonly used mHealth tools (Wang et al., 2024) due to their effectiveness in promoting exercise and increasing users' physical activity levels. Previous research has confirmed fitness apps' beneficial influence on users' exercise habits and health in general (Angosto et al., 2023; Chiu et al., 2021). They are third-party software programs that use data collected from a smartphone's built-in functions to measure fitness and health parameters (Higgins, 2016). Most fitness apps resort to behavioral change techniques, including exercise instruction, self-monitoring, and social support (Middelweerd et al., 2014). Fitness apps in this thesis refer to apps that provide training units and workouts in an interactive format, workout planning, online community access, and reminder functions for regular training, share training results online and monitor health habit data. Recent studies suggest that these are all vital functions of fitness apps that users particularly appreciate (Guo et al., 2022; Li et al., 2019).

In the future, with the increasing variety of apps and functions (e.g., nutrition, meditation, sleep) available, fitness apps will become ever more central to users' fitness and health regimens. In fact, two-thirds of Germans are currently using fitness apps (Bitkom Research, 2023). Unsurprisingly, worldwide, digital fitness and well-being is the fastest-growing digital health segment overall in 2024 (Statista Market Insights, 2024a); however, despite fitness apps' known potential for supporting physical activity and mental health, users only realize the desired behavior changes when they use apps continuously. Analyzing continued use is highly relevant to the scientific literature in terms of behavioral and technological aspects, as the low retention rates of fitness apps impede the prevention of health risks and their associated reductions in healthcare expenditure and hinder the potential for achieving widespread, long-term health benefits.

Overall, as healthcare systems shift toward consumer-centered care and prevention, digital health solutions will be shaped by consumers' needs and expectations. Personalization, convenience, immediacy, and cost-effectiveness are required to materialize the benefits associated with enhanced health prevention. This is highly relevant to future user behavior research, as it not only contributes to the theoretical understanding of user behavior concerning digital health solutions and services but also informs the development of strategies to improve retention rates. To obtain a holistic understanding of the factors determining continued use, assessing users' post-adoption behaviors is imperative in research and practice. Therefore, several gaps in the literature have been identified that will be explored in greater detail below.

1.3 Research gaps and aims

The healthcare industry only recently turned to how to navigate the post-pandemic world. Findings from pre-pandemic concerning teleconsultation and fitness apps are becoming potentially obsolete as COVID-19 propelled shifts in user behaviors and expectations. Although the existing literature has advanced the understanding of specific aspects of user adoption and continued use behaviors regarding healthcare and lifestyle technologies pre-COVID-19 in several contexts, whether patients and users perceive lasting benefits or eventually abandon them in the long-term remains yet to be explored.

Accordingly, this thesis has a twofold aim: (1) to attain a better understanding of the continued use behaviors of the two selected healthcare technologies and (2) to propose solutions for the continued study of behavioral problems in the context of healthcare treatment and prevention by elaborating on the value of a richer post-adoption model.

The research gaps addressed in Part A of this thesis concern the analysis of patients' continued use of teleconsultation as a critical healthcare technology that gained prominence during the pandemic. Whether the momentum of using telemedicine caused by the recent surge of first-time users will lead to a paradigm shift in healthcare delivery remains unknown.

The COVID-19 pandemic attracted research on the initial adoption of teleconsultation and other telemedical applications and their significance for public health crisis resolution (An et al., 2021; Baudier et al., 2023; Kamal et al., 2020). However, the adoption of teleconsultation during the pandemic was influenced by unique, often temporary conditions (e.g., lockdowns), which removed barriers, such as licensing restrictions and regulatory limits, and boosted use rates (Bokolo, 2021b). In the post-COVID-19 era, these factors have largely evolved, affecting patients' continuance intentions, as their motivations for using teleconsultations potentially differ from those under pandemic constraints. Furthermore, patients' perspectives have seldom been explored, and the literature still lacks insights into their intentions to continue using teleconsultations after the health crisis resolution in 2023. While Grenier Ouimet et al. (2020) and Zhu et al. (2023) have specifically delved into patients' continued teleconsultation use by drawing on extended versions of the ECM, their studies were conducted during the pandemic, potentially distorting the relevance of their findings for non-pandemic conditions and limiting explanatory power. Consequently, the extant literature fails to provide insights into present user expectations, needs, and motivations.

Part A, therefore, focuses on identifying technological and psychological variables and their impact on patients' continuance intentions. By considering patient perspectives, this thesis aims to explore the influencing factors that reinforce continued use that align with long-term health goals. A combined approach of using the core variables from Bhattacherjee's (2001) variant of Oliver's (1980) ECM with different theoretical frameworks is employed to bridge the gaps in the literature.

Part B illuminates users' continued use of fitness apps. In the emerging field of prevention and well-being, technological and app-based interventions contribute significantly, enabling users to achieve their fitness goals. Notably, the gap between the acceptance and discontinuance of healthcare and lifestyle-related technologies is not yet fully understood and requires thorough investigation. The growing importance and popularity of fitness apps have attracted research focused on exploring the behavioral outcomes of fitness app usage, such as whether they can help users achieve their health goals (Herrmann & Kim, 2017; Li et al., 2024; Molina & Myrick,

2020) or lose weight (Chen et al., 2015; Chew et al., 2022). So far, current scientific findings feature little user research.

Although some studies started to consider the factors determining the acceptance and continuance of fitness apps (Liu et al., 2022; Wang & Qi, 2021), existing research mainly focused on the determinants of adopting fitness apps that consider post-adoption behavior as an extension of technology acceptance (Beldad & Hegner, 2018; Huang & Ren, 2020). In contrast, studies explaining continuance intention that consider actual post-adoption behavior for fitness apps are scarce. The resulting gap in the literature is troubling since only a few studies have drawn from the appropriate theoretical background. Although some studies in the fitness app context drew on extended versions of the ECM incorporating social (e.g., social connection) or hedonic (e.g., perceived entertainment) factors (e.g., Chiu et al., 2021; Zhang & Xu, 2020; Zhu et al., 2023), they fail to provide insights concerning the reasons for users' continuance by integrating psychological factors into their analysis.

The increased demand for fitness apps during the past years may not result in the much-needed digitalization regarding health promotion. Therefore, evaluating users' post-adoption behaviors with fitness apps is ever more relevant. To address this aspect, Part B uses extended technology continuance models to examine current users' expectations, needs, and motivations to continue using fitness apps.

1.4 Thesis structure and results

1.4.1 Part A: Digitalization of disease care and treatments – patient perspectives

The first part of this thesis acknowledges the significance of teleconsultation in redefining patient treatment and care and explores patients' continued use intentions in non-pandemic situations. Figure 2 presents an overview of Part A's structure.

Table 2. Composition of Part A.

Part A: Digitalization of disease care and treatments – patient perspectives			
Macro-perspective:		**Micro-perspective:**	
Research Paper No. 1: Telemedicine as a viable option of healthcare? An assessment of patients' continuance intention after the pandemic		Research Paper No. 2: The role of self-determination theory in explaining patients' motivation to continue using telemedicine in a post-pandemic world	
Content	Abstract perspective on the determinants of patients' continuance intention for telemedicine.	**Content**	Granular perspective on the impact of psychological factors on patients' motivation to continue using telemedicine.
Method	Structural equation modeling based on the expectation-confirmation model.	**Method**	Structural equation modeling based on the expectation-confirmation model and self-determination theory.

Part A: Digitalization of disease care and treatments – patient perspectives			
Macro-perspective:		**Micro-perspective:**	
Research Question	What factors influence patients' continuance intention to use teleconsultation post-pandemic in Germany?	**Research Question**	How do psychological factors influence patients' satisfaction with telemedicine and their continuance intention in the aftermath of COVID-19?

1.4.1.1 Summary of Research Paper No. 1

Telemedicine as a viable option of healthcare? An assessment of patients' continuance intention after the pandemic

Inspired by the considerable increase in telemedicine use by physicians and patients during COVID-19, the first research paper explores the factors that influence the continued use of telemedicine from a patient perspective. In the context of the high abandonment rates of other healthcare technologies, the reinforcement of continued telemedicine use post-pandemic is ever more relevant. Although the initial acceptance of healthcare technologies, such as telemedicine, is essential to promoting a much-needed paradigm shift in healthcare behavior, only continued use results in viable, comprehensive technology success. By drawing on an extension of the expectation-confirmation model (ECM), this research paper investigates the role of technological factors and social influence in patients' continued use of teleconsultation from a macro perspective.

Of 464 participants who regularly used video conferencing during the COVID-19 pandemic, a sub-sample of 151 respondents who had already used video consultations with doctors about acute symptoms, chronic illnesses, and similar telemedicine applications was drawn. This research paper verifies the overall predictive validity of the ECM and recent research concerning healthcare technologies. Patients' perception of usefulness—measured by time savings and rapid access to healthcare treatments—was the primary driver of continued use. However, social influence also seems important within the context of teleconsultation. Current non-users of telemedicine indicated openness to such new healthcare technologies.

1.4.1.2 Summary of Research Paper No. 2

The role of self-determination theory in explaining patients' motivation to continue using telemedicine in a post-pandemic world

After affirming that findings about IS continuance use behaviors can be applied to healthcare technology, the second research paper analyzes the psychological determinants that drive

patients' motivation to continue using teleconsultation instead of visiting their physicians on-site in non-pandemic settings. The ECM has been critiqued for overlooking the role of users' motivation in continued use behaviors regardless of the technology being used. This paper investigates solutions to the supposed decline in teleconsultation use post-pandemic from the perspective of patients' motivation by synthesizing ECM and self-determination theory (SDT).

The findings suggest that perceived usefulness is the main predictor of patients' continued telemedicine use, although psychological needs (i.e., perceived competence and perceived relatedness) also affect patients' motivation, satisfaction, and continuance intentions. Incorporating ECM and SDT results in a more complete explanation of patients' telemedicine post-adoption behaviors. The combination of ECM and SDT appears to lay the foundation for improved research for digitalized healthcare delivery. This study points to the benefits of focusing on competence and relatedness as crucial dimensions of telemedicine quality.

1.4.2 Part B: Technologies in lifestyle and health promotion

The second part of the thesis emphasizes the shift toward health promotion and well-being in user behavior. It explores users' fitness app post-adoption behaviors as fitness apps are one of the key mHealth technologies pushing the frontier of healthcare self-management. Figure 3 presents Part B's structure.

Table 3. Composition of Part B.

Part B: Technologies in lifestyle and health promotion			
Post-adoption behaviors of fitness apps in the aftermath of COVID-19			
Research Paper No. 3: Understanding continued fitness app utilization: An extended expectation-confirmation model framework and the role of gratifications		Research Paper No. 4: Exploring the antecedents of users' fitness app continuance in the aftermath of COVID-19: An integrated TAM-ECM framework and the role of task-technology fit	
Content	Granular perspective on the effect of gratifications as antecedents to confirmation and the mediating roles of psychological factors of users' fitness app post-adoption behaviors.	**Content**	Granular perspective on the antecedents of users' continued fitness app use by exploring technological and psychological use motives.
Method	Structural equation modeling based on the expectation-confirmation model, flow theory, and uses and gratifications theory.	**Method**	Structural equation modeling based on the technology acceptance model and the expectation-confirmation model.
Research Question	How do motivational and psychological factors influence the confirmation-satisfaction-continuance paradigm?	**Research Question**	How do technological and psychological antecedents influence user beliefs about fitness apps in the aftermath of COVID-19?

1.4.2.1 Summary of Research Paper No. 3

Understanding continued fitness app utilization: An extended expectation-confirmation model framework and the role of gratifications

The third research paper illuminates the presence of the acceptance–discontinuance gap in users' post-adoption behaviors: Downloads of fitness apps skyrocketed during COVID-19 and remain high, promising a steadily growing market despite simultaneous low retention. Understanding the continued use of fitness apps is essential to address the changing user needs and expectations and ensure that the apps meet user demands and remain relevant to pave the way for digitized prevention measures. This paper examines whether technology-related or psychological and motivational factors drive the expectation-confirmation-satisfaction link. It evaluates mediating roles from a utilitarian and hedonic perspective. To do so, it extends the ECM with flow theory and uses and gratification theory (UGT).

A total of 403 complete responses from actual fitness app users were collected across various fitness online communities. The findings suggest that perceived usefulness is more important in determining users' satisfaction and, in turn, continuance intention compared to flow experience. While states of flow can enhance users' motivation, perceived usefulness assures users that the app is genuinely helping them progress toward their health goals. Concerning gratifications obtained from app use, perceived ease of use, perceived enjoyment, and social influence are essential antecedents to confirmation reinforcing satisfaction and continued fitness app utilization. Intuitive and personalized functions and gamification drive users' continued use and present essential building blocks for digitalized healthcare prevention in the future.

1.4.2.2 Summary of Research Paper No. 4

Exploring the antecedents of users' fitness app continuance in the aftermath of COVID-19: An integrated TAM-ECM framework and the role of task-technology fit

Drawing on the previous findings, the fourth research paper proposes an integrated model of users' technology acceptance and continuance intentions regarding fitness app usage post-pandemic. Building on the extant literature about technology adoption and continued use, a framework is constructed that integrates different constructs of user beliefs to increase its explanatory power and more holistically explain users' post-adoption behaviors toward fitness apps post-pandemic. Furthermore, gender-related differences concerning user beliefs are

examined. The framework is enriched with task-technology fit (TTF) to examine the potential antecedents of user beliefs that determine users' post-adoption behaviors.

The findings confirm the potential utility of a newer healthcare technology model, as the research paper's theoretical approach further pushes the frontier of understanding users' post-adoption behaviors. The results reveal that satisfaction is the main predictor of users' fitness app continuance intentions, while perceived ease of use influences users' behavior only indirectly. TTF is a crucial antecedent to users' beliefs driving fitness app post-adoption behaviors: Fitness app users' perceived TTF is essential to the extent to which their pre-acceptance expectations are confirmed which, in turn, results in satisfaction and continued use. The role of confirmation in predicting perceived ease of use and perceived usefulness in determining satisfaction proved to be more essential to female fitness app users. Personalized functions that match users' task requirements, health goals, and tracking options drive users' continuance intentions.

1.4.3 Status quo of submissions

The research papers presented in this thesis were written by multiple authors. The individual authors' contributions to each article are briefly listed in Table 4 according to the contributor role taxonomy (CRediT) for identifying author contributions to research articles (Allen et al., 2019; Allen et al., 2014). Table 4 also presents the submission/publication status for each journal and the number of revisions that were required for publication.

Table 4. Submission/publication status of the research papers.

Research Paper	Journal	Submission status/ publication		CRediT-author statement
1	BMC Digital Health	Status	Under Review (22.09.2023)	**Teresa Ries:** Conceptualization, methodology, formal analysis, investigation, resources, data curation, writing – original draft, writing – review and editing, visualization, supervision, project administration **Daniel Baier:** Writing – original draft, writing – review and editing, supervision, project administration
		Number of Revisions	2	
2	Marketing ZFP – Journal of Research and Management	Status	Published (19.02.2024)	**Teresa Ries:** Conceptualization, methodology, formal analysis, investigation, resources, data curation, writing – original draft, writing – review and editing, visualization, supervision, project administration **Daniel Baier:** Methodology, formal analysis, writing – original draft, writing – review and editing, visualization, supervision, project administration
		Number of Revisions	1	

Research Paper	Journal	Submission status/ publication		CRediT-author statement
3	Journal of Service Theory and Practice	Status	Under Review (01.11.2024)	**Teresa Ries:** Conceptualization, methodology, formal analysis, investigation, resources, data curation, writing – original draft, visualization, supervision, project administration **Nicola Bilstein:** Writing – original draft, supervision **Daniel Baier:** Writing – original draft, supervision, project administration
	Additionally submitted to the 54th Annual Conference of the European Marketing Academy (EMAC)	Status	Submitted (04.11.2024)	
4	Sports in Society	Status	Under Review (10.09.2024)	**Teresa Ries:** Conceptualization, methodology, formal analysis, investigation, resources, data curation, writing – original draft, visualization, supervision, project administration **Daniel Baier:** Methodology, writing – original draft, supervision, project administration

2. Part A: Digitalization of Disease Care and Treatments – Patient Perspectives

2.1 Research Paper No. 1: Telemedicine as a viable option of healthcare? An assessment of patients' continuance intention after the pandemic

Abstract

Background: The COVID-19 pandemic has considerably increased the usage of video conferencing in general and also, to a smaller extent, telemedicine among medical professionals and patients of all ages.

Objective: This paper aims to investigate whether the increased usage of video conferencing during the pandemic has a positive effect on the respondents' (post-) adoption of telemedicine. We investigate whether the continuance intention is driven by determinants like confirmation of expectations, perceived usefulness, and perceived ease of use, as well as satisfaction and social norm.

Methods: A continuance theory-based online questionnaire was developed and shared in several online health communities to collect responses from participants in Germany. They all used video conferencing regularly during the COVID-19 pandemic (n=464). A subsample (n=151, 32.5%) also used video consultations about acute symptoms, chronic illnesses, and/or similar telemedicine applications with a doctor.

Results: Overall, the users of video consultations and similar telemedicine applications (n=151) demonstrated high perceived ease of use (4.29 on average) and high satisfaction (4.26 on average). All constructs were measured by responses to three or more items on a Likert scale ranging from 1= "strongly disagree" to 5= "strongly agree". The continuance intention demonstrated to be lower than satisfaction (4.06 on average) but still was high. The perceived usefulness of telemedicine was found to be the main driver of continuance intention. These findings contrast with other research concerning healthcare technologies, where satisfaction was usually the strongest predictor. Moreover, besides the subsample of respondents who used teleconsultation and other telemedicine applications during the pandemic, most findings also hold for the subsample of participants who – up to now – only used video conferencing in general.

Conclusions: Based on our study, especially the perceived usefulness of telemedicine – measured by time savings and quick access to healthcare treatments – is the primary driver of telemedicine acceptance in the eyes of the patients. The pandemic has increased many patients' capabilities to deal with teleconsultation with doctors and similar telemedicine applications.

Even the up to now non-users of telemedicine indicated openness to these new healthcare technologies.

1. Introduction

1.1 Background

The COVID-19 pandemic has caused a profound spike in demand for digitally assisted healthcare delivery, potentially promoting a paradigm shift in healthcare models worldwide (Baudier et al., 2023; Pang et al., 2022). Thereby contributing momentum to previous endeavors to provide digitally assisted healthcare and opening new avenues of healthcare delivery. As people were urged to adhere to the strict COVID regulations to prevent further outbreak of the virus, telemedicine appeared particularly helpful in limiting contagion with COVID-19 (Baudier et al., 2023; Omboni et al., 2022; Pongiglione et al., 2023; Weißenfeld et al., 2021). By treating patients remotely, telemedicine ensured continued healthcare delivery without putting patients and physicians at risk of infection (Assaye et al., 2023; Bokolo, 2021b; Dash et al., 2021).

The pandemic has attracted research on the adoption of healthcare technologies and their significance for public health crisis resolution. Contrary to previous research, the present study examines post-adoption behaviors of teleconsultation and the utilization of similar telemedicine applications for non-pandemic conditions from a patient's point of view in Germany. According to Sadik and Salman (2021), prior literature concerning telemedicine has not specified the underlying definition of telemedicine and the related context enough. Telemedicine platforms provide medical care by utilizing communication technologies to overcome physical distances between patients and physicians (Bokolo, 2021b; Kamal et al., 2020). This type of care has proven advantageous due to increasing accessibility and efficiency (Pongiglione et al., 2023; Rajkumar et al., 2023), resulting in cost and time savings for both patients and physicians (Assaye et al., 2023; Bokolo, 2021a; Weißenfeld et al., 2021). Our study focused on teleconsultations about acute symptoms, chronic illnesses, and/or similar telemedicine applications.

According to a McKinsey & Company (2020) study, adoption rates for teleconsultation in Germany remained low prior to the pandemic. Hence, COVID-19 has profoundly increased the demand for digitally assisted consultation, pressuring policymakers to break down legal regulations to ensure widespread adoption. Demand has skyrocketed in Germany; whereas less than 3,000 German patients were using video consultations in 2019, utilization rates had risen

by a 900-fold increase to 2.67 million patients in 2020 (McKinsey & Company, 2021). In the same vein, Assaye et al. (2023) in their study concerning healthcare professionals' utilization of telemedicine found that the majority of participants regarded the significance of telemedicine during the COVID-19 pandemic as either high or very high. So far, recent studies have mainly considered the factors determining the initial adoption of telemedicine (i.e., irrespective of the underlying definition) by using different theories, including the technology acceptance model (TAM) (An et al., 2021; Holtz et al., 2022; Kamal et al., 2020) and the unified theory of acceptance and use of technology (UTAUT) (Cimperman et al., 2016; Rho et al., 2015).

Due to the increased demand for teleconsultation in the past years, it appears questionable whether this momentum will likely result in a paradigm shift in healthcare delivery or whether patients will abandon it now that the pandemic has passed. Research on post-adoption behaviors concerning teleconsultation or other telemedical services remains scarce (Grenier Ouimet et al., 2020). For instance, Harst et al. (2019) only provide an overview of the few studies concerning telemedical services that have been carried out up to now. Consequently, the lack of literature related to teleconsultation and similar telemedicine applications concerning patients' post-adoption behaviors for non-pandemic conditions is troubling. High abandon rates of other healthcare technologies, such as mHealth apps (Cho, 2016; Krebs & Duncan, 2015; Vaghefi & Tulu, 2019), may counteract the development towards a paradigm shift in healthcare. These developments make the examination of the influencing factors of post-adoption behaviors ever more relevant.

Given that according to IS theory, the realization of technology's benefits for users depends on its effective and continuous use, this dearth of literature concerning factors influencing post-adoption behaviors of telemedicine is significant. Therefore, the current study aims to answer the following research question: What factors influence patients' continuance intention to use teleconsultation post-pandemic in Germany? To address this question, we draw on an extension of information systems (IS) continuance theory as proposed by Bhattacherjee (2001) and empirically test our research model by surveying patients from Germany. The following section provides an overview of the theoretical model, followed by methods and results. After discussing the results, managerial and theoretical contributions are presented, followed by limitations, research outlook, and concluding remarks.

1.2 Research model and hypotheses development

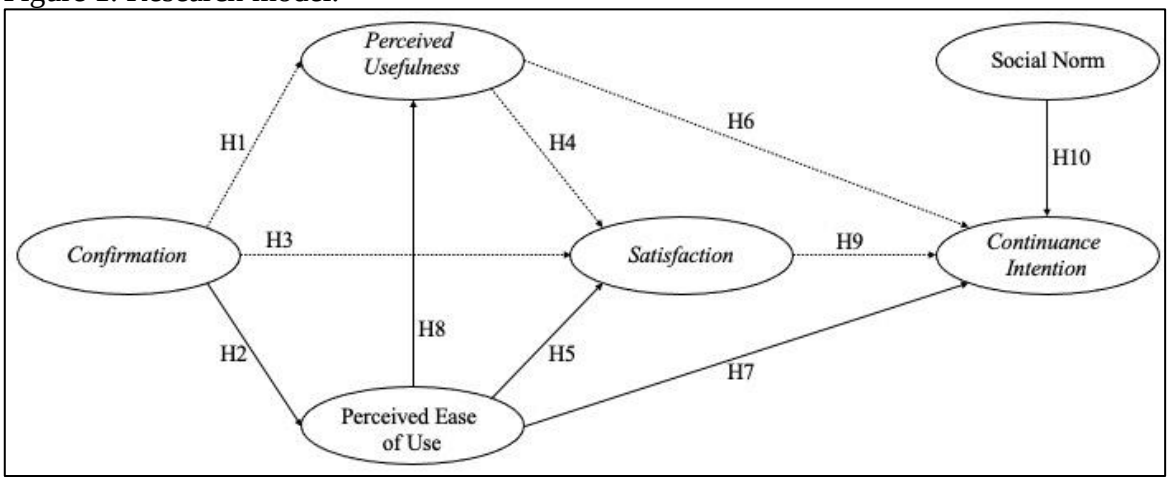
Generally, examining telemedicine post-adoption behaviors becomes ever more relevant considering the rapidly developing IoT-based healthcare technologies that are continuously evolving and growing in number. The analysis of telemedicine adoption helps foster a widespread roll-out of digitally assisted healthcare models. However, it is not sufficient in explaining viable and long-term telemedicine use. Accordingly, our research model draws and builds on Bhattacherjee 's (2001) IS continuance theory that was developed specifically to comprehend users' technology post-adoption behaviors. We contribute to the literature by innovatively extending the IS continuance theory (Bhattacherjee & Barfar, 2011) to gain new insights into the continuance intention of patients in the context of health technology in Germany.

Figure 1 depicts the corresponding variables and relationships of the original model (cf. variables in italics and dotted relationships). In brief, the model asserts that the user experience of a technology either confirms or disconfirms initial expectations toward it, which is captured by confirmation (Bhattacherjee, 2001). It follows that confirmation arises if the perceived performance of telemedicine exceeds prior expectations (cf. confirmation). Simultaneously, users obtain perceived benefits of the technology (cf. perceived usefulness). Confirmation and high perceived usefulness of the technology subsequently lead to satisfaction (cf. satisfaction). Perceived usefulness and satisfaction then predict continuance intention regarding the technology in question (cf. continuance intention). It is common practice in technology post-adoption research to use continuance intention as a proxy for actual continuance use behavior (Grenier Ouimet et al., 2020; Lee, 2010). Previous research confirms its suitability for various technologies (Kaium et al., 2020; Lee, 2010).

Furthermore, we innovatively incorporated two additional constructs into the original theory – perceived ease of use and social norm – to enhance our understanding of factors influencing the continuance intention to use telemedicine. Past research confirms the prediction power of perceived ease of use for novel technologies (Cho, 2016; Wang & Cao, 2022). We, therefore, extend the initial model with perceived ease of use. Due to the novelty of telemedicine for many patients, we do not expect wear-out effects that generally result from increasing familiarity with a technology (Bhattacherjee & Barfar, 2011; Bhattacherjee & Lin, 2015). We also integrated social norm into the research model. In the case of healthcare technologies, prior research so far has not addressed the relationship between social norm and continuance intention. Nonetheless, findings concerning e-learning technologies provide solid grounds for further

investigation concerning this association (Zobair et al., 2019). Finally, Figure 1 shows the research model from which we draw our hypotheses.

Figure 1. Research model.



Notes: H = Hypothesis.

Confirmation of expectations is crucial in determining continuance intentions (Amin et al., 2022; Bhattacherjee & Barfar, 2011). High perceived usefulness refers to the users' perceived technology benefits associated with its use (Grenier Ouimet et al., 2020; Wang & Cao, 2022). Extant research posits that the main reasons for using telemedicine include, among others, cost and time efficiencies (Harst et al., 2019; McKinsey & Company, 2021; Zhu et al., 2023; Zobair et al., 2019). When initial expectations regarding telemedicine are confirmed, patients are likely to acknowledge its usefulness. We thus consider perceived usefulness to be a key predictor and propose the following hypothesis:

H1. Patients' confirmation of expectations is positively related to their perceived usefulness of teleconsultation and similar telemedicine applications.

Perceived ease of use refers to the extent to which users believe a particular technology can be used without effort (Yan, Filieri, Ragusco, & Gortin, 2021). Hence, it increases with use experience, reducing the effort necessary to obtain skills related to technology utilization. In other words, perceived ease of use is inversely associated with the effort required to use a new technology (Cho, 2016). Consequently, the confirmation of expectations requires enough ability to use telemedicine adequately. This means patients who can confirm the primary purpose of telemedicine platforms are also likely to be able to use it effectively. We hence propose the following hypothesis:

H2. Patients' confirmation of expectations is positively related to their perceived ease of use of teleconsultation and similar telemedicine applications.

Satisfaction in the IS context refers to the users' overall evaluation of a technology's performance. If users' perceived technology performance exceeds their prior expectations, satisfaction emerges; dissatisfaction results from prior expectations compared with actual performance deemed insufficient by users. Confirmation of expectations is likely to lead to satisfaction. Previous literature found confirmation to be a key determinant of satisfaction concerning healthcare technologies (Amin et al., 2022; Wang & Cao, 2022; Yan, Filieri, Ragusco, & Gortin, 2021; Zhu et al., 2023). It seems plausible to argue that patients are satisfied with telemedicine if their expectations are confirmed. We therefore propose the following hypothesis:

H3. Patients' confirmation of expectations is positively related to their satisfaction with teleconsultation and similar telemedicine applications.

Previous literature indicates that perceived usefulness and ease of use directly and positively influence satisfaction. Perceived usefulness serves as a baseline to reference against corresponding confirmations, which in turn may result in satisfaction (Bhattacherjee et al., 2008; Franque et al., 2021; Yan, Filieri, Ragusco, & Gortin, 2021). Perceived ease of use is often construed as a prime determinant of affect towards adopting technology (Thong et al., 2006). Due to the emotional component of satisfaction, it seems plausible to assume that perceived ease of use influences satisfaction. Prior research also suggests that perceived usefulness primarily determines continuance intention through the users' perceived benefits from a specific technology (Franque et al., 2021). Previous findings concerning health technology contexts have supported this notion (Grenier Ouimet et al., 2020; Kaium et al., 2020). Albeit the strong prediction power of perceived usefulness on technology adoption, prior research also emphasizes the significant influencing role of perceived ease of use on continuance intention for novel technologies (Cho, 2016; Lee, 2010). At large, we assume that perceived usefulness and perceived ease of use are critical determinants of satisfaction and continuance intention concerning telemedicine. We thus postulate:

H4. Perceived usefulness of teleconsultation and similar telemedicine applications is positively related to patients' satisfaction.

H5. Perceived ease of use of teleconsultation and similar telemedicine applications is positively related to patients' satisfaction.

H6. Perceived usefulness of teleconsultation and similar telemedicine applications positively influences patients' continuance intention.

H7. Perceived ease of use of teleconsultation and similar telemedicine applications positively influences patients' continuance intention.

Extant research moreover stresses the effect of perceived ease of use on perceived usefulness (Lee, 2010). The perception of technology as useful may depend on the comprehension that only a few resources are necessary to learn its application. This means patients perceive telemedicine as useful if they feel its application is not demanding. Thus, we derive the following hypothesis:

H8. Patients' perceived ease of use will be positively associated with the perceived usefulness of teleconsultation and similar telemedicine applications.

Satisfaction is a frequently explored factor and was found to impact the continuance intention of healthcare technologies directly (Amin et al., 2022; Wang & Cao, 2022; Yan, Filieri, Ragusco, & Gortin, 2021). It seems plausible to assume that perceived positive experiences with telemedicine translate into a higher likelihood of patients continuing to use telemedicine (Zhu et al., 2023). This leads to the following hypothesis:

H9. Satisfaction with teleconsultation and similar telemedicine applications is positively associated with patients' continuance intention to use it.

Theories from social psychology, such as TRA and TPB, propose that intentions are determined by subjective norms and personal attitudes concerning a particular behavior (Ajzen, 1991; Franque et al., 2021). Social norm encompasses normative influences and refers to the extent to which an individual believes referent others approve or disapprove of a specific behavior (Ajzen, 1991). Prior literature confirms that subjective norms directly influence intentions in various contexts (Chang et al., 2014; Chen et al., 2012). We therefore expect that patients are likely to develop a positive intention toward continue using telemedicine if they believe that referent others approve it (Bhattacherjee & Lin, 2015). Consequently, we hypothesize:

H10. Social norm is positively related to patients' continuance intention to use teleconsultation and similar telemedicine applications.

2. Methods

2.1 Data collection and descriptive statistics

An online questionnaire was developed using Qualtrics to analyze the underlying constructs and their relations. Respondents were asked to answer several introductory questions concerning their prior experiences with teleconsultation and similar telemedicine applications.

Then, items measuring the constructs expectation confirmation (EC), perceived usefulness (PU), perceived ease of use (PEOU), satisfaction (SATIS), subjective norm (SN), and continuance intention (CONI) were presented. The last part inquired about participants' demographics (i.e., age, gender, income, employment status, education level, and place of residence). Appendix A (see Additional file 1: Questionnaire design and measurement constructs) gives an in-depth overview of the questionnaire's structure and summarizes item constructs and their source.

Data was collected by spreading the self-administered questionnaire online via several German online health communities and at German universities during an eight-week period in Spring 2023. The invitation to participate provided the survey link and a clear indication that participation is voluntary and anonymous so that no conclusions can be drawn about individual participants. The survey was administered in German. A total of 464 responses were considered for further analysis. A sub-sample of 151 participants already had used teleconsultations about acute symptoms, chronic illnesses, and/or similar telemedicine applications.

Within the sub-sample, 48.3% of the respondents used teleconsultation and similar telemedicine applications once in the past six months. 13.9% utilized teleconsultations and similar telemedicine applications even more than three times within the past six months. Concerning actual usage experiences, 92.7% of respondents from the sub-sample did not encounter problems when utilizing teleconsultation or similar telemedicine applications. Respondents who encountered difficulties in most cases referred to connectivity issues. Moreover, 47.7% of the sub-sample used teleconsultation to obtain initial or follow-up prescriptions; 44.4% indicated using teleconsultation to treat acute symptoms such as gastroenteritis. Additionally, participants used various telemedicine applications such as teleconsultation platforms (e.g., teleclinic), digital health applications for a series of symptoms, online psychotherapy, and online dermatologist services.

Participants without prior usage experiences named a range of barriers that kept them from using teleconsultation and similar telemedicine applications. For instance, 36.9% of the total sample indicated that their general practitioner did not offer telemedical services, followed by 15.1% of respondents who could not find adequate platforms that provided such services. Furthermore, some respondents stated that they did not see additional value or need in using telemedical services.

Table 1 summarizes participants' socio-demographic characteristics. The age proportion was relatively equal in both the total sample and the sub-sample. Hence, our sub-sample comprises younger patients aged 30 – 50 years who already utilized teleconsultations compared to low user rates of older patients in the total sample. Among the participants from the total sample, 60.8% (n = 282) were female, while the majority of the sub-sample was male (64.2%). In both samples, most participants had a monthly income between 1.001 – 2.000 Euros (cf. Table 2). Most of the respondents were students (60.3%). Furthermore, two-thirds of the sub-sample had already reached a bachelor's or master's degree (see Table 1). Most respondents in both samples lived in a city (cf. Table 1).

Table 1. Descriptive statistics.

Demographics/ Characteristics	*Specifications*	*Counts (Proportion) n=464 All*	*Counts (Proportion) n=151 Exp.*	*Counts (Proportion) n=313 Others*
Age	≤ 20 years	20 (4.3%)	6 (4.0%)	14 (4.5%)
	21 – 30 years	358 (77.2%)	113 (74.8%)	245 (78.3%)
	31 – 40 years	44 (9.5%)	19 (12.6%)	25 (8.0%)
	41 – 50 years	23 (5.0%)	10 (6.6%)	13 (4.2%)
	51 – 60 years	11 (2.4%)	2 (1.3%)	9 (2.9%)
	> 60 years	4 (0.9%)	0 (0.0%)	4 (1.3%)
	No response	4 (0.9%)	1 (0.7%)	3 (1.0%)
Gender	Female	282 (60.8%)	97 (64.2%)	185 (59.1%)
	Male	177 (38.1%)	54 (35.8%)	123 (39.3%)
	Divers	5 (1.1%)	0 (0.0%)	5 (1.6%)
Monthly net income	< 1,000 €	132 (28.4%)	33 (21.9%)	99 (31.6%)
	1,001 – 2,000 €	145 (31.3%)	54 (35.8%)	91 (29.1%)
	2,001 – 3,000 €	66 (14.2%)	28 (18.5%)	38 (12.1%)
	> 3,000 €	66 (14.2%)	24 (15.9%)	42 (13.4%)
	No response	55 (11.9%)	12 (7.9%)	43 (13.7%)
Employment status	Employed full-time	110 (23.7%)	42 (27.8%)	68 (21.7%)
	Employed part-time	61 (13.1%)	25 (16.6%)	36 (11.5%)
	Pupil	6 (1.3%)	1 (0.7%)	5 (1.6%)
	Student	280 (60.3%)	81 (53.6%)	199 (63.6%)
	Apprentice	4 (0.9%)	2 (1.3%)	2 (0.6%)
	No response	3 (0.6%)	0 (0.0%)	3 (0.6%)
Education	High school graduate	127 (27.4%)	39 (25.8%)	88 (28.1%)
	Bachelor's degree	221 (47.6%)	70 (46.4%)	151 (48.2%)
	Master's degree or higher	86 (18.5%)	34 (22.5%)	52 (16.6%)
	Other	28 (6.0%)	8 (5.3%)	20 (6.4%)
	No response	2 (0.4%)	0 (0.0%)	2 (0.6%)
Place of residence	City	336 (72.4%)	118 (78.1%)	218 (69.6%)
	Suburban	58 (12.5%)	15 (9.9%)	43 (13.7%)
	Rural	66 (14.2%)	18 (11.9%)	48 (15.3%)
	No response	4 (0.9%)	0 (0.0%)	4 (1.3%)

2.2 Items and constructs

All constructs were measured by multiple items on a five-point Likert scale (1= "Strongly disagree" to 5 = "Strongly agree"). The underlying items were validated scales derived from

existing literature. Based on the maturity of IS continuance intention research, the study benefits from previous empirical validations, ensuring item validity and reliability.

3. Results

3.1 Bias test results

Given the intrinsic limitations of survey research, biases related to the perceptual nature of the constructs measured may be present. Common method bias is a frequent phenomenon associated with self-administered questionnaires, resulting in overestimating relationships between variables. To appraise common method bias, we used Harman's single-factor approach (Podsakoff et al., 2003). Results indicate that the first factor represents 45,65% of the total variance, which is below the recommended threshold of 50%. We thus did not detect any moderate to high levels of common method bias within our research.

3.2. Measurement model evaluation

First, we assessed the underlying constructs. Appendix B (see Additional file 1) depicts the results for the total sample (n = 464) as well as the sub-sample (n = 151). Overall, users from the sub-sample demonstrated high perceived ease of use (mean = 4.29, SD = .65) and high satisfaction (mean = 4.26, SD = .78). The continuance intention demonstrated to be lower than satisfaction (mean = 4.06, SD = .94) but still was high.

To analyze the underlying data, structural equation modeling was used (SEM); we used R and SPSS for data analysis. First, a confirmatory factor analysis (CFA) was conducted on the structural model to assess the overall fitness of the model and examine the constructs' reliability and validity. Two items (i.e., PU2 and PEOU2) were dropped based on the CFA and modification index of indicator variables. Table 2 summarizes results from the CFA correspondingly. Generally, results from the CFA showed a satisfactory model fit, with $chi^2(df)= 389.055$ (120), p = .000; RMSEA = .070 ≤ .080; CFI = .952 > .900; TLI = .939 > .900; SRMR = .037 ≤ .050 (Hair et al., 2014; Schermelleh-Engel et al., 2003).

Table 2. Measurement model results.

Construct	*Item*	*Factor Loadings*	*Cronbach's α*	*CR*	*AVE*
Confirmation	EC1	.777	.796	.805	.581
	EC2	.826			
	EC3	.671			
Perceived Usefulness	PU1	.680	.783	.784	.550
	PU3	.701			
	PU4	.831			
	PEOU1	.779	.822	.816	.599

Construct	*Item*	*Factor Loadings*	*Cronbach's α*	*CR*	*AVE*
Perceived Ease of Use	PEOU3	.683			
	PEOU4	.839			
Social Norm	SN1	.841	.881	.881	.712
	SN2	.833			
	SN3	.858			
Satisfaction	SF1	.858	.899	.899	.748
	SF2	.861			
	SF3	.876			
Continuance Intention	CI1	.894	.899	.899	.749
	CI2	.860			
	CI3	.841			

Model-Fit-Index: chi²(df)= 389.055 (120), p= .000; RMSEA= .070; CFI= .952; TLI = .939; SRMR= .037.

All constructs were measured with reflective items. Construct reliability and validity were examined by drawing on composite reliability (CR) and Cronbach's α. All values exhibit satisfying results (Cronbach, 1951) (cf. Table 2). Standardized factor loadings and the average variance extracted (AVE) were checked to determine convergent validity. All factor loadings exceed the threshold of ≥.70 (Hair et al., 2014) and ≥.50 (Fornell & Larcker, 1981) , respectively (cf. Table 2). Next, discriminant validity was checked by applying the Fornell-Larcker criterion and the heterotrait-monotrait ratio (HTMT). Fornell-Larcker tabulation is provided in Appendix C (see Additional file 1), and HTMT results are displayed in Table 3. Considering HTMT, all pairings pass the conservative threshold of <.85 (Henseler et al., 2015).

Table 3. Assessment of discriminant validity.

	EC	PU	PEOU	SN	SATIS	CONI
EC						
PU	.833					
PEOU	.793	.823				
SN	.291	.446	.388			
SATIS	.809	.795	.827	.374		
CONI	.644	.823	.665	.521	.675	

3.3 Structural model evaluation

Moving on to evaluating the structural model, variance inflation factors (VIFs) were checked. Values ranged from 1.125 to 2.097, passing the conservative threshold of 3.3 for the absence of collinearity issues (Kock & Lynn, 2012). The structural model indicated satisfactory model fit, with chi²(df) = 418.148 (125), p = .000; RMSEA = .072 ≤ .080; CFI = .947 > .900; TLI = .935 > .900; SRMR = .047 ≤ .050 (Hair et al., 2014; Schermelleh-Engel et al., 2003). Next, R2 values were checked, exhibiting .830 for PU, .650 for PEOU, .761 for SATIS, and .674 for CONI (R2 Adjusted: .829 for PU, .649 for PEOU, .759 for SATIS, and .671 for CONI). Overall,

in-sample predictive power can be considered moderate (Hair et al., 2019). Table 4 depicts the results of the hypotheses testing.

Table 4. Hypotheses tests.

H	*Path*	*Results*	*Est.std*	*z-value*
H1	EC → PU	Supported	0.333***	4.238
H2	EC → PEOU	Supported	0.806***	28.457
H3	EC→ SATIS	Supported	0.298***	3.599
H4	PU → SATIS	Rejected	0.170	0.971
H5	PEOU → SATIS	Supported	0.891***	4.248
H6	PU → CONI	Supported	1.009***	5.400
H7	PEOU → CONI	Rejected	-0.300	-1.062
H8	PEOU → PU	Supported	1.121***	7.876
H9	SATIS → CONI	Supported	0.611***	4.198
H10	SN → CONI	Supported	0.250**	6.671

Notes: H = Hypothesis, EC = Expectation confirmation, PU = Perceived usefulness, PEOU = Perceived ease of use, SATIS = Satisfaction, CONI = Continuance Intention, SN = Social norm.

Nearly all hypotheses could be supported at the 0.001 significance level. Concerning the proposed ECM relationships, statistical significance could be established for H1, H3, H6, and H9. Statistical significance was also observed for EC on PEOU (H2), PEOU on SATIS (H5), and PU (H8), as well as SN on CONI (H10). Surprisingly, we could not establish statistical significance for H4 and H7 (see Table 4).

To test indirect effects, we utilized the bootstrapping method recommended by Zhao et al. (2010). Table 5 summarizes the results. In our study, only one indirect effect was significant for the path "EC > PEOU > CI". The 95% confidence interval excludes zero (.273; .681); hence, we deduce that PEOU mediates the relationship between EC and PU. To assess the magnitude of mediation, we evaluated the variance accounted for (VAF) value that indicates the strength of the indirect effect relative to the total effect (Helm et al., 2009). VAF values lie between 0 and 100%. Values between 20% and 80% demonstrate partial mediation; full mediation occurs if values exceed 80%. Since the VAF value for the indirect effect was 60,04%, we conclude that PEOU partially mediates the effect of EC on PU.

Table 5: Indirect effects.

Indirect Effects	*Path*	*Results*
IE1	EC → PU → CONI	0.248†
IE2	EC → PEOU → CONI	-0.134
IE3	EC → SATIS → CONI	0.039
IE4	PU → SATIS → CONI	0.017
IE5	PEOU → SATIS → CONI	0.065
IE6	PEOU → PU → SATIS	0.079
IE7	EC → PU → SATIS	0.042
IE8	EC → PEOU → SATIS	0.398
IE9	EC → PEOU → PU	0.500***

Notes: EC = Expectation confirmation, PU = Perceived usefulness, PEOU = Perceived ease of use, SATIS = Satisfaction, CONI = Continuance Intention, SN = Social norm.

4. Discussion

4.1 Principal findings

Unlike previous research on the acceptance of telemedicine (Kamal et al., 2020; Kim & Han, 2023; Ong et al., 2022), this study has investigated the factors that influence post-adoption behaviors of telemedicine in the aftermath of the COVID-19 pandemic in Germany. Weißenfeld et al. (2021) corroborate the importance of the healthcare sector in Germany. Teleconsultation and similar telemedicine applications yield the potential to transform into a global supply structure (Zanaboni et al., 2009). The need for a paradigm shift in healthcare delivery models towards digital time- and cost-efficient solutions remains salient. The dearth of literature concerning telemedicine continuance behaviors is troubling, as the discontinuance of telemedicine use represents a loss of opportunities to provide comprehensive and effective health care (Baudier et al., 2023; Gupta et al., 2023).

Moreover, extant literature has seldom considered post-adoption behaviors of telemedicine (Grenier Ouimet et al., 2020); to the best of our knowledge, no research exists on patients' telemedicine continuance intention in the aftermath of the pandemic. Relying mainly on the expectation-confirmation model (ECM), this study tested multiple hypotheses linked to (1) the relationships between the main components of the ECM and (2) innovatively extended it to gain new insights into telemedicine users' continuance intentions. The main results of the structural equation modeling supported the postulated hypotheses in most cases.

Based on our findings, perceived usefulness is the main predictor of telemedicine continuance intention post-pandemic. In general, this finding is consistent with existing research on the ECM concerning healthcare technologies (Cho, 2016; Grenier Ouimet et al., 2020). Regardless of the context, perceived usefulness, particularly for utilitarian technologies, has proven to be a key predictor of users' technology continuance intentions (i.e., users only continue using

technology if they predict it is beneficial in the future) (Bhattacherjee & Lin, 2015; Gupta et al., 2023; Nabavi et al., 2016).

Telemedicine as a utilitarian system aims to provide patients with instrumental value. Based on the sub-sample, our findings suggest that time savings and quick access to healthcare treatments are the main benefits emphasized by patients. In particular, acute treatment of symptoms and fast access to initial and follow-up prescriptions have proven beneficial. Put differently, solving health problems efficiently is telemedicine users' most important usage rationale (Baudier et al., 2023; Falgarone et al., 2022). Interestingly, respondents in our study with no prior usage experiences often did not see any additional value or benefit in using teleconsultations and similar telemedicine applications, which proves the importance of perceived usefulness relating to post-adoption behaviors.

In contrast to our findings, other research concerning healthcare technologies identified satisfaction as the strongest predictor of continuance intention (Chiu et al., 2021; Kaium et al., 2020). Results concerning prediction strength of perceived usefulness and satisfaction on continuance intention in the healthcare technology context remain inconsistent. Satisfaction in our model had a significant but smaller effect on continuance intention than perceived usefulness (cf. H9). High satisfaction, in this case, means that telemedicine services exceeded patient expectations; high perceived usefulness relates to the belief that telemedicine will improve patients' health management (Wang et al., 2022). Our findings thus indicate that participants perceive the utility of telemedicine to be even more important when determining whether to continue using telemedicine than the congruence between expectations and actual performance.

Furthermore, contradicting initial expectations, perceived usefulness did not have a statistically significant effect on telemedicine satisfaction, whereas perceived ease of use positively and significantly influenced user satisfaction but did not indicate a significant effect on telemedicine continuance intention. First, previous findings concerning the role of perceived usefulness on healthcare technology satisfaction remain ambiguous. Some research concerning health technologies corroborates the vital link between perceived usefulness and satisfaction (Chiu et al., 2021; Yan, Filieri, Ragusco, & Gortin, 2021; Zhu et al., 2023), while others could also not establish a direct effect of perceived usefulness on satisfaction (Cho, 2016). To explain this unexpected finding, it may be relevant to consider later revisions of the ECM. Due to inconsistent empirical findings and insufficient theoretical support (Bhattacherjee et al., 2008) dropped, the direct association between perceived usefulness and satisfaction from the original

model. The two main reasons are that the direction of causality between post-usage perceptions and satisfaction and the relation between belief and affect remain ambivalent.

Second, in contrast to other research that posits a significant influence of perceived usefulness in determining users' attitudes towards technology, perceived ease of use in our study poses a greater impact on the emotional state of telemedicine users. This result is consistent with previous findings on post-adoption healthcare technology behaviors (Cho, 2016; Yan, Filieri, Ragusco, & Gortin, 2021). Furthermore, against our initial assumption and some prior evidence (Paré et al., 2018), perceived ease of use did not directly influence participants' telemedicine continuance intentions. This effect is, however, congruent with previous research (Cho & Lee, 2020; Yan, Filieri, & Gorton, 2021). It may be explained by the aforementioned wear-out effects confirming that participants were familiar with telemedicine (Bhattacherjee & Barfar, 2011; Bhattacherjee & Lin, 2015).

Consequently, whether telemedicine use is easy or not, respondents will tend to use it, mainly because of its high perceived usefulness. Based on the significant effect of perceived ease of use on perceived usefulness (cf. H8), we can assume that respondents felt that telemedicine utilization was not demanding, which increased their perception of usefulness. Generally, if users perceive technology as easy to use, they are more likely to perceive it as useful, per our findings (Binyamin & Zafar, 2021; Gupta et al., 2023; Noceda et al., 2023). The inclusion of perceived ease of use in the research model hence emerges as an essential contribution to understanding telemedicine continuance behaviors.

Next, considering social norm, its influence on continuance intention is supported (cf. H10). Existing research on social norm's effect on technology continuance intentions within the ECM is ambiguous. While some research reports no significant relationship between social norm and continuance intention (Hartono et al., 2021), this study demonstrates that social norm is an important influencing factor. Our finding is similar to results from (Lee, 2010) assessing post-adoption behaviors in an e-learning context or (Hsu et al., 2018) concerning continuance intentions of mobile telecommunication services.

Our finding thus suggests that patients' determination of whether to use telemedicine in the future partly depends on social influences. Interestingly, previous findings emphasize that social influences may gradually fade out over time as the technology becomes increasingly familiar. Users then decide to continue using a technology according to their own needs regardless from others (Huang, 2019; Wang et al., 2017). The fact that wear-out effects

concerning perceived ease of use were present in this study (i.e., telemedicine was perceived as familiar), together with the positive significant influence of social norm on participants' telemedicine continuance intention, however, contradicts this presumption. Such decreasing influences of social norms may depend on the context and the specific technology in question.

Furthermore, as expected confirmation of initial expectations directly and positively influenced telemedicine perceived usefulness, perceived ease of use and satisfaction. These findings align with previous literature (Chiu et al., 2021; Cho, 2016; Wang et al., 2022; Zhu et al., 2023). Interestingly, the effect of confirmation on perceived usefulness in our study is partly mediated by perceived ease of use. The support of IE9 hence points out that participants in our study were likely to acknowledge telemedicine's usefulness partly because previous expectations concerning the ease of use were confirmed.

Finally, comparing the total sample with the sub-sample indicated similar underlying age proportions for non-users and users of teleconsultation and similar telemedicine applications. Based on our findings, non-users were rather old, aged 50 and older, while users of teleconsultation and similar telemedicine applications appeared to be younger (i.e., 30 – 50 years). Our findings align with previous research concerning the utilization of teleconsultation and similar telemedicine applications. For instance, Falgarone et al. (2022) in their study on teleconsultation solutions for primary care in France found that younger working women of childbearing age used this service the most. Interestingly, Miyawaki et al. (2021) found that during the COVID-19 pandemic, younger patients generally increased the use of telemedicine more than older patients.

In contrast, patients older than 70 also increased the use of telemedicine. Principally, previous research concerning usage behaviors of telemedical services and age is inconclusive (Gordon & Hornbrook, 2016; Park et al., 2023; Walker et al., 2020). These differences in usage behavior based on age may be explained through general familiarity with information communication technologies (Miyawaki et al., 2021; Pang et al., 2022).

4.2 Contributions of the study

This study is one of the first within the context of healthcare technologies intending to shed light on the post-adoption behaviors concerning telemedicine use in Germany. First, by applying core constructs from the ECM and innovatively extending it, our study contributes to the general theoretical understanding of post-adoption behaviors. The present study, therefore, provides new empirical evidence for the applicability of the ECM and its extension to

telemedicine. Hence, our findings contribute to advancing knowledge of why and how patients are motivated to continue using telemedicine; we examined patients' key drivers to continue using telemedicine in the aftermath of COVID-19. Consequently, the present research provides new insights into the main predictors of continued use of telemedicine, which is crucial to achieving the anticipated paradigm shift in healthcare delivery.

Second, as discussed above, prior research concerning healthcare technologies has seldom considered the post-adoption behaviors of patients who have previously used telemedicine. Nevertheless, rather than scrutinizing adoption behaviors, it is vital to comprehend the post-adoption behavioral patterns of telemedicine users. Considering the rapid developments of IoT-key technologies in the healthcare industry, the discontinuance of telemedicine use equates to the loss of opportunities for effective healthcare delivery. Apart from the recent developments in healthcare technologies under COVID-19, disruptive digital solutions such as telemedicine provide grounds for comprehensive and efficient healthcare delivery (Noceda et al., 2023; Rajkumar et al., 2023). Therefore, our findings generate new insights into the determinants that influence the continued use of such viable technologies.

Third, we provide new insights into the role of social influence in the context of telemedicine. As the impact of referent others on post-adoption behaviors concerning healthcare technologies has not been extensively studied (Li et al., 2022), we bridge this gap in the literature by empirically testing the role of social norms in the continued use of telemedicine. The role of social influence appears to be particularly relevant when bearing in mind the demographic structures in Germany. To promote the paradigm shift of healthcare delivery in aging societies, especially elderly patients will need to get accustomed to the regular use of healthcare technologies (Miyawaki et al., 2021; Pang et al., 2022; Park et al., 2023). Therefore, the role of social influences in determining the continued use of telemedicine and other healthcare technologies needs to be scrutinized in more detail.

Finally, in terms of practice, our findings corroborate the need to adapt the medical ecosystem toward integrating digital solutions and delivery models. The frequent evaluation of perceived benefits and value propositions arising from telemedicine is critical, given the vital role of perceived usefulness in developing patients' continuance intentions (Falgarone et al., 2022; Noceda et al., 2023). Further, telemedicine technologies need to provide utilitarian values to their patients and deliver on them to generate value added for patients; efficient and timely healthcare delivery will increase users' willingness to continue using the telemedicine service (Noceda et al., 2023). In this regard, as perceived usefulness directly relies on confirmed

expectations, patients should be provided with information about the possibilities, potential benefits, and limitations of telemedicine. Another key finding from our study is that telemedicine needs to be easy to use to maintain patient satisfaction and increase their perception of the technology's usefulness. Therefore, platform providers need to design concise and intuitive user interfaces (Noceda et al., 2023; Rajkumar et al., 2023).

4.3 Limitations and suggestions for future research

As for most scientific research, several methodological limitations need to be addressed. First, while this study's sample size was considerably large to derive statistical conclusions, the sample population is not comparable to the population structure based on age and sex in Germany. Female participants accounted for around 60.8% of responses. The predominance of women is also found in other healthcare technology studies (Falgarone et al., 2022; Imlach et al., 2020; Lee & Cho, 2017; Yan, Filieri, Ragusco, & Gortin, 2021). In the context of telemedicine, research so far has not examined the role of gender in continued usage behaviors of telemedicine. Future investigations may, therefore, assess the relevance of gender within the ECM concerning telemedicine use.

Additionally, 81.6% of respondents in this research were aged 30 years or younger. Hence, we cannot be certain whether this study's underlying theory and constructs are appropriate for explaining the continuance of the intentions of older telemedicine patients. To promote a paradigm shift in healthcare delivery models, insights into telemedicine usage behaviors of older patients are needed, which provides avenues for future research. Primarily, the role of social influence in promoting the continued use of older patients provides grounds for further research.

Due to the context-specific nature of this research, the generalizability of the findings may be limited. The sample population may not represent the target population interested in utilizing healthcare technologies such as telemedicine as an alternative to on-site healthcare treatment. This study discusses telemedicine in general. With the growing variety of telemedicine services (e.g., teleconsultations, telemonitoring, etc.), it is plausible that user behavior changes according to the application/ service used. Technology defines use contexts. So, other telemedicine technologies are worth investigating. Based on patients' specific treatment needs (e.g., cardiovascular diseases, diabetes, etc.) and corresponding treatment offers, results on the evaluation of continuing to use telemedicine may differ. Future research may investigate

specific medical needs that can be treated via telemedical services to promote the paradigm shift in healthcare delivery.

5. Conclusion

The present study employs an integrated research model based on the expectation-confirmation model (ECM), perceived ease of use, and social norm to comprehend why patients continue using telemedicine in the aftermath of COVID-19 in Germany. Hence, our findings offer new perspectives and insights into the potential of telemedicine as a vital alternative to on-site healthcare delivery. Our findings show that telemedicine's usefulness is especially central to promoting a paradigm shift of healthcare delivery models toward digital solutions. We highlight the role of social influence, particularly for older patients, to encourage the continued use of telemedicine and other healthcare technologies. Utilitarian and easy-to-use user interfaces of telemedicine platforms provide grounds for improved and efficient treatment options in the future, not just during a health crisis.

Appendix

Additional file 1: Appendix A. Questionnaire design and measurement constructs.

Questionnaire introduction:

Dear participant,

We are pleased that you are willing to participate!

Healthcare via telemedicine offerings has become more critical for patients, physicians, and companies due to the coronavirus pandemic. Telemedicine offerings include various digitally supported examination and treatment options, which will be explained in detail during the study. In the course of the study at the University of Bayreuth, we want to take a closer look at this topic.

We will ask about your experiences and opinions on telemedicine and video consultations with a doctor.

The duration of the survey is about 9 minutes.

Your answers are subjective assessments; therefore, there are no right or wrong answers. Please read the answer choices carefully; we have built-in quality checks!

All data collected will be kept strictly confidential. Data collection, processing, and use are anonymized so that no conclusions can be drawn about individual persons. The information collected will only be collected and used for the purpose of this research project.

Thank you very much for your participation!

Contact: Chair of Marketing and Innovation University of Bayreuth Universitätsstraße 30 95447 Bayreuth, Germany

Explanation:

Please read the following text carefully!

Telemedicine services allow audiovisual communication technologies (e.g., smartphones/computers) to offer diagnostics, consultations, and medical emergency services despite physical separation. These services can be provided by the general practitioner or online platforms (e.g., ZAVA, Kry, TeleClinic) and run analogously to an examination in an on-site practice. This means that in video consultations, patients are always attended to by a trained physician, with the difference that the physician and patient are physically separated and communicate via smartphone, tablet, or laptop.

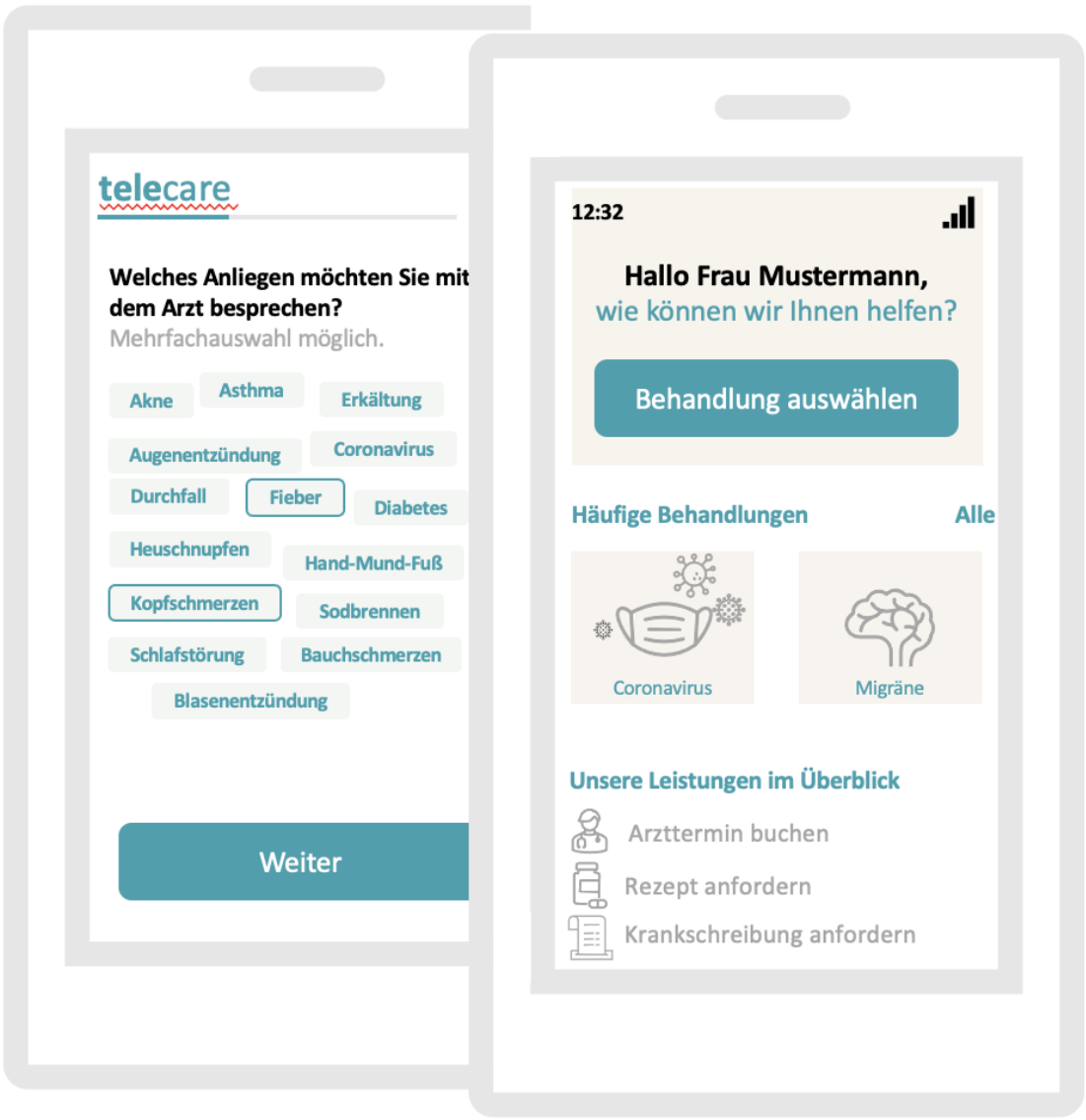
Telemedicine services include, but are not limited to:

- Booking and conducting a video consultation with a physician for various symptoms, annual checkups, preventive care, or chronic conditions.
- Obtaining initial and follow-up prescriptions online. In some cases, this requires a video consultation with a physician. In the case of follow-up prescriptions, the consultation may not be necessary.
- The use of digital health applications (DiGAs). These are apps or Internet-based offerings such as electronic diaries (e.g., diabetes diary), diagnostic and therapy software (e.g., back training), or online therapy programs (e.g., depression).

Introductionary questions (display logic not specified here):

1. Have you already used a telemedical service (e.g., a video consultation with a doctor or an online initial or follow-up prescription request)?
2. Did you find the implementation easy? Were there any problems?
3. How often have you used telemedicine services in the last six months?
4. Which of the following offers have you already used? (Multiple answers possible)
   - Video consultation with a physician for current symptoms (e.g., gastrointestinal, cold, etc.)
   - Video consultation with a physician for chronic diseases (e.g., heart disease)
   - Use of digital health apps. If yes, which ones?
   - Other (6) _____
   - Initial or follow-up prescription obtained online (8).
   - Preventive medical checkups (9)
5. What has kept you from using telemedicine services in the past?
6. Can you imagine using telemedicine services for yourself in the future?

Case:



Please read the following text carefully. This text is an example of how a telemedicine treatment can run.

You can see above how a telemedicine platform (from your primary care physician or a third-party provider) can look and be used. Imagine you have a fever and a headache. You have called your usual primary care physician's office, but they indicate a full waiting room and no available appointments for the day. You are advised to book a doctor's appointment via video consultation to diagnose your complaints and symptoms.

You book an appointment for a video consultation with a doctor for the same day. To do this, you have selected your symptoms and a free appointment slot on the platform and provided your contact details. An appointment is available just 15 minutes after what you book. You

connect to a secure video conference from your sofa. The appointment starts on time, and your doctor appears on the screen (e.g., smartphone, tablet, or laptop). The attending physician takes note of your symptoms and asks you questions about your current general situation, pre-existing conditions, and medications you are taking. Your doctor diagnoses you with flu, issues a prescription to treat your symptoms, and sends you a sick note for your employer, which you receive in real-time via mail or on your installed app.

Main part of the questionnaire:

Construct		*Measurement items*	*Source*
Expectation Confirmation (EC)	EC1	My experience with telemedicine was better than I originally expected.	(Bhattacherjee, 2001; Grenier Ouimet et al., 2020)
	EC2	The use of telemedicine has given me more benefits than originally anticipated.	
	EC3	In general, my initial expectations related to using telemedicine have been met.	
Perceived Usefulness (PU)	PU1	Telemedicine allows me to quickly resolve one or more health issues for me or my partner and my child(ren).	(Davis, 1989; Grenier Ouimet et al., 2020; Lee, 2010)
	PU2	Using telemedicine saves me a lot of time (e.g., waiting in the emergency room, the medical clinic, the pharmacy...).	
	PU3	Using telemedicine meets my health needs.	
	PU4	In general, using telemedicine has proven very useful in my life.	
Perceived Ease of Use (PEOU)	PEOU1	Learning to use teleconsultation was easy for me.	(Davis, 1989; Grenier Ouimet et al., 2020; Lee, 2010)
	PEOU2	Telemedicine platforms are easy to master.	
	PEOU3	Overall, I find telemedicine is easy to use.	
	PEOU4	In general, the use of telemedicine has proven to be very useful in my life.	
Social Norm (SN)	SN1	People important to me support my use of teleconsultation.	(Lee, 2010)
	SN2	People who influence me think that I should use teleconsultation.	
	SN3	People whose opinions I value prefer that I should use teleconsultation.	
Satisfaction (SF)	SATIS1	I was satisfied with the performance of teleconsultation.	(Bhattacherjee, 2001; Lee, 2010)
	SATIS2	I was pleased with the experience of using teleconsultation.	
	SATIS3	My decision to use teleconsultation was a wise one.	
Continuance Intention (CONI)	CONI1	I plan to continue using teleconsultation platforms to ensure my health or that of my partner and my child(ren).	(Davis, 1989; Grenier Ouimet et al., 2020; Lee, 2010)
	CONI2	I do not want to stop using teleconsultation platforms.	
	CONI3	I will use teleconsultation on a regular basis in the future.	

Final part of the questionnaire:

i. Age
= Please enter your age:

ii. Sex
= Please indicate your gender:

- Diverse
- Male
- Female

iii. Occupation
= What is your current occupation?

- Student
- Apprentice
- Student
- Working part-time
- Working full-time
- Unemployed

iv. Education level
= What is your most recent degree?

- High school diploma
- Bachelor's degree
- Master's degree or higher
- Other

v. Monthly Income
= What is your net monthly income?

- ≤ 1000 Euros
- 1001 - 2000 Euros
- 2001 - 3000 Euros
- ≥ 3001 Euros
- Not specified

Additional file 1: Appendix B. Assessment of measurement scales.

	Counts (N = 464)		Counts (N = 151)	
	Mean	SD	Mean	SD
EC	3.87	.80	3.98	.80
PU	3.75	.84	3.96	.78
PEOU	3.93	.82	4.29	.65
SN	3.03	.65	3.17	.60
SATIS	3.87	.86	4.26	.78
CONI	3.77	1.01	4.06	.93

Additional file 1: Appendix C. Fornell-Larcker evaluation.

	EC	PU	PEOU	SN	SATIS	CONI
EC	**.762**					
PU	.664.	**.742**				
PEOU	.597	.626	**.774**			
SN	.258	.374	.312	**.844**		
SATIS	.672	.687	.686	.334	**.865**	
CONI	.538	.692	.532	.464	.613	**.865**

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2.2 Research Paper No. 2: The role of self-determination theory in explaining patients' motivation to continue using telemedicine in a post-pandemic world

Abstract

COVID-19 has led to a considerable increase in telemedicine use by physicians and patients. However, usage is expected to decline post-pandemic despite the benefits in terms of convenience, reachability, accessibility, and cost. We are investigating antidotes to this supposed decline from the patient's perspective: Which psychological needs and motivations may increase the patient's satisfaction with telemedicine and their continuance intention? Our research combines the well-known expectation-confirmation model (ECM) from satisfaction research with motivation antecedents and outcomes according to self-determination theory (SDT). We developed and shared a self-administered questionnaire in online health communities. A patient sample (n=464) participated in the survey. A subsample (n=151) had experiences with medical teleconsultation or similar medical applications, whereas other patients (n=313) had teleconsultations in administration, business, or education only. Overall, both subsamples reveal almost the same results. Perceived usefulness (e.g., time-saving and quick access to healthcare treatment) is the most important continuance intention predictor. However, psychological needs from SDT (e.g., perceived competence and perceived relatedness) also determine motivation, satisfaction, and continuance intention. The combination of ECM and SDT appears to lay the foundation for improved research for digitalized healthcare delivery. Further, both subsamples demonstrate high satisfaction with telemedicine. Nevertheless, telemedicine providers and marketers should carefully optimize the patient journey while minimizing patient waiting time and focus on understanding users' health needs to differentiate their services in the market.

Keywords: Continuance intention, expectation-confirmation model (ECM), intrinsic motivation, psychological needs, self-determination theory (SDT), telemedicine

1. Introduction

Telemedicine – the provision of medical services at a distance – has a long tradition in medicine, telecommunication, and health economics. It is reported that the inventor of the first practical telephone, Alexander Graham Bell, was also the first to seek help from a doctor via phone in 1876 (Fatehi & Wootton, 2012). Nowadays, telemedicine, telehealth, and eHealth are widespread umbrella terms that, in addition to medical teleconsultation, also include remote

medical monitoring, remote health applications, and related administration, business, and education services (Ndwabe et al., 2024).

Because telemedicine reduces the risk of infection through personal contact, the COVID-19 pandemic pressured policymakers to repeal telemedicine regulations for service providers, physicians, and patients. These activities helped to accelerate teleconsultation adoption (Baudier et al., 2021; 2023; Chauhan et al., 2022; Pang et al., 2022). So, Bitkom e.V., the association of the German information and telecommunications industry, reports that the share of 16-year-old and older Germans that already consulted a physician via the internet increased from 13% in 2020 to 22% in 2023 (Bitcom Research, 2023). Accordingly, major reasons for this use were time-saving compared to visiting a physician (51% of the respondents, multiple answers allowed), convenience (38%), no personal appointment possible (31%), outside office hours (21%), the need of a specialist (16%), and curiosity (12%).Anthony Jr. (2021), Cobelli et al. (2023), and Sims (2018) support this observation by showing that medical teleconsultation enables efficient healthcare at reduced costs. There are many recent studies focusing on the number of first-time telemedicine users, all of which are seeing an increase during the pandemic (An et al., 2021; Chauhan et al., 2022; Kamal et al., 2020; Zobair et al. 2019). On the other side, studies on repeat users and uses (post-adoption behavior) are rare and have mixed results (Cho et al., 2014; Wang et al., 2021a).

However, especially for information and communication systems (e.g., online shops, streaming platforms, social networks but also telemedicine), the number of first-time users is less important than the number of repeat users. Due to so-called network effects or demand-side economies of scale, benefits for service providers, physicians, and patients depend on this use continuation (Ambalov, 2018; Bhattacherjee, 2001; Franque et al., 2021). Many healthcare technologies had high numbers of first-time users (purchase, download, installation, initial use), but due to high abandonment rates their offers had to be stopped (Ahmad et al., 2020; Amin et al., 2022; Bao and Lee, 2023; Luo et al., 2023). So, recently, the service providers Kry and Zava abandoned their teleconsultation offers in Germany due to few repeat users despite a promising start (Borsch, 2022). For telemedicine, the implication is that the lack of literature on post-adoption behavior is concerning (Amin et al., 2022) and makes it important to examine factors that influence continuance intention. It remains questionable whether the momentum of telemedicine caused by the recent upsurge of first-time users will lead to a paradigm shift in healthcare delivery or whether patients will abandon its use in the post-pandemic era.

To fill this research gap, this study focuses on patients' telemedicine use continuance intention (i.e., post-adoption behavior). Similar to existing research in information systems on use continuance we adopt the core variables from Bhattacherjee's (2001) variant of Oliver's (1980) well-known expectation-confirmation model (ECM) that has been well researched and validated for various technologies (Chow & Shi, 2014). Yet, it has been criticized for overlooking the role of users' motivation in use continuance (Sørebø et al., 2009; Thong et al., 2006). Here, motivation may determine continuance intention more precisely, even more than, e.g., patients' demographics. Consequently, previous research for other technologies has extended the original ECM with various factors (Nabavi et al., 2016), such as perceived ease of use (Cho, 2016) or social influence (Lee, 2010). However, only few studies have focused on the psychological factors that may explain use continuance intention of healthcare technologies (Yan et al., 2021) and none have considered motivational aspects influencing continued telemedicine use in the aftermath of COVID-19. Hence, this research fills this gap in the literature by analyzing continuance intention and motivational aspects in a non-pandemic situation. As our contribution, we innovatively complement ECM with the theoretical perspective of self-determination theory (SDT) (Deci & Ryan, 2000; Ntoumanis et al., 2021; Ryan & Deci, 2017), an approach that has previously been neglected in marketing (Gilal et al., 2019). By this, we aim to explain how psychological factors influence patients' satisfaction with telemedicine and their continuance intention in the aftermath of COVID-19. SDT pertains to basic need fulfillment and the development of intrinsic motivation, even though it also includes extrinsic motivation. ECM and SDT have common (i.e., extrinsic motivation) and distinct constructs (e.g., basic needs in SDT). Hence, these two approaches can be understood as complementary to each other. We empirically test our developed model combination by surveying German-speaking patients. The present study hence contributes to literature by validating Bhattacherjee's (2001) ECM variant and complementing it with SDT.

The rest of the paper is structured as follows: The next section briefly reviews the literature on ECM and SDT. Our research model, as well as the developed hypotheses, are then presented. After a discussion of our data collection and the results of our empirical study, the managerial and theoretical contributions are summarized, followed by a discussion of the limitations of our study as well as managerial implications, a research outlook, and concluding remarks.

2. Literature Review

2.1 Expectation-confirmation model (ECM)

The understanding of consumer satisfaction, its antecedents, and its effects is crucial in consumer marketing. Many investigations have validated its assumed link to customer loyalty and firm performance (see, e.g., Anderson et al., 1994; Gruca & Rego, 2005; Homburg et al., 2009; Lim et al., 2020; Oliver, 2010; Rego et al., 2013). Consequently, investigations by researchers and practitioners that are based on Anderson's (1973) Confirmation/Disconfirmation Paradigm as well as Oliver's (1980) expectation-confirmation model (ECM) are widespread (Fournier & Mick, 1999; Homburg et al., 2009; Woodruff et al., 1983; Yi, 1990). In these modeling and measurement approaches, consumer satisfaction is conceptualized as an attitude-like judgment that reflects product comparisons with pre-consumptive expectations after initial or repeated product uses (Oliver, 2010; Woodruff et al., 1983).

In order to support his proposed relations between expectancy confirmation, satisfaction, and future use intention, Oliver (1980) performed a two-stage field study on a flu vaccination program: Residents of a small town received a first questionnaire before the start of a flu season. Pre-exposure expectation, attitude, and vaccination intention were measured using single- and multi-item scales. After the flu season, vaccinated respondents received a second questionnaire measuring expectancy confirmation, satisfaction, attitude, and vaccination intention for future vaccination programs. Expectancy confirmation was measured on a "worse than expected – better than expected" single-item scale which proved superior over difference scores between measured expectation and measured performance (see, e.g., Prakash, 1984; Weaver & Brickman, 1974). Oliver (1980) applied structural equation modeling to the responses, an analysis that supported the assumed ECM relations. Woodruff et al. (1983) and many others confirmed and/or extended ECM in later years, e.g., by replacing the expectations with product-independent experienced-based norms or by modeling other consumer satisfaction outcomes such as future selling costs (Lim et al., 2020).

In information systems research, Bhattacherjee's (2001) ECM variant is well-known which makes it possible to predict the acceptance of a voluntary information system (e.g., an online shop, a search engine, a streaming platform) by consumers after a few initial uses. In contrast to Oliver (1980), Bhattacherjee (2001) focused on use continuance intention as outcome. Moreover, he explicitly integrated post-usage performance expectations ("perceived usefulness") besides attitude-like satisfaction as a continuance intention determinant

(Bhattacherjee et al., 2008). Nowadays, especially in information systems research, Bhattacherjee's (2001) ECM variant is widespread since it predicts especially continuance intention, a construct that is closely connected to customer acquisition and retention cost reduction (Hossain & Quaddus, 2012; Parthasarathy & Bhattacherjee, 1998).

However, recently, ECM and similar approaches that try to explain consumer's purchase/usage behavior (e.g., theory of planned behavior, model of goal-oriented behavior) have been criticized for neglecting intrinsic motivation (Gilal et al., 2019). To solve this problem, Gilal et al. (2019) proposed the integration of the so-called self-determination theory (SDT).

2.2 Self-determination theory (SDT)

Self-determination theory (SDT) was developed by Deci and Ryan in psychology during the 1970s and 1980s as a macro theory for understanding the motivational basis of personality and social behavior (Deci & Ryan, 1985). SDT proposes that intrinsic motivation leads to better outcomes than extrinsic motivation (Roca & Gagné, 2008; Ryan & Deci, 2017) and that intrinsic motivation is determined by innate psychological needs – the needs for autonomy, competence, and relatedness (Deci & Ryan, 2000; Gagné & Deci, 2005; Ryan & Deci, 2017). In contrast to many other approaches to human motivation and as an assumed major advantage, SDT postulates that varied forms of motivation exist that differently influence an individual's performance, engagement, or mental health (Deci & Ryan, 2000; Ryan & Deci, 2017). Table 1 (adapted from Deci & Ryan 2000) summarizes these varied forms of motivation along a continuum from amotivation (i.e., lack of motivation) to extrinsic (i.e. usefulness) and intrinsic motivation (i.e., genuine enjoyment). They postulate that this continuum is related to a behavioral continuum from fully non self-determined to fully self-determined.

Table 1. The self-determination continuum of behavior showing its motivational, self-regulatory, and perceived locus of causality bases (adapted from Deci and Ryan 2000).

Behavior	Fully non self-determined ……. Fully self-determined					
Type of motivation	Amotivation	Extrinsic motivation				Intrinsic motivation
Type of regulation	Non-regulation	External regulation	Introjected regulation	Identified regulation	Integrated regulation	Intrinsic regulation
Locus of causality	Impersonal	External	Somewhat external	Somewhat internal	Internal	Internal

The form of motivation depends on its locus of causality (on a continuum from impersonal to external and internal) and its internalization process (= regulation). Different variants of

regulating the causalities exist (Deci & Ryan, 2000; Ryan & Deci, 2017), ranging from external (e.g., avoiding punishment), introjected (e.g., maintaining pride), and identified (e.g., personal importance) to integrated (e.g., fully volitional or self-determined extrinsic motivation) (Deci & Ryan, 2000). In summary, intrinsic motivation and well-internalized extrinsic motivation (i.e., motivation based on identified or integrated regulation) are the building blocks for self-determined behavior and use intensity. As an antecedent, satisfaction of the three basic psychological needs is generally assumed to determine these motivational types and behavior, an assumption that has also been shown in the context of healthcare behavior (Hagger & Protogerou, 2020; Ntoumanis et al., 2021; Ryan & Deci, 2017).

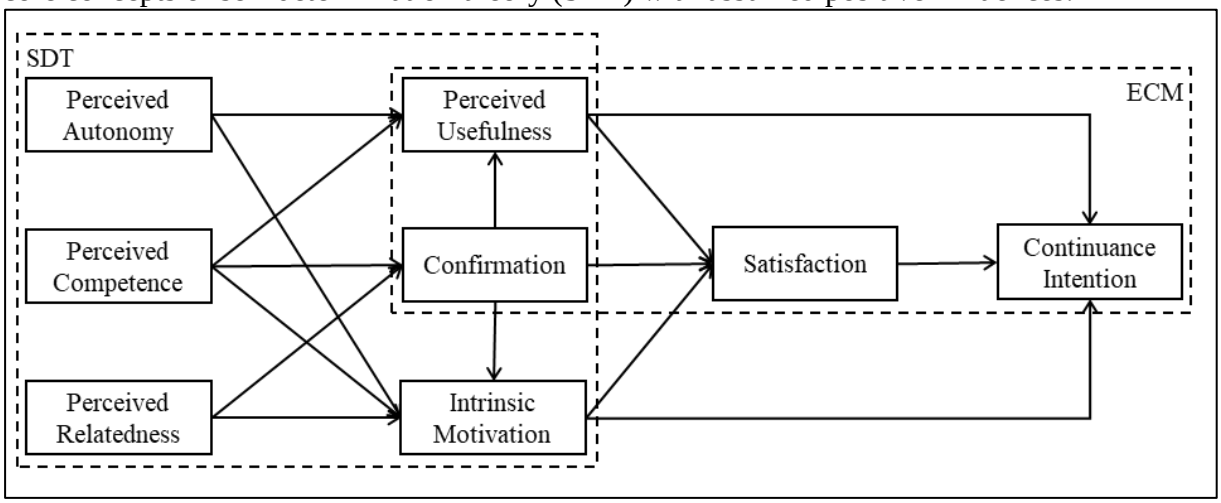
In education, organizations, sports and physical activity, religion, health and medicine, parenting, virtual environments and media, close relationships, and psychotherapy, SDT is a highly influential theory, whereas in marketing SDT has been ignored for a long time (Gilal et al., 2019). However, recently, SDT applications in branding, customer loyalty, online shopping, or tourism are piling up (see, e.g., Dholakia, 2006; Lin et al., 2009; Schepers et al., 2012) and further marketing applications have been proposed (Gilal et al., 2019).

3. Research Model and Hypotheses Development

3.1 Overview

Against the background of rapidly developing digital healthcare technologies and devices the examination regarding users' post-adoption behavior becomes increasingly important. Generally, analyzing initial acceptance is not sufficient in explaining viable use of any technology in the long term (Ambalov, 2018; Franque et al., 2021; Luo et al., 2023; Nabavi et al., 2016). Consequently, to explore patients' post-adoption behavior, we combine Bhattacherjee's (2001) variant of Oliver's (1980) ECM with Deci and Ryan's (1985) SDT in our research model. Figure 1 summarizes our combined research model, the common constructs, and its hypotheses. The construct intrinsic motivation reflects the SDT types of motivation from Table 1 as a continuum.

Figure 1. Research model that complements the expectation-confirmation model (ECM) with core concepts of self-determination theory (SDT) with assumed positive influences.



In brief, the ECM part of the model postulates that initial expectations are either confirmed or disconfirmed by use experience. Confirmation captures whether user experience surpasses or undergoes prior expectations. With use experience, perceptions about the technology's benefits are developed which either meet or do not meet expectations, measured by perceived usefulness. If expectations are met, satisfaction with the technology arises, which depends on confirmation and perceived usefulness. Finally, continuance intention develops with perceived usefulness and satisfaction (cf. continuance intention).

To enhance our understanding of factors affecting post-adoption behavior (i.e., use continuance intention) we further supplement our model with core concepts from SDT. Briefly, the SDT part of the model proposes that intrinsic motivation, compared to extrinsic motivation (additionally measured by perceived usefulness as discussed in Bhattacherjee et al., 2008), leads to better performance and persistence (Roca & Gagné, 2008; Ryan & Deci, 2017). Furthermore, intrinsic motivation and perceived usefulness are determined by the above-mentioned innate psychological needs – for autonomy, competence, and relatedness – which underly it (Gagné & Deci, 2005; Ryan & Deci, 2017). First, autonomy refers to volition or in other words the aspiration of self-initiating and self-regulating behavior. Second, competence relates to the aspiration to sense effectiveness in attaining valued outcomes, and, last, relatedness pertains to feeling connected with others. Consequently, intrinsic motivation arises with the satisfaction of these three needs. As such, these needs are considered a key predictor of personal development and well-being (Hagger & Protogerou, 2020).

3.2 SDT related hypotheses

Previous research classified perceived usefulness as one type of extrinsic motivation, which is consistent with the self-determination continuum (Roca & Gagné, 2008; Sørebø et al., 2009). In other words, perceived usefulness is akin to identified motivation. Accordingly, perceived autonomy is expected to enhance internalized forms of extrinsic motivation (i.e., perceived usefulness) and intrinsic motivation concerning technology use (Deci & Ryan, 2000; Ryan & Deci, 2017). Past findings confirm the relationship between perceived autonomy and extrinsic and intrinsic motivation respectively (Ntoumanis et al., 2021; Sørebø et al., 2009; Wang et al., 2021b). Therefore, we postulate:

H1. Patients' perceived autonomy when using telemedicine positively influences perceived usefulness.
H2. Patients' perceived autonomy when using telemedicine positively influences intrinsic motivation.

Drawing on SDT, users feel qualified to utilize a technology when the need for competence is fulfilled (Ryan & Deci, 2017). It seems plausible that the feeling of being qualified to use telemedicine may increase autonomous types of both, intrinsic and well internalized types of extrinsic motivation (i.e., perceived usefulness). The discrepancy between expectation and performance may be reduced as competence increases users' effective utilization of the technology. We thus assume expectation-confirmation to be influenced by perceived competence. This means, the higher the perceived competence of a patient when using telemedicine, the higher their expectancy confirmation. We therefore derive the following hypotheses:

H3. Patients' perceived competence when using telemedicine positively influences perceived usefulness.
H4. Patients' perceived competence when using telemedicine positively influences confirmation.
H5. Patients' perceived competence when using telemedicine positively influences intrinsic motivation.

Albeit the strong predictive power of perceived autonomy and perceived competence on motivation, prior research also confirms the significant influencing role of perceived relatedness (Ntoumanis et al., 2021). Here, perceived relatedness expresses a patient‘s desire to

be supported by medical staff. Perceived relatedness is assumed to influence autonomous types of motivation, both identified and intrinsic motivation. Based on the above, we hypothesize:

H6. Patients' perceived relatedness to medical staff when using telemedicine services positively influences perceived usefulness.
H7. Patients' perceived relatedness to medical staff when using telemedicine services positively influences intrinsic motivation.

3.3 ECM related hypotheses

Perceived usefulness is determined by the confirmation of initial expectations about a technology and has previously been conceptualized in an e-learning context as autonomous motivation concerning the use of such technologies (Roca & Gagné, 2008; Sørebø et al., 2009). It seems reasonable that patients' expectancy confirmation influences their motivation to use telemedicine. This implies that both perceived usefulness (i.e., identified regulation) and intrinsic motivation (i.e., true autonomous motivation) are influenced by confirmation. Based on the ECM, we expect that disconfirmed expectations concerning telemedicine may hamper use motivation and vice versa. If expectations are confirmed, satisfaction arises. Previous literature supports the confirmation-satisfaction association in the healthcare technology context (Amin et al., 2022; Wang & Cao, 2022; Yan et al., 2021). Therefore, we propose the following hypotheses:

H8. Patients' expectancy confirmation is positively related to their perceived usefulness of telemedicine.
H9. Patients' expectancy confirmation is positively related to their intrinsic motivation to use telemedicine.
H10. Patients' expectancy confirmation is positively related to their satisfaction with telemedicine.

Bhattacherjee's (2001) ECM variant emphasizes that perceived usefulness serves as a baseline to reference against corresponding confirmation (Bhattacherjee, 2001; Bhattacherjee et al., 2008; Franque et al., 2021). This, in turn, results in satisfaction (or dissatisfaction). Therefore, perceived usefulness also influences subsequent telemedicine continuance decisions, based on the perception of its benefits. This relationship has been confirmed by previous research concerning healthcare technologies (Grenier Ouimet et al., 2020; Kaium et al., 2020; Sims, 2018). Additionally, satisfaction is assumed to be a key determinant of continuance intention (Franque et al., 2021; Wang et al., 2022). This leads to the following hypotheses:

H11. Patients' perceived usefulness of telemedicine is positively related to their satisfaction with telemedicine.
H12. Patients' perceived usefulness of telemedicine is positively related to their intention to continue using telemedicine.
H13. Patients' satisfaction with telemedicine is positively associated with their intention to continue using telemedicine.

Satisfaction is more likely to arise when users enjoy the utilization of a technology (Lu et al., 2021). In the case of healthcare technologies, prior research seldom addresses the relationship between intrinsic motivation and post-adoption satisfaction (Wang et al., 2022). Nonetheless, findings in various other domains provide strong grounds for further investigations concerning this association (Hsu & Chiu, 2004; Sørebø et al., 2009). Intrinsic motivation to utilize telemedicine may affect patients' satisfaction with the technology. Based on SDT, we further propose that the likelihood to continue using a technology is higher when users are interested in its utilization (i.e., intrinsic motivation) which is supported by existing research (Davis et al., 1992; Lee et al., 2005). Therefore, we derive the following hypotheses:

H14. Patients' intrinsic motivation positively influences their satisfaction with telemedicine.
H15. Patients' intrinsic motivation is positively associated with their continuance intention to use telemedicine.

4. Methods

4.1 Data collection and descriptive statistics

Using Qualtrics (2023), an online questionnaire was employed to analyze the underlying constructs and their relations. The survey was conducted in German. Participants answered several introductory questions concerning their prior experiences with physicians and telemedicine and received introductory video presentations of medical teleconsultations. Only respondents who had sufficient contact with physicians (personal and/or virtual) and teleconsultations (medical or not) in the last year were allowed to participate in the survey. Then, items measuring the constructs of the research model (perceived autonomy, perceived competence, perceived relatedness, confirmation, intrinsic motivation, perceived usefulness, satisfaction, and continuance intention) were presented. Finally, participants' demographics (i.e., age, gender, income, employment status, education level, and place of residence) were collected. The survey was online during an eight-week period in Spring 2023 and was

advertised in online health communities. A total of n=464 valid questionnaires were collected from patients and considered for further analysis.

A respondent subsample (n=151, 32.3%) stated that they already had experience with medical teleconsultation and similar applications. These so-called "experienced users" (shortly: "exp.") were rather young: 74.8% of them were 21 to 30 years old. Only a small proportion of them were 41 years old or older (8.6%). None of them were older than 53 years. 64.2% of them were female. Nearly all of them (n=134, 88.7%) had used telemedicine applications in the past six months. Many of them (n=61, 40.4%) had used telemedicine applications at least twice in the last six months, some of them (n=21, 13.9%) even more than twice. The treatment of acute symptoms was mentioned most frequently in the subsample as the reason for a medical teleconsultation or similar applications (n=67, 44.4%).

The rest of the sample, the so-called "others", were patients with teleconsultation experience in administration, business, or education (n=313, 67.7%). Among them, 64.2% (n=185) were female. Age ranged from 15 to 77 years with a mean of 27.5 years. Most participants were between 21 and 30 years old (n=245, 78.3%). Furthermore, most "others" were students (n=199, 63.6%) with a monthly income up to 2,000 Euro (n=190). Moreover, the majority of participants' highest education level was a bachelor's degree (n=151, 48.2%). Across both samples, city dwellers constituted the largest proportion of the respondents (n=336, 72.4%). Table 2 summarizes the sociodemographic characteristics of respondents in both subsamples ("experienced users" and "others") and in the total sample.

Table 2. Sociodemographic characteristics of respondents in the total sample and both subsamples ("experienced users/exp." and "others").

Demographics/ Characteristics	*Specifications*	*Counts (Proportion) n=464 All*	*Counts (Proportion) n=151 Exp.*	*Counts (Proportion) n=313 Others*
Age	≤ 20 years	20 (4.3%)	6 (4.0%)	14 (4.5%)
	21 – 30 years	358 (77.2%)	113 (74.8%)	245 (78.3%)
	31 – 40 years	44 (9.5%)	19 (12.6%)	25 (8.0%)
	41 – 50 years	23 (5.0%)	10 (6.6%)	13 (4.2%)
	51 – 60 years	11 (2.4%)	2 (1.3%)	9 (2.9%)
	> 60 years	4 (0.9%)	0 (0.0%)	4 (1.3%)
	No response	4 (0.9%)	1 (0.7%)	3 (1.0%)
Gender	Female	282 (60.8%)	97 (64.2%)	185 (59.1%)
	Male	177 (38.1%)	54 (35.8%)	123 (39.3%)
	Divers	5 (1.1%)	0 (0.0%)	5 (1.6%)
Monthly net income	< 1,000 €	132 (28.4%)	33 (21.9%)	99 (31.6%)
	1,001 – 2,000 €	145 (31.3%)	54 (35.8%)	91 (29.1%)
	2,001 – 3,000 €	66 (14.2%)	28 (18.5%)	38 (12.1%)
	> 3,000 €	66 (14.2%)	24 (15.9%)	42 (13.4%)
	No response	55 (11.9%)	12 (7.9%)	43 (13.7%)

Demographics/ Characteristics	*Specifications*	*Counts (Proportion) n=464 All*	*Counts (Proportion) n=151 Exp.*	*Counts (Proportion) n=313 Others*
Employment status	Employed full-time	110 (23.7%)	42 (27.8%)	68 (21.7%)
	Employed part-time	61 (13.1%)	25 (16.6%)	36 (11.5%)
	Pupil	6 (1.3%)	1 (0.7%)	5 (1.6%)
	Student	280 (60.3%)	81 (53.6%)	199 (63.6%)
	Apprentice	4 (0.9%)	2 (1.3%)	2 (0.6%)
	No response	3 (0.6%)	0 (0.0%)	3 (0.6%)
Education	High school graduate	127 (27.4%)	39 (25.8%)	88 (28.1%)
	Bachelor's degree	221 (47.6%)	70 (46.4%)	151 (48.2%)
	Master's degree or higher	86 (18.5%)	34 (22.5%)	52 (16.6%)
	Other	28 (6.0%)	8 (5.3%)	20 (6.4%)
	No response	2 (0.4%)	0 (0.0%)	2 (0.6%)
Place of residence	City	336 (72.4%)	118 (78.1%)	218 (69.6%)
	Suburban	58 (12.5%)	15 (9.9%)	43 (13.7%)
	Rural	66 (14.2%)	18 (11.9%)	48 (15.3%)
	No response	4 (0.9%)	0 (0.0%)	4 (1.3%)

4.2 Items and constructs

All constructs were measured on five-point multi-item Likert scales (1="Strongly disagree" to 5="Strongly agree"). We derived the underlying items from validated scales in the literature (see Table 3). Based on the maturity of both, ECM and SDT research, the study at hand benefits from previous empirical validations. Therefore, item validity and reliability are ensured.

Table 3. Assessment of convergent validity and internal consistency reliability.

Construct; references for items	*Items*	*FL*	*Cron-bach's α*	*CR*	*AVE*	*Mean (SD) n=464 All*	*Mean (SD) n=151 Exp.*	*Mean (SD) n=313 Others*
Perceived autonomy Chatzisarantis et al., 2008; Sørebø et al., 2009	I feel like I can choose how I use telemedicine services for my health (PA1).	.824	.687	.827	.615	3.503 (.832)	3.618 (.837)	3.447 (.825)
	I feel that I can use telemedicine services for my health as I choose (PA2).	.777						
	My social environment (family, friends, colleagues) gives me confidence in my ability to use telemedicine services (PA3).	.749						
Perceived competence Sørebø et al., 2009; Williams et al., 1998	My social environment (family, friends, colleagues) tells me that I can incorporate telemedicine services well in everyday life (PC1).	.607	.633	.798	.574	3.631 (.746)	3.899 (.661)	3.502 (752)
	Most of the time, I feel I am in good hands with telemedicine services (e.g., video cons.) (PC3).	.855						
	I feel confident in my ability to use telemedicine-ne services (e.g., booking a video cons.) (PC4).	.789						
Perceived relatedness La Guardia et al., 2000; Vlachopoulos & Michailidou, 2006	When using telemedicine services, I felt that I interacted with the medical staff in a very friendly manner (PR1).	.867	.912	.938	.791	3.676 (.823)	3.987 (.819)	3.526 (.783)
	When using telemedicine services, I have felt very comfortable with the medical staff assigned to me (PR2).	.903						
	The medical staff took good care of me during my use of telemedicine services (PR3).	.906						

Construct; references for items	*Items*	*FL*	*Cron-bach's α*	*CR*	*AVE*	*Mean (SD) n=464 All*	*Mean (SD) n=151 Exp.*	*Mean (SD) n=313 Others*
	The medical staff was generally very friendly to me during my use of telemedicine services (PR4).	.878						
Confirmation Bhattacherjee, 2001; Grenier Ouimet et al., 2020	My experience with telemedicine was better than I originally expected (EC1).	.859	.796	.880	.711	3.784 (.801)	3.982 (.796)	3.688 (.786)
	The use of telemedicine has given me more benefits than originally anticipated (EC2).	.879						
	In general, my initial expectations related to using telemedicine have been met (EC3).	.789						
Perceived usefulness Davis, 1989; Grenier Ouimet et al., 2020; Lee, 2010	Telemedicine allows me to quickly resolve one or more health issues for me (PU1).	.833	.819	.881	.649	3.883 (.795)	4.070 (.731)	3.792 (.810)
	Using telemedicine saves me a lot of time (PU2).	.778						
	Using telemedicine meets my health needs (PU3).	.772						
	In general, using telemedicine has proven very useful in my life (PU4).	.837						
Intrinsic motivation Lin et al. 2009; Sørebø et al. 2009; Wang et al. 2021b	The telemedical service (e.g., use of a digital health application) was interesting (IM1).	.822	.836	.901	.753	3.678 (.869)	3.967 (.774)	3.539 (.879)
	I like using the telemedical service (IM2).	.889						
	The telemedical service I have used helps me manage my health (IM3).	.891						
Satisfaction Bhattacherjee, 2001; Lee, 2010	I was satisfied with the performance of telec. (SF1).	.912	.899	.937	.832	3.866 (.858)	4.256 (.780)	3.677 (.831)
	I was pleased with the experience of using telec. (SF2).	.910						
	My decision to use telec. was a wise one (SF3).	.915						
Continuance intention Grenier Ouimet et al., 2020; Lee, 2010	I plan to continue using telec. platforms to ensure my health or that of my partner and my child(ren) (CI1).	.923	.899	.937	.832	3.771 (1.011)	4.064 (.939)	3.629 (1.015)
	I do not want to stop using telec. platforms (CI2).	.910						
	I will use telec. on a regular basis in future (CI3).	.964						

Notes: (All: all respondents, Exp.: subsample of experienced users, AVE: average variance extracted, CR: composite reliability, Mean: from 1="Strongly disagree" to 5="Strongly agree", FL: Factor loading, SD: Standard deviation, telec.=teleconsultation).

5. Empirical Results

5.1 Bias test results

Due to the intrinsic limitations of survey research, biases related to the perceptual nature of the measured constructs may exist in this research. A frequent phenomenon in connection with self-administered questionnaires refers to common method bias (i.e., the overestimation of relationships between variables). To appraise common method bias, we used Harman's single-factor approach (Podsakoff et al., 2003). Here, results indicate that the first factor represents 43.77% of the total variance, which is below the recommended threshold of 50%. Therefore, we did not detect any moderate to high levels of common method bias within our study.

5.2 Measurement model evaluation

First, we assessed the underlying constructs. Across the whole sample, means ranged from 3.503 (for perceived autonomy) to 3.883 (for perceived usefulness). The subsample of experienced users demonstrated high satisfaction (mean = 4.256, SD = .780). The continuance intention demonstrated for them to be lower than satisfaction (mean = 4.064, SD = .939) but still was high (see Table 3). Intrinsic motivation in the "others" subsample (mean = 3.539, SD = .879) deviated notably from the experienced users (mean = 3.967, SD = .774). Generally, participants have responded positively concerning psychological needs as well as ECM constructs, which indicates the model applied in the study is appropriate.

To analyze the underlying data, structural equation modeling was applied based on SmartPLS 4.1 (Ringle et al., 2022) and SPSS 29.0 (IBM, 2023). All constructs were measured with reflective items, as discussed in the previous section (Table 3). One item for the construct perceived competence ("I was able to learn interesting new skills by using telemedicine services/platforms (PC2).") had to be dropped due to a very low standardized factor loading (.446). After this elimination, the values for Cronbach's α and composite reliability (CR) exceeded the recommended threshold of ≥ .60 (Cronbach, 1951; Mohamad et al., 2015) (see Table 3). To determine convergent validity, again, standardized factor loadings were reviewed. Now, besides item PC1 with .607, all standardized factor loadings were larger or equal to .749 and so exceeded the threshold of .65 (Hair et al., 2010). Concerning PC1, Cheung et al. 2023 state that past research proposed differing rules for evaluating the magnitude of standardized factor loadings. While Hair et al. (2010) argue that standardized factor loadings should be larger or equal .50, Stevens, 2001 even recommends standardized factor loadings to be larger or equal .40 for interpretation purposes. Moreover, average variance extracted (AVE) was checked. AVE values should exceed the threshold of .50 (Fornell and Larcker, 1981). In this study, AVE values were higher than the recommended threshold (see Table 3), and convergent validity was established.

Next, discriminant validity was checked. Heterotrait-monotrait ratio (HTMT) was employed for analysis, results are displayed in Table 4. Besides two pairings with a slightly higher value of .854 (perceived usefulness and confirmation) and of .857 (perceived autonomy and perceived competence), all other pairings pass the conservative threshold of < .85 (Henseler et al., 2015). Additionally, Table 4 shows bootstrapping results with respect to HTMT. Since the upper limits of the confidence intervals are clearly below 1.0 for all pairings, we confirm that discriminant validity has been established.

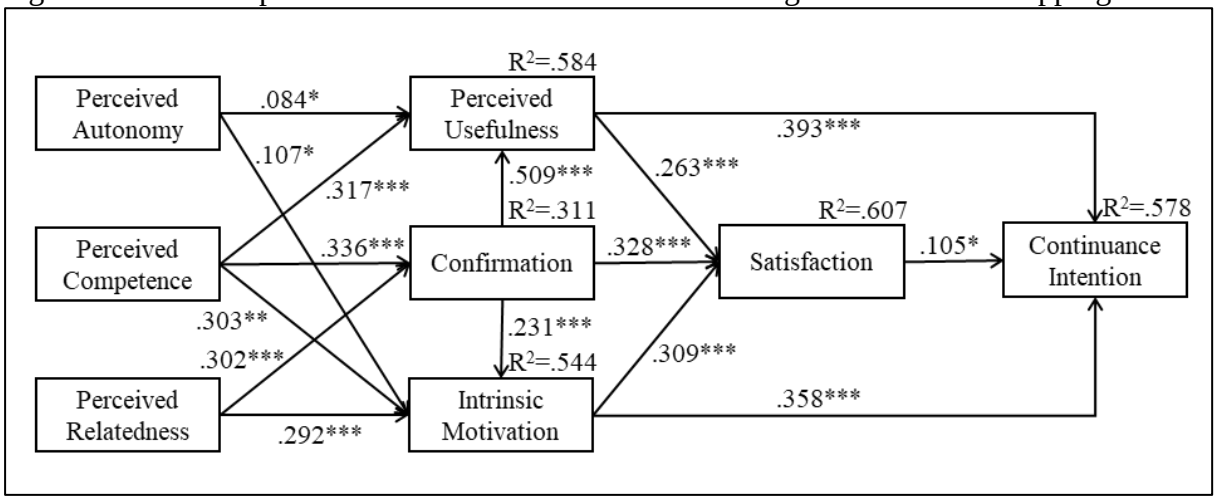
Table 4. Assessment of discriminant validity: Heterotrait-monotrait ratio (HTMT) across all pairs of constructs after bootstrapping with sample means values and 95% confidence intervals.

	Perceived Autonomy	Perceived Competence	Perceived Relatedness	Confirmation	Intrinsic Motivation	Perceived Usefulness	Satisfaction
Perceived Competence	.857 [.744; .967]						
Perceived Relatedness	.485 [.352; .607]	.650 [.530; .759]					
Confirmation	.425 [.296; .552]	.651 [.553; .747]	.560 [.468; .641]				
Intrinsic Motivation	.608 [.476; .732]	.847 [.768; .925]	.684 [.590; .767]	.676 [.588; .757]			
Perceived Usefulness	.560 [.444; .671]	.815 [.727; .897]	.581 [.486; .666]	.854 [.793; .909]	.757 [.679; .827]		
Satisfaction	.503 [.376; .620]	.781 [.694; .860]	.700 [.620; .770]	.806 [.735; .870]	.753 [.683; .814]	.791 [.724; .851]	
Continuance Intention	.578 [.461; .684]	.843 [.774; .909]	.535 [.451; .612]	.644 [.561; .724]	.774 [.713; .828]	.802 [.746; .853]	.678 [.607; .745]

5.3 Structural model evaluation across all respondents

Moving on to evaluating the structural model, variance inflation factors (VIFs) were checked. Their values range from 1.329 to 2.321 and, therefore, the conservative threshold of 3 for absence of collinearity issues (Kock & Lynn, 2012) and the threshold of 3.3 for common method bias. Next, R^2 (adjusted R^2) values were examined, exhibiting .311 (.308) for confirmation, .584 (.581) for perceived usefulness, .544 (.540) for intrinsic motivation, .607 (.604) for satisfaction, and .578 (.575) for continuance intention. Overall, in-sample predictive power can be considered moderate (Hair et al., 2019).

Figure 2. Estimated path coefficients in our research model together with bootstrapping results.



Notes: ***: significant at the .001 level, **: at the .01 level, *: at the .05 level.

Concerning the proposed ECM and SDT relationships, statistical significance could be established using the usual bootstrapping procedure with respect to all hypotheses at the .05 level and nearly all at the .001 level (see Figure 2 and Table 5).

Table 5. Hypotheses tests and bootstrapping results.

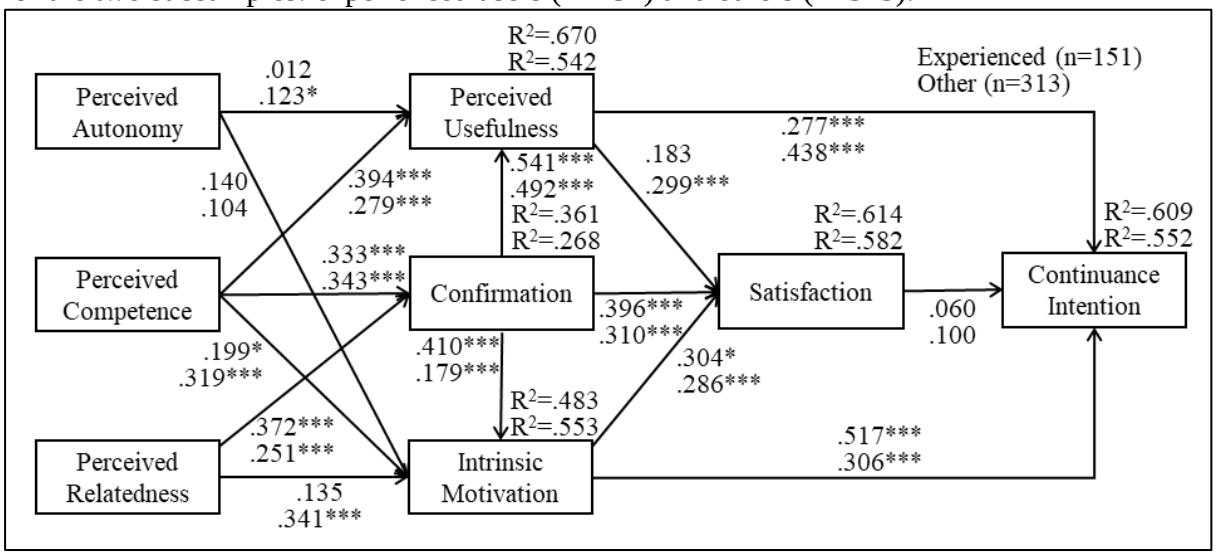
Hypo-thesis	*Path*	*Path coefficient (effect size f^2)*	*Confidence interval (95%)*	*t-statistic (p-value)*
H1	Perceived autonomy → Perceived usefulness	.084 (.012)	[.008, .163]	2.127 (.033)
H2	Perceived autonomy → Intrinsic motivation	.107 (.017)	[.007, .207]	2.127 (.033)
H3	Perceived competence → Perceived usefulness	.317 (.141)	[.225, .409]	6.819 (.000)
H4	Perceived competence → Confirmation	.336 (.097)	[.248, .427]	7.314 (.000)
H5	Perceived competence → Intrinsic motivation	.303 (.108)	[.193, .403]	5.679 (.000)
H6	Perceived relatedness → Confirmation	.302 (.097)	[.209, .393]	6.424 (.000)
H7	Perceived relatedness → Intrinsic motivation	.292 (.123)	[.193, .398]	5.606 (.000)
H8	Confirmation → Perceived usefulness	.509 (.468)	[.433, .579]	13.732 (.000)
H9	Confirmation → Intrinsic motivation	.231 (.081)	[.144, .312]	5.426 (.000)
H10	Confirmation → Satisfaction	.328 (.136)	[.229, .434]	6.815 (.000)
H11	Perceived usefulness → Satisfaction	.263 (.076)	[.164, .359]	5.276 (.000)
H12	Perceived usefulness → Continuance intention	.393 (.173)	[.304, .478]	8.821 (.000)
H13	Satisfaction → Continuance intention	.105 (.012)	[.009, .201]	2.171 (.030)
H14	Intrinsic motivation → Satisfaction	.309 (.139)	[.213, .401]	6.547 (.000)
H15	Intrinsic motivation → Continuance intention	.358 (.153)	[.274, .441]	8.311 (.000)

Notes: Confidence regions are given at the .05 level.

5.4 Structural model evaluation across the subsamples of experienced users and others

To compare our results across the two subsamples, the experienced users (n=151) and the others (n=313), we applied the nonparametric confidence set approach for multigroup analysis as proposed by Sarstedt et al. (2011): In a first step, PLS path modeling is applied separately for each group followed by a bootstrap procedure as discussed in section 5.3. Figure 3 shows the estimated path coefficients for both subsamples, again together with bootstrapping results.

Figure 3. Estimated path coefficients in our research model together with bootstrapping results for the two subsamples: experienced users (n=151) and others (n=313).



Notes: ***: significant at the .001 level, **: at the .01 level, *: at the .05 level.

Then, in a second step, bias-corrected 95%-bootstrap confidence intervals for the path coefficients of both subsamples are calculated and compared between the subsamples. If there is no overlap between the two intervals, one can assume that group-specific path coefficients are significantly different (Sarstedt et al., 2011). The procedure is implemented in SmartPLS 4.1 and shows here that most path coefficients are similar but four are significantly different: The influence of perceived competence and perceived relatedness on intrinsic motivation as well as the influence of perceived usefulness and intrinsic motivation on satisfaction are stronger for the subsample of others than for the subsample of experienced users. Moreover, Figure 3 shows that these four influences are significant at the .001 level for the subsample of others, whereas not for the subsample of experienced users. Since the subsample of others has had, up to now, no contact with medical teleconsultation (only for administration, business, or education purposes), we attribute these differences to the lower construct values according to Table 3 that may also reflect a perceived inability to judge satisfaction.

6. Discussion

6.1 Principal findings

The present research has examined how psychological needs influence the motivation to continue using telemedicine in the aftermath of COVID-19. Previous research has focused on the acceptance of telemedicine (Baudier et al., 2021; Kamal et al., 2020; Kim & Han, 2023; Ong et al., 2022). The scarcity concerning research on telemedicine continuance behavior is troubling; the discontinued use of medical services at a distance represents a loss of opportunities to provide comprehensive, cost- and time-efficient solutions of healthcare

delivery (Baudier et al., 2021; 2023; Cobelli et al., 2021). This makes the need for a paradigm shift ever more relevant. Additionally, telemedicine post-adoption behavior so far has been insufficiently researched (Grenier Ouimet et al., 2020). To the best of our knowledge, no research on patients' intention to continue using in the aftermath of COVID-19 exists. In the course of introducing e-prescriptions in January 2024 in Germany, the importance of telemedicine, among other healthcare technologies, in patients' everyday lives will become ever more significant, highlighting the need to examine patients' post-behavior.

Relying mainly on Anderson's (1973) Confirmation/Disconfirmation Paradigm as well as Oliver's (1980) expectation-confirmation model (ECM), this study tested multiple hypotheses linked to the relationship between the main components of Bhattacherjee's (2001) ECM variant and innovatively extended the ECM variant with concepts from SDT for gaining new insights of telemedicine users' continuance intention. The main results of the structural equation modeling supported the postulated hypotheses in most cases. We found support for most of our hypotheses across the whole sample but also across the subsamples of experienced users and of others; twelve out of fifteen hypotheses expressed high statistical significance. The results obtained in this research suggest that at least three of the four additional variables from SDT are highly important in explaining patients' telemedicine continuance intention. Based on our findings the integration of basic psychological needs and intrinsic motivation helps examining patients' post-adoption behavior.

Due to the homogenous nature of the sample, i.e. younger, and mostly female participants, we did not expect any major differences between groups. However, we did find that experienced users seem to be especially young (i.e., 21 to 30 years old) although older participants demonstrated willingness to use continuance in the future. Satisfaction demonstrated to be higher compared to continuance intention in both the total sample and the subsample of experienced users, although continuance intention still was high in both cases. Interestingly intrinsic motivation is notably higher for experienced users than for others which underlines the importance of motivational aspects concerning telemedicine post-adoption behavior.

Among the three basic psychological needs, perceived competence appears to be the most important variable concerning the extent to which participants felt motivated to continue using telemedicine (cf. *H3* and *H5*) and confirmed their previous expectations with the technology (cf. *H4*). Therefore, patients are more willing and motivated to continue using telemedicine when they feel competent to do so. Consequently, the likelihood of confirming telemedicine expectations and the resulting motivation to use telemedicine increases with the perceived

competence. From this, we conclude that perceived competence influences pre-acceptance expectations of telemedicine by making them more realistic which in turn makes post-acceptance usage behavior more efficient. This is in line with previous findings considering e-learning continuance intention (Sørebø et al., 2009).

Furthermore, contradicting initial expectations we found only weak influence of perceived autonomy on extrinsic/intrinsic motivation (cf. *H1/H2*). First, the difference in results between perceived competence and perceived autonomy was surprising since SDT emphasizes perceived autonomy to be essential to intrinsic motivation (Howard et al., 2020; Ryan & Deci, 2017). However, this finding may be attributable to contextual conditions. Autonomy refers to volition, in case of sickness or healthcare treatment needs, the satisfaction of perceived autonomy may be of minor relevance to form intrinsic motivation. The opposite may be true for telemedicine competence which makes it more relevant for developing intrinsic telemedicine motivation.

At the same time, the missing connection with autonomy in the present research may also be attributable to our choice of conceptualization and measurement of autonomy. We conceptualized autonomy based on participants' perceptions of their autonomy need satisfaction in connection with telemedicine, based on results from Ryan et al. (2006). Autonomy, however, may also be conceptualized as autonomy support measuring respondents' perceptions of the extent to which they feel their surrounding is autonomy-supportive in connection with telemedicine usage (Hsieh et al., 2022).

Secondly, existing research relating to the effect of relatedness (i.e., social influences) on the motivation to continue using technology remains inconclusive. Perceived relatedness pertains to feeling connected with others. Previous research emphasizes that with increasing familiarity of a technology, social influences may gradually fade out over time. Hence, users increasingly decide to continue using a technology according to their own needs regardless from others (Huang, 2019). Consequently, the influence of satisfying relatedness to form motivation may wear out over time. However, our findings corroborate the importance of perceived relatedness in a telemedicine use context, as patients need to feel connected and understood by their assigned doctor. It could be that patients differentiate between the social influence of significant others versus their doctor. In this study, perceived relatedness pertains to the social influence of medical staff, which was found to be crucial for confirmation and intrinsic motivation and, hence, satisfaction and continuance intention. In the telemedicine context, we can assume that

the need for relatedness to medical staff (i.e., feeling understood, taken care of, comfortable, etc.) is evolving with the technology by feeling connected.

Next, considering our research model based on ECM, the proposed relationships between expectation confirmation, perceived usefulness, satisfaction, and continuance intention are supported (cf. *H8, H10-H13*). Existing research relating to the effects within ECM supports our findings (Chiu et al., 2021; Wang et al., 2022; Zhu et al., 2023). Here perceived usefulness is the main predictor of telemedicine continuance intention; the most important usage rationale for respondents was to solve health problems efficiently.

Surprisingly, satisfaction in our model had a weak effect on continuance intention (cf. *H13*) compared to the influence of perceived usefulness and intrinsic motivation across the whole sample and the two subsamples. Previous research concerning healthcare technologies so far has not included intrinsic motivation, in addition to perceived usefulness and satisfaction, as antecedents of continuance intention. A possible explanation for this finding hence may relate to differences in conceptualization. Satisfaction within the ECM pertains to a general experience of positive, negative, or indifferent feelings toward a technology (i.e., telemedicine). Perceived usefulness in our study relates to the belief that telemedicine improves individual health management, and intrinsic motivation refers to genuine enjoyment and self-determined behavior, which seems to be even more relevant for the users, i.e., the subsample.

Our findings thus indicate that participants perceive the utility of telemedicine and their self-determined decision when to use it to be even more important than the congruence between expectations and actual performance when determining whether to continue using telemedicine. In a similar vein, Sørebø et al. 2009 could not establish an effect of satisfaction on e-learning continuance intention and assumed that specific experiences, such as perceived usefulness and intrinsic motivation, may neutralize the impact of the general experience of being satisfied.

Last, as expected, the confirmation of expectations results in intrinsic motivation, which in turn leads to satisfaction and the intention to continue using telemedicine (cf. H9, H14, and *H15*). These findings align with previous literature (Panisoara et al., 2020; Sällberg & Bengtsson, 2016; Sørebø et al., 2009).

6.2 Contributions of the study

This study is one of the first in the context of telemedicine, intending to shed light on the influence of psychological aspects on the motivation to continue using telemedicine in

Germany. First, by applying constructs from ECM and complementing it with core constructs from SDT, our study contributes to general theoretical understanding of post-adoption behavior concerning healthcare technologies. By innovatively combining two established theories, our study moves beyond predicting continuance intention. As such it adds to our understanding of the interrelationship between the core constructs from ECM with motivation and its underlying psychological aspects and derives new findings with marketing relevance. Our research, therefore, provides new empirical evidence for the applicability of the ECM within the healthcare technology context and how the fulfillment of basic psychological needs influences patients' motivation to continue using telemedicine in the aftermath of COVID-19.

Secondly, by examining patients' key drivers along with psychological aspects to continue using telemedicine, our findings contribute to the advancement of knowledge in this field. So far, research has mainly focused on post-adoption behavior concerning medical staff (e.g., physicians and nurses) (Cobelli et al., 2023; Garavand et al., 2022; Kamal et al., 2020). Accordingly, the present study offers new insights into the main predictors and psychological aspects of continued utilization of telemedicine from a patient perspective. Our findings indicate that apart from technological factors (i.e., perceived usefulness), motivational factors also predict continuance intention. Thus, our results generate actionable insights for telemedicine providers/developers, marketers, and policymakers. Perceived usefulness was found to be a crucial determinant for promoting users' continuance intention. Patients typically use telemedicine services for specific purposes and expect the platforms' functions to guide them to achieve their health goals i.e., get a diagnosis or receive a treatment. Therefore, telemedicine providers/developers should focus on understanding users' health needs to differentiate their services in the market. Based on our participants' responses differentiated services such as dermatologic or mental health treatments were used most often. Moreover, with growing awareness of mental and physical health and the growing significance of specific health needs, telemedicine providers need to pay greater attention to growing markets to meet different users' needs such as management of special diets or sleep monitoring.

Among the three basic psychological needs, perceived competence appeared to be the most influential. This, in turn, is relevant for achieving a paradigm shift in healthcare delivery models. Telemedicine constitutes a key healthcare technology, which yields the potential for comprehensive healthcare delivery (Cobelli et al., 2021; Lu et al., 2021). The discontinuance of telemedicine represents a loss of opportunities to restructure today's healthcare delivery models. By exploring motivational aspects of telemedicine continuance intentions from a

patient perspective, our findings provide new insights concerning healthcare technology post-adoption behavior relevant to marketing research. The relationships established between perceived competence and perceived usefulness and intrinsic motivation and continuance intention are valuable for telemedicine providers. To increase consumer retention, telemedicine providers offer personalized functions such as instructions and self-monitoring options. This increases patients' self-determination. Recent research acknowledges the growing importance of patients' health consciousness (Ali & Ali, 2020; Rahaman et al., 2023; Yan et al., 2021). Yan et al. (2021) found in a health app context that the effect of perceived usefulness on satisfaction was strengthened by health consciousness. That means that users are more willing to accept complex functions and interfaces as long as their perceived usefulness is strong.

Finally, in terms of practice, our findings indicated that participants value the utility of telemedicine and their self-determined decision when to use it. It seems that patients' level of perceived telemedicine competence plays a critical role in confirming their pre-acceptance expectations, the development of usefulness beliefs and in turn the development of intrinsic motivation. This emphasizes that patient support via effective marketing measures is an important complementary investment for both, the pre-acceptance, and the subsequent usage phase (Cegarra-Sánchez et al., 2020; Chauhan et al., 2022). Therefore, perceived benefits and values proposed by telemedicine technology should be evaluated frequently. Patients should be provided with information about potential benefits and limitations of telemedicine technology to increase sense of self-determination and competence.

Furthermore, as patient's perceived usefulness depends on expectancy confirmation and strengthen patients' willingness to continue using telemedical services, platform providers should give realistic expectations and be sensitive to patients' telemedicine performance expectations (Lu et al., 2021). Patients surveyed in this research expected timely and easy access to doctors via telemedicine, some commented that they were frustrated when they could not be diagnosed remotely. Therefore, providers should establish effective communication and involve among others policymakers and insurance companies to deploy their services. Moreover, we advise providers to place emphasis on telemedicine as a reliable and efficient healthcare technology that provides timely and comprehensive treatment options (Chauhan et al., 2022). In other words, telemedicine providers should keep waiting times to the minimum and optimize the patient journey as users aim at saving time through online treatments.

More broadly, our study points to the benefits of focusing on competence and relatedness as a crucial dimension of telemedicine quality. Hence, the commitment of providers as well as the

scope, quality and speed of treatments offered provide avenues for sustaining patients' continued use independent from their health status.

6.3 Limitations and suggestions for future research

This research has limitations. First, 60.8% of the participants in our sample were female; 81.5% of respondents were aged 30 years or younger. Therefore, we cannot be sure whether the underlying theories and constructs are appropriate for explaining the continuance intention of other patient groups using telemedicine. The role of gender and age concerning telemedicine continuance intentions has so far not been examined extensively (Baudier et al., 2021), which builds grounds for future investigations, particularly when considering the importance of perceived usefulness as the main predictor of telemedicine continuance intention. Future analyses thus could explore the role of usefulness depending on sex and age. Furthermore, recent studies have examined factors influencing telemedicine adoption in less-developed countries with weak infrastructure (Kaium et al., 2020; Kamal et al., 2020), however, post-adoption behavior has not been researched so far.

Second, the generalizability of the findings may be limited due to the context-specific nature of our research. Telemedicine represents only a rather small fraction of healthcare technologies. According to varied use contexts, behavior may change with the increasing diversity of telemedicine services (e.g., teleconsultation, remote monitoring). Therefore, it is worth investigating different telemedicine technologies continuance intentions based on specific treatment needs (e.g., diabetes, rheumatism) to advance the paradigm shift of healthcare delivery.

Finally, the conceptualization of the three basic psychological needs relating to healthcare technologies may need to be revised. Also, there were some low factor loadings on perceived competence and autonomy. However, to the best of our knowledge there exists no other research complementing ECM with core constructs from SDT concerning healthcare technologies. Optimizing the items used in this regard provides avenues for future research. Moreover, especially the influencing role of perceived competence concerning healthcare technologies needs to be scrutinized in more detail which yields potential for future marketing research.

7. Conclusion

To summarize, our research takes an initial step toward extending and validating ECM with SDT additions from a patient's perspective to continue using telemedicine. Our research provides new insights into the potential of understanding a patient’s motivation to continue using telemedicine compared to conventional treatment options. According to our findings, patients’ perceived usefulness of telemedicine as well as their perceived competence to use telemedicine are key influencing factors in promoting the much-needed paradigm shift in healthcare delivery. We moreover highlight the need to scrutinize the interrelationship between ECM and SDT constructs in more detail to establish grounds for improved, digitalized healthcare delivery models in the future, not just during a health crisis.

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3. Part B: Technologies in Lifestyle and Health Promotion

3.1 Research Paper No. 3: Understanding continued fitness app utilization: An extended expectation-confirmation model framework and the role of gratifications

Abstract

Purpose: As users increasingly demand to take charge of their health, digital tools such as fitness apps are being used in unprecedented ways. The COVID-19 pandemic has heightened the importance of health promotion and fundamentally changed how consumers use and access fitness apps. Despite the exponential rate at which fitness apps are introduced to the market, most users cease using them soon after their initial trial.

Approach: This study evaluates the antecedents to confirmation and satisfaction and their mediating roles by considering psychological and motivational aspects in determining users' fitness app continuance intentions. It draws from three well-established theoretical models: the expectation-confirmation model, flow theory, and uses and gratifications theory. Based on structural equation modeling, empirical data from 403 German fitness app users verified the proposed research model.

Findings: Perceived usefulness and flow experience positively and significantly affect satisfaction. Perceived ease of use, perceived enjoyment, and social influence are essential to confirmation, reinforcing continued fitness app utilization. Our findings help developers align app design with user needs, fostering higher satisfaction and retention. Intuitive and personalized functions and gamification drive users' continued use and present essential building blocks for digitalized healthcare prevention in the future.

Originality: Against their irrefutable importance, the influence of user-related psychological and motivational aspects on the post-adoption patterns of fitness apps has not been analyzed in depth in the literature, especially not after COVID-19, which has led to significant changes in consumers' usage behaviors of apps. This study bridges the gap in the literature. Understanding fitness apps' continued use is essential to address changing user needs and expectations and ensure that the apps meet user demands and remain relevant to pave the way for digitized prevention measures.

Key Words: Expectation-confirmation model, flow experience, UGT, fitness app users, post-adoption use behavior.

1. Introduction

Disruptive digital solutions such as fitness apps provide grounds for viable and purposeful healthcare (Dodds et al., 2022; Stoumpos et al., 2023). Fitness apps are third-party software programs that use data collected from a smartphone's built-in functions to measure fitness and health parameters (Higgins, 2016). Most fitness apps resort to behavioral change techniques, including exercise instruction, self-monitoring, social support, and contingent rewards (Middelweerd et al., 2014). In the wake of COVID-19, fitness apps contributed momentum to provide digitally assisted health prevention and open avenues for cost-effective means to promote physical activity (Yadav et al., 2022) since patients prioritize their well-being more than before the COVID-19 health crisis (Buchter et al., 2023). Fitness apps still offer tremendous potential for improving health outcomes. With the increasing variety of apps and functions (e.g., nutrition, meditation, sleep) available, they will become ever more central to users' fitness and health regimens.

However, the pandemic has fundamentally changed how consumers use fitness apps and access health technology (Brodie et al., 2021; Nam et al., 2023). With growing awareness of health risks, users focus more on preventive measures, viewing fitness apps as essential for maintaining long-term health rather than just tracking fitness activities (Liu & Avello, 2021). Moreover, isolation during the pandemic reinforced the value of community, prompting many fitness apps to build social interaction capabilities, such as virtual classes, challenges, and community forums. These features encourage a sense of connection and accountability that was not as emphasized before. Such developments underscore the shift in user needs from the purely physical focus seen in pre-pandemic fitness technologies toward holistic fitness experiences (McKinsey & Company, 2021). Consequently, fitness apps in our study refer to apps that provide training units and workouts in an interactive format, track recorded training performance and its subsequent evaluation, set performance targets and progress, provide reminder functions for regular training, meditation exercises, and optionally additional offers such as food recipes, mindfulness exercises or learning videos.

The growing popularity of fitness apps attracted researchers' attention. Yet findings from studies pre-pandemic are becoming potentially obsolete due to the shift toward the increasing importance of preventive measures and longevity (Stoumpos et al., 2023). Although the existing literature has advanced the understanding of specific aspects of user adoption and continued use behaviors of fitness apps pre-COVID-19 or during COVID-19 in several contexts, research still lacks a detailed picture concerning continued use behaviors. Hence,

empirical evidence on how to reinforce continued use after the pandemic and ensure loyalty is still limited (Elsotouhy et al., 2024; Wei et al., 2021). Until now, research has either focused on the acceptance of fitness apps and their significance for public health in crisis (Liu et al., 2022; Wang & Qi, 2021) or analyzed primarily utilitarian aspects of fitness apps' continued use (Guo et al., 2022; Huang & Ren, 2020; Li et al., 2022). However, understanding the reasons for users' continuance in using technology is critical for designing strategies for continuously attracting user retention (Nabavi et al., 2016). This is especially important considering that changing habits, maintaining healthy behaviors, and perpetuating good practices over time are challenging and require effort, often hindering achieving the apps' full potential (Pellegrini et al., 2018). In this regard, it is problematic that many healthcare technologies (e.g., wearable devices, health apps, or telemedicine) show high numbers of initial users (purchase, download, installation, initial use) but low retention rates (Ahmad et al., 2020; Amin et al., 2022; Bao & Lee, 2023). Still, for healthcare technologies like fitness apps, retaining high numbers of users is usually more meaningful than the number of first-time users (Cho, 2016), as the benefits of service providers, developers, and users depend on this use continuation due to network effects or demand-side economies of scale (Ambalov, 2018; Bhattacherjee, 2001; Franque et al., 2021). Moreover, from a user's perspective, discontinuing a fitness app may negatively affect their health-related behaviors (Cho, 2016). Therefore, and considering fitness apps' economic relevance and potential to create positive societal and behavioral changes, we investigate why users continue to use fitness apps by scrutinizing users' functional, hedonic, and social experiences and psychological factors.

Recent research on continuance intention highlights that the adoption or abandonment of apps may be related to the user's functional, hedonic, and social experience and psychological factors (Schuster & Parkinson, 2022; Yan et al., 2021). Thus, the mere analysis of functional experiences of users' long-term continued use shall not be enough to explain users' continuance behaviors thoroughly. However, despite their irrefutable importance, the influence of user-related psychological aspects on the post-adoption patterns of fitness apps has not been analyzed in depth in the literature. It currently fails to capture the full scope of user behavior, which goes beyond basic satisfaction or initial adoption. User motives to use fitness apps vary: Some might prioritize personal fitness goals, while others are motivated by community and external rewards (Jiang et al., 2022). However, users' perspectives and feedback are valuable to researchers, marketers, and app developers to gain valuable insights by examining users' experiences with current apps. By addressing user perspectives, apps that meet user

expectations can be built, increasing their appeal to a broader audience and fostering a more comprehensive, user-centered experience aligning with the long-term goals of preventive health (Bocking et al., 2022; Chandra Nigam & Chanda, 2024; Yap et al., 2022). Consequently, to explain fitness app continuance, we expand the expectation-confirmation model (ECM) (Bhattacherjee, 2001) by integrating psychological (i.e., flow experience) and motivational (i.e., gratifications obtained through app use) factors.

Flow attempts to explain cognitive states in which individuals are deeply absorbed in an activity, which means they act with total involvement Csikszentmihalyi (1975). It pertains to a holistic experience; individuals in a flow state typically are highly concentrated and experience a loss of self-consciousness. Recent research applied flow theory in health technologies continuance (Yan et al., 2021). However, it has not been used to predict continuance intention for fitness apps. Since definite goals, immediate feedback, and a balance between users' skills and challenges can trigger flow experiences, we presume that users can enter states of flow while operating their fitness app and performing physical activities (Kim, 2022; Yan et al., 2021).

Uses and gratification theory (UGT) (Katz et al., 1973) focuses on why and how users choose specific media outlets to gratify their psychological needs, and it originates from traditional mass communications research. UGT provides a valuable framework for explaining mediated communication's psychological and behavioral dimensions. With more built-in features such as planning, goal setting, self-monitoring, and receiving continuous feedback, fitness apps have become convenient, technologically based platforms resonating with different gratifications obtained through the app use. Therefore, drawing on UGT, we analyze whether gratifications obtained from app use act as intrinsic motivators, strengthening users' expectation confirmation, and identify their role in determining continuance intention since findings concerning continued fitness app use are scarce (Lee & Cho, 2017).

Our paper thus contributes to the literature by integrating hedonic, social, and psychological factors into the ECM (Bhattacherjee, 2001) to examine whether technology-related or psychological and motivational factors drive the expectation-confirmation-satisfaction paradigm. We thus aim to (1) identify the factors that explain continuance intentions for fitness apps by verifying the proposed theoretical model with empirical data from fitness app users in Germany and (2) consider the role of motivation in users' continuance intentions for fitness apps by analyzing how gratifications obtained influence user confirmation and reinforce continuance intention.

The rest of the paper is structured as follows: The following section briefly reviews the literature on fitness app continuance. The research model, as well as the developed hypotheses, are then presented. After a presentation of the data collection and results of the empirical study, managerial and theoretical contributions are summarized, followed by a discussion of the study's limitations, a research outlook, and concluding remarks.

2. Theoretical Framework

2.1 Information system (IS) continuance

The term continuance intention refers to a user's decision to carry on using a technology, which is conceptually different from a user's first-time usage of a technology (Bhattacherjee, 2001); it thus describes a form of post-adoption behavior (Nabavi et al., 2016). Previous studies concerning the continued use of technologies have primarily applied different technology adoption models to explore users' continuance intention, such as the unified theory of acceptance and use of technology (UTAUT) (Venkatesh et al., 2003) or the technology acceptance model (TAM) (Davis, 1989). Nabavi et al. (2016) in their meta-analysis on IS continuance found that TAM was the second most widely used theoretical model to explain technology post-adoption behaviors. However, according to Bhattacherjee (2001), technology adoption and technology continuance intention are two different notions. Continuance intention seeks to explain continued use after the initial adoption of technology. For this reason, Bhattacherjee and Barfar (2011) argued that models initially designed to explain technology acceptance are not appropriate for explaining IS continuance because this may generate misunderstandings and misapplications of the theories. Furthermore, meta-analyses show that the ECM has proven to be the most solid in determining IS continuance for various technologies (Franque et al., 2021; Nabavi et al., 2016). While TAM and UTAUT understand continuance as an extension of acceptance behavior, the ECM is based on the expectation-confirmation-satisfaction paradigm, which builds on actual usage experience (Premkumar & Bhattacherjee, 2008). Although technology characteristics and some aspects of users' hedonic and social experience play a vital role in determining attitudes and behavior, these models do not incorporate psychological elements such as users' states of flow nor the extent to which the users' actual use experience contributes to achieving flow (Valinatajbahnamiri & Siahtiri, 2021).

This study draws from the ECM and extends it with flow experience and gratifications obtained through app use to understand app users' behavior and insights comprehensively. The ECM is based on the expectation-confirmation theory (ECT) (Oliver, 1980), often used in marketing to

explain how consumer satisfaction leads to repurchase intentions. It relies on the premise that confirmation of prior expectations, expectations of benefits, and emotional responses determine users' decisions to continue using an IS. Thereby, confirmation of prior expectations is a core factor uniquely distinguishing the ECM from other models to explain IS use behaviors (Thong et al., 2006). In the original model, two factors determine users' continuance intention: their assessment of previous technology usage experiences and their anticipation of future benefits obtained from continued technology usage (Bhattacherjee & Barfar, 2011). The ECM has been well-researched and validated for various technologies and proven to have good predictive validity in explaining users' continuance intention from a utilitarian view (Hong et al., 2006; Thong et al., 2006).

2.2 Literature review: fitness apps

Table 1 summarizes the academic literature on fitness app continuance intentions. As can be seen from the literature overview, most of the previous research concerning fitness app post-adoption behaviors has focused on explaining continued use by drawing on technology acceptance models. For instance, Beldad & Hegner, 2018 and Huang and Ren (2020) both built on extended versions of TAM to explain fitness app continuance. However, theoretical frameworks designed to explain technology acceptance, such as TAM, may be inappropriate for explaining technology continuance because, conceptually, TAM and ECM predict two distinct and temporally separate user behaviors (Bhattacherjee & Barfar, 2011). The resulting gap in the literature concerning fitness app continuance is troubling since, up until now, only a few studies have drawn from the appropriate theoretical background. In this regard, Chiu et al. (2021) integrated the ECM and the investment model, while Zhang and Xu (2020) included social connection into the ECM to reflect social influences and, more recently, Jiang et al. (2023) drew on an extended ECM that incorporated hedonic aspects like perceived entertainment and satisfaction. Even though these studies confirm the predictive validity of the ECM within the fitness app context and advance our understanding of the influencing factors driving fitness app post-adoption behaviors, they mainly focus on utilitarian and hedonic aspects of users' post-adoption behaviors and fail to provide insights concerning the effect of psychological factors. From other standpoints, Lee and Cho (2017) based on UGT, and Yu and Chen (2019) based on task-technology fit (TTF), investigated potential influencing factors beyond the traditional variables proposed in technology continuance research. Although these studies explore potential antecedents in explaining fitness app continuance, they do not fully and comprehensively explore it, reducing explanatory power. Finally, only two other studies

(see Table 1) delved into users' continued use behaviors after the COVID-19 health crisis. Consequently, the literature currently fails to provide insights into user expectations, needs, and motivations that may have evolved since the pandemic's resolution.

As evident from this literature review, few studies to date apply theoretical frameworks designed to explain fitness app continuance and, secondly, focus on the psychological factors that may explain users' decision to continue using a fitness app. In this study, we considered socio-psychological factors for various reasons. Firstly, users place varying degrees of importance on health, which may affect their decision to continue or discontinue using a fitness app. Hence, motivations vary across users, influencing whether users consider such apps useful and easy to use in the pre-adoption stage (Lee & Cho, 2017). Consequently, we propose that gratifications obtained from previous use of the apps may affect the influence of variables that enhance user satisfaction and continuance intention with fitness apps. Secondly, fitness apps differ from other digital technologies concerning their features that help users pursue long-term health goals (Yan et al., 2021). Features like interactive training formats, progress tracking, self-monitoring, and reminders inherent to most fitness apps nowadays may trigger flow experience. In a state of flow, users' attention is limited to the stimulus field, and they sense control over their behaviors (Csikszentmihalyi, 1975), which results in pleasurable experiences that may lead to satisfaction and continuance intention. Consequently, this study augments the ECM framework by integrating flow experience and gratifications. The following section explains the theoretical constructs in our framework (Fig. 1) and develops hypotheses for this study.

Figure 1. Conceptual model of the determinants of continuance intention for fitness apps.

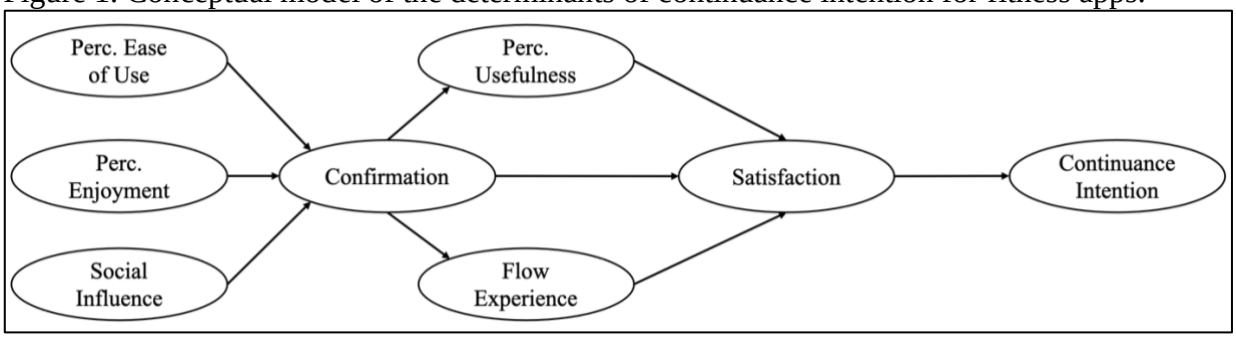

Table 1. Summary of previous research.

Authors	Time of data collection			Theories to which user's fitness app continuance was linked				Considered Variables	Key results
	Pre-COVID 19	During COVID-19	Post-COVID 19	ECM	FT	UGT	Other		
Beldad and Hegner (2018)	X						TAM	TAM-variables, trust, social influence, and health valuation	Perceived ease of use, perceived usefulness, and injunctive social norm directly and significantly affected users' continuance intention. Trust in the app developer and descriptive social norm did not affect continued use intention. However, they both influenced users' perceptions of a fitness app's usefulness.
Chiu et al. (2021)		X		X			Investment Model	ECM-variables, investment size and quality of alternatives	ECM relationships were confirmed; satisfaction and investment size positively influenced users' commitment, which in turn positively impacted continuance intention.
Cho et al. (2020)		X					TAM, Investment Model	TAM-variables, , investment size, quality of available alternatives, relationship commitment	Perceived ease of use positively influenced perceived usefulness, which further affected users' continuance intention. Perceived usefulness and perceived ease of use significantly influenced satisfaction, investment size, and quality of available alternatives. These three constructs also affected users' relationship commitment, which, in turn, influenced continuance intention.
Hu et al. (2020)		X					Customer value theory, Socio-technical approach	Utilitarian value, hedonic value, social ties, personalization, sociability, informativeness, number of users, and number of peers	Utilitarian value and hedonic value were positively and social ties were negatively related to continuance intention. Technological characteristics had significant positive influences on utilitarian value, hedonic value, and social ties. Network effects significantly and positively influenced hedonic value and social ties.
Huang and Ren (2020)		X					TAM	TAM- constructs, perceived enjoyment,	Instruction provision, self-monitoring, self-regulation, and goal attainment indirectly influenced continuance intention through perceived usefulness, and this indirect effect was moderated

Authors	Time of data collection			Theories to which user's fitness app continuance was linked				Considered Variables	Key results
	Pre-COVID 19	During COVID-19	Post-COVID 19	ECM	FT	UGT	Other		
								self-efficacy and technological functions	by exercise self-efficacy such that the association between perceived usefulness and continuance intention was stronger for those with low exercise self-efficacy.
Jiang et al. (2023)			X	X			TAM	ECM-variables, perceived ease of use, perceived quality, perceived usability, perceived entertainment and user stickiness	Perceived ease of use positively affected perceived usefulness but not satisfaction; perceived usefulness, perceived interestingness, and perceived quality directly and significantly impacted user satisfaction and continuance intention. Perceived usefulness mediated the relationship between perceived ease of use and satisfaction, and partially mediated the relationship between perceived interest and satisfaction.
Lee and Cho (2017)	X					X		Recordability, networkability, credibility, comprehensibility, and trendiness, accuracy and entertainment	Results showed that the gratifications recordability, networkability, credibility, comprehensibility, and trendiness significantly predicted user continuance intention; Accuracy and entertainment were not significant predictors.
Li et al. (2019)	X						ECT, Social comparison theory	Activity amount ranking, activity frequency, confirmation, and upward comparison tendency	Activity amount ranking and activity frequency ranking positively affected confirmation, which in turn positively affected continuous intention. The impact of activity amount ranking and activity frequency ranking on continuous intention was moderated by expectation confirmation.
Sampat et al. (2023)			X		X		Belief-attitude-behavior framework	Gameful experience, personalization, flow experience and satisfaction	Gameful experience and personalization led to flow experience, which directly and significantly influenced satisfaction. Satisfaction led to word of mouth and loyalty towards fitness apps.
Yu and Chen (2019)	X						TTF	TTF-variables, continued usage	Task characteristics and technology characteristics significantly and positively influenced task-

Authors	Time of data collection			Theories to which user's fitness app continuance was linked				Considered Variables	Key results
	Pre-COVID 19	During COVID-19	Post-COVID 19	ECM	FT	UGT	Other		
								attitude, continued usage behavior, performance impact	technology fit, which in turn positively affected continued usage behavior; performance impacts were positively related to continued usage attitude and continued usage behavior; continued usage attitude had a significantly positive impact on continued usage behavior; performance impacts played a significant intermediary role between task-technology fit and continued usage behavior.
Zhang and Xu (2020)		X		X				ECM-variables, fitness achievement, social connection and entertainment	Confirmed usefulness, confirmed ease of use, satisfaction, fitness achievement, and social connection significantly and positively affected continuance intention. Entertainment showed no effect.
This study			**X**	**X**	**X**	**X**		**ECM-variables, flow experience, perceived ease of use, perceived enjoyment and perceived social influence.**	**Perceived usefulness and flow experience were positively related to satisfaction and, in turn, continuance intention. Perceived ease of use and perceived enjoyment prove to be important antecedents to satisfaction promoting continued fitness app utilization, while perceived social influence showed no effect on satisfaction and in turn, continuance intention**

Notes: FT: Flow theory, UGT: Uses and gratification theory, ECM: Expectation-confirmation model, TAM: Technology acceptance model, UTAUT: Unified theory of acceptance and use of technology, ECT: Expectation-confirmation theory, TTF: Task-technology fit.

3. Hypotheses Development

3.1 Expectation-confirmation-satisfaction paradigm and flow theory

Consistent with the post-adoption paradigm (Bhattacherjee, 2001), satisfaction arises if the ex-ante expectation matches the actual use experience and if the frame of reference (i.e., prior expectations) results in the perception that the technology is useful for accomplishing the given task. Consequently, the greater the extent to which fitness app users can confirm their prior expectations, the higher their satisfaction with the app will be (Zhang & Xu, 2020). Still, to better understand how confirmation affects satisfaction with the app, we investigate two competing underlying processes: First, we focus on perceived usefulness as a utilitarian process in user behavior, arguing that fitness apps are mainly used for specific purposes (e.g., tracking/ monitoring features to become fitter or lose weight) (Angosto et al., 2023). Accordingly, the perception of usefulness affects users' satisfaction and intention to continue using it (Cho, 2016). Also, recent research in other technology contexts found that satisfaction mediates the relationship between perceived usefulness and continuance intentions (Islam et al., 2017; Kumar et al., 2018; Wu & Kuo, 2008; Yan et al., 2021). Second, we scrutinize flow experience as a more hedonic-oriented processing variable. Hence, confirmation of initial expectations may also positively contribute to users' level of flow experience elicited by operating the app (Cheng, 2021). In their research on health-app-induced flow, Gómez-Rico et al. (2023) found that functional experiences are vital determinants in entering a state of flow due to user experiences that lead to a favorable psychological state. This finding corroborates that operating fitness apps can induce states of flow, which may be triggered, among others, by distinct goals, immediate feedback, and challenges that meet users' skills (Gómez-Rico et al., 2023), all characteristics inherent to fitness apps (Angosto et al., 2023). Users' attention is limited to the stimulus field, and they sense control over their behaviors, resulting in pleasurable experiences (Csikszentmihalyi & LeFevre, 1989). Therefore, we expect that users enter a state of flow while performing the activities suggested by the app. Extant literature emphasizes a direct effect of flow experience on continuance intention in the case of various online technologies (Cheng, 2021; Gao et al., 2015; Hong & Di, 2017; Lee & Kim, 2017). However, Yan et al. (2021) indicate that satisfaction mediates the relationship between flow experience and continuance intention. Therefore, we hypothesize:

H1. Confirmation has a positive effect on satisfaction.

H2. By increasing satisfaction, confirmation increases continuance intention.

H3. By increasing perceived usefulness, confirmation increases **a)** satisfaction and **b)** continuance intention. (serial mediation)

H4. By increasing flow experience, confirmation increases **a)** satisfaction and **b)** continuance intention. (serial mediation)

3.2 Gratifications obtained from fitness app use

According to UGT, utilitarian and hedonic needs motivate users to adopt (Luo et al., 2011) and even continue using (Chen et al., 2016) information technologies. Studies concerning healthcare technologies have emphasized similar effects. However, to the best of our knowledge, no other empirical study has explored whether confirming gratifications obtained from fitness app use ultimately result in satisfaction and, in turn, continuance intention.

Utilitarian gratifications refer to users' extrinsic motivations for technology use and determine the fulfillment of users' utility expectations and extrinsic motivations. Perceived ease of use promotes a positive evaluation and increases with use experience, which reduces the effort necessary to obtain skills related to the technology (Thong et al., 2006). According to prior literature, the perception that technology is easy to use likely leads to the fulfillment of utilitarian gratifications. If users confirm that the fitness app helps them accomplish their goals, satisfaction arises, ultimately resulting in continuance intention. Recent findings confirm this within the context of healthcare technology (Cho, 2016; Guo et al., 2022; Yan et al., 2021; Zhang & Xu, 2020). We assume that the higher the perceived ease of use, the more users can concentrate on the task itself without being distracted by operational challenges requiring additional cognitive effort. If users can confirm that the app is easy to use, a sense of utilitarian gratification arises, ultimately leading to satisfaction and continued use. Drawing from the above, we conclude:

H5. By increasing confirmation, perceived ease of use strengthens **a)** satisfaction and **b)** continuance intention. (serial mediation)

Hedonic gratifications pertain to users' intrinsic motives for technology use. Specifically, we examine users' perceived enjoyment as one type of hedonic gratification. Perceived enjoyment refers to the extent to which users perceive utilizing the technology as pleasurable (Luo et al., 2011). According to recent studies, enjoyable features like gamification or interactive challenges contribute to hedonic gratification in healthcare

technology (Putri et al., 2019; Tu et al., 2019). So far, no comparable research exists on the influence of perceived enjoyment relating to the expectation-satisfaction-continuance paradigm of fitness app post-adoption behaviors. However, building up on UGT, we expect that if users confirm that the app turns complex or repetitive fitness tasks into enjoyable activities, satisfaction increases and, in turn, fosters continuance intention. Thus, we assume that higher levels of perceived enjoyment are obtained as hedonic gratification by fitness app users (Putri et al., 2019), resulting in satisfaction and continuance intention. Therefore, we hypothesize:

H6. By increasing confirmation, higher levels of perceived enjoyment increase **a)** satisfaction and **b)** continuance intention. (serial mediation)

Based on UGT, social gratifications are essential in fulfilling user needs, potentially determining whether they continue using or abandoning a technology (Li et al., 2022). In this study, social gratifications pertain to users' social influence, which results from features often inherent to fitness apps, like challenges or social sharing (Angosto et al., 2023). Hence, we assume that social influence shapes initial expectations about fitness apps (Zhang & Xu, 2020). Users feel validated in their choice when the app meets these socially reinforced expectations. Consequently, the greater the extent to which fitness app users can confirm their prior expectations, the higher their satisfaction with the app will be, ultimately leading to continued use. Hence, we propose:

H7. By increasing confirmation, higher levels of social influence positively influence **a)** satisfaction and **b)** continuance intention. (serial mediation)

4. Methods

4.1 Data collection and descriptive statistics

Using Lime Survey, an online questionnaire was employed to analyze the underlying constructs and their relations. The survey was administered in German. Respondents were asked whether they currently used a fitness app and provided with an explanatory text concerning the definition of fitness apps. They were then asked to specify the kind and name of the fitness app they were using. Only participants who used apps that provided some sort of interactive format, such as training units, workouts, or challenges, were considered for further analysis. However, recording and evaluating training performance, setting performance targets, and reminder functions for regular training are inherent to most fitness apps by now.

Participants were asked to keep the specific fitness app they used in mind to answer the introductory questions concerning their prior experiences with the particular fitness app. Next, items measuring the ECM constructs, flow experience, and the three gratifications mentioned earlier were presented. Finally, participants' demographics (i.e., age, gender, income, employment status, education level, and place of residence) were inquired. Data was collected by spreading the online self-administered questionnaire across various fitness online communities and health forums to understand the German fitness landscape. A cross-sectional design was chosen, and data collection started on October 30, 2023, and ended on January 30, 2024. The study population constituted German fitness app users who continued using fitness apps even after the pandemic was declared over in May 2023 and were working out regularly. Questions concerning the usage were queried regarding usage in the last month (E.g., "How often have you used the fitness or wellness app in the last month?") to ensure that participants actually continued using fitness apps post-pandemic. The online context of the present study can be deemed suitable: On the one hand, with 4.24 billion downloads worldwide in 2023 and projected revenues of 6.15 billion euros worldwide by 2025 (Statista Market Insights, 2024), emphasizing that fitness apps retain an essential role in users' health regimes. On the other hand, the high number of young users utilizing fitness apps and other healthcare technologies (Techniker Krankenkasse, 2022) indicates high literacy in app use.

A total of 539 responses were recorded. Eighty-nine participants indicated they had no prior experience with fitness app utilization and resigned from the questionnaire early. After eliminating incomplete responses and speeders (n = 47), 403 responses were considered for further analysis. Table 2 outlines the sample's descriptive statistics and characteristics. Users were relatively young (mean = 26.77, standard deviation = 6.739), and 64.3% were female. Furthermore, most participants were students (n = 247, 61.3%) with a monthly income of up to 2,000 Euros (n = 161). Most participants' highest education level was a bachelor's degree (n = 193, 47.9%). City dwellers constituted the largest proportion of the respondents (n = 284, 70.5%). The Appendix provides a summary of the participants' demographics in Table A1. In terms of use experience, most users regularly utilized Asana Rebel (n = 185, 45.9%). 96.3% (n = 388) perceived their fitness application utilization as easy. Few users experienced problems (n = 15, 3.7%), mainly concerning the technical features of their fitness app. Over one-third of the sample (n = 132, 32.8%) used their fitness app several times a week, while 82 (20.3%) users

utilized their app even daily. Improving athletic performance was mentioned most frequently as the reason behind using fitness apps (n = 246, 61.0%). This was corroborated in the comment section: users emphasized the importance of workout plans tailored to their needs (e.g., weight loss or weight training) and emphasized seamless integration of third-party devices and real-time data tracking options as essential features.

4.2 Items and constructs

All constructs were measured by multiple reflective items on a five-point Likert scale (1= "strongly disagree" to 5= "strongly agree"). The underlying items were derived from validated scales from existing literature. Based on the maturity of ECM, flow theory, and UGT, the study benefits from previous empirical validations. Across the sample, means ranged from 3.063 (for social influence) to 4.288 (for perceived ease of use). Users demonstrated high satisfaction (mean = 4.036, SD = .788); continuance intention (mean = 3.670, SD = 1.059) was lower than satisfaction but still high (see Table 2). Generally, participants responded positively concerning psychological factors (i.e., flow experience and UGT constructs) and ECM constructs, indicating that the model applied here is appropriate.

5. Results

5.1 Measurement model evaluation

Following the two-step analysis approach used in partial least squares structural equation modeling (PLS-SEM), model evaluation begins with the outer or measurement model. The algorithm was set to a path weighting scheme, allowing 3000 iterations at maximum and using a stop criterion of 10^{-7}. Results converged after six iterations. Outer loadings were assessed employing a threshold of >.65 (Hair et al., 2014), finding that all indicators survived except for three items (i.e., FE3, FE4, and PE4), which had to be dropped due to moderate to very low standardized factor loadings. Construct reliability and validity were assessed based on composite reliability (CR) and average variance extracted (AVE) (Hair et al., 2019). All values exhibit satisfying results (see Table 2).

Next, discriminant validity was checked. The Fornell-Larcker criterion (Fornell & Larcker, 1981) and heterotrait-monotrait ratio (HTMT) (Henseler et al., 2015) were applied for analysis. The Appendix provides Fornell-Larcker tabulation in Table A2, and HTMT results are displayed in Table 3. All pairings pass the conservative threshold of <.85 (Henseler et al., 2015). Additionally, Table 3 shows bootstrapping results for

HTMT. The critical value of 1 is excluded from all intervals, corroborating discriminant validity. The bootstrapping run further indicated satisfying values for the lower and upper limits of the confidence intervals for CR (Hair et al., 2019). Therefore, examining the measurement model suggests the absence of measurement problems. Construct reliability and validity, as well as discriminant validity, could be established.

Table 2. Assessment of convergent validity and internal consistency reliability.

Construct; references for items	*Items*	*Factor-loadings*	*CR*	*AVE*	*Mean (SD) n=403*
Confirmation (Bhattacherjee, 2001)	My experience with the fitness app was better than I had originally expected (EC1).	.831	.854	.661	3.601 (.747)
	Using the fitness app has brought me more benefits than I originally expected (EC2).	.843			
	In general, my initial expectations regarding the use of the fitness app were met (EC3).	.761			
Perceived usefulness (Yan et al., 2021)	Using the fitness app improves my performance (PU1).	.728	.880	.648	3.712 (.762)
	Using the fitness app helps me to effectively pursue my health goals (PU2).	.824			
	The fitness app makes it easier for me to maintain a healthy lifestyle (PU3).	.826			
	I find the fitness app useful for following a healthy lifestyle (PU4).	.836			
Satisfaction (Yan et al., 2021)	I am happy with my decision to use this fitness app (SAT1).	.917	.939	.837	4.036 (.788)
	I am satisfied with my experience with this fitness app so far (SAT2).	.918			
	My decision to use this fitness app was a good one (SAT3).	.909			
Continuance intention (Cheng, 2021; Yan et al., 2021)	I intend to continue using the fitness app in the future (CI1).	.938	.915	.784	3.670 (1.059)
	I will use the fitness app regularly in the future (CI2).	.937			
	I intend to continue using this fitness app and not use any other apps (CI3).	.770			
Flow Experience (Cheng, 2021; Yan et al., 2021)	I feel like I am in control when I use the fitness app (FE1).	.829	.815	.687	3.645 (.757)
	I am absorbed in what I am doing while using the fitness app (FE2).	.828			
Perceived Enjoyment (Cheng, 2021)	I find the fitness app pleasant to use (PE1).	.852	.866	.684	3.884 (.669)
	The user interface of the fitness app makes the workout process feel good (PE2).	.790			
	I find the interaction with the fitness app pleasant (PE3).	.837			
Perceived Ease of Use (Yan et al., 2021)	It was easy for me to learn how to use the fitness app (PEOU1).	.703	.847	.582	4.311 (.612)
	The user interface of the fitness app is clear and easy to understand (PEOU2).	.792			
	Using the fitness app has generally proven to be very useful for me (PEOU3).	.832			
Social Influence (Cheng, 2021)	People who are important to me (e.g., relatives, friends, and colleagues) approve of my use of the fitness app (SI1).	.755	.906	.708	3.063 (.804)

Construct; references for items	*Items*	*Factor-loadings*	*CR*	*AVE*	*Mean (SD) n=403*
	People who influence me are of the opinion that I should use this fitness app (SI2).	.870			
	People whose opinion I value are in favor of me using the fitness app (SI3).	.901			
	My personal environment is of the opinion that I should use the fitness app (SI4).	.833			

Notes: AVE = Average Variance Extracted, CR = Composite Reliability, Mean: from 1= "Strongly disagree" to 5= "Strongly agree", SD = Standard Deviation).

Table 3. Assessment of discriminant validity.

	Confirmation	Continuance Intention	Flow Experience	Perceived Ease of Use	Perceived Enjoyment	Social Influence	Perceived Usefulness	Satisfaction
Confirmation								
Continuance Intention	0.674 [.574; .761]							
Flow Experience	0.585 [.437; .744]	0.497 [.346; .648]						
Perceived Ease of Use	0.500 [.380; .612]	0.410 [.309; .513]	0.412 [.283; .564]					
Perceived Enjoyment	0.692 [.591; .785]	0.666 [.569; .753]	0.659 [.504; .816]	0.676 [.590; .757]				
Social Influence	0.340 [.212; .461]	0.318 [.188; .442]	0.281 [.149; .425]	0.137 [.111; .223]	0.322 [.193; .441]			
Perceived Usefulness	0.720 [.637; .797]	0.681 [.593; .757]	0.569 [.422; .722]	0.431 [.360; .540]	0.618 [.510; .715]	0.277 [.139; .417]		
Satisfaction	0.815 [.757; .869]	0.793 [.721; .852]	0.655 [.520; .795]	0.578 [.480; .666]	0.780 [.708; .847]	0.325 [.207; .431]	0.718 [.638; .792]	

Notes: HTMT across all pairs of constructs after bootstrapping with sample means values and 95% confidence intervals.

5.2 Structural model evaluation

Moving on to assessing the structural model, variance inflation factors (VIFs) were examined. Their values range from 1.000 to 1.571 and, therefore, pass the conservative threshold of <3.0 for the absence of collinearity issues (Kock & Lynn, 2012) and the threshold of <3.3 for common method bias. Harman's single-factor approach was used to appraise common method bias further (Podsakoff et al., 2003). Results indicate that the first factor represents 33,4% of the total variance, which is below the recommended threshold of 50%. Next, R^2 (adjusted R^2) values were examined, exhibiting .336 (.331) for confirmation, .322 (.320) for perceived usefulness, .140 (.138) for flow experience, .562 (.559) for satisfaction, and .504 (.503) for continuance intention. Overall, in-sample predictive power can be considered moderate (Hair et al., 2019). Having ensured that all measures worked correctly, hypotheses were tested using a bootstrapping procedure with 10,000 subsamples. Point estimators, as well as 95% confidence intervals, were derived.

Our findings regarding testing the direct hypothesis show that confirmation positively and significantly influences satisfaction at the 0.001 level (β = .283, p < .001), which supports H1.

5.3 Mediation test

We utilized the bootstrapping method Zhao et al. (2010) recommended to test the proposed mediation effects. Table 4 summarizes the results. Hair et al. (2011) state that significant indirect effects confirm mediation. All eight indirect effects were significant in our study, with a 95% confidence interval, excluding zero. Therefore, we can deduce that satisfaction mediates the effect of confirmation on continuance intention (H2). Furthermore, perceived usefulness and flow experience mediate the relationship between confirmation and satisfaction (H3a and H4a), while perceived usefulness, flow experience, and satisfaction mediate the effect of confirmation on continuance intention (H3b and H4b). Secondly, we can infer that the effects of perceived ease of use, perceived enjoyment, and social influence are important gratifications reinforcing the effect of confirmation on satisfaction and continuance intention (H5a,b–H7a,b).

Table 4. Mediation assessment.

Hypothesis	*Relationship*	*Supported*	*Path coefficient*	*Standard Deviation*	*t-statistic*	*Confidence interval (95%)*
H2	EC → SAT → CI	Yes	.303	.033	9.178***	[.238, .368]
H3a	EC → PU → SAT	Yes	.176	.030	5.921***	[.120, .237]
H3b	EC → PU → SAT→ CI	Yes	.125	.023	5.461***	[.083, .173]
H4a	EC→ FE → SAT	Yes	.068	.019	3.505***	[.034, .109]
H4b	EC → FE → SAT → CI	Yes	.048	.014	3.463***	[.024, .078]
H5a	PEOU → EC → SAT	Yes	.099	.023	4.252***	[.056, .147]
H5b	PEOU → EC → SAT→ CI	Yes	.070	.017	4.040***	[.039, .107]
H6a	PE → EC → SAT	Yes	.152	.026	5.755***	[.102, .205]
H6b	PE → EC → SAT → CI	Yes	.108	.020	5.469***	[.071, .148]
H7a	SI → EC → SAT	Yes	.070	.019	3.708***	[.035, .110]
H7b	SI → EC → SAT→ CI	Yes	.050	.014	3.544***	[.024, .080]

Notes: ***: significant at the .001 level, **: at the .01 level, *: at the .05 level, n.s.: not significant. EC = Expectation Confirmation, SAT = Satisfaction, CI = Continuance Intention, PU = Perceived Usefulness, FE = Flow Experience, PEOU = Perceived Ease of Use, PE = Perceived Enjoyment, SI = Social Influence

6. Discussion

6.1 Contributions to theory

Despite the exponential rate at which fitness apps are still introduced to the market, most users cease using them soon after their initial trial; this gap between acceptance and discontinuance will likely not result in the much-needed digitization of preventive health

measures. The lack of research in this regard is troubling because it limits our understanding of long-term continued use and the effectiveness of fitness apps. While initial adoption indicates how many people are willing to try tools like fitness apps, the analysis of post-adoption behaviors reveals how users actually interact with them over time. Whether they find sustained value, face barriers, or eventually abandon them, considering the evolving user needs and expectations is especially relevant in the post-pandemic context. This study develops a theoretical framework, emphasizing the meaning of ECM (Bhattacherjee, 2001) and augmenting it by integrating flow experience and gratifications as psychological and motivational factors to examine their influence on the continuance of fitness apps. Based on our findings, all hypotheses regarding the indirect effects of perceived usefulness and flow experience on satisfaction and continuance intention and the gratifications' effect on the confirmation-satisfaction-continuance link are supported.

The significant effect of confirmation on satisfaction aligns with previous findings concerning various technologies (Nabavi et al., 2016; Sarkar & Khare, 2019; Wu et al., 2022). As a critical construct of the ECM, expectation confirmation is essential for the continuance intention of fitness apps because it directly influences user satisfaction. When users can confirm that the app meets their expectations, they are more likely to continue using it. Thus, confirmation reinforces users' perception of the app's ability to support their fitness goals, enhancing long-term use. Without this alignment, users are more likely to discontinue their app use due to unmet expectations.

The study also contributes by integrating flow experience into the ECM as an antecedent to satisfaction. Our findings support the role of flow experience on satisfaction towards fitness apps, affecting continuance intention. This result is consistent with studies relating to e-learning (Guo et al., 2016) and online courses (Daneji et al., 2019). Our analysis considers flow experience in a novel fitness app context. Users' perceived usefulness serves as a practical motivator that aligns directly with users' expectations for tangible progress. In contrast, users in states of flow feel a sense of accomplishment and enjoyment, leading to a more satisfying interaction with the app and strengthening users' intention to continue using it. However, perceived usefulness as a utilitarian factor in user behavior seems to be the more pivotal predictor than the hedonic-oriented processing variable of flow experience. This may be because perceived usefulness aligns with users' primary objective: to achieve fitness results. While states of flow (i.e., the immersive,

enjoyable experience during use) can enhance engagement and motivation, perceived usefulness assures users that the app is genuinely helping them progress toward their goals (Wu & Chen, 2017), reinforcing satisfaction through tangible results rather than just the experience. This aligns with other studies that indicate that perceived usefulness is a stable predictor of continuance intention, particularly in health and fitness applications because it directly addresses the primary objectives that drive users to adopt these tools in the first place (Cho et al., 2015; Huang & Ren, 2020).

Drawing from UGT, we contribute to the literature by incorporating gratifications obtained from app use as antecedents to confirmation and explore whether they reinforce satisfaction and continuance intention. Based on our results, perceived ease of use, perceived enjoyment, and social influence seem to have shaped users' initial expectations and contributed to the confirmation of those expectations, which in turn strengthened their satisfaction and continuance intention. Previous studies on health apps established a significant, direct effect of perceived ease of use on continuance intention (Cho, 2016; Zhang & Xu, 2020). Our study considers perceived ease of use as an antecedent to confirmation in a novel fitness app context. Results here indicate that if users can confirm their expectations that the app will simplify, rather than complicate, their fitness journey and support them in achieving their health goals, the extent to which they feel satisfied increases, reinforcing continuance intention. In recent years, the attention to perceived ease of use of technology has diminished, possibly reflecting users' adaptability to new technologies and their familiarity with dynamic changes. In the fitness app context, however, perceived ease of use is essential to reduce users' efforts and barriers to reinforcing a new habit. Ultimately, easy and intuitive functions are necessary for users to continue using their fitness app. Therefore, the influence of perceived ease of use remains critical in predicting users' continuance intention.

Moreover, our findings reveal that perceived enjoyment is critical concerning the extent to which they feel satisfied with the fitness app, depending on whether they can confirm their expectations. It seems to enhance the app's intrinsic appeal. Increasing the likelihood of a positive experience also strengthens motivation and reduces the sense of effort associated with engaging in fitness activities that often require commitment and discipline. In digital environments where expectations about functionality and experience are salient, enjoyment also contributes to users' overall perception of value. Our findings thus imply that users who confirm experiencing enjoyment alongside usefulness are

likelier to perceive satisfaction or, in other words, perceive the app as a comprehensive solution that meets both practical and emotional needs, which is corroborated by findings from Oyibo and Vassileva (2021). In the same vein, Lee and Cho (2017) found that perceived technical functions and affective aspects strongly and positively influence users' continuance intention with fitness apps.

Finally, users who perceive social gratifications (e.g., challenges or sharing results) from the app meet their expectations are more likely to be satisfied, reinforcing continuance intention with the fitness app. While the literature on technology adoption underlines the meaning of social influence (Beldad & Hegner, 2018), studies on technology continuance remain inconclusive in a fitness app context. Zhang and Xu (2020) found that social influence directly affected continuance. In contrast, Huang et al. (2023) found that social influence affected users' fitness app continuance intention only indirectly by influencing their perceived usefulness, indicating that users may attach higher importance to personal relevance, such as how well the app supports their unique fitness needs, rather than referent others' opinions or social validation. Although this may be true concerning the prediction of continuance intention, our results emphasize that social influence is at least a decisive factor in confirming expectations. This implies that if users feel their app obtains social gratifications (e.g., by providing strong community features), confirming their expectations for a supportive environment enhances their satisfaction and strengthens their continuance intention. Recent studies confirm that users in fitness settings often rely on social influence as a source of ongoing motivation because maintaining regular exercise or health routines can be challenging (Huang et al., 2023; Li et al., 2022).

In summary, examining antecedents of confirmation has proven vital in identifying specific reasons for using fitness apps other than technological factors. It enlarged the understanding of how these gratifications precede and influence confirmation and, thus, users' satisfaction and willingness to continue using them. This broadens the knowledge of fitness app users' specific needs and expectations and how these can be met.

6.2 Contributions to practice

As evidenced by the empirical results, the present findings provide practitioners with profound insights into how customer retention and continued use can be addressed. Especially by recognizing that confirming expectations is vital in determining

satisfaction, the study offers valuable insights into optimizing the user experience. Furthermore, the effect of perceived ease of use on confirmation requires a comprehensive understanding of user preferences, corroborated by findings from Cho et al. (2020) and Yousaf et al. (2021). Simple functions designed to undertake specific health and fitness-related tasks as effortlessly and quickly as possible are crucial to user satisfaction and when forming new, healthy habits (Kuru, 2023). Supporting users with easy-to-use, intuitive functions and effective communication measures is thus an essential complementary investment for both the pre-acceptance and the subsequent usage phase. Practitioners need a clear understanding of user needs and expectations, which underlines the importance of market research in developing strategies to retain users. Ensuring user satisfaction is highly relevant, particularly regarding the rapid growth of similar healthcare technologies and the high market competition of online and offline fitness offers. Practitioners may consider developing loyalty programs or membership models that reward regular use to strengthen satisfaction. This could be done through a points system where users collect points for each app use, which they can redeem for exclusive content or discounts on fitness products. In addition, regular updates and new functions should be implemented to keep the app attractive in the long term.

Findings also indicate that participants value the utility of fitness apps. Perceived usefulness was the most crucial determinant for promoting users' satisfaction and, in turn, continuance intention to use fitness apps. Users typically use fitness apps for specific purposes and expect the platforms' functions to guide them to achieve their health goals, i.e., lose weight (Angosto et al., 2023). Practitioners are strongly advised to ensure connectivity and seamless integration with other devices to elevate user experiences by enabling personalized, immediate feedback and adaptive training programs. Based on user responses in this study and in line with findings from extant literature (Kim & Lee, 2022; Kuru, 2023), customized functions and tailored recommendations are crucial elements of fitness apps. Han and Zo (2023) in their research on the perceived values of mHealth apps and Yadav et al. (2022) in their study on users' motivation and barriers when adopting healthcare apps also emphasize the importance of highlighting advantages and benefits to ensure users understand the app's value. Practitioners can use the current technological advances by integrating artificial intelligence (AI) into their apps to personalize the user experience further and increase user loyalty by providing personalized recommendations based on individual fitness data and user behavior. This

could be done by implementing an intelligent training assistant that analyses progress and automatically adapts workouts to best support the user's goals.

The integration of flow experience shows that the experience of flow (i.e., deep immersion) positively influences satisfaction and, thus, the long-term use of fitness apps. Fitness apps should be designed to be compatible with users' health and fitness needs and tailored to their individual use motives. Concerning the balance between workout challenges and users' skills, user retention increases if developers ensure that challengeable but achievable tasks can be set and functions such as intermediate goals or nutritional control are provided. Features such as monitoring progress add to a state of flow, reinforcing usefulness beliefs and satisfaction with the app.

Finally, the study points to the benefits of focusing on enjoyment as a crucial dimension of fitness app quality. Next to providing utilitarian value to users, apps should also create pleasurable experiences to ensure user retention. This may be achieved through personalized messages encouraging users and celebrating their successes. Apps could also provide motivational content that helps users achieve their personal health goals (e.g., through tailored nutrition plans) (Schuster & Parkinson, 2022). Recent research further emphasizes that gamification can considerably impact users' enjoyment and engagement (Silva et al., 2023) with the fitness app and ensure user retention (Huang et al., 2023; Kim & Lee, 2022). In their recent study on gamification-based digital therapeutics Sestino and D'Angelo (2024) not only confirm the importance of gamification elements but also highlight their significance to elderly users to adhere to care plans and ensure continued use. In their research on the gamification of fitness apps, Feng et al. (2020) discovered that incommensurate elements (i.e., not related to individual performance) were more effective in increasing user engagement with the app. Similarly, findings from this study suggest incorporating functions like badges to ensure user retention. Emotional (i.e., enjoyment) connections may be promoted through storytelling and personalized experiences in the app. Developing content that creates an emotional resonance, such as user success stories or interactive elements that emphasize the user's progress and personal challenges, may elevate user experiences and enjoyment of the app and thus influence their decision to continue using it.

6.3 Limitations and Future Research

Although the study yields essential insights into understanding users' post-adoption behaviors of fitness apps, a few limitations and opportunities for future research exist. First, different fitness apps incorporate various, even contrasting functions, which may be associated with distinct behavioral patterns. For instance, some users here primarily wanted to maintain a healthy lifestyle, while others wanted to improve their mental health through regular workouts. Due to the context-specific nature of this research, the generalizability of the findings may be limited. Depending on different use contexts, post-adoption behaviors may also change with the increasing diversity of functions. Hence, future research can scrutinize user motivations in more detail to identify specific underlying needs.

Secondly, while this research sample size was considerably large to derive statistical conclusions, the sample population is not comparable to the population structure based on age and sex in Germany. Female and younger users comprised the majority of the underlying sample of this study. As a result, the principal theories and constructs may not be appropriate in explaining post-adoption behaviors from other user groups utilizing fitness apps. The predominance of women and participants aged 20 to 30 is also found in other healthcare technology research (Lee & Cho, 2017; Yan et al., 2021; Yuan et al., 2015). According to Splendid Research (2019), the typical fitness app user is female, sporty, and under 30 years old, which is corroborated by a report from W3B (2018) indicating that one in three 30- to 50-year-olds uses fitness apps, while nearly 50% of 20- to 30-year-olds do. With a growing need to address challenges related to healthy aging and longevity, it would be interesting to examine whether the theories and constructs used in this research are appropriate for explaining post-adoption behaviors amongst older people (Frishammar et al., 2023). It is recommended that the research model be replicated in other countries and cultures to confirm the validity of the model in different contexts.

Finally, this study is the first to obtain users' post-adoption behavior of fitness apps post-pandemic. Data collection started six months after the pandemic was declared over. However, a longitudinal study design is needed to provide a holistic understanding of which relationships inferred in this research continue to hold.

7. Conclusion

This study is one of the first in the context of healthcare technologies, intending to shed light on the influence of psychological and motivational aspects on users' decisions to continue using fitness apps. Despite the exponential rate at which fitness apps are still introduced to the market, most users cease using them soon after their initial trial. Such a gap between acceptance and discontinuance will likely not result in digitalizing preventive measures to improve health outcomes. The influence of psychological and motivational factors in explaining continued fitness app use has not yet been analyzed sufficiently in the extant literature, especially not after COVID-19, which has led to significant changes in consumers' usage behaviors of apps. This study evaluated antecedents to satisfaction and their mediating roles from a utilitarian and hedonic perspective in determining users' fitness app continuance intentions and examined the role of gratifications in driving the confirmation-satisfaction-continuance link. Perceived usefulness is more important in determining users' satisfaction and, in turn, continuance intention compared to flow experience. While states of flow can enhance users' motivation, perceived usefulness assures them that the app is genuinely helping them progress toward their goals. Furthermore, including gratifications as antecedents to confirmation advanced the understanding of critical user needs. Intuitive and personalized functions and gamification drive users' continued use and present essential building blocks for digitalized healthcare prevention in the future.

Appendix

Table A1. Sociodemographic characteristics of respondents (n = 403).

Demographics/ Characteristics	*Specifications*	*Counts*	*Proportion (in %)*
Age	≤ 20 years	23	5.7
	21 – 30 years	316	78.4
	31 – 40 years	45	11.0
	41 – 50 years	9	2.0
	51 – 60 years	7	1.5
	> 60 years	2	0.4
Gender	Female	249	64.3
	Male	142	35.2
	Diverse	2	0.5
Monthly Income	< 1000 Euros	100	24.8
	1001 – 2000 Euros	161	40.0
	2001 – 3000 Euros	56	13.9
	> 3000 Euros	54	13.4
	N/S	32	7.9
Employment status	Employed Full-time	87	21.6
	Employed Part-time	37	9.2
	Student	247	61.3
	Apprentice	3	07
	Retired	1	0.2
	Other	28	6.9
Education	Graduate	144	35.8
	Bachelor's degree	193	47.9
	Master's degree or higher	54	13.4
	Other	12	3.0
Place of residence	City	284	70.5
	Suburban	49	12.2
	Rural	70	17.4

Table A2. Fornell-Larcker evaluation.

	Confirmation	Continuance intention	Flow experience	Perceived ease of use	Perceived enjoyment	Social influence	Perceived usefulness	Satisfaction
Confirmation	.813							
Continuance intention	.545	.886						
Flow experience	.374	.345	.829					
Perceived ease of use	.442	.425	.307	.763				
Perceived enjoyment	.529	.552	.426	.559	.827			
Social influence	.274	.280	.194	.068	.263	.841		
Perceived usefulness	.567	.582	.382	.409	.496	.232	.805	
Satisfaction	.670	.710	.460	.560	.650	.287	.622	.915

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3.2 Research Paper No. 4: Exploring the antecedents of users' fitness app continuance in the aftermath of COVID-19: An integrated TAM-ECM framework and the role of task-technology fit

Abstract: The COVID-19 health crisis led to a significant increase in the demand for fitness apps, which remains high even after the end of the pandemic. However, the question arises whether fitness apps can gain momentum post-pandemic or whether users will abandon their use. Unlike related studies on user acceptance of fitness apps or corresponding post-adoption behaviors during COVID-19, this research proposed a hybrid model examining antecedents to user beliefs in predicting continued use behaviors post-pandemic. Based on structural equation modelling, the proposed synthesis of the expectation-confirmation model with the technology acceptance model was verified with empirical data from 403 actual fitness app users from Germany. The results confirm that satisfaction is the main predictor for users' fitness app continuance intention, while perceived ease of use only had an indirect effect. Task-Technology fit is a crucial antecedent to user beliefs in driving post-adoption behaviors of fitness apps. The hybrid model showed the potential to provide a more complete explanation of fitness app users' continuance intentions in the aftermath of COVID-19.

Key Words: Continuance intention, hybrid model, fitness app users, post-adoption use behavior, post-pandemic.

1. Introduction

In recent years, the digital transformation has permeated healthcare systems and patient care, and the sports and fitness industry is no exception (Mertala & Palsa, 2024; Thompson et al., 2024). Catalyzed by the COVID-19 health crisis, numerous digital health approaches have been brought to market to limit the virus outbreak (Angosto et al., 2023; Ko et al., 2023). Coinciding with users' increasing understanding of the value of physical activity and individual health (Andersson et al., 2022; Kumar et al., 2018; Lewis, 2008; Schulenkorf & Siefken, 2019), fitness apps have been one of the vital healthcare technologies experiencing a spike in demand ever since. For instance, the number of fitness app downloads worldwide rose from 1.02 billion in 2017 to 3.20 billion in 2021 during COVID-19 and is expected to reach 5.53 billion downloads in 2027 (Statista Market Insights, 2024), indicating that even after the pandemic with on-site

fitness options (e.g., gyms) readily available again to the public, online fitness services are still in high demand.

The rise of fitness apps has thus revolutionized the traditional understanding of sport and exercise. Apart from their value to end-users by offering convenient ways to maintain and monitor health goals, they represent significant opportunities and challenges for sports management (Molina & Myrick, 2021; Tjønndal, 2022; Tu et al., 2019). As such, fitness apps have the potential to fundamentally change the interaction between sports organizations and their members by enabling innovative business models, improved customer engagement, and personalized user experiences (Fenton et al., 2022). However, prior literature confirms the existence of a gap between acceptance and discontinuance in user behavior that is especially apparent in healthcare technology (Cho, 2016). Although the initial acceptance of fitness apps is essential in promoting the much-needed paradigm shift in healthcare and fitness behavioral changes (Berg et al., 2015), only continued use leads to viable and comprehensive technology (i.e., app) success (Bhattacherjee, 2001). Therefore, an in-depth understanding of users' post-adoption behaviors is needed to materialize the benefits on the individual and organizational levels.

So far, extant research based on various theoretical backgrounds mainly focused on analyzing user acceptance/adoption of fitness apps (Baer et al., 2022; Dhiman et al., 2019; Wei et al., 2021) or continued use behaviors during COVID-19 (Guo et al., 2022; Li et al., 2022). Nevertheless, findings on users' fitness app post-adoption behaviors, particularly in the aftermath of the pandemic, are rare (Elsotouhy et al., 2024) but ever more relevant to practitioners. For example, recent findings confirm that although decision-makers within sports organizations acknowledge the importance of innovation and digital tools, less than half proved to have a clear strategy in this regard. This leaves sports organizations behind compared to other industries in terms of innovation strategy (PwC, 2019). Moreover, it is a long-known phenomenon that gender shapes the decision-making process determining the adoption of a new technology and short-term use behaviors (Venkatesh et al., 2000). Recent research on technology continuance further corroborates this notion by indicating gender-related differences in post-adoption use behaviors in the healthcare context (Martín et al., 2023). For instance, Dam et al. (2018) in their study on health app adoption found that selected subgroups (e.g., younger males) tend to be motivated by social comparison of health and fitness results. At the same time,

such functions decrease the intention of females to use the app. However, the current literature on fitness app post-adoption behaviors lacks clarity in this regard.

In this study, we, therefore, synthesize Bhattacherjee's (2001) expectation-confirmation model (ECM) and Davis (1989) technology acceptance model (TAM) and integrate users' perception of task-technology fit (TTF) (Goodhue & Thompson, 1995) to propose a hybrid model explaining users' intention to continue using fitness apps. The aim of this research is (1) to identify the factors that explain continuance intentions for fitness apps by verifying the proposed research model with empirical data from fitness app users in Germany and (2) to examine the role of additional possible influencing factors not proposed in the original ECM. We combine these theoretical perspectives for the following reasons: First, although ECM has proven good predictive validity for various technologies, it has been criticized for overlooking other influencing factors potentially affecting users' post-adoption behaviors (Lee, 2010), which also holds for subsequent healthcare technology-related research (Ries & Baier, 2024). Moreover, by integrating ECM and TAM into a hybrid framework based on their similarities, we expect to enhance explanatory power (Hong et al., 2006) and provide a more holistic explanation of users' continuance intention concerning fitness apps. By incorporating the different constructs of user beliefs (i.e., confirmation from ECM and perceived ease of use from TAM) (Hong et al., 2006), this research provides an in-depth understanding of the antecedents to users' post-adoption behaviors concerning continued fitness app utilization. Finally, task-technology fit (i.e., matching technology functions with users' task requirements) is worth understanding drawing from research on ERP systems (Cheng, 2020) as such fit may precede user beliefs affecting their continuance intention of fitness apps. This, in turn, may help explain the acceptance-discontinuance phenomenon.

While previous research has examined ECM and TAM independently in explaining healthcare technology usage (Beldad & Hegner, 2018; Cho, 2016; Guo et al., 2022), to the best of our knowledge, no study has yet theoretically combined these two models and extended it with antecedents to user beliefs (i.e., TTF) within the healthcare technology context. Therefore, the primary contributions of this research are threefold: First, evaluating the synthesis of ECM and TAM and its further extension with TTF by empirically testing which factors are critical in affecting users' continuance intention. Second, exploring potential gender-specific differences in use behavior to give more clarity missing in current literature, and third, helping to fill the gap in the literature

between acceptance and continuance streams of fitness app usage research. By examining users' post-adoption behavior and analyzing gender differences in app usage, we thus lay grounds for how sports managers can use digital tools to reach their target groups better and build long-term customer relationships. The following section provides an overview of the literature and the research model, followed by methods and results. After discussing the results, managerial and theoretical contributions are outlined, and limitations, research outlook, and concluding remarks are presented.

2. Literature Review and Hypotheses Development

2.1 Expectation-confirmation model (ECM)

The ECM, as proposed by Bhattacherjee (2001), is rooted in IS continuance theory, specifically examining users' post-adoption behaviors to explain the long-term and continued use of an IS. It has been well-researched and validated for various technologies and demonstrated good predictive validity in explaining users' post-adoption behaviors (Hong et al., 2006; Thong et al., 2006). Grounded on the expectation-confirmation theory (ECT) (Oliver, 1980) often applied in the marketing field to explore the influence of satisfaction on consumers repurchase intentions, ECM extends the traditional expectation-confirmation research to propose a direct relationship between disconfirmation and post-usage perceptions of benefits (i.e., perceived usefulness) (Bhattacherjee & Lin, 2015). While ECT assesses both consumers' ex-ante and ex-post expectations, ECM transforms ex-ante expectations to post-usage perceived usefulness and replaces repurchase intention with continuance intention for continued IS usage (Bhattacherjee, 2001). Essentially, ECM proposes that IS continuance intention depends on users' satisfaction with prior technology utilization and users' perception of the usefulness of further use. Both are grounded on how users' initial expectations were disconfirmed during previous usage experiences. Additionally, perceived usefulness is also proposed to impact satisfaction perceptions (Bhattacherjee et al., 2008).

The utility of the ECM has been supported across various research fields, including online consumer behavior research (Lee, 2010; Sarkar & Khare, 2019), sports marketing (Chiu et al., 2021; Kim et al., 2023), and eHealth (Gupta et al., 2021; Kumar & Natarajan, 2020). For instance, Cheng (2021) in his research on robo-advisors noted that the synthesis of ECM with flow theory helps explain users' continuance intentions. In the e-learning field based on an extended ECM, Sørebø et al. (2009) explored the effects of extrinsic and intrinsic motivators on predicting teachers' e-learning continuance intentions. However,

the ECM has rarely been applied in the context of fitness and health apps (Cho, 2016; Cho & Lee, 2020; Ries & Baier, 2024), and users' post-adoption behaviors of fitness apps in the aftermath of COVID-19 have yet to be examined. The continued use of fitness apps after the pandemic remains highly important in establishing the much-needed paradigm shift in the digitization of healthcare and lifestyle technologies, and it is highly relevant to practitioners due to high market competition in this field. Therefore, based on Bhattacherjee's (2001) proposed model, this research aims to explain the influence of technological factors (e.g., perceived ease of use) and antecedents to user beliefs (i.e., TTF) to investigate their relationships with users' continuance intentions with fitness apps post-pandemic. Detailed inferences and related research hypotheses are elaborated on below.

Drawing from related research on healthcare technologies and apps (Cho, 2016; Ries & Baier, 2024) and consistent with the post-adoption paradigm (Bhattacherjee, 2001), users whose previous expectations about the fitness app are met are likely to perceive the usefulness of the app as well. Moreover, satisfaction arises if the prior expectation about the fitness app matches the actual use experience (Zhang & Xu, 2020). Fitness apps are mainly used with a clear purpose (e.g., weight loss) (Angosto et al., 2023). Hence, users consider the app useful if it helps accomplish a given task. Consequently, perceived usefulness positively influences users' satisfaction and their intention to continue using it. In line with findings from marketing research (Bolton, 1998; Mittal & Kamakura, 2001), a key predictor for recurrent use of technology is the level of user satisfaction, which also holds for subsequent findings concerning fitness apps (Zhang & Xu, 2020). The proposed relationships are reinforced by succeeding healthcare technology and fitness research (Chiu et al., 2021; Cho & Lee, 2020; García-Fernández et al., 2018). Therefore, we hypothesize:

H1. Confirmation will positively affect users' perceived usefulness of fitness apps.
H2. Confirmation will positively influence users' satisfaction with fitness apps.
H3. Perceived Usefulness will positively impact users' satisfaction with fitness apps.
H4. Perceived Usefulness will positively impact users' continuance intention of using fitness apps.
H5. Satisfaction will positively influence users' continuance intention of fitness apps.

2.2 Synthesis of ECM and TAM

First introduced by Davis (1989) as a theoretical extension of the theory of reasoned action (TRA) seeking to explain behavior (Fishbein & Ajzen, 1975), TAM is one of the core theories explaining users' initial technology adoption. According to TAM, actual technology usage is determined by users' behavioral intention, which in turn is predicted by the two fundamental constructs, perceived usefulness and perceived ease of use, constituting the primary beliefs that determine technology acceptance. Referring to Davis (1989), perceived usefulness is defined as ''the degree to which a person believes that using a particular system would enhance his/her job performance", and perceived ease of use is defined as ''the degree to which a person believes that using a particular system would be free of physical and mental effort" (p. 320). Moreover, both constructs influence users' attitudes toward using the technology, which, in line with TRA, determines users' behavioral intentions leading to actual technology use. Relying on high prediction accuracy, previous research has extensively examined the relationships predicting users' technology acceptance for various types of technologies, including e-learning (Cheung & Vogel, 2013), AI-based technologies (Li, 2023; Song, 2019), or social media usage in the sports sector (Eagleman, 2013). It has recently been applied to explore continuance intentions among other technologies for fitness apps (Beldad & Hegner, 2018; Cho et al., 2020; Huang & Ren, 2020).

Although psychology research provides the building blocks for both acceptance and continuance streams of research, they have different theoretical backgrounds: ECM is based on the expectation-confirmation-satisfaction paradigm, while TAM pertains to the beliefs-attitudes-behavior paradigm proposed by TRA (Premkumar & Bhattacherjee, 2008). It follows that TAM, as a static model, is based on user perceptions (i.e., prospective expectations) about using a specific technology. In contrast, as a process model, ECM builds on actual usage experience (i.e., retrospective perceptions) (Premkumar & Bhattacherjee, 2008). Therefore, the similarity of both theories provides grounds for integrating the two models into a hybrid framework. Regarding the complementary nature of ECM and TAM, their synthesis is expected to enhance explanatory power, as evidenced by extant research in other technology fields (Hong et al., 2006): Conceptually, attitude and satisfaction both pertain to users' evaluation of the technology. Satisfaction in the post-usage phase is an evaluation of pre-usage attitudes (Cheng, 2021). Furthermore, in line with research from Bhattacherjee (2001) and Hong

et al. (2006), continuance intention of a technology and users' intention to use the technology exhibit a high degree of similarity. For these reasons, the present study proposes a hybrid model incorporating ECM and TAM. Details are elaborated on below.

First, the confirmation of expectations necessitates the ability to use fitness apps adequately. As perceived ease of use increases with use experience and thereby reduces the effort necessary to obtain skills related to the technology (Davis, 1989), users who confirm their previous expectations of the fitness app are also likely to be able to use it effectively. In other words, the extent to which fitness app users confirm their expectations of the application influences their perceived ease of use (Cho & Lee, 2020). Next, perceiving the fitness app as useful depends on the understanding that only a few cognitive resources are necessary to learn its application, which is inversely related to the effort required to use it (Cho, 2016). This means users perceive fitness apps as useful if they feel that their application is not demanding or complex; the easier it is for users to interact with the fitness app, the higher the likelihood they will find it useful. Within the context of technology adoption, perceived ease of use is often constituted as a prime determinant of affect (Davis, 1989). Since it can be argued that satisfaction is one type of affect (Thong et al., 2006), users' perceptions that the fitness app is easy to use will likely lead to satisfaction with it (Yan et al., 2021b). Albeit the strong prediction power of perceived usefulness in the context of technology adoption (Davis, 1989; Karahanna et al., 1999), research findings also underline the critical influencing role of perceived ease of use on continuance intention for novel technologies (Venkatesh, 2000). Hence, if users perceive their fitness app as easy to use, concentration on the required task is enhanced, resulting in their continuance intention. So far, results relating to the synthesis of ECM and TAM within the context of healthcare technology remain scarce (Kumar & Natarajan, 2020). Drawing from research concerning ERP systems (Cheng, 2020), we postulate:

H6. Confirmation will positively affect users' perceived ease of use of fitness apps.

H7. Perceived ease of use will positively influence users' perceived usefulness of fitness apps.

H8. Perceived ease of use will positively impact users' satisfaction with fitness apps.

H9. Perceived ease of use will positively influence users' continuance intention of fitness apps.

2.3 Integration of TTF into the hybrid model of ECM and TAM

To explain how technology influences user performance, Goodhue and Thompson ’s (1995) TTF model is often applied in related research. It draws from two reciprocal streams of research, i.e., user attitudes as antecedents of actual use and task-technology fit as a determinant of performance (Goodhue & Thompson, 1995). In short, the TTF model refers to the extent of fit between a new technology and user needs. It thus relates to the congruity between users’ task requirements, their respective abilities, and the technology’s functionality. TTF assumes that user performance with technology can be increased based on the premise that users’ needs match the functionality of the technology (Goodhue & Thompson, 1995). TTF, hence, is determined by both task and technology characteristics. These, in turn, directly influence performance (Dishaw & Strong, 1999).

Consequently, users’ perception of its performance impact increases when the technology matches the task. TTF has been extensively applied to technology adoption and acceptance contexts (Chen, 2019; Oliveira et al., 2014; Yen et al., 2010) and, more recently, to a variety of technology post-adoption behavior settings such as e-learning continuance intentions (Cheng, 2019), online shopping continuance behaviors during COVID-19 (Al-Hattami, 2021), or users’ continued use of chatbots in a tourism context (Dhiman & Jamwal, 2023). The present research utilized TTF in the context of fitness apps for three main reasons. First, TTF is a validated and tested theoretical framework for assessing reasons behind accepting technology from an individual’s perspective (Cane & McCarthy, 2009). Second, it has been fruitfully applied to various technology applications (Aljukhadar et al., 2014). Third, previous research has proven its compatibility with other theoretical models for various technological contexts, such as the unified theory of acceptance and use of technology (UTAUT) (Wang et al., 2020) in a healthcare technology setting, UTAUT2 (Faqih & Jaradat, 2021) concerning augmented reality in education, or TAM (Dishaw & Strong, 1999) regarding general technology utilization. Therefore, we explore whether TTF as an antecedent to user beliefs and satisfaction affects users’ fitness app continuance intentions.

The following proposed relationships are drawn from research on e-learning continuance studies (Cheng, 2019) and user ERP-system continuance intentions (Cheng, 2020); as of today, no comparable research exists concerning the healthcare technology and fitness context. If users feel that the fitness app meets specific task needs, confirmation of it arises. Users perceive congruence between their fitness app utilization and their health

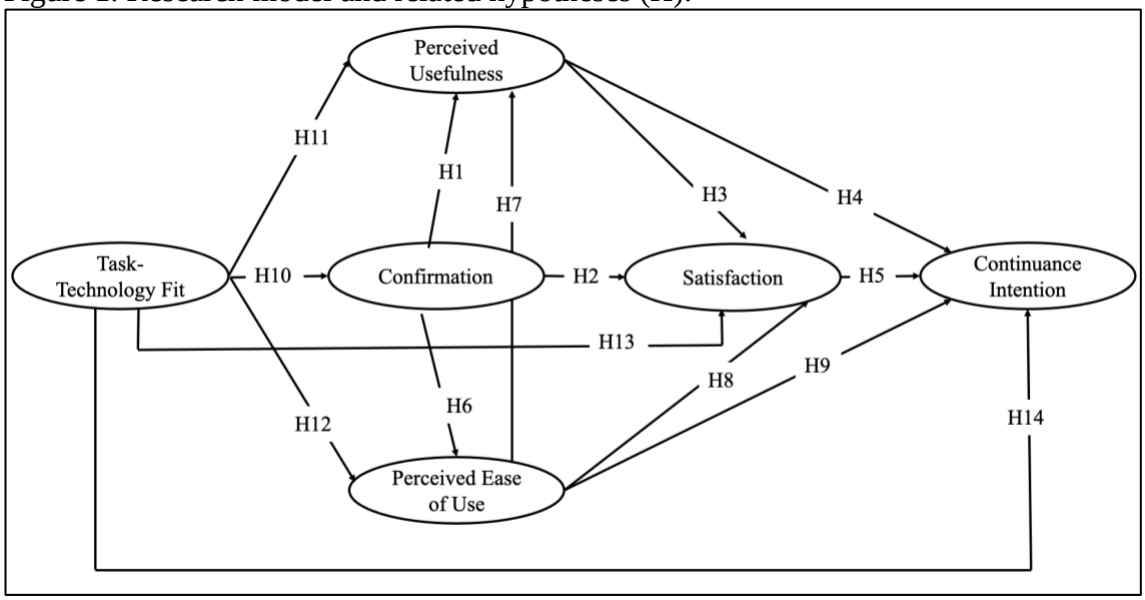
task requirements. Next, the perceived usefulness of the fitness app is determined by the level of specific task characteristics it meets. Users will perceive it as useful if the app supports them in completing their fitness and health goals. Furthermore, users' perception of fit between tasks and their fitness app is an antecedent of their perceived ease of use of the fitness app.

Additionally, the more the fitness app meets users' task characteristics, the higher users' perceived ease of use will be. The positive conjunction between perceived fit and perceived ease of use thus entails that high fit enables users not to make significant alterations to their workout style or health requirements. It follows that users' perceived fit between tasks and technology positively influences their satisfaction with the fitness app. That is a good fit between the fitness app and users' health goals or workout tasks, directly and positively impacting their satisfaction with the fitness app. Finally, the perception of fit between tasks and the fitness app precedes users' continuance intention; thus, when users perceive that the fitness app suits their tasks, they will intend to use it in the future. We therefore derive the following hypotheses:

H10. TTF will positively affect users' confirmation of fitness apps.
H11. TTF will positively impact users' perceived usefulness of fitness apps.
H12. TTF will positively influence users' perceived ease of use of fitness apps.
H13. TTF will positively impact users' satisfaction with fitness apps.
H14. TTF will positively affect users' continuance intention of using fitness apps.

Figure 1 depicts the proposed research model and outlines the above-postulated relationships.

Figure 1. Research model and related hypotheses (H).



3. Methods

3.1 Data collection and descriptive statistics

An online questionnaire was employed using LimeSurvey to assess the underlying constructs and their relationships. The survey was administered in German and was directed to fitness app users who are currently using a fitness app and are working out regularly. Data was collected by spreading the online self-administered questionnaire across various fitness online communities and health forums over three months to comprehensively understand fitness app use behaviours. According to Bitkom Research (2023) two-thirds and primarily younger Germans are using fitness and health apps on their smartphones, which was also recently confirmed by Tillmann et al. (2024). Therefore, fitness app users intensively use online communities and health forums, suggesting that the present study's online context can be deemed suitable.

Furthermore, Statista Market Insights (2024) projects revenues of 6.15 billion euros worldwide by 2025, while revenues in Germany reached 142.7 million euros in 2023, emphasizing that fitness apps retain an essential role in users' health regimes even with on-site alternatives readily available after the pandemic has been declared over. In order to possibly exclude the influence of COVID-19 on users' continued fitness app use behaviour and to ensure sufficient time between the end of the pandemic in May 2023 and the time of the survey, data collection started on October 30, 2023, and ended on January 30, 2024. Participants answered several introductory questions concerning their prior experiences with fitness apps. Next, items measuring the ECM constructs, the TAM-

construct perceived ease of use, and task-technology fit were presented. Lastly, respondents' demographics (i.e., age, gender, income, employment status, education level, and residence) were queried. A total of 539 responses were recorded. Eighty-nine participants indicated that they had no prior experience with fitness app utilization and resigned from the questionnaire early. After eliminating incomplete responses and speeders, 403 responses were considered for further analysis.

Table 1 outlines the sample's descriptive statistics and characteristics. Fitness app users were relatively young; 78.4% were aged 21 – 30; only a small fraction of users were aged 40 and older (3.9%). The majority of respondents were female (64.3%) and were students (n = 247, 61.3%) with a monthly income of up to 2,000 Euros (n = 161). Most respondents held a bachelor's degree (n = 193, 47.9%) and lived in cities (n = 284, 70.5%). Concerning use experience, most participants regularly utilized Asana Rebel (n = 185, 45.9%), followed by adidas Runtastic (n = 99, 24.6%). 96.3% of users (n = 388) perceived their fitness application as easy to use, and only a few users reported problems (n = 15, 3.7%) which mainly concerned technical features of their fitness app (e.g., small smartphone screens). One hundred thirty-two participants surveyed used their fitness app several times a week, while eighty-two users utilized their app even daily. In terms of use context, improving athletic performance was the most frequent use motive (n = 246, 61.0%). Almost one-third (n = 128, 31.8%) of the participants surveyed used their fitness app to improve their mental health through regularly working out. In comparison, 41.2% of respondents (n = 166) wanted to optimize their physical health, and 39% of the users (n= 157) explicitly wanted to lose weight with the help of a fitness app.

Table 1. Sociodemographic characteristics of respondents (n = 403).

Demographics/ Characteristics	*Specifications*	*Counts*	*Proportion (in %)*
Age	≤ 20 years	23	5.7
	21 – 30 years	316	78.4
	31 – 40 years	45	11.0
	41 – 50 years	9	2.0
	51 – 60 years	7	1.5
	> 60 years	2	0.4
Gender	Female	249	64.3
	Male	142	35.2
	Diverse	2	0.5
Monthly Income	< 1000 Euros	100	24.8
	1001 – 2000 Euros	161	40.0
	2001 – 3000 Euros	56	13.9
	> 3000 Euros	54	13.4
	N/S	32	7.9
Employment status	Employed Full-time	87	21.6
	Employed Part-time	37	9.2

Demographics/ Characteristics	*Specifications*	*Counts*	*Proportion (in %)*
	Student	247	61.3
	Apprentice	3	07
	Retired	1	0.2
	Other	28	6.9
Education	Graduate	144	35.8
	Bachelor's degree	193	47.9
	Master's degree or higher	54	13.4
	Other	12	3.0
Place of residence	City	284	70.5
	Suburban	49	12.2
	Rural	70	17.4

3.2 Items and constructs

All constructs were measured by multiple reflective items on a five-point Likert scale (1= "strongly disagree" to 5= "strongly agree"). The underlying items were derived from validated scales from existing literature. Based on the maturity of ECM, TAM, and TTF, the current research benefits from previous empirical validations. Item validity and reliability are thus ensured.

4. Results

4.1 Measurement model evaluation

First, the underlying constructs were examined. Across the sample, means ranged from 3.601 (for confirmation) to 4.311 (for perceived ease of use). Users demonstrated a high level of satisfaction (mean = 4.036, SD = .788), while continuance intention (mean = 3.670, SD = 1.059) showed to be slightly lower than satisfaction but still was high (see Table 2). Generally, users responded positively concerning the underlying constructs, indicating that the model applied here is appropriate.

Based on the two-step analysis approach used in partial least squares structural equation modeling (PLS-SEM), the evaluation of the model started with the outer model. The algorithm was set to a path weighting scheme, allowing 3,000 iterations at maximum, using a stop criterion of 10^{-7}. Results converged after six iterations. Table 2 summarizes the results. Employing a threshold of .65 (Hair et al., 2014), outer loadings were assessed, finding that all indicators survive and convergent validity thus could be established. Construct reliability and validity were examined by drawing on composite reliability (CR), Cronbach's α, and average variance extracted (AVE). All values exhibit satisfying results.

Next, discriminant validity was checked by applying the heterotrait-monotrait ratio (HTMT) (Henseler et al., 2015) for analysis. Results are displayed in Table 3. All pairings pass the conservative threshold of < .85 (Henseler et al., 2015). In addition, Table 3 depicts HTMT results from bootstrapping. The critical value of 1 is excluded from all intervals, establishing discriminant validity. The bootstrapping run further indicates satisfying values for the lower and upper limits of the confidence intervals for Cronbach's α and CR (Hair et al., 2019). The evaluation of the measurement model thus demonstrates the absence of measurement problems. Construct reliability and validity, as well as discriminant validity, could be established.

Table 2. Assessment of convergent validity and internal consistency reliability.

Construct; references for items	*Items*	*Factor loadings*	*Cron-bach's α*	*CR*	*AVE*	*Mean (SD) n=403*
Task-Technology Fit Cheng (2020)	The fitness app fits well with my health and fitness needs (TTF1).	.876	.865	.908	.714	3.782 (.754)
	Using the fitness app fits in well with the way I want to manage my health and sports performance (TTF2).	.886				
	Using the fitness app fits in well with the way I want to promote my health (TTF3).	.873				
	Using the fitness app fits in well with all aspects of my lifestyle (TTF4).	.735				
Confirmation Bhattacherjee (2001)	My experience with the fitness/wellness app was better than I had originally expected (EC1).	.828	.742	.853	.660	3.601 (.747)
	Using the fitness/wellness app has brought me more benefits than I originally expected (EC2).	.841				
	In general, my initial expectations regarding the use of the fitness/wellness app were met (EC3).	.772				
Perceived usefulness Yan et al. (2021b)	Using the fitness/wellness app improves my performance (PU1).	.721	.818	.880	.648	3.712 (.762)
	Using the fitness/wellness app helps me to effectively pursue my health goals (PU2).	.824				
	The fitness/wellness app makes it easier for me to maintain a healthy lifestyle (PU3).	.830				
	I find the fitness/wellness app useful for following a healthy lifestyle (PU4).	.839				
Perceived Ease of Use Yan et al. (2021b)	It was easy for me to learn how to use the fitness/wellness app (PEOU1).	.705	.782	.843	.575	4.311 (.612)
	The user interface of the fitness/wellness app is clear and easy to understand (PEOU2).	.768				
	Using the fitness/wellness app has generally proven to be very useful for me (PEOU3).	.849				
	I find the fitness/wellness app easy to use (PEOU4).	.702				
Satisfaction Yan et al. (2021b)	I am happy with my decision to use this fitness/wellness app (SAT1).	.918	.903	.939	.837	4.036 (.788)
	I am satisfied with my experience with this fitness/wellness app so far (SAT2).	.918				
	My decision to use this fitness/wellness app was a good one (SAT3).	.909				

Construct; references for items	*Items*	*Factor loadings*	*Cron-bach's α*	*CR*	*AVE*	*Mean (SD) n=403*
Continuance intention Cheng (2021)	I intend to continue using the fitness/wellness app in the future (CI1).	.937	.861	.915	.784	3.670 (1.059)
	I will use the fitness/wellness app regularly in the future (CI2).	.938				
	I intend to continue using this fitness/wellness app and not use any other apps (CI3).	.772				
	Using the fitness app fits in well with all aspects of my lifestyle (TTF4).	.735				

Notes: AVE = Average Variance Extracted, CR = Composite Reliability, Mean: from 1= "Strongly disagree" to 5= "Strongly agree", SD = Standard Deviation).

Table 3. Assessment of discriminant validity.

	Continuance Intention	Confirmation	Perceived Ease of Use	Perceived Usefulness	Satisfaction	Task-Technology Fit
Continuance Intention						
Confirmation	0.674 [.574; .761]					
Perceived Ease of Use	0.410 [.309; .513]	0.500 [.380; .612]				
Perceived Usefulness	0.681 [.593; .757]	0.720 [.637; .797]	0.431 [.320; .540]			
Satisfaction	0.793 [.721; .852]	0.815 [.757; .869]	0.578 [.480; .666]	0.718 [.638; .792]		
Task-Technology Fit	0.715 [.634; .783]	0.629 [.535; .715]	0.492 [.387; .596]	0.671 [.565; .770]	0.726 [.643; .796]	

4.2 Structural model evaluation

Moving on to evaluate the structural model, variance inflation factors (VIFs) were checked. Values ranged from 1.000 to 2.339, passing the conservative threshold of < 3.0 for the absence of collinearity issues (Kock, 2015) and the threshold of < 3.3 for common method bias. Next, R^2 (adjusted R^2) values were reviewed, exhibiting .260 (.258) for confirmation, .434 (.429) for perceived usefulness, .283 (.280) for perceived ease of use, .637 (.633) for satisfaction, and .566 (.561) for continuance intention. Overall, in-sample predictive power can be considered moderate (Hair et al., 2019). Having ensured that all measures worked correctly, hypotheses were tested using a bootstrapping procedure with 10,000 subsamples. Point estimators, as well as 95% confidence intervals, were derived. Table 4 shows the results.

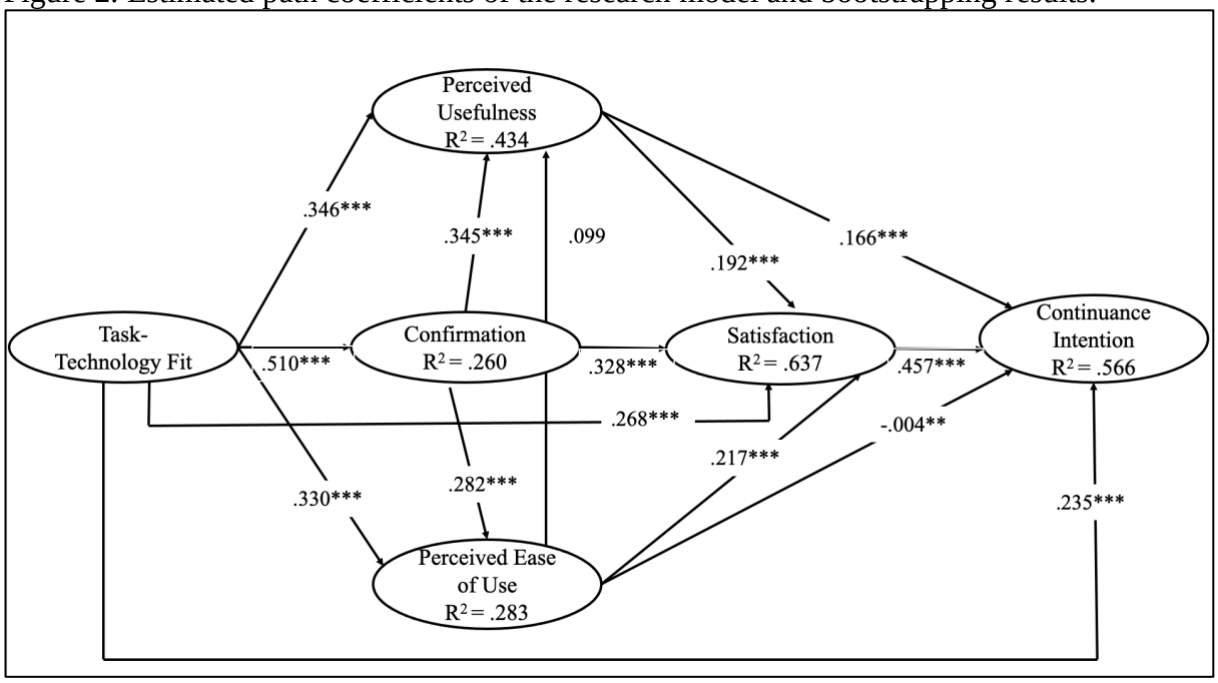
Nearly all hypotheses could be supported at the .001 significance level. Concerning the proposed ECM and TAM relationships, statistical significance could be established for all hypotheses except for H7 (Fig. 2, Tab. 4). Additionally, contrary to our prior beliefs, perceived ease of use exhibits a significant but weak negative effect on continuance

intention (H9). Results from the bootstrapping procedure suggest specific and joint-mediation effects of the two key mediators, perceived usefulness and satisfaction, in the relationship between perceived ease of use and continuance intention. Table 5 shows that only satisfaction can significantly explain the effect of perceived ease of use on continuance intention (t = 4.299, p = 0.000), while perceived usefulness seems to mediate the relationship between perceived ease of use and satisfaction (t = 2.653, p = 0.008).

Table 4. Hypotheses testing results.

Hypo-thesis	*Path*	*Path coefficient (effect size f^2)*	*Confidence interval (95%)*	*t-statistic (p-value)*
H1	Confirmation → Perceived usefulness	.345 (.143)	[.277, .461]	7.917 (<0.001)
H2	Confirmation → Satisfaction	.328 (.177)	[.384, .536]	11.813 (<0.001)
H3	Perceived usefulness → Satisfaction	.192 (.057)	[.108, .279]	4.429 (<0.001)
H4	Perceived usefulness → Continuance Intention	.166 (.036)	[.146, .356]	4.762 (<0.001)
H5	Satisfaction → Continuance Intention	.457 (.205)	[.323, .581]	6.940 (<0.001)
H6	Confirmation → Perceived Ease of Use	.282 (.082)	[.177, .389]	5.191 (<0.001)
H7	Perceived Ease of Use → Perceived Usefulness	.099 (.012)	[-.012, .207]	1.780 (0.075)
H8	Perceived Ease of Use → Satisfaction	.217 (.092)	[.153, .322]	5.521 (<0.001)
H9	Perceived Ease of Ese → Continuance Intention	-.004 (.000)	[.020, .222]	2.352 (0.019)
H10	Task-Technology Fit → Confirmation	.510 (.351)	[.433, .583]	13.240 (<0.001)
H11	Task-Technology Fit → Perceived Usefulness	.346 (.141)	[.478, .655]	12.440 (<0.001)
H12	Task-Technology Fit → Perceived Ease of Use	.330 (.112)	[.392, .555]	11.390 (<0.001)
H13	Task-Technology Fit → Satisfaction	.268 (.115)	[.571, .714]	17.755 (<0.001)
H14	Task-Technology Fit → Continuance Intention	.235 (.067)	[.548, .688]	17.588 (<0.001)

Figure 2. Estimated path coefficients of the research model and bootstrapping results.



Notes: ***: significant at the .001 level, **: at the .01 level, *: at the .05 level.

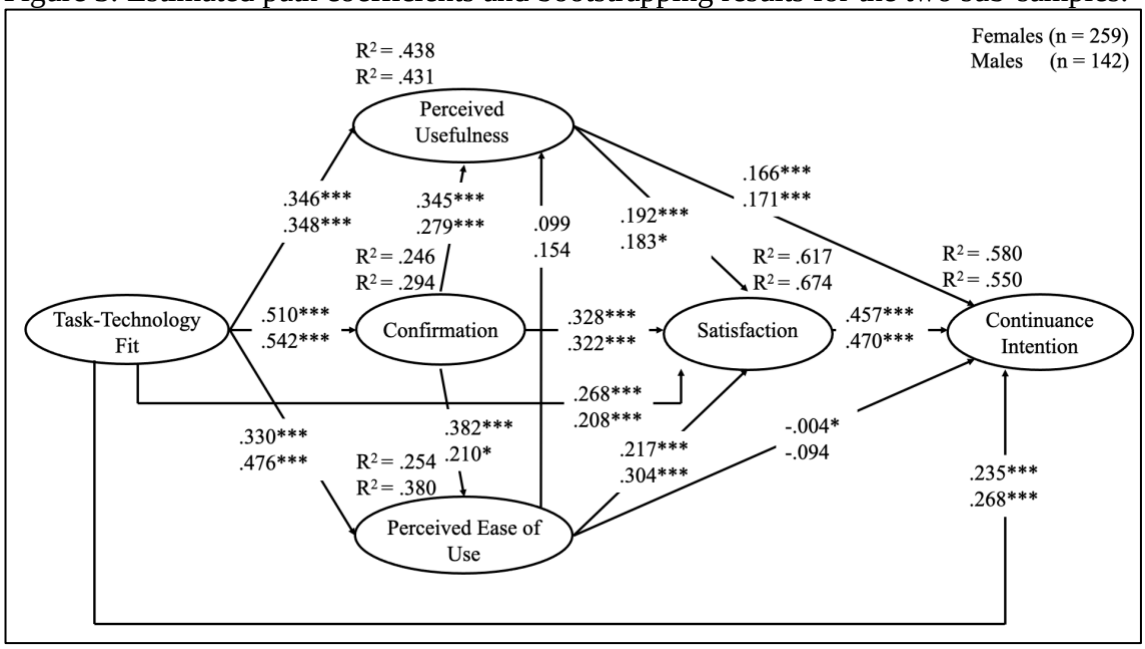
Table 5. Mediation assessment.

	Indirect effects		*Direct effects*		*Total effects*	
	Path coefficient	*t-statistic (p-value)*	*Path coefficient*	*t-statistic (p-value)*	*Path coefficient*	*t-statistic (p-value)*
Perceived Ease of Use → Perceived Usefulness → Continuance intention	.016	1.460 (0.144)	-.004	0.088 (0.930)	.120	2.352 (0.019)
Perceived Ease of Use → Satisfaction → Continuance intention	.099	4.299 (<0.001)	-.004	0.088 (0.930)	.120	2.352 (0.019)
Perceived Ease of Use → Perceived usefulness → Satisfaction → Continuance intention	.009	1.607 (0.108)	-.004	0.088 (0.930)	.120	2.352 (0.019)
Perceived Ease of Use → Perceived Usefulness → Satisfaction	.058	2.653 (0.008)	.217	5.131 (<0.001)	.236	5.521 (<0.001)

4.3 Structural model evaluation across the subsamples of female and male users

Due to the apparent divergence in gender-related fitness app continuance behaviours, we applied a mean comparison and multigroup analysis. Concerning construct means, female participants rated all constructs higher except for task-technology fit which male participants ranked higher. We applied Sarstedt et al. 's (2011) non-parametric confidence set approach for multigroup analysis executed in SmartPLS 4.1: First, PLS path modelling was operated separately for each group, followed by bootstrap calculation. Figure 3 shows the estimated path coefficients for the gender-related subsamples and bootstrapping results. Additionally, we calculated and compared the 95%-bootstrap confidence intervals for the path coefficients of both subsamples. Results indicate similarity for most path coefficients except for the relationships between confirmation and perceived ease of use, perceived usefulness and satisfaction, and perceived ease of use and continuance intention. Figure 3 further depicts that the influences between confirmation on perceived ease of use and perceived usefulness on satisfaction are significant at the .001 level for female participants. The link between perceived ease of use and continuance intention significantly differed at the .05 level for the female subsample. Table A1 in the Appendix summarizes the results.

Figure 3. Estimated path coefficients and bootstrapping results for the two sub-samples.



Notes: ***: significant at the .001 level, **: at the .01 level, *: at the .05 level.

5. Discussion

Relying mainly on the synthesis of ECM and TAM, this study tested multiple hypotheses linked to the relationships between the two theoretical models and innovatively extended it. Overall, the results show that fitness apps go beyond the mere functionality of a monitoring device and have far-reaching implications for sports management. By verifying the proposed research model with empirical data from 403 actual fitness app users, our findings provide evidence for the applicability of the ECM in a fitness context and generate new insights on customer loyalty and satisfaction in an increasingly digitalized market. The main results of the structural equation modeling supported the postulated hypotheses in most cases: Thirteen out of fourteen hypotheses expressed high statistical significance. The findings suggest that users are still very interested in fitness apps post-pandemic, even after the gyms have reopened, indicating that fitness apps yield the potential to be added permanently to traditional fitness offerings.

Specifically, we confirmed high statistical significance of the proposed ECM relationships (cf. *H1-H5*). Therefore, our results reinforce the predictive validity of the ECM in general (Cheng, 2019; Tam et al., 2020) and with respect to similar research concerning healthcare technologies (Cho, 2016; Franque et al., 2021; Kumar & Natarajan, 2020; Kumar et al., 2018; Zhang & Xu, 2020), indicating a lasting change in behavior relevant to sports management. Furthermore, our findings emphasize that satisfaction is

the main predictor of users' continuance intention (*H5*), which has often been confirmed in various technology contexts (Yan et al., 2021a).

Moreover, the results generate valuable insights concerning the integration of ECM and TAM into a hybrid model (*H6*-*H9*). Against our initial assumption and some prior evidence (Cho, 2016; Kumar & Natarajan, 2020), perceived ease of use did not exhibit a statistically significant influence on perceived usefulness (*H7*), and it indicated a significant weak negative effect on users' continuance intention (*H9*). Our findings thus suggest that, on the one hand, users perceive usefulness to be even more critical than easy-to-use functions when determining whether to continue using fitness apps: Perceived ease of use seems to have a more significant influence on the emotional state of fitness app users but not their attributed usefulness beliefs. Similarly, Cho et al. (2014) and Cho and Lee (2020) found that whether or not a technology is considered easy to use, individuals may continue using it mainly because of its usefulness. On the other hand, considering the large positive effects of perceived usefulness and satisfaction on continuance intention, the effect of perceived ease of use on continuance intention could have been diminished. The positive indirect effect of perceived ease of use on continuance intention via satisfaction supports this notion. Interestingly, in their literature review on continuance intention of online technologies, Yan et al. (2021a) report that many studies suggest that perceived ease of use influences continuance intention only indirectly, with its effect on continuance intention being fully mediated by perceived usefulness. However, the assessment of specific indirect effects showed that perceived usefulness in our study does not mediate the relationship between perceived ease of use and continuance intention. This is particularly relevant for sports management. Understanding that users perceive the utility of the app as more decisive for decision-making than easy-to-use functions is crucial for developing services and products that strengthen customer loyalty.

As to the fit factor, our results emphasize that fitness app users' perception of TTF positively influenced their confirmation of expectations, perceived usefulness, and perceived ease of use, which together caused their satisfaction with the fitness app and subsequently led to their continuance intention of the fitness app (cf. *H10*-*H14*). The findings align with previous IS continuance research (Cheng, 2019, 2020), indicating that users' perceived TTF is an essential determinant of user satisfaction with technology and, in turn, continuance intention. This corroborates the importance of effectively meeting

users' needs. Digital tools such as fitness apps should thus be seen as a supplement and an integral part of traditional sports and fitness offerings.

Finally, concerning gender-related usage behaviors, the role of confirmation in predicting perceived ease of use is more important to female fitness app users than male users, and the same holds for the role of perceived usefulness in determining satisfaction (see Fig. 3). Previous research found that females pertain higher orientation to health behaviors (e.g., goal setting). In contrast, males apply higher importance to competitiveness (e.g., live tracking functions) when using fitness apps (Klenk et al., 2017). These gender-related differences may be explained based on the underlying motives for using fitness apps, resulting in different perceptions of usefulness and expectations. Furthermore, our results demonstrate that female users are slightly more critical of perceived ease of use when determining the continuance intention of fitness apps than male users (Fig. 3). This may be attributed to the differences in the importance of specific features (Klenk et al., 2017). Interestingly, Wu and Kuo (2008) who empirically investigated the role of habitual usage and past usage on technology acceptance evaluations and continuance intention, explained that the habitual use of a system or technology may dilute the predictive power of perceived usefulness and perceived ease of use on users' continuance intention. Since 53.1% of the users surveyed used their fitness app daily (20.3%, n = 82) or several times a week (32.8%, n = 132), past usage here may have diluted the perception of easy-to-use functions explaining the missing or weak effects of H7 and H9.

5.1 Theoretical and practical implications

The findings of this research provide theoretical implications in the context of the continued use of fitness apps. They support the usefulness of including post-adoption variables and associated antecedents to user beliefs into a hybrid model to allow for a more complete explanation of users' post-adoption behavior. In addition, we extended the ECM by confirming the relationship between technology adoption (i.e., TAM) and continued technology usage (i.e., ECM) behaviors. Combining synergistic variables, therefore, helps predict continued use behaviours. Our study outlined the importance of satisfaction, which was found to promote users' continuance intention of fitness apps for non-pandemic situations. We also explained the relationship between TTF and its role in confirming users' pre-acceptance expectations and, in turn, resulting in satisfaction and continuance intention. Our results are the first to prove the value of a richer post-adoption model in the healthcare and fitness context, which is especially important to the sports

management literature. Digital tools such as fitness apps are more than a fad and will increasingly become part of traditional sports and fitness offerings. We contribute to sports management literature by providing a more thorough understanding of the continued use of fitness apps and their significance for integrating digital solutions (i.e., combining physical and digital offers). Developing strategies that enable traditional providers to remain competitive in the increasingly digitalized market (Thompson et al., 2024; Zipp & Nauright, 2024) by establishing hybrid business models is, therefore, ever more relevant.

The current findings also have several managerial implications. Designing and implementing digital solutions that meet the growing expectations of consumers and, at the same time, support the organization's economic success are becoming increasingly important (Fenton et al., 2022). In this regard to user satisfaction, using data to personalize services and adapting to gender-specific needs are vital aspects to be considered. With the ongoing demand for fitness apps after the pandemic, sports organizations need to develop hybrid models offering both onsite and online services to remain competitive. Sports organizations, thereby, need to ensure that their digital offerings are functional and aligned with user needs and expectations to ensure satisfaction and, in turn, continued use behaviors. Therefore, managing user beliefs is imperative, especially in the context of high market competition (Molina & Myrick, 2021; Pal et al., 2023). For instance, one approach would be to integrate virtual trainers provided by fitness apps. These trainers could create customized training programs based on users' goals and provide regular feedback. Such a service could also be offered as an add-on for members who travel frequently or do not have access to a physical gym.

Our findings also highlight the importance of personalized functions and individual training data in determining the continued use of fitness apps. Drawing from user responses in our study and similar to findings from extant literature (Kim & Lee, 2022; Kuru, 2023; Molina & Myrick, 2021), personalized functions and tailored recommendations based on real-time data were essential in shaping users' decision-making process regarding whether to continue or discontinue their app use. Moreover, the data generated through fitness apps provides rich analytics into user needs and behavioral patterns (Mertala & Palsa, 2024). Sports managers can analyze this data to optimize services, develop new offerings, and create targeted marketing campaigns. For example, by analyzing usage data, sports managers can find out which times and classes

are particularly popular so they can adapt their offerings accordingly and use resources more efficiently. Our findings thus support the relevance of data-driven management in the sports sector (Herold et al., 2024).

We also outlined the importance of gender-related differences in app usage, which provides valuable information for designing targeted marketing strategies and developing gender-specific offers (Carmichael et al., 2015; Zhu et al., 2022). Sports managers can use these insights to create specific programs or features that address gender-related requirements and perceptions, potentially increasing the effectiveness of marketing measures. Furthermore, integrating fitness apps enables sports organizations to reach new target groups that may have previously had little access to traditional fitness offerings. This could be done by developing content tailored to different fitness levels, age groups, or specific interests.

Finally, fitness apps also play an essential role in health management, particularly in the area of prevention (Paul et al., 2023). Recent findings emphasize that the regular use of fitness apps can promote positive health behaviors (Angosto et al., 2023; Chiu & Cho, 2021). These developments challenge traditional gyms and sports clubs to rethink their business models and adapt to the new realities (Zipp & Nauright, 2024). Regarding health promotion, sports managers could develop fitness app-based preventive programs, which, for example, could address specific target groups (i.e., elderly users or individuals with chronic diseases) to improve their health status and promote preventive measures. Collaborating with health insurers and other health organizations would maximize their reach and impact.

5.2 Limitations and future research

Although our study yields essential insights into understanding fitness app users' continuance intention in the aftermath of COVID-19, a few limitations and opportunities exist for future research. First, while this research sample size was considerably large to derive statistical conclusions, female users accounted for around 64.3% of responses. The sample population is not comparable to the population structure based on age and sex in Germany, and the present findings may not be generalized to other cultures and populations. Data from other sources and settings would help confirm the validity of the underlying research model in different contexts.

Moreover, 84.1% of participants in our research were aged 30 years old or younger. With a growing need to address health and fitness challenges in all age groups (Baer et al., 2022; Pfister, 2012; Taveira & Barbosa, 2024), it would be interesting to explore whether the research model and the underlying constructs are appropriate for explaining the continuance intention of fitness apps amongst older adults. Secondly, it is necessary to adapt the proposed research model to different fitness apps rather than to fitness apps in general. Our results emphasize how digital technologies can optimize fitness offerings, increase customer loyalty, and respond to the market's changing needs. However, due to the growing variety of fitness apps (e.g., workouts, diets, monitoring functions), it is worthwhile to investigate further how different app functions are bound to specific user behaviors (Cho, 2016; Yan et al., 2021b) to address this growing market.

Lastly, as our study is the first to obtain the post-adoption use behavior of fitness apps after the pandemic, we adopted a cross-sectional design to explore users' continuance intentions. To preclude possible influencing effects of COVID-19 on the initial adoption of fitness apps, we started our data collection six months after the pandemic was declared over. However, to derive a more tenable conclusion and provide a holistic understanding of which relationships inferred in this research continue to hold, future research should employ a longitudinal study design.

6. Conclusion

COVID-19 has corroborated the much-needed digitization of healthcare and fitness behaviors worldwide. In the future, fitness apps will continue to gain importance in health regimes. Therefore, we shed light on the role of fitness apps in modern sports management and how these technologies can increase the efficiency and effectiveness of sport-related services. This study validated the synthesis of ECM and TAM in a healthcare technology context and is the first to include antecedents to user beliefs in the research model. The hybrid model showed the potential to provide a more complete explanation of fitness app users' post-adoption behaviors post-pandemic as it moves beyond the mere prediction of continuance intentions. It adds to the general understanding of the interrelationship between user beliefs (i.e., perceived usefulness and perceived ease of use), their associated antecedents (i.e., TTF), and their satisfaction that together drive users' continuance intention of fitness apps. Results reveal that satisfaction is the primary determinant of users' continuance intention, while perceived ease of use only had an indirect effect. TTF is a crucial antecedent to user beliefs in promoting fitness app

utilization post-pandemic. The continued popularity of fitness apps signals a shift in the fitness market that sports managers cannot ignore. The present findings offer valuable approaches for improving sports management through digital technologies such as fitness apps and adapting them to current market trends and needs. To promote user satisfaction and remain competitive in the long term, sports organizations are well advised to analyze customer needs and requirements by developing offers tailored to different fitness levels, age groups, or specific interests.

Appendix

Table A1. Results from non-parametric multigroup analysis.

				Path coefficients (Effect size - f^2)		T statistics (p-value)			
				Female	Male	Female	Male	Female Bias-corrected confidence interval (95%)	Male Bias-corrected confidence interval (95%)
H1	Confirmation	→	Perceived Usefulness	.345 (.143)	.279 (.092)	7.238 (.000)	3.342 (.001)	[0.295, 0.478]	[0.100, 0.440]
H2	Confirmation	→	Satisfaction	.328 (.177)	.322 (.196)	10.251 (.000)	5.829 (.000)	[0.242, 0.432]	[0.189, 0.453]
H3	Perceived Usefulness	→	Satisfaction	.192 (.057)	.183 (.058)	3.515 (.000)	2.386 (.017)	[0.105, 0.284]	[0.063, 0.318]
H4	Perceived Usefulness	→	Continuance Intention	.166 (.036)	.171 (.036)	3.701 (.000)	3.485 (.000)	[0.049, 0.304]	[0.015, 0.281]
H5	Satisfaction	→	Continuance Intention	.457 (.205)	.470 (.191)	5.994 (.000)	3.839 (.000)	[0.320, 0.568]	[0.253, 0.656]
H6	Confirmation	→	Perceived Ease of Use	.282 (.082)	.210 (.050)	4.791 (.000)	2.078 (.038)	[0.195, 0.408]	[0.047, 0.380]
H7	Perceived Ease of Use	→	Perceived Usefulness	.099 (.012)	.154 (.026)	0.701 (.484)	1.411 (.158)	[-0.063, 0.160]	[-0.041, 0.319]
H8	Perceived Ease of Use	→	Satisfaction	.217 (.092)	.304 (.171)	3.383 (.001)	4.033 (.000)	[0.077, 0.248]	[0.171, 0.424]
H9	Perceived Ease of Use	→	Continuance Intention	-.004 (.000)	-.094 (.010)	1.965 (.049)	0.969 (.333)	[-0.060, 0.143]	[-0.249, 0.055]
H10	Task-Technology Fit	→	Confirmation	.510 (.351)	.542 (.416)	9.922 (.000)	9.232 (.000)	[0.405, 0.572]	[0.433, 0.628]
H11	Task-Technology Fit	→	Perceived Usefulness	.346 (.141)	.348 (.119)	10.631 (.000)	7.075 (.000)	[0.236, 0.456]	[0.155, 0.539]
H12	Task-Technology Fit	→	Perceived Ease of Use	.330 (.112)	.476 (.258)	8.027 (.000)	9.488 (.000)	[0.145, 0.386]	[0.298, 0.612]
H13	Task-Technology Fit	→	Satisfaction	.268 (.115)	.208 (.066)	14.909 (.000)	10.072 (.000)	[0.204, 0.377]	[0.057, 0.370]
H14	Task-Technology Fit	→	Continuance Intention	.235 (.067)	.268 (.076)	13.532 (.000)	11.721 (.000)	[0.100, 0.330]	[0.025, 0.511]

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4. Concluding Remarks

4.1 Contribution to theory and implications for practice

In response to the challenges of digitalizing the healthcare industry and increasing consumer centricity in healthcare delivery, this thesis illuminates two selected contemporary phenomena: (1) the continued use of healthcare technologies to improve comprehensive patient treatment and care and (2) the increasing importance of digitalized and preventative solutions given consumers' increasing awareness of health and well-being.

In Part A, Bhattacherjee's (2001) expectation-confirmation model (ECM) was applied and empirically validated to examine the key drivers and psychological aspects inspiring patients to continue using teleconsultations in non-pandemic situations. Thus, Part A addresses the common criticism that the original ECM overstates the role of satisfaction in continued use behaviors and neglects the role of motivational aspects and social influences (Sørebø et al., 2009). Perceived usefulness proved the main predictor of teleconsultation continuance intentions. That is, patients are more likely to continue using utilitarian technologies if they predict they will be beneficial in the future. Part A contributes to the literature by deriving more profound insights into the main predictors and motivational aspects of patients' continued utilization of teleconsultation in the aftermath of the COVID-19 crisis. Expanding the ECM to include social norms and perceived ease of use offers a more comprehensive perspective on the barriers to teleconsultation use and factors relevant to patients' continuance intentions. Likewise, the combination of ECM and SDT provides a deeper explanation of the psychological needs that influence teleconsultations: Perceived competence and perceived relatedness also determine patients' motivation, satisfaction, and continuance intention. By capturing these dimensions, teleconsultation services that meet functional needs and resonate with patients on a personal and motivational level can be designed. Time-efficient services, swift access to care, transparent communication channels, and user-friendly interfaces are essential to promote continued utilization. The results established in Part A emphasize the value of a hybrid post-adoption model by offering a more comprehensive framework to analyze patient behavior in teleconsultation and telemedicine. These factors help researchers and practitioners understand the nuances of patient satisfaction and continued use.

Furthermore, contributions were made to understanding fitness apps' utilitarian and hedonic technology characteristics in Part B. Only a few studies have adopted a comprehensive approach to the psychological mechanisms underneath fitness app users' post-adoption behavior. The combination of theories in Part B responds to shortcomings in the original ECM and addresses the current lack of findings derived from adequate IS continuance models. Despite the significance of technological and utilitarian factors, satisfaction is the main predictor of continuance intentions concerning fitness apps. Part B, therefore, contributes to current research by providing a holistic explanation of users' continuance intentions based on extended versions of the ECM. As fitness apps gain importance in future health regimes, combining different theoretical frameworks provides a foundation to explore technology adoption and continued technology use behaviors as an integrated concept rather than two distinguished notions. Fitness apps should provide personalized features that support users' goals and keep their satisfaction levels high. Intuitive user interfaces and a high-quality user experience are crucial to encourage long-term use.

In addition to the individual contributions of each research paper, this thesis surpasses the mere prediction of continuance intentions and adds to the general understanding of the interrelationship between the functional and psychological aspects shaping patients' and users' continuance intentions regarding teleconsultation and fitness apps. This thesis identifies three key implications for post-adoption behaviors concerning these healthcare technologies. Firstly, the two core variables from the original model, satisfaction and perceived usefulness, are essential drivers of continued use. Both digital health solutions emphasize the importance of satisfaction and perceived usefulness. However, the factors that lead to satisfaction vary: Fitness apps emphasize fun, gamification, and flow, while teleconsultation focuses on the quality of healthcare services, efficiency, and perceived benefits. The varying importance of continuance intentions' main determinant (i.e., perceived usefulness for teleconsultation and satisfaction for fitness apps) in this thesis implies that continuance intention prediction may be influenced by the regularity of technology use. According to Bhattacherjee et al. (2008), the effect of satisfaction is likely to diminish with greater temporal separation between prior experience and intention; in turn, the long-term perception of post-usage usefulness will likely exert an increasingly dominant effect over time. This is supported by fitness app users' use of the application

regularly (i.e., weekly or even daily), while telemedical technologies are inherently used in acute situations.

Secondly, an important theoretical implication of this thesis is the strength of including post-adoption variables and associated antecedents of user beliefs to facilitate a more complete explanation of users' post-adoption behavior. The research model development in response to critiques of the original ECM emphasizes that incorporating additional factors is critical to understanding user satisfaction and continued use in digital health applications like fitness apps and teleconsultations. This approach provides a more comprehensive understanding of why users continue to use teleconsultation platforms and fitness apps. It supports more tailored and effective interventions for improving user retention and health outcomes, which is especially important for explaining the acceptance–discontinuance phenomenon observed in various healthcare technologies. Propelled by the COVID-19 health crisis, many users initially turned to digital health solutions out of necessity, yet sustaining their use post-pandemic depends on understanding the influencing factors that encourage long-term use. This thesis, therefore, contributes to technology and usage research as it pushes the frontier of continued use behaviors by offering new insights into how digital health solutions (i.e., teleconsultation and fitness apps) can be designed to support both individual well-being and broader healthcare outcomes.

Finally, synthetically speaking, the results emphasize the importance of the link between the ECM and psychological influencing factors in understanding continuance intentions, indicating that the continuous use of digital health technologies is not only a question of their functional aspects (e.g., perceived usefulness). While ECM focuses on usefulness and satisfaction in explaining users' post-adoption behaviors, adding psychological and emotional factors allows for a more holistic analysis. Moreover, although the literature questions the role of perceived ease of use for other technologies due to users' increasing familiarity with them (Bhattacherjee & Barfar, 2011; Bhattacherjee & Lin, 2015), in the context of healthcare technologies, perceived ease of use was a crucial determinant of continuance intentions for both core technologies. However, its exact role and influence vary depending on the type of application and the user's expectations. As teleconsultations are often intended to solve specific medical problems, ease of use is particularly important for quick and effective access to health services. Teleconsultation platforms must simplify access to appointments, video calls, and medical records, while

fitness apps should be easy to navigate and include clear instructions, motivational tools (e.g., gamification elements), and customizable features.

In terms of practice, this thesis, as the empirical results affirm, offers practitioners profound insights into how retention and continued use in healthcare delivery and prevention can be facilitated. The results of the individual research papers highlight one common theme for digital health solutions in general: Expectancy confirmation is a crucial determinant of whether users continue or discontinue healthcare technology (i.e., teleconsultation and fitness apps) use. The findings confirm that patients and users value the utility of both technologies. For patients and users to confirm their beliefs, realistic usefulness beliefs must be formed, which will, optimally, result in satisfaction and, in turn, continuance intentions. Therefore, developers and app providers should foster realistic expectations and be sensitive to users' performance expectations and task requirements to elevate their experiences and enable personalized, immediate access to treatment options or training programs. Effective marketing measures are a crucial complementary investment for pre-acceptance and subsequent usage phases. Likewise, user-centered design and user experience are vital aspects of retention. Both technologies must be centered on users' needs and preferences.

4.2 Limitations and future research

As in most scientific research, some methodological limitations associated with the studies undertaken in Parts A and B must be addressed. First, while the research sample sizes were sufficiently large to derive statistical conclusions, the sample populations (primarily female and younger) of the studies were not comparable to Germany's population structure by sex and age. Therefore, the underlying theories and constructs may not be appropriate for explaining the continuance intentions of other patient and user clusters. Most published works focus on the U.S. and Asian countries, while until now, little research has focused on Germany and what exists was mostly produced pre-pandemic (Uncovska et al., 2023). In the context of Germany's aging society and demographic structure, elderly patients and users will need to become accustomed to the regular use of healthcare technologies. Examining the post-adoption behaviors of users within other cultural, socioeconomic, and demographic contexts, therefore, presents avenues for future research. Second, the generalizability of the findings in Parts A and B may be limited due to the context-specific nature of the research—both in terms of geographical context and medical setting. Health-related behaviors change with context

(i.e., acute treatment, diagnosis, prevention, etc.) and the increasing diversity of digital solutions offered to patients and users (Yan, Filieri, Raguseo, & Gorton, 2021). In the context of changing behaviors according to specific needs (e.g., treatment needs, such as diabetes, or health goals, such as losing weight), investigating different continuance intentions more granularly is worthwhile to advance the current understanding of health-related post-adoption behaviors. Third, although this thesis addresses various shortcomings of the original ECM, its inherently static view of the expectation and confirmation process was retained in the research papers. That is, changing expectations due to new expectations based on ongoing experiences were not considered. Finally, the studies captured users' post-adoption use behaviors of healthcare technologies after the pandemic. Therefore, all of the studies adopted a cross-sectional design to answer the research questions. Longitudinal studies are needed to derive a more tenable conclusion and provide a holistic understanding of which relationships inferred in the individual research paper remain robust.

4.3 Conclusion

Emerging technologies and innovations are a transformative force that is poised to redefine healthcare systems and offer unprecedented opportunities and solutions to augment healthcare delivery, efficiency, and health outcomes. As healthcare systems shift toward patient-led care, with patients acting as health service consumers, digital health solutions will be shaped by these consumers' needs and expectations. This will entail personalized, convenient, immediate, and cost-effective services that are relevant to future user behavior research. While the literature has improved the understanding of specific aspects of digital transformation in the healthcare industry and its influence on patients and users, a detailed picture of post-adoption behaviors remains lacking in several contexts. This thesis contributes to the literature and practice by illuminating the factors that are critical in determining users' post-adoption behaviors of health solutions, yielding the potential to drive the much-needed digital transformation of healthcare systems. Healthcare will increasingly revolve around sustaining well-being rather than responding to illness. To embrace the potential of healthcare technologies, this thesis applied a combined analysis of theoretical frameworks that was necessary to comprehend the decision-making process regarding different healthcare technologies. With the ongoing advancement of health technologies, further elaboration of the topic is needed to understand consumers' motives, demands, and needs. As healthcare delivery becomes

progressively more holistic (i.e., leveraging a broader range of health solutions, including hybrid models of digital solutions and in-person visits), future research must also consider users' motives and needs holistically to adapt current models and theories to the ever-changing landscape of healthcare delivery.

Appendix: Additional Research Paper

Table A1. Additional research paper.

Author(s) & Year	Title	Medium	Status
Ries, T. & Rese, A.	Can information help bridge the attitude–behavior gap in sustainable clothing consumption?	Cleaner and Responsible Consumption	Under Review (19.11.2023)

Additional research paper: Can information help bridge the attitude–behavior gap in sustainable clothing consumption?

Abstract

This research explores the widely known gap between the attitudes on sustainability that consumers express and their subsequent behavior concerning the purchase of sustainable clothing. Given the increasing global mass production and consumption of clothes, the textile industry is taking action to achieve greater sustainability. Previous research has identified the availability of sustainability information as an influencing factor on consumers to engage in pro-environmental behaviour. Study 1 (n=441) investigates different factors concerning information transition on sustainable clothing and confirms the importance of information quality in this context. Study 2 (n=448) finds different preferences for online information channels and information content depending on the age group. Our findings indicate that merely communicating information is not sufficient to close the attitude–behavior gap; consumers need appealing and clear information in all purchase phases in line with their age-related preferences if they are to respond pro-environmentally.

1. Introduction

Currently, shortened clothing production cycles and intense competitive practices are posing a threat to environmental welfare (Gazzola et al., 2020; Pookulangara & Shephard, 2013). Fast fashion business models reinforce environmental degradation along the supply chain, such as water waste and high emissions of hazardous chemicals, and continue to prompt consumers to overconsume (Kumar et al., 2021; Pookulangara & Shephard, 2013). Hence, soil, air, and groundwater are negatively impacted by such business practices and consumption patterns, which add up to more than 92 million tons

of waste prior to and after purchase (Niinimäki et al., 2020; United Nations, 2018). The not inconsiderable amount of research on environmental consciousness continues to find that consumer behavior confirms the existence of a gap between the attitudes expressed and subsequent purchase behavior (Dhir et al., 2021; Rausch & Kopplin, 2021). Although there have been extensive efforts to explain this gap in consumer behavior, empirical results have so far been inconsistent (ElHaffar et al., 2020; Rausch & Kopplin, 2021; Zaremohzzabieh et al., 2021). Despite considerable analysis of the influencing factors in the past (e.g., perceived price premium), knowledge of the drivers and inhibitors of sustainable clothing purchase behavior remains limited (Rausch et al., 2021).

The lack of information and, therefore, the poor environmental knowledge are much-cited and extensively explored barriers to sustainable consumption (Shao et al., 2017; Tanner & Wölfing Kast, 2003; Turunen & Halme, 2021). Information is the combination and interpretation of data that consumers perceive through their senses; knowledge and information are interrelated, pointing the consumer to relevant product details and attributes that simplify the purchase decision (Nguyen et al., 2019a). Despite the research on environmental knowledge (Dhir et al., 2021), the findings concerning the role of information and its interrelation with knowledge in building purchase intentions remain scarce (Auger et al., 2010; Turunen & Halme, 2021). This deficiency in the research is alarming because information yields the potential to promote the much-needed paradigm shift in consumer behavior. Hence, our aim is to develop an understanding of the importance of sustainable information quality on sustainable clothing purchase intentions. Moreover, we seek to clarify which information channels – for example, social media outlets (Johnstone & Lindh, 2022; Lee et al., 2020; Xiao et al., 2018) – and which types of information content – for example, details on the supply chain (Meise et al., 2014) – may reduce the attitude-behavior gap. Overall, this paper focuses on two research questions in the context of sustainable clothing: (1) What are the possible influencing factors on purchase intentions including sustainable information quality? (2) Which types of information channel and information content are important for purchase intentions?

Relying on the information processing perspective (Bettman et al., 1998; Hansen, 2005) and cue utilization theory (Richardson et al., 1994; Steenkamp, 1989), we investigate the information transition gap in greater detail. This gap concerns the availability of sufficient and appropriate sustainability information on the product level (Bashir, 2022; Shao et al., 2017). We first conducted Study 1 (n= 441) to investigate more broadly the different

factors related to sustainability information cues that are influencing purchase intentions: sustainable information quality, sustainability certifications, company reputation, and online opinion seeking. In Study 2, we identified and evaluated information contents and channels relevant to purchase decisions based on best-worst scaling (BWS) analysis (n=448). Our study samples incorporate different German age groups, allowing us to make appropriate comparisons. Prior research in this field has focused on younger generations Y and Z (Johnstone & Lindh, 2022; Kumar et al., 2021), whereas older age groups have received only cursory attention in the research (Bulut et al., 2017). To help bridge this attitude–behavior gap, we investigate whether consumers ascribe importance to different information channels and information content according to their age.

The need for a paradigm shift towards comprehensive sustainable consumer behaviors is apparent. Thus, we contribute to the literature by (1) highlighting the importance of sustainability information in terms of its quality for decision making and (2) analyzing preferences from information searching based on age to close the attitude–behavior gap. The following section provides an overview of the theoretical background, analyzing the importance of information concerning sustainable clothing consumption. We then present our methodology and the results of the two studies. After an evaluation of the results, we discuss managerial and theoretical contributions, followed by a consideration of the study's limitations and the topic's research outlook. We conclude with a brief summary of the study's pertinence.

2. Literature Review

2.1 Theoretical background

On a global level, the per-capita textile production over the period from 1975 to 2018 has increased from 5.9 kg to 13 kg (Peters et al., 2019). In particular, fast fashion clothing consumption and its production has increasingly resulted in environmental challenges, such as demands placed on limited resources and the creation of large amounts of textile waste (Niinimäki et al., 2020; Peters et al., 2019).

To mitigate the negative environmental effects caused by fast fashion clothing, consumers are said to increasingly consume sustainable clothing (Bashir, 2022; Dhir et al., 2021; Pookulangara & Shephard, 2013; Rausch et al., 2021). This implies consumers are expressing positive attitudes towards purchasing sustainable clothing. However, empirical findings regularly conclude that such attitudes are not translated into actual

behavior. This is referred to as the attitude-behavior gap (Nguyen et al., 2019a; Rausch et al., 2021; Zafar et al., 2021; Zaremohzzabieh et al., 2021). Possible explanations for the attitude–behavior gap have been reported not solely from a business perspective. The theory of reasoned action (TRA) and its extension, the theory of planned behavior (TPB), have proven influential in explaining the phenomenon that this gap represents. Both theories were aimed at predicting and explaining behavior, and they emerged from early social-psychological findings that individual attitudes have no direct influence on behavior (Ajzen, 1991).

The TRA proposes that attitudes and social norms guide behavior intentions and, in turn, behavior. Later, the concept of perceived behavioral control was added, leading to the emergence of the TPB proposition. Both theories were extended to investigate a plethora of sustainable behaviors, such as green products (Paul et al., 2016), green skincare products (Hsu et al., 2017), and responsible tourism (Mondal & Samaddar, 2021). Regarding sustainable behavior, the empirical results remain inconsistent, however. It is often argued that attitudes are a poor predictor of actual behavior, especially in the context of sustainable consumption. This is supported by the fact that the attitude-behavior gap is salient, especially in relation to the purchase of sustainable clothing (Nguyen et al., 2019a; Rausch & Kopplin, 2021; Zafar et al., 2021). Accordingly, the literature in this field has identified and examined several possible influencing factors (Johnstone & Tan, 2015; Rausch et al., 2021).

2.2 Influencing factors on sustainable consumption

From an information processing perspective and, in particular, from the cue utilization theory, consumers are said to make use of a small set of product cues for product evaluation in the event of unclear or deficient information (Auger et al., 2010; Richardson et al., 1994; Steenkamp, 1989). This is due to the limitations of consumers' cognitive capacity. Research has found that, amongst others, perceived price premium, quality, and design act as consumption barriers for sustainable products and hamper, in particular, the purchase of sustainable clothing (Johnstone & Tan, 2015; Rausch & Kopplin, 2021). Consumers are often unwilling to pay a price premium for sustainable clothes (Rausch & Kopplin, 2021). Price, moreover, goes hand in hand with quality; prior findings emphasize that consumers, in general, feel that the quality and characteristics of sustainable products are inferior to non-sustainable products (ElHaffar et al., 2020). Hence, consumers do not perceive sustainable clothing as a justifiable alternative to fast

fashion offers, nor do they expect sustainable clothing to meet their quality and design expectations (Rausch et al., 2021). The gap between expectation and perception in sustainable clothing points to the inadequacy of sustainable information to address consumer concerns about the sustainability of fashion items (Bashir, 2022; Shao et al., 2016; Turunen & Halme, 2021). Several sustainability information cues relate to the expectation–perception gap and are relevant to this research (see Table 1).

Table 1. Overview of sustainability information cues.

Influencing factors	Studies	Sample	Findings
Sustainable Information Quality	O'Rourke and Ringer (2016)	41,398 GoodGuide.com page visits	Users seeking sustainability information were found to display higher purchase intentions when this information was positive. However, the importance of information varies with product categories. Hedonic products may profit more from sustainability information compared to utilitarian products.
	Kong et al. (2016)	287 South Korean consumers	Detailed product information on sustainability increases knowledge/understanding and, hence, strengthens purchase intentions.
	Mohd Suki (2016)	300 Malaysian consumers	Green brand knowledge is a key influencing factor affecting purchase intentions. Decision making and, hence, purchase intentions profit from information on product details (e.g., supply chain, packaging).
Sustainability Certifications	Brach et al. (2018)	157 German consumers	Certifications from third parties positively influence purchase intentions. If consumers perceive the certification to be credible, apprehended information asymmetries are reduced, increasing the intention to purchase.
	Ma et al. (2017)	903 U.S. consumers	Consumers will use sustainability certifications as a decision heuristic when they are easy to understand and deemed useful.
Skepticism	Goh and Balaji (2016)	303 Malaysian consumers	The findings indicate that skepticism towards environmental products lowers consumers' environmental knowledge and concern, which in turn adversely impacts consumers' purchase intentions.
	Farooq and Wicaksono (2021)	International sample	Consumer skepticism towards sustainable products is mainly the result of previous incidents of greenwashing. Additionally, consumers are more skeptical of large companies compared to smaller ones and this seems to be industry specific.
Company Reputation	Castaldo et al. (2009)	400 Italian customers	If consumers perceive a company to embody ethical or social values, they will trust such strong reputations to deliver their promises.
	Kim and Oh (2020)	316 Korean consumers	When a consumer's perception of reputation is high, the perceived level of a product's sustainability directly impacts purchase intentions.
	Bartels et al. (2020)	198 Dutch consumers (Study 1)	A company's sustainability reputation may influence whether consumer responses towards it are positive or negative. A positive reputation reduces consumers' skepticism, which leads to positive advocacy behaviors.
	Carter et al. (2021)	82 U.S. undergraduate students (Study 1)	A company's sustainability reputation influences consumer responses by impacting consumer choices, thus increasing purchasing behavior.
Online Opinion Seeking	Saeed et al. (2019)	91 Pakistani consumers	Social media platforms serve as a substantial information source in the sustainability context. Purchase intention was a more likely source for consumers using social media.
	Johnstone and Lindh (2018)	788 consumers (from 59 countries)	The importance of influencers in increasing awareness of sustainability matters is dependent on age. Younger consumers/millennials seem to attach higher importance to influencers compared to older age groups.
	Johnstone and Lindh (2022)	448 European millennials	Millennials assign high importance to influencers when making sustainable clothing choices. Influencers strengthen the effect of fashion consciousness on purchase intentions, in contrast to measures highlighting corporate social responsibility (e.g., CSR practices, certification).

Prior findings indicate that consumers seldom understand the need for changes in behavior to more sustainable behaviors due to missing knowledge. Consumer knowledge may influence perception of the information available (i.e., focus on relevant and important information) (Pelsmacker & Janssens, 2007; Turunen & Halme, 2021). On the other hand, consumer knowledge can develop further from additional information (Bashir, 2022; Kim & Oh, 2020). Research has argued that the openness of companies to disclose information from business documents increases transparency and positively affects the attitudes of consumers towards fashion products (Bhaduri & Ha-Brookshire, 2011).

Offering transparent information that documents and explains the sustainability of products increases customer attention and, in turn, enhances the usage of sustainability-friendly practices (Turunen & Halme, 2021; Wu et al., 2019). In particular, authentic information and accurate data help to establish the credibility of companies regarding their efforts to meet customer expectations on sustainability (Chen & Chang, 2012; Turunen & Halme, 2021). Credibility and controllability/traceability are confirmed as important aspects of the information quality dimension in a sustainability context, leading to more positive attitudes and purchase intentions (Pelsmacker & Janssens, 2007). Consequently, consumer behavior is significantly influenced by the interrelationship between information quality and knowledge (Dhir et al., 2021; Pelsmacker & Janssens, 2007). Moreover, according to previous research, skeptical consumers seek additional information on sustainable products when making purchasing decisions (Leonidou & Skarmeas, 2017). Hence, we propose:

H1-1. Sustainable information quality increases the intention to purchase sustainable clothing.

H1-2. Sustainable information quality alleviates consumer skepticism concerning sustainable clothing.

The lack of knowledge on alternative materials and their environmental benefits impedes the purchase of sustainable clothing. Then again, the lack of information on material components and origins leads to high perceived risk when purchasing sustainable products (Johnstone & Lindh, 2022; Meise et al., 2014). Additionally, the motives of companies are questioned, and greenwashing concerns are increasingly widespread. To counteract the fact that many consumers do not proactively seek or trust the information provided due to high skepticism, companies increasingly make use of sustainability

certifications (Farooq & Wicaksono, 2021; Turunen & Halme, 2021). Independent institutions issue such certifications and help alleviate consumer concerns by increasing trust in the company (Hsu et al., 2017; Lee et al., 2020). Due to the higher level of objectivity, information asymmetries and the perceived skepticism of consumers may well be reduced. Additionally, previous findings show that sustainability certifications may result in higher perceived product quality, thereby influencing brand reputation. A high reputation as a result of past actions may lead to high perceived product quality (Fanasch, 2019). Therefore, we derive the following hypothesis:

H1-3. Sustainability certifications increase the intention to purchase sustainable clothing.
H1-4. Sustainability certifications alleviate consumer skepticism concerning sustainable clothing.
H1-5. Sustainability certifications positively influence a company's reputation.

Consumer concerns about companies disseminating false or ambiguous information on the sustainability of their products are increasingly prevalent (Goh & Balaji, 2016). Especially with regard to sustainable fashion, consumers often feel that information is contradictory or impedes their decision making, which often leads to skepticism and greenwashing concerns (Goh & Balaji, 2016; Meise et al., 2014; Pelsmacker & Janssens, 2007; Turunen & Halme, 2021). If information is misleading or not available at all, consumers will not be persuaded to decide in favor of the product in question (Farooq & Wicaksono, 2021; Goh & Balaji, 2016). Previous research found mixed results concerning the direct influence of green skepticism on consumer purchase intentions (Goh & Balaji, 2016; Matthes & Wonneberger, 2014). In general, consumer skepticism refers to the perception that a company disseminates misleading information. It arises when consumers perceive inconsistency between a company's claims and its actual performance (Nguyen et al., 2019b). Therefore, we postulate:

H1-6. Consumer skepticism negatively influences the intention to purchase sustainable clothing.

Perceived risks associated with the purchase of sustainable clothing and skepticism may be reduced by a company's reputation (Farooq & Wicaksono, 2021; Kim & Oh, 2020). In general, reputation refers to the assessment of a company by its stakeholders over time (Bartels et al., 2020). A good company reputation, therefore, yields strategic advantages by providing unique values to its customers compared to competing companies (Castaldo et al., 2009; Kim & Oh, 2020). It is formed through the accumulated performances of the

company in the past and serves as a subjective decision criterion of perceived product quality and perceived value (Kim & Oh, 2020). High perceived brand reputation conveys high reliability, which in turn lowers consumers' sensitivity to perceived uncertainty and skepticism associated with purchasing sustainable clothing (Kim & Oh, 2020). Hence, we postulate:

H1-7. A company's reputation increases the intention to purchase sustainable clothing.
H1-8. A company's reputation alleviates consumer skepticism concerning sustainable clothing.

Consumers increasingly search for information on sustainable products online (Johnstone & Lindh, 2018; Zafar et al., 2021) and turn to social media influencers to retrieve relevant information for their decision making (Johnstone & Lindh, 2022). Consequently, online opinion seeking relates to a consumer's active information search on the internet to be able to make an informed decision. Perceived risks may be mitigated through online reviews from influencers, for example, by explaining a garment's fit and feel or giving information on care instructions (Johnstone & Lindh, 2018, 2022; Kim & Kim, 2021; Kim & Oh, 2020). Moreover, the spread of social media allows companies to disseminate information effectively. This diminishes the information asymmetry of followers who participate in the dialogue and, therefore, increases consumer trust (Arrigo et al., 2022). Thus, online opinion seeking yields the potential to increase a company's reputation while reducing perceived skepticism. We therefore hypothesize:

H1-9. Online opinion seeking increases the intention to purchase sustainable clothing.
H1-10. Online opinion seeking alleviates consumer skepticism concerning sustainable clothing.
H1-11. Online opinion seeking positively influences a company's reputation.

2.3 Information channels and information content

Consumers face increasingly complex decision-making processes when engaging in sustainable lifestyles (Kumar et al., 2021; Nguyen et al., 2019b). Often, pro-environmental behaviors result in perceived trade-offs between conventional choices and sustainable alternatives. Information, as the combination of relevant data necessary to make a purchase decision, reduces perceived trade-offs by guiding consumers towards environmentally preferable products (Meise et al., 2014). Furthermore, knowledgeable

consumers receive information differently by interpreting it in a context that mitigates skepticism about product characteristics (Pelsmacker & Janssens, 2007).

Johnstone & Lindh (2018) found that sustainability awareness evolves over time, depending on age. Older consumers are more likely to implement pro-environmental behaviors due to extensive information acquisition and knowledge building. Therefore, information needs, behaviors, and sources may depend on and differ between age groups (Johnstone & Lindh, 2018). For instance, older generations abide by trusted retailers when searching for information, while millennials obtain a large portion of their information on sustainability aspects from social media (Johnstone & Lindh, 2022; Parment, 2013). In general, Generation X and baby boomers are not as tech-savvy as younger generations. They are said to display different shopping behaviors online, which also influences information behavior. In contrast, Generation Y and Z consumers are more knowledgeable on sustainability in company supply chains and in their consumption compared to older generations (Gazzola et al., 2020). However, this does not mean that younger generations implement sustainable behaviors in the long term.

The role of information when making purchase decisions may differ according to age group. Consumers older than 40 (i.e., Generation X) are said to make decisions according to more rational purchase criteria, pointing to the importance of information, knowledge, and transparency in decision making (Johnstone & Lindh, 2018; Lissitsa & Kol, 2016). In contrast, Generation Y and Z consumers base their purchase decisions on emotional factors and social or peer influences (Johnstone & Lindh, 2022; Thangavel et al., 2022).

The fashion industry increasingly makes use of digital platforms as a key tool to disseminate information, striking a chord with today's media consumption patterns (Gazzola et al., 2020; Johnstone & Lindh, 2022). Research so far has primarily focused on the online information behavior of Generations Y and Z concerning sustainable clothing. The dearth of literature on older age groups is vexing because these cohorts exhibit immense purchasing power and compose key consumer segments based on their size and ongoing relevance in the workforce (Hu & Huang, 2023; Lissitsa & Kol, 2016; Parment, 2013). The significance of these market segments points to the need to analyze their preferred online information channels and information content on sustainable clothing, offering the prospect of finding new insights into the attitude–behavior gap.

Companies can provide information through a variety of channels, with Internet of things (IoT) technologies and platform solutions making it increasingly convenient to access information. Information sharing, communication, and education are now being accelerated by social media platforms, such as Instagram and Tik Tok (Halvorsen, 2019; Johnstone & Lindh, 2022; Son et al., 2022). The literature reports a shift from consumers receiving information passively to participating actively and, thus, interacting with brands and companies as well as other consumers (Halvorsen, 2019; Son et al., 2022). Consequently, consumers are increasingly moving towards making purchases online independent of the product category (Parment, 2013). Yet, the previous literature emphasizes that online shopping behaviors are heterogeneous and dependent on age groups (Thangavel et al., 2022). Therefore, how consumers of all ages obtain information has changed drastically and, with it, their information behavior. Based on the above, we hypothesize:

H2-1. Different age groups ascribe varying importance to different online information channels concerning sustainable clothing.

Consumers increasingly require transparency, asking for information on the materials processed or even details on the supply chain and manufacturing process (Gazzola et al., 2020; Hsu et al., 2017; Meise et al., 2014). However, the extant literature found that consumers often feel overwhelmed by the abundance of information provided, resulting in confusion and myopia (Bashir, 2022; Turunen & Halme, 2021). Information on the sustainable aspects of a product or sustainable alternatives to a product often suffers from perceived low levels of credibility because of an overflow of too much incorrect information or a complete lack of correct information (Pelsmacker & Janssens, 2007; Thangavel et al., 2022).

Vague information hampers decision making and impedes actual purchase behavior irrespective of the age of the consumer (Thangavel et al., 2022). However, the higher a consumer's knowledge level, the lower the likelihood that inadequate information is trusted. In making purchase decisions, consumers assign varying importance to different information content based on their existing knowledge and previous experiences with sustainable clothing (Thangavel et al., 2022). Based on the above, we derive the following hypotheses:

H2-2. Different age groups assign varying importance to different online information content concerning sustainable clothing.

3. Research Design and Methodology

This research consists of two studies: Study 1 aims to analyze how the nature of the information and the way it is transmitted influence the intention to purchase a bio-based polymer sports shoe from Adidas. The purpose of Study 2 is to identify respondents' preferred information channels and information content when purchasing sustainable clothing online.

3.1 Study 1

Data collection and descriptive statistics. To assess the underlying constructs and their relations, an online questionnaire was developed using Qualtrics. Before conducting the main study, the questionnaire was pre-tested, and minor modifications were implemented. The final questionnaire consisted of three major sections. We gained deeper insights into the respondents' consumption behaviors and perception of sustainability with several introductory questions. Participants were asked about their experiences with and concerns about buying sustainable textile innovations (e.g., fibers of hemp or pineapple). In the main part, respondents were asked to evaluate a bio-based polymer sports shoe in terms of purchase intentions (PI), sustainable information quality (INFO), sustainability certifications (CERT), their skepticism (SKEP) concerning the brand as well as their online opinion seeking behavior (OPINS), and the reputation of the brand (REPU). The last part inquired into participants' demographics – namely, gender, age, monthly income, and employment status.

Data were collected in December 2020 using an online panel provided by consumerfieldwork GmbH with a total reach of 39,306 participants. We used a specified quota of 50% female and 50% male participants. Respondents were aged 16 to 39; we targeted participants from generational cohorts Y and Z. In the context of sustainable consumption, both generations play a central role in the development of environmentally friendly behaviors. Because of the cohorts' intensive use of social media, they are often exposed to a variety of information (Bento et al., 2018). Additionally, in 2020, 39% of Adidas customers were aged 20 to 39 (VuMa, 2019). We, therefore, captured a large fraction of Adidas's target customers. A total of 441 respondents participated in the survey. Of the 441 obtained responses, 109 (25%) were incomplete and were excluded. Consequently, 332 responses were analyzed.

Table 2 outlines the sample's descriptive statistics and characteristics. In the sample design, there were equal numbers of females and males, and ages ranged from 16 to 39 with an average age of 30 years. Almost half of the sample worked full time (48%) and one-third earned a monthly income between 1,500 Euros and 1,999 Euros.

Table 2. Descriptives of Study 1 respondents.

Demographics/ Characteristics	Specifications	Counts	Proportion (in %)
Age	< 20 years	11	2.5
	20 – 24 years	56	12.8
	25 – 29 years	127	28.9
	30 – 34 years	110	25.0
	35 – 39 years	135	30.8
Gender	Female	168	50.6
	Male	163	49.1
	Diverse	1	0.3
Monthly Income	< 900 Euros	58	13.2
	900 – 1499 Euros	45	10.2
	1500 – 1999 Euros	69	15.6
	2000 – 2599 Euros	63	14.3
	2600 – 3199 Euros	50	11.3
	3200 – 4499 Euros	32	7.3
	4500 – 5999 Euros	7	1.6
	> 6000 Euros	8	1.8
Employment status	Employed Full-time	211	47.8
	Employed Part-time	36	8.2
	Pupil	10	2.3
	Student	48	10.9
	Apprentice	10	2.3
	Unemployed	17	3.9
Purchase frequency of clothes per month	Less than one garment	174	52.4
	1 – 2 garments	121	36.4
	3 – 4 garments	29	8.7
	5 – 6 garments	6	1.8
	More than six garments	2	0.6
Sustainable clothing purchase experience	Yes	119	35.8
	No	113	34.0
	Not Sure	100	30.1

Regarding their average purchase frequency of clothes, most respondents – of which 55.2% were male (n = 90) – indicated buying less than one garment (n =174, 52.4%) per month. About a third of participants (35.8%) – of which 49.4% (n = 83) were female – had already bought sustainable clothing (Table 2). In addition, respondents were asked to rate different purchase criteria of textiles according to their perceived priority with the most important (=1) to the least important (= 8). Comparing mean values, respondents considered aesthetics/design (mean = 2.97, SD = 2.01), fit (mean = 3.4, SD = 2.05) and quality (mean = 3.89, SD = 2.06) the most important purchasing criteria, whereas

sustainability (mean = 6.18, SD = 1.85) was considered the second least important (see Appendix A for further details).

Items and constructs. All constructs of the main questionnaire part were measured by multiple items on a five-point Likert scale (1= "Strongly disagree" to 5 = "Strongly agree"). The underlying items are validated scales derived from the existing literature (see Table 2).

Measurement model evaluation. First, we assessed the underlying constructs. Overall, respondents demonstrated a high need for sustainable information quality (mean = 3.96, SD = .79) and an interest in sustainability certifications as a decision heuristic (mean = 3.80, SD = .76). Purchase intention was shown to be lower (mean = 3.24, SD = 1.08) but were still high.

To analyze the underlying data, structural equation modeling (SEM) was used. All constructs were measured using reflective items, and the data obtained were analyzed using R version 4.1.0 and SPSS29. To test the fit of the overall model as well as the reliability and validity of the constructs, a confirmatory factor analysis (CFA) was conducted on the structural model. Table 3 summarizes results from the CFA. Here, the results showed a satisfactory model fit generally, with $chi^2(df)= 290.914 (137)$, $p = .000$; RMSEA = .058 ≤ .080; CFI = .959 > .900; TLI = .949 > .900; SRMR = .05 ≤ .050 (Hair et al., 2014; Schermelleh-Engel et al., 2003).

Table 3. Measure validation.

Construct	*Item*	*Std. FL*	*Cronbach's α*	*AVE*	*FLR*	*VIF*
Purchase Intentions (PI)	I would think about buying this sports shoe.	.934				
Kim and Oh (2020)	My willingness to buy this sports shoe is high.	.864	.932	.823	.887	—
	I would consider buying this sports shoe.	.922				
Sustainable Information Quality (INFO)	Transparent information on the sustainability of the product would be helpful.	.792				
Nguyen et al. (2019b); Tseng and Hung (2013)	I would find authentic information on the sustainability of the product's value chain useful.	.804	.804	.579	.717	2.837
	Information from the company that documents and explains the sustainability of the product would be useful.	.695				
Sustainability Certifications (CERT)	I believe that sustainable products that have	.854	.826	.618	.761	2.972

Construct	*Item*	*Std. FL*	*Cronbach's α*	*AVE*	*FLR*	*VIF*
Kim and Lennon (2008); Lee et al. (2020)	sustainability certification are trustworthy in terms of keeping their promise.					
	Products with sustainability certifications are more trustworthy than non-certified products in terms of sustainability.	.705				
	Sustainability certifications help assess the actual sustainability of the product.	.808				
Skepticism (SKEP) Albayrak et al. (2013); Kim and Oh (2020); Mohr et al. (1998)	I generally believe very few claims made by companies about their sustainability.	.693	.800	.507	.685	1.255
	I am skeptical about the accuracy of claims about corporate sustainability.	.759				
	I believe that it is often not clear from the information available to consumers whether companies are actually producing in a way that is less harmful to the environment.	.611				
	Basically, I question the sustainability claims of most companies.	.769				
Reputation (REPU) Kim and Oh (2020)	The Adidas brand has a good reputation.	.773	.861	.697	.765	1.189
	I have a positive image of the Adidas brand.	.913				
	I think that the Adidas brand has positive qualities.	.793				
Online Opinion Seeking (OPINS) Sun et al. (2006)	It is important to me to consider the shopping experiences of authentic influencers when making my own purchasing decisions.	.925	.938	.835	.863	1.055
	I feel more comfortable buying products when I have sought authentic influencers' opinions on social media.	.922				
	I am searching for inspiration on social media from authentic influencers when I am undecided about a purchase decision.	.908				

Notes: The columns depict standardized factor loadings (Std. FL), Reliability - Cronbach's α, Average variance extracted (AVE), Fornell-Larcker-Ratios (FLR) and Variance Inflation Factors (VIF).

Internal consistency was assured since all items had Cronbach's $\alpha \geq 0.7$ (Cronbach, 1951) and standardized factor loadings close to ≥ 0.7 (Shevlin & Miles, 1998) (see Table 3). In addition, all constructs had values above the threshold for convergent reliability (average variance extracted) ≥ 0.5 (Fornell & Larcker, 1981). Table 3 summarizes the results. We

established discriminant validity since all of the Fornell & Larcker (1981) ratios were less than one, and the Heterotrait-Monotrait (HTMT) ratios were less than 0.85 (ranging from 0.05 to 0.72) and significantly less than one (Henseler et al., 2015) (see Appendix B).

Structural model evaluation. Moving on to evaluating the structural model, we checked the variance inflation factors (VIFs) of the indicators and constructs, indicating no severe collinearity problem (see Table 3). VIFs meet the conservative threshold of 3 for the absence of collinearity issues (Hair et al., 2019) and the threshold of 3.3 for common method bias (Kock, 2015). The structural model indicates satisfactory model fit, with $chi^2(df) = 291.145$ (138), $p = .000$; RMSEA = .058 ≤ .080; CFI = .959 > .900; TLI = .949 > .900; SRMR = .049 ≤ .050 (Hair et al., 2014; Schermelleh-Engel et al., 2003). Next, R2 values were checked, exhibiting 0.388 for PI, 0.140 for SKEP, and 0.130 for REPUT (R2 Adjusted: 0.379 for PI, 0.129 for SKEP, and 0.125 for REPU). Overall, in-sample predictive power can be considered moderate (Hair et al., 2019).

Table 5. Results from structural equation modeling.

H	*Path*	*Path coefficients*	*Confidence Intervals*	*z-Statistics (p-value)*	*Results*
H1-1	INFO → PI	0.505	[0.325, 0.685]	5.491 (< 0.001)	Supported
H1-2	INFO → SKEP	0.432	[0.223, 0.641]	4.055 (< 0.001)	Supported
H1-3	CERT → PI	0.109	[-0.072, 0.289]	1.182 (0.237)	Rejected
H1-4	CERT → SKEP	-0.185	[-0.404, 0.033]	-1.660 (0.097)	Rejected
H1-5	CERT → REPU	0.312	[0.200, 0.423]	5.482 (< 0.001)	Supported
H1-6	SKEP → PI	-0.125	[-0.240, -0.009]	-2.115 (0.034)	Supported
H1-7	REPU → PI	0.061	[-0.052, 0.180]	1.083 (0.279)	Rejected
H1-8	REPU → SKEP	-0.229	[-0.379, -0.104]	-3.447 (0.001)	Supported
H1-9	OPINS → PI	0.198	[0.100, 0.296]	3.975 (< 0.001)	Supported
H1-10	OPINS → SKEP	0.041	[-0.081, 0.163]	0.664 (0.506)	Rejected
H1-11	OPINS → REPU	0.177	[0.066, 0.287]	3.139 (0.002)	Supported

Notes:(*** p<.001; ** p<.01; * p<.05; † p<.10). PI: purchase intentions, INFO: sustainable information quality, CERT: sustainability certifications, SKEP: skepticism, OPINS: online opinion-seeking behavior, REPU: reputation of the brand.

All hypotheses except for H1-3, H1-4, H1-7, and H-10 were supported (see Table 5). INFO and OPINS were found to positively impact PI, whereas SKEP negatively affected PI. REPU and INFO both exhibit alleviating effects on SKEP. INFO appears to be the major driver of PI and SKEP, while CERT has a strong influence on REPU compared to OPINS.

Discussion. Sustainable information quality had the strongest significant influence on purchase intentions (H1-1). Lack of information or missing credibility are much-cited barriers in research on sustainability (Mohd Suki, 2016; Wijekoon & Sabri, 2021), which is even more true in the context of sustainable clothing. The textile industry in general is

characterized by high information asymmetry and imperfect information. To build on this result, the following study expands our understanding of the role of information in sustainable clothes by testing consumers' preferred information channels and information contents and allowing comparison of different age groups.

The results from the first study show that, contrary to our assumption, consumers do not perceive reputation as a decisive factor in purchase intentions (H1-7). Findings on the relationship between company reputation and purchase intention are inconclusive (Nguyen & Leblanc, 2001). Most research, however, finds strong significant relationships between reputation and purchase intentions in varying contexts (Hengboriboon et al., 2022; Kim & Oh, 2020). A possible explanation for the weak link could be that respondents may not believe the shoe is from the specific manufacturer displayed (Nguyen & Leblanc, 2001).

3.2 Study 2

Conceptualization. As a first step in Study 2, we based the selection of the underlying attributes on a thorough review of the literature. We drew on a BWS experiment that had been conducted in previous literature on sustainable clothing (Rausch et al., 2021; Viciunaite & Alfnes, 2020) to evaluate the identified attributes. Due to the simplicity of the question format and its parsimony when collecting data (Flynn & Marley, 2014), methodologically, BWS represents an alternative to ranking, rating, or other choice-based data collection procedures (Mueller & Rungie, 2009). Respondents are forced to make trade-offs between different alternatives. This, in turn, prevents participants from developing and expressing inflated expectations (Louviere et al., 2015). Based on BWS experiments, conclusions about the attributes' relative importance can be drawn. Moreover, BWS provides information on both the best alternative and the worst alternative.

In this study's BWS experiment, we first introduced some preliminary questions (e.g., the frequency of clothing purchase behavior). Respondents were then asked to select which information content or information channel was the most/least important to them when getting informed about sustainable clothing (see Appendix C). In our analysis, respondents assessed twelve choice sets in total. One half of the choice sets referred to information channels. The other half concerned information content, with three repetitions of items for both choice sets. Participants were presented with ten different

items concerning information channels, with five items per choice set and eight items relating to information content with four items per choice set. Finally, socio-demographic data were collected.

Study and participants. To analyze the importance of the information channels and information content, we developed an online questionnaire with Sawthooth Software's Lighthouse Studio 9.8.1. Data were collected using an online panel in July 2021. Respondents were aged between 22 and 69, allowing for a sub-sample of participants aged 40 and older to be compared against the total sample. Respondents of the sub-sample encompassed Generation X and baby boomers. A total of 448 respondents participated in the survey, of which 113 respondents comprised the sub-sample relating to those aged 40 and older. The gender balance was reasonably equal in both the full sample and the sub-sample. Age in the sample ranged from 22 to 69 with an average of 37.21 years. In the sub-sample, 24.8% had a monthly income higher than 3,001 Euros, while it was lower for most of the total sample. Hence, our sub-sample comprises online consumers with a medium or high income compared to the total sample with a low or medium income. Most of the respondents were in employment (61.1%). Furthermore, two-thirds of the sub-sample had obtained a bachelor's or master's degree (see Table 6).

Concerning participants' purchase behavior concerning clothes, most of the sample (n = 289, 64.5%) indicated buying clothes less than once a month. More than half of the sample had already bought sustainable clothes (n = 242, 54%). Most respondents said they did not feel sufficiently informed about the sustainability aspects of consumption. Moreover, the majority of respondents indicated that companies fail to provide sufficient information regarding the sustainability of their clothing (n = 73 "Disagree"; n = 219 "Somewhat Disagree), and more than one-third of respondents doubted the credibility of the information provided on sustainability.

Table 6. Descriptives of Study 2 respondents.

Demographics/ Characteristics	Specifications	Counts (N = 448)	Proportion (in %)	Counts (N = 113)	Proportion (in %)
Age	20 – 24 years	1	0.2	/	/
	25 – 29 years	40	9.0	/	/
	30 – 34 years	166	37.1	/	/
	35 – 39 years	127	28.4	/	/
	40 – 44 years	55	12.3	55	48.8
	45 – 49 years	13	2.9	13	11.5
	50 – 54 years	16	3.6	16	14.3
	55 – 59 years	16	3.6	16	14.3
	60 – 64 years	6	1.3	6	0.5
	65 – 69 years	7	1.6	7	0.6

Demographics/ Characteristics	Specifications	Counts (N = 448)	Proportion (in %)	Counts (N = 113)	Proportion (in %)
Gender	Male	258	57.6	50	44.2
	Female	188	42.0	61	54.0
	Diverse	2	0.4	2	1.8
Monthly Income	< 1000 Euros	74	16.5	19	16.8
	1.001 – 2.000 Euros	134	29.9	33	29.2
	2.001 – 3.000 Euros	134	29.9	25	22.1
	> 3000 Euros	79	17.6	28	24.8
	Not specified	27	6.0	8	7.1
Employment status	Master's degree	179	40.0	53	46.9
	Bachelor's degree	122	27.2	15	13.3
	High school	86	19.2	22	19.5
	Secondary school	38	8.5	15	13.3
	Basic secondary schooling	17	3.8	7	6.2
	Others	6	1.3	1	0.9
Purchase frequency of clothes per month	Less than one garment	289	64.5	73	64.6
	1 – 2 garments	141	31.5	39	34.5
	3 – 4 garments	12	2.7	1	0.9
	5 – 6 garments	5	1.1	0	0.0
	More than six garments	1	0.2	0	0.0

Results. In our analysis of information channels, we applied HB estimation and ran 30,000 iterations. In support, we calculated average BW scores. The model's root likelihood (RLH) is 0.605. Across the entire sample, the official company's website was chosen as the most important attribute, just ahead of the company's YouTube channel. Google advertisements are rather unimportant as were the company's Facebook account (see Table 7). Overall, consumers value conventional information channels managed by the company itself rather than other information outlets. Those attributes (i.e., website, newsletter, social media) were found to be extremely important. Surprisingly, the official company Facebook account is of limited relevance and only half as important as the company's newsletter and Instagram account (with respect to their probability scores).

Table 7. Best-worst scaling results for information channels (n = 448).

	Average BW score	Zero-centered utility	Probability score
Corporate website	0.614	4.752 (2.600)	24.809 (7.850)
Social media: YouTube channel	0.153	1.189 (1.900)	13.341 (8.636)
Newsletter via e-mail	0.024	0.220 (2.630)	10.229 (9.859)
Social media: Instagram account	-0.035	-0.318 (3.123)	9.055 (9.912)
Blogs	-0.011	-0.076 (2.470)	8.956 (8.832)
Commercials on television	-0.121	-0.928 (3.560)	8.086 (9.968)
Forum	-0.096	-0.736 (3.353)	7.921 (9.563)
Podcast	-0.163	-1.254 (3.080)	6.370 (8.559)
Google advertisements	-0.197	-1.558 (3.058)	5.638 (7.987)

	Average BW score	Zero-centered utility	Probability score
Social media: Facebook account	-0.168	-1.292 (2,487)	5.595 (7.317)

Note: Standard deviations in parentheses.

Additionally, we performed a post-hoc Tukey HSD test (on the zero-centered utilities) to test the differences between the attributes. The majority of attributes' utilities were found to be significantly different from each other except for YouTube versus blogs, YouTube versus forum, Facebook versus Google advertisements, Facebook versus forum, Facebook versus podcast, Facebook versus commercials on television, newsletter versus blog, Google advertisements versus forum, forum versus podcast, and forum versus commercials on television.

To gather further insights, we investigated the importance of age-specific attributes (see Table 8). Older respondents care more about online forums on sustainability topics ($t = -2.879$, $p = 0.004$) and company newsletters ($t = -5.193$, $p < 0.001$) compared to younger respondents. Both groups consider the official company website as the most important attribute and, for younger respondents, it is even more decisive for their purchase decisions ($t = 3.640$, $p < 0.001$). Furthermore, younger respondents place more emphasis on social media channels, such as the company's Instagram ($t = 2.898$, $p = 0.004$) and YouTube accounts ($t = 2.555$, $p = 0.011$). Hence, H2-1 is supported.

Table 8. Age-specific best-worst scaling results for information channels.

	Zero-centered utility		Probability score	
	≤ 39 years	≥ 40 years	≤ 39 years	≥ 40 years
Corporate website***	4.739 (2.640)	3.801 (1.724)	24.544 (8.018)	26.192 (7.159)
Social media: YouTube channel **	1.256 (1.871)	0.760 (1.513)	13.604 (8.583)	12.017 (8.045)
Newsletter via e-mail *	0.096 (2.580)	0.674 (2.158)	9.670 (9.599)	12.362 (9.820)
Social media: Instagram account **	-0.072 (3.206)	-0.992 (1.854)	10.036 (10.355)	5.259 (6.560)
Blogs	-0.076 (2.531)	-0.125 (1.602)	9.108 (8.955)	7.855 (6.879)
Commercials on television	-0.844 (3.521)	-1.001 (2.901)	8.204 (9.976)	7.528 (9.274)
Forum **	-0,954 (3.392)	0.036 (2.378)	7.519 (9.372)	9.588 (9.613)
Podcast	-1.248 (3.093)	-0.750 (2.358)	6.281 (8.509)	6.937 (8.338)
Google advertisements	-1.607 (3.080)	-1.007 (2.319)	5.542 (7.877)	6.332 (7.884)
Social media: Facebook account	-1.189 (2.367)	-1.396 (2.396)	5.494 (6.841)	5.821 (7.840)

Notes: Standard deviations in parentheses. T-test conducted with zero-centered utilities, ***= $p < 0.001$, **= $p < 0.01$, *= $p < 0.05$.

Analogous to examining information channel attributes, we applied hierarchical Bayes (HB) estimation and ran 20,000 iterations to analyze preferred information content.

Furthermore, we calculated the average BW scores. The model's root likelihood (RLH) is 0.615. For our respondents, certifications, product labelling concerning material components, and information on the contribution to sustainability are the most important sustainable apparel attributes (see Table 9).

A certification can be viewed as not only a sustainable attribute re-directing consumer consumption behaviors but also an economic attribute alleviating consumer concerns on trust in the company. It allows consumers to make informed buying decisions with fewer and more specific investments. Material usage, which is indirectly connected to CO2 emissions and water wastage (e.g., dyeing process for jeans), is considered important. Respondents emphasize the environmental facets of sustainable clothing, which are associated with degradation along the supply chain (e.g., high CO2 emissions and water waste). A company's recycling offerings, which are indirectly connected to decreasing clothing waste, are considered only half as important. Moreover, labels in online shops providing instructions on care are rather unimportant.

Table 9. Best-worst scaling results for information contents (n = 448).

	Average BW score	Zero-centered utility	Probability score
Certifications	0.263	1.925 (3.547)	18.802 (13.173)
Product labeling: product information on material components	0.216	1.172(1.792)	16.939 (10.378)
Quantified value contribution to sustainability	0.173	1.059 (1.970)	15.938 (9.745)
Product labeling: information on working conditions	0.169	1.109 (2.172)	15.862 (9.835)
Details about the value chain	0.019	0.292 (2.437)	12.240 (10.031)
Information on a company's recycling offerings	-0.139	-0.813 (2.351)	8.086 (9.968)
Information on product benefits	-0.213	-1.579 (2.812)	7.546 (10.632)
Labeling of care instructions in online shops	-0.487	-3.166 (2.856)	3.989 (7.692)

Note: Standard deviations in parentheses.

A post-hoc Tukey HSD test revealed that all attributes' zero-centered utilities are significantly different from each other, except for material components versus working conditions, material components versus quantified value, and working conditions versus quantified value. On respondents' age, both groups consider information on material components as the second most important attribute and, for older respondents, it is even more decisive for their purchase decisions ($t = -1.969$, $p = 0.050$) (see Table 10). In contrast, details on the value chain are more important for younger respondents than for older respondents ($t = 2.719$, $p = 0.007$). Hence, H2-2 is supported.

Table 10. Age-specific best-worst scaling results for information content.

	Zero-centered utility		Probability score	
	≤ 39 years	≥ 40 years	≤ 39 years	≥ 40 years
Certifications	1.750 (3.573)	2.257 (2.950)	18.058 (13.064)	21.560 (13.148)
Product labeling: product information on material components *	1.092 (1.813)	1.460 (1.410)	16.413 (10.281)	19.773 (9.949)
Quantified value contribution to sustainability	1.091 (1.945)	0.862 (1.832)	16.028 (9.697)	15.368 (9.433)
Product labeling: information on working conditions	1.159 (2.163)	0.837 (1.956)	16.271 (9.845)	14.536 (9.503)
Details about the value chain **	0.441 (2.476)	-0.248 (1.847)	12.798 (10.288)	9.762 (7.956)
Information on a company's recycling offerings	-0.818 (2.363)	-0.732 (2.007)	8.670 (9.928)	7.528 (9.274)
Information on product benefits: e.g., comfort and durability.	-1.529 (2.885)	-1.607 (2.127)	7.796 (10.815)	6.335 (8.966)
Labeling of care instructions in online shops	-3.184 (2.851)	-2.829 (2.570)	3.966 (7.858)	3.971 (6.604)

Note: Standard deviations in parentheses. T-test conducted with zero-centered utilities, ***= $p < 0.001$, **= $p < 0.01$, *= $p < 0.05$.

Discussion. Study 2 extends the results of the SEM and provides additional support for the importance of information in general and for the specific information channels and content. Moreover, Study 2 allows for comparison between different age groups. Prior empirical findings on the age–purchase intention relationship in a sustainability context are inconclusive (Burkolter & Kluge, 2011; Cowart & Goldsmith, 2007). Our findings lead us to conclude that different age groups vary in their goals and reasons for buying sustainable clothing. This explains the age-dependent need for different information channels and content.

The prior literature confirms that consumers over 40 express a greater need for objective information to make purchasing decisions, which is supported by the results obtained here (Bento et al., 2018; Lissitsa & Kol, 2016). Studies 1 and 2 have shown that providing information influences purchase intentions in the context of shopping for sustainable clothes online and that different information channels and information content differ in their importance in making purchase decisions. Furthermore, Study 2 shows that the effect varies with consumer age concerning the information channels and information content preferred. This is indicative of support for the influence of sustainability certifications and online opinion seeking in Study 1.

4. General Discussion

The attitude–behavior gap in consumer activity relating to the purchase of sustainable clothing remains salient. The dearth of literature concerning the role of information in the development of purchase intentions necessitates a more thorough understanding of the phenomenon. From our two studies, we highlight the role of information, especially of different information channels and information content, in increasing purchase likelihood. Our study's findings provide grounds for bridging the attitude-behavior gap.

Study 2 provides evidence that independent of age, consumers consider a company's website the most important channel and sustainability certifications the most important content when searching for information. The importance of sustainability certifications as key information content is supported by findings from Study 1 and previous literature (Brach et al., 2018). Empirical findings suggest that sustainability certifications issued by independent third parties play a crucial role in bridging the attitude-behavior gap. Interestingly, Grunert et al. (2014) found that older consumers display higher levels of environmental concern but show lower levels of understanding and use of such certifications. According to Potter et al. (2021), the results of the influence of age on using sustainability certifications are inconclusive. Despite past findings, our results indicate that, irrespective of age, consumers consider sustainability certification an important heuristic in decision making. Moreover, the extant research found that sustainability certifications were increasingly important in decision making regardless of context, which further supports our finding (Potter et al., 2021).

Additionally, Study 2 shows that consumers in the sub-sample are drawn to more traditional information channels, such as company newsletters and online communities, compared to the total sample. Younger consumers in the sample showed similar preferences to the sub-sample (i.e., the company website or its YouTube channel), However, they also ascribed greater importance to social media channels, such as Instagram and blogs. Despite this general comparison between the total sample and the sub-sample, it is interesting to note that, within their own group, younger consumers rated a company's Instagram account as less important than a company's website and almost as important as a company's newsletter. Hence, the results from Study 2 indicate that the role of social media is less important for younger consumers when forming purchase intentions concerning sustainable clothes than previously proposed by the research.

In general, the extant literature postulates an increase in importance of social media in decision making. Social media platforms are said to have growing power in influencing information search concerning sustainable clothes (Johnstone & Lindh, 2022; Shravya, 2022). Hence, accessing social media has proven influential in forming purchase intentions. The findings from Study 1 support this general development. Seeking information from influencers was found to have a significant effect on purchase intentions. Moreover, research on the influence of age on social media use and information seeking in the context of sustainable clothing is scarce (Johnstone & Lindh, 2022). In sum, according to our research, other information sources have proven more important when seeking information on sustainable clothes in an online setting. Thus, we can only partly confirm earlier findings (Johnstone & Lindh, 2022; Khodabandeh & Lindh, 2021) on the relevance of social media, which indicates that consumers perceive other information sources as more important when shopping for sustainable clothing online.

In general, Studies 1 and 2 highlight the importance of information and its transmission in bridging the attitude-behaviour gap. Principally, information related to sustainability was found to be a key influencing factor when attempting to close the attitude-behavior gap (O'Rourke & Ringer, 2016; Stöckigt et al., 2018). Our results provide evidence for the crucial role of information when purchasing sustainable clothing. However, it is necessary to differentiate between making information available and providing the right information through the right channels and with credible substance (Bento et al., 2018; Stöckigt et al., 2018). Information may only be effective in closing the attitude–behavior gap if presented as appealing and understandable for consumers through the channels typically preferred by their respective age groups.

4.1 Theoretical contributions

This study is one of the first in the context of sustainable clothing to shed light on age-related differences in online information behavior that may help bridge the attitude–behavior gap. Our findings indicate that information on sustainable clothing has the potential to close the attitude–behavior gap. Hence, we can confirm previous findings that credible information increases purchase likelihood (Nguyen & Leblanc, 2001; Stöckigt et al., 2018). Moreover, we provide details on which information channels and which information content are most influential in actual purchase behavior based on age.

Research in sustainability has shown mixed results and varying effects for different age groups on online shopping behaviors. Based on our findings, we assign part of the reason for such mixed effects to different age-dependent shopping goals. The prior literature provides evidence that sustainability goals change over time; older consumers exhibit greater awareness, incorporating sustainable aspects into their behavior over the long term (Parment, 2013). This may explain why respondents of the sub-sample in Study 2 make use of more traditional information channels and content compared to the total sample.

Previous research proposed that younger consumers are regularly influenced by peers and influencers when making purchasing decisions concerning sustainable clothes. Our findings support the relevance of social media outlets and influencers in decision making. However, results from Study 2 emphasize that younger consumers do not necessarily use social media exclusively as an information source; they appear not to consider it as important as the extant research had previously suggested (Khodabandeh & Lindh, 2021). Furthermore, the mere communication of information is not sufficient to change behavior. Information needs to be credible and presented by channels that are considered relevant by the respective age group (e.g., the sub-sample in Study 2 considers company newsletters of greater relevance compared to younger participants in the study). If fashion companies continue to provide information without targeting it to the relevant consumer group, consumers will always be overwhelmed with information that bears no relevance to their decision making. This, in turn, increases the gap between attitude and behavior rather than reducing it.

4.2 Practical implications

Our findings on the role that information channels and information content play in sustainable clothing shopping – and, specifically, in determining age-dependent preferences – carry several implications that help bridge the attitude–behavior gap. In addition to clothing retailers and manufacturers, various stakeholders, such as governments and NGOs, may be interested in educating consumers on sustainable matters and, thus, enhancing their purchasing behavior concerning sustainable clothing. On age differences, our research suggests that communicating more effectively with consumers will boost actual purchasing of sustainable clothing and, thus, narrow the attitude–behavior gap.

In general, Studies 1 and 2 provide evidence that information provided by the company itself has a more authentic impact on consumers than obtaining information from influencers. Companies can reduce the risk of incorrect or misleading information by controlling the information narrative. This in turn facilitates consumer decision making and helps translate consumer purchase intentions into actual purchase behavior. Here, companies can make use of sustainability certifications. Results from Study 1 show that consumers use such certifications to verify information provided by the company. Drawing on third-party labels helps raise perceived authenticity and objectivity of the information displayed by reinforcing the consumer confidence in their purchasing decisions. This is in line with the findings from our second study. From a managerial point of view, actions to mitigate the impact of consumer concerns and perceived risk associated with the purchase of sustainable clothes might produce more promising effects. Our findings show that the corporate website is a particularly important information channel independent of consumer age.

Furthermore, our results confirm that consumer confidence in purchasing sustainable clothing is reinforced by objective components of information – for instance, product labeling and information on the quantification of a consumer's contribution/self-efficacy. Quantification allows consumers to understand their own impact on the environment. Due to the long-term nature of sustainability goals and the lack of tangibility in results, quantification helps raise customer motivation to behave pro-environmentally (Zafar et al., 2021). Consequently, we recommend that clothing retailers provide objective facts and figures on their information channels.

Based on our findings from Study 2, clothing retailers should make use of regular e-mail newsletters. Such newsletters can inform consumers explicitly and regularly on topics such as recycling offers and what consumers themselves can actively do to conserve resources. Moreover, both studies indicate the relevance of videos in providing information. Audio-visual content, such as YouTube videos and podcasts offer the potential to share information that can be conveyed in a clear, entertaining, and understandable way. Our results lead us to the recommendation that retailers and fashion companies should incorporate such information sources into their channels even at the risk of consumers becoming quickly distracted or annoyed by advertisements in "free formats" on corresponding platforms.

4.3 Limitations and future research

As with most scientific research, several methodological limitations need to be addressed. First, while the sample sizes of both studies were significantly large in order to derive statistical conclusions, the responses were collected via online panels. Generally, sample populations in both studies were comparable to the population structure in Germany based on age and sex. However, the results of both studies may not be applicable to consumers who are not online because they cannot be covered by an online panel. Therefore, we cannot be certain that the sample populations in either study are representative of the target population of customers interested in purchasing sustainable clothes. Because of the online setting of both studies, self-selection bias might influence results. Moreover, we were not able to control or correct contextual factors influencing response behavior due to the web-based design of both studies. Furthermore, constructs were measured using a Likert scale. Consequently, measurements might be inaccurate due to self-assessment. Social desirability in the context of sustainability might also bias answers towards the high end. This research only includes German participants, so no conclusions on cultural influences can be drawn. According to prior empirical results, consumer behavior may be influenced by cultural factors and environmental knowledge may vary from country to country (Kumar et al., 2021; Paul et al., 2016).

This research was conducted examining the role of information in buying sustainable clothing based on consumer age and in bridging the attitude–behavior gap. Future investigations could assess the relevance of information in other sustainability contexts, such as sustainable tourism, to generalize results and gather insights into the attitude–behavior phenomenon. Comparing the results from our research with preliminary findings indicates that differences in online shopping behavior based on age might be influenced by product category, which may provide grounds for further investigation. Furthermore, issues concerning information overload on consumers has not been part of this research, but it is relevant to consumer decision making and may be a topic worthy of addressing in future research.

In addition, the respective value orientations of consumers may depend on age and may develop over time. Hence, information behavior and goal setting concerning sustainable clothing may be influenced by these values. Depending on whether a consumer has a more egoistic or altruistic value orientation, the need for information in decision-making situations differs according to different foci (Groot & Steg, 2008). Consumers with

predominantly egoistic values focus on the assessment of the cost/benefit ratio while altruistically oriented consumers focus on the benefit that results from their behavior for others in decision-making situations. Hence, those value types may express discrete information needs concerning channels and content. In a sustainability context, such interplay of information, consumer age-dependent values, and their influence on subsequent behavior offers an interesting avenue for further research.

5. Conclusion

Fashion consumption and its substantial impact on the environment demands a paradigm shift to more sustainable purchase behaviors. In consequence, identifying factors to increase the purchase of sustainable clothing and closing the attitude–behavior gap constitutes a major challenge. Our research provides insights into the general influencing factors on purchase behavior concerning sustainable clothing, and it sheds light on the varying importance of information channels and information content for different age groups. Our two studies show that sustainable information quality holds out the prospect of closing the attitude–behavior gap. We have highlighted the varying preferences in information behavior for different age groups. Social media has proved to be influential but not to the degree suggested by the extant research. The mere communication of information will not be sufficient to change consumer behavior. Age-dependent differences in information behaviors must be taken into account in providing information to respective target groups. Against the background of age-dependent preferences, uncoordinated information dissemination may lead to confusion and skepticism. Only information that is relevant to the specific consumer segment will exhibit the power to change behavior and close the attitude–behavior gap. Fashion companies and retailers are well advised to adapt their marketing mix accordingly.

Appendix A: Purchase criteria ranked by importance

Table A1. Importance ranking.

Purchase criteria	Mean (SD)
Aesthetics/ design	2.97 (2.01)
Fit	3.4 (2.05)
Quality	3.89 (2.06)
Price-performance ratio	3.99 (2.24)
Comfort	4.14 (1.71)
Haptics (material texture)	4.98 (1.87)
Sustainability	6.18 (1.85)
Brand	6.44 (1.87)

Note: 1 = most important, 8 = least important.

Appendix B: Discriminant validity – Heterotrait-Monotrait ratio criterion

Table B1. Heterotrait-Monotrait tabulation.

	Influencing Factors	1	2	3	4	5	6
1	Purchase intention						
2	Sustainable information quality	.555					
3	Skepticism	.040	.192				
4	Sustainability certifications	.475	.717	.102			
5	Reputation	.267	.250	.095	.320		
6	Online opinion seeking	.190	.049	.045	.025	.170	

Appendix C: Summary of BWS Item Explanations

Table C1. Information channels.

Information channel	Description
YouTube channel of the company	The growing use of online videos as consumers actively seek information reinforces the role of YouTube.
Company Instagram account	Consumers get inspired by influencers via social media platforms. Influencers may provide detailed product information (e.g., features related to fit, quality, and comfort), their opinions, and their experiences with a sustainable garment.
Facebook account of the company	Companies can inform their followers on Facebook, (at regular intervals) about the sustainability of their clothing and share news, as well as interact with their consumers.
Newsletter via e-mail	Especially loyal consumers but also new customers can be informed at regular intervals by a newsletter (e.g., about promotions and discounts for sustainable clothing).
Corporate website	Extensive details about sustainability in relation to clothing can be provided on the corporate website so that consumers can actively inform themselves.
Google advertisements	Google advertisements create awareness about the sustainable clothing offerings of a company. They may also establish trust by ratings from other consumers.
Blogs	Blogs may provide information on the sustainability of a company or its products.
Forum	Forums allow consumers to interact with each other on topics such as sustainability. They provide opportunities for networking, consultation, and cooperation.
Podcasts	Podcasts are used in both personal and business settings and provide opportunities to educate consumers about sustainability.
Commercials on television	Running advertisements and campaigns can provide information about sustainability in relation to clothing or sustainable attributes of a company.

Table C2. Information contents.

Information content	Description
Certifications (e.g., Blue Angel/ Fair Trade)	Certifications are a decision-making heuristic used by consumers when they have little information about a particular product. Certifications can reduce consumer uncertainty, provide a higher level of objectivity, and promote trust.
Product labeling: product information about material components e.g., natural fibers	Product descriptions may encompass detailed information about the materials used. Consumers often have little idea about alternative sustainable materials and their characteristics.
Product labeling: information about working conditions	Sustainable clothing is associated with safe and humane working conditions, such as, among others, fair wages, safety standards, and no child labor.
Information about product benefits: e.g., comfort and durability	Information about the benefits of sustainable clothing, such as higher comfort of natural materials compared to conventional materials or durability may help to evaluate the quality of clothing.

Information content	Description
Quantified value contribution to sustainability (e.g., consumed emissions or water savings during production)	Usually, statements such as: “environmentally friendly” and “protects the environment” provides little help to consumers in making a purchase decision. Therefore, information should be provided as comprehensibly as possible about the extent to which their purchase saves resources along the value chain.
Details about the value chain	Consumers usually have little information about a company’s supply chain. Transparent information about the manufacturing process and the “total distance” a garment travels during production can strengthen trust and encourage the purchase decision for a sustainable garment.
Labeling of care instructions in online shops	Manufacturers can, for example, provide information on how many washes a garment can withstand as well as specific care instructions for alternative materials.
Information about a company's recycling offerings	Consumers perceive the recycling of clothing as costly. If information or services for take-back programs are provided in the pre-purchase phase, the willingness to buy can be increased (e.g., resell clothing commercially or recycle material components, possibly incentivize with vouchers for returning used clothing).

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Hiermit erkläre ich, dass ich die vorliegende Dissertation selbstständig und ohne Benutzung anderer als der angegebenen Hilfsmittel angefertigt habe. Alle Stellen, die wörtlich oder sinngemäß aus veröffentlichten oder unveröffentlichten Schriften entnommen wurden, sind als solche kenntlich gemacht.

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München, den 05. November 2024 _____

Teresa Maria Ries