

Together forever? How customer co-creation affects the adoption of digital service innovations over time

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Abstract

This study delves into the intricate relationship between customers' willingness to co-create (WCC) and the required level of co-creation (LCC) for effective service innovation adoption. In response to recent findings suggesting a “co-creation sweet spot,” beyond which additional co-creation activities have detrimental effects, this research aims to provide both theoretical and empirical insights into this phenomenon. Unlike previous investigations focusing on either the willingness to co-create or the level of co-creation at a particular point in time and overlooking potential interactions, our study considers their interactions over time, acknowledging that revenue for most digital services is generated through ongoing customer usage. Utilizing longitudinal data from 352 participants across four waves and employing structural equation modeling, our analysis reveals a nuanced pattern. Customers' willingness to co-create predominantly shapes usage intention in the pre-adoption stage, while the level of co-creation becomes a critical driver for continuous usage in the post-adoption stages. Further analysis using response surface analysis with polynomial regression confirms a specific matching logic: customers with low (high) willingness to co-create expect a low (high) level of co-creation from a service innovation. From a theoretical perspective, our findings contribute to bridging the research gap concerning an optimal co-creation level, offering insights into psychological processes underlying the co-creation sweet spot. Furthermore, we also shed light on temporal aspects of the interplay between willingness to co-create and the level of co-creation, offering a more holistic perspective on their joint influence on adoption behavior. From a managerial perspective, our study challenges the traditional assumption that more co-creation naturally leads to better outcomes. It emphasizes the significance of tailoring the level of co-creation in digital service innovations based on customers' intrinsic

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willingness. This strategic customization aligns with the evolving landscape of digital service innovation, offering practical insights for managers striving to optimize their co-creation strategies.

KEYWORDS

adoption, co-creation, continuous usage, digital services, innovation

1 | INTRODUCTION

As the digital economy continues to expand and reshape industries worldwide, the profound influence of digital technologies on global markets is undeniable. Particularly, innovations in digital services continue to significantly influence and dynamically shape how we interact, access information, and conduct transactions. Highlighting this trend, the global app market stands out as a key player, generating revenues of 467 billion U.S. dollars in 2023 (Statista, 2024). This positions mobile apps at the forefront of digital service innovations, showcasing their potential for generating substantial revenue.

However, despite their contribution to the digital economy's growth, digital service innovations face a high failure rate (Talwar et al., 2020). To succeed, their business models typically require customers not only to adopt the service initially, but also to use it continuously (Stocchi et al., 2020). Therefore, active customer participation in service provision and consumption becomes increasingly vital (Heidenreich & Handrich, 2015). This aligns with the fundamental premise of service-dominant logic, which challenges the traditional view of customers as buyers and emphasizes their active role as co-creators (Neghina et al., 2017; Ruiz-Alba et al., 2019; Vargo & Lusch, 2004). Customer co-creation, as a cooperative process between customers and firms to create value through direct and indirect collaboration in service provision and consumption (Ranjan & Read, 2016), is thus viewed as a fundamental prerequisite for the creation of valuable services (Morosan & DeFranco, 2019; Perks et al., 2012; Vargo & Lusch, 2004).

While almost all digital services necessitate some degree of customer co-creation, service providers can influence the extent to which customers are involved in the creation of the service outcome. For example, when offering an innovative fitness app such as Freeletics, providers can regulate the degree to which customers are required or allowed to provide personal data in order to receive customized workouts and audio coaching. Although past research generally supports the positive impact of customer co-creation on service innovation adoption and success (Chan et al., 2010; Handrich & Heidenreich, 2013; Hsieh & Hsieh, 2015; Rajah et al., 2008), recent studies introduce the notion of a “co-creation sweet spot.” These

Practitioner points

- Companies need to conduct in-depth market research to identify the different levels of willingness to co-create among potential customers. They should specifically target segments with a high willingness to co-create, as these individuals are more likely to adopt innovations early and influence others through positive recommendations. Tailoring initial service offerings to these segments, possibly through exclusive access or incentives, can effectively leverage their enthusiasm for broader service adoption.
- Managers are advised to develop marketing strategies and service designs that are aligned with the specific co-creation willingness levels of their customer segments. For customers with a high willingness to co-create, managers should highlight co-creation aspects and offer more advanced options. Conversely, for those less inclined to co-create, it's important to simplify the co-creation process and emphasize ease of use through targeted marketing efforts, such as tutorials or demonstrations, to motivate their participation.
- Service providers must continuously refine their service offerings and co-creation opportunities based on customer feedback and engagement data throughout the adoption process. Initially, offerings should be designed to match customers' willingness to co-create. As customers progress in their journey and become more engaged, service providers should introduce more complex co-creation features to sustain interest and deepen customer involvement. This strategy ensures ongoing engagement and maximizes the likelihood of continuous service usage.

studies indicate that exceeding this optimal point, additional co-creation activities may yield adverse effects on service outcomes (Gligor & Maloni, 2022; Stokburger-

Sauer et al., 2016). In particular, Gligor and Maloni's (2022) research indicates that excessive co-creation can harm the customer experience, leading to negative customer responses. This occurs when the level of co-creation (LCC)—a customer's subjective perception of the degree of co-creation activities needed to use a particular service—exceeds their expectations. This insight prompts the consideration that successful co-creation processes may yield different outcomes for customer adoption processes, depending on whether the sweet spot is reached or not.

However, knowledge on the psychological processes underpinning this co-creation sweet spot remains limited. Recent insights suggest that a crucial factor lies in a certain matching logic between the level of co-creation and customers' willingness to co-create (WCC), representing their intrinsic motivation for value co-creation. Unfortunately, empirical investigations have been limited to the effects on customer adoption behavior by either one of these constructs, neglecting possible interactions between willingness to co-create and the level of co-creation. Furthermore, previous research exclusively has analyzed each construct's influence at a certain point in time (i.e., using cross-sectional designs) and mostly prior to usage (Heidenreich & Handrich, 2015; Jain et al., 2021; Molinillo et al., 2020; Stokburger-Sauer et al., 2016). However, innovation-decision models from adoption theory (Rogers, 2003) suggest that the drivers of customer adoption behavior vary depending on the adoption process stage (Talke & Heidenreich, 2014), with adopter-specific variables (e.g., technological anxiety) driving initial usage, and service-specific variables (e.g., ease of use) driving continuous usage (Evanschitzky et al., 2015). The same pattern may apply to the adopter-specific variable of willingness to co-create and the service-specific variable of level of co-creation. However, empirical evidence of the aforementioned proposition is lacking due to the scarcity of research that considers both constructs, and examines their effects in longitudinal studies.

This article strives to address these research gaps by applying a longitudinal perspective to investigate the influence of customers' willingness to co-create, the service specific level of co-creation, and their interaction on initial and continuous usage of digital service innovations. In addressing these gaps, our study answers the calls made in prior research to delve into the co-creation sweet spot (Gligor & Maloni, 2022; Stokburger-Sauer et al., 2016) and to examine how co-creation's influence on customer adoption behavior varies over time using longitudinal data (Heidenreich et al., 2015; Jain et al., 2021; Sarmah et al., 2017; Vermehren et al., 2022). More specifically, we collected data from 352 participants taking part in a four-wave panel study to examine their adoption and usage behavior with innovative mobile applications over time. Results from structural equation

modeling and response surface analysis with polynomial regression indicate that both co-creation constructs' relative importance varied significantly over time, and that adoption and subsequent usage were driven by a certain matching logic between these constructs.

From a theoretical point of view, the corresponding findings contribute to prior literature in three ways. First, by revealing the distinct impacts of both co-creation constructs on customer adoption behavior over time, we contribute to the development of the service-dominant logic (Vargo & Lusch, 2004) by offering new insights on the prerequisites for value creation during customer adoption processes. Likewise, our results expand upon adoption theory (Rogers, 2003) by providing initial empirical evidence on the applicability of assumed effect patterns within adopter- and service-specific factors throughout the adoption process (Nabih et al., 1997; Talke & Heidenreich, 2014) in the realm of co-creation.

Second, our study pioneers in empirically validating the proposed matching logic between willingness to co-create and the level of co-creation. This validation explains the mixed findings on the effects of co-creation levels on customer behavior and the identified co-creation sweet spot (Gligor & Maloni, 2022). In doing so, it deepens our understanding of the inverted U-shaped relationship between the level of co-creation and customer behavior, emphasizing that the co-creation sweet spot manifests when there is a match between the level of co-creation and customers' willingness to co-create. Beyond that point, additional co-creation activities have detrimental effects, as they exceed the customers' willingness to co-create.

Third, our findings not only respond to the call for research on an optimal degree of co-creation, as highlighted by Stokburger-Sauer et al. (2016), but they also bring a nuanced perspective to this area of inquiry. Our findings reveal that the optimal level of co-creation is not a universal standard but is intricately tied to the individual characteristics of each customer, particularly their willingness to co-create.

From a managerial perspective, our research challenges the prevalent assumption that increased co-creation always leads to better outcomes, underscoring the crucial need to adjust the level of co-creation in digital service innovations to align with customers' inherent willingness. This managerial contribution signifies a move toward a more personalized and customer-centric strategy, acknowledging the diverse preferences and co-creation capabilities of different customer segments. Implementing such an individualized approach is essential for optimizing the effectiveness of co-creation strategies, thereby fostering continuous usage and maximizing innovation success. In essence, our findings advocate for a dynamic and adaptive service design that aligns with customers' varying degrees of willingness to co-create,

ultimately leading to enhanced customer satisfaction and successful digital service adoption.

2 | CURRENT STATE OF RESEARCH

To create a thorough overview of prior research on willingness to co-create and the level of co-creation, we conducted a comprehensive database search on EBSCOHost, ScienceDirect, and Web of Science (Bartels & Reinders, 2011), encompassing articles available through February 2023. The search string, tailored to our research focus was set up as follows: “willingness to co-create” or “motivation to co-create” or “readiness to co-create” or “level of co-creation” or “degree of co-creation” or “extent of co-creation”. The search targeted each article's title, abstract, and keywords. Table S1A illustrates the database search process. During the first step of the search process, 89 articles were sourced from the databases (35 each from EBSCOHost and Web of Science, and 19 from ScienceDirect). In the second step, duplicates were eliminated, and the eligibility of the remaining articles (i.e., consumer research), was assessed through a thorough analysis of their full texts. During Step 3, the remaining 23 articles from the database search were enriched with eight articles identified through a cross-reference and manual search. Table S1B outlines the characteristics of the final 31 articles.

All articles found in the search process center on customer co-creation during later phases of the service process model (Grönroos, 2011; Handrich & Heidenreich, 2013), specifically during service provision and consumption. These studies examined collaborative activities in the customer-provider interface linked to the service, emphasizing how customers co-produce and co-consume innovative services (Oertzen et al., 2018). Unlike research on customer co-creation during the early stages of the service process model (Franke & Piller, 2004; Franke & Schreier, 2010; Poetz & Schreier, 2012), in which customers co-ideate and co-design new services (Oertzen et al., 2018), the studies found in the database search focused on customer co-creation in the context of existing service innovations. Given our research objective to investigate the effects of customer co-creation on the initial and continuous adoption of existing service innovations, the subsequent sections of the manuscript will maintain a focus on customer co-creation during service provision and consumption.

With respect to willingness to co-create and the level of co-creation as focal constructs, the articles indicate a consensus on both constructs' definitions and conceptualizations. Willingness to co-create describes a customer's disposition toward co-creating value during the provision

and consumption of services that is shaped essentially by the customer's intrinsic motivation to share information, invest effort, and receive customized offerings during interactions with the service provider (Handrich & Heidenreich, 2013; Jain et al., 2021; Vermehren et al., 2022). The level of co-creation refers to a customer's subjective perception of the degree of co-creation activities needed to use a particular service that essentially is shaped by the anticipated necessary amount of information shared, effort invested, and customization received during the interaction with the service provider (Heidenreich et al., 2015; Kuzgun et al., 2022; Riana et al., 2022; Sugathan & Ranjan, 2019; Wei et al., 2019). Thus, in terms of conceptual similarities, both constructs follow the common assumption in literature that co-creation comprises three constituent elements: (1) customization (e.g., Etgar, 2008; Neghina et al., 2017; Sjödin et al., 2020); (2) effort (e.g., Demirezen et al., 2020; Hoyer et al., 2010; Youngdahl et al., 2003); and (3) information sharing (e.g., Etgar, 2008; Tajvidi et al., 2020; Yi & Gong, 2013). In terms of conceptual differences, willingness to co-create is rooted in adopter-specific factors that form a customer's general motivation (i.e., not relating to a specific service) to engage in co-creation activities. Thus, it is relatively stable over time. The level of co-creation is rooted in service-specific factors that form a customer's perception of the degree of co-creation required to use a particular service; thus, it may vary over time based on the usage experience.

Upon closer examination of the 31 articles, it becomes evident that numerous conceptual and methodological limitations exist, indicating notable research gaps that merit attention. From a conceptual perspective, 19 studies centered on the level of co-creation, while 12 studies concentrated on willingness to co-create as their focal constructs, with none investigating both constructs. This presents a concern for the following reasons. While several studies consistently have confirmed that customers' willingness to co-create fosters collaboration during co-creation processes (Lazarus et al., 2014; Neghina et al., 2017), as well as enhances adoption of service innovations (Heidenreich & Handrich, 2015; Jain et al., 2021; Sarmah et al., 2017), the demand-side performance implications of the level of co-creation are rather ambiguous. Some studies have found evidence of its beneficial role (Grisseemann & Stokburger-Sauer, 2012; Sugathan et al., 2017a, 2017b), confirming positive effects on new service evaluation (Xu et al., 2014) and service innovation adoption (Kamboj & Gupta, 2020). However, other studies have found detrimental effects of high co-creation levels on demand-side performance metrics, like customer satisfaction (Gligor & Maloni, 2022; Haumann et al., 2015; Heidenreich et al., 2015) or purchase

behavior (Stokburger-Sauer et al., 2016). Providing more nuanced findings, Stokburger-Sauer et al. (2016) found that increasing co-creation levels positively impact customer behavior up to a certain point which can be described as a “sweet spot”. However, beyond that point further increases in the level of co-creation lead to negative effects. Similarly, Gligor and Maloni (2022) highlighted a co-creation sweet spot, with results unveiling an inverted U-shaped relationship between value co-creation and satisfaction. This implies that while increased co-creation can be advantageous, there is a critical threshold beyond which additional co-creation leads to negative effects. Gligor and Maloni (2022) suggested that this sweet spot occurs at the juncture where expectations about co-creation activities align with the experiences derived from engagement in these activities. However, both theoretical rationales and empirical evidence are lacking regarding how customers develop expectations about the appropriate level of co-creation. Yet, given that a customer's willingness to co-create largely shapes customers' motivation for engaging in value co-creation (Heidenreich & Handrich, 2015; Jain et al., 2021; Savitha et al., 2022), it is reasonable to infer that expectations regarding the suitable level of co-creation before usage stem from customer's willingness to co-create. Thus, a certain matching logic between the level of co-creation and customers' willingness to co-create seems crucial in explaining the asymmetric effects of co-creation levels on customer reactions, such as service innovation adoption. Empirically validating the matching logic through a focused examination of interactions between both co-creation constructs can elucidate the co-creation sweet spot and address this research gap.

From a methodological perspective, all 31 articles are empirical and examined the antecedents and consequences of either customers' willingness to co-create or the level of co-creation. The studies covered a broad range of contexts, including both analog services in hospitality and tourism contexts, as well as digital services, such as internet booking services and mobile applications. However, all the studies used cross-sectional data and examined only one point in time, mostly prior purchases. This is problematic for several reasons. First, it must be noted that the development of customers' expectations about appropriate co-creation levels based on their intrinsic motivation to co-create is a complex and dynamic process that may differ over time. More specifically, previous studies on adoption behavior over time have found differences in how individual expectations are formed during the pre- and post-adoption stages (Gupta et al., 2020).

Second, innovation-decision models from adoption theory suggest that drivers of customer adoption behavior during the pre-adoption stage differ from those during

the post-adoption stages (Nabih et al., 1997; Talke & Heidenreich, 2014). Thus, different effect sizes found for willingness to co-create and level of co-creation in prior research might be driven by the particular stage of the adoption process in the investigation (pre-adoption vs. post-adoption stages), rather than by actual psychological mechanisms at play during adoption.

Third, analyzing the effects of both constructs on adoption over time is crucial because contrary to traditional products, service innovations generate revenue through customers' continuous usage. Digital service innovations in particular often rely on ongoing revenue streams, such as monthly fees or ads. Thus, a single application or purchase does not generate sufficient revenue to make the service innovation profitable. Instead, continuous usage over an extended period is necessary to achieve profitability (Benbunan-Fich & Benbunan, 2007). To understand co-creation's role in digital service innovation adoption fully, it is necessary to investigate not only the impact of co-creation constructs during the pre-adoption stage, but also during the post-adoption stages. Evidence of the former may be helpful in understanding co-creation's role in initial adoption, but it falls short in explaining co-creation's contribution to continuous adoption (Talke & Heidenreich, 2014). Investigating the relative importance of willingness to co-create and level of co-creation in service innovation adoption, as well as potential interactions between these constructs over time using a longitudinal study design, would help close the aforementioned literature gaps. Table 1 concisely outlines the limitations and consequent research gaps identified in the analyzed articles.

3 | HYPOTHESES DEVELOPMENT

3.1 | Customer adoption behavior over time

Adoption theory (Rogers, 2003) suggests that customers' adoption of service innovations is a dynamic process that occurs over time (Karahanna et al., 1999). To capture this process, various innovation-decision models have been developed over the years (Nabih et al., 1997; Rogers, 2003; Talke & Heidenreich, 2014). Although these models differ in their conceptual structures and the number of stages they propose, they all assume a distinction between the pre-adoption and post-adoption stages. Thus, adoption is viewed as an ongoing process encompassing outcomes during both the pre-adoption (i.e., usage intention) and post-adoption stages (i.e., continuous usage) (Kim & Malhotra, 2005; Rogers, 2003). The process of adoption itself ends when the service innovation has been

TABLE 1 Overview on research gaps in prior customer co-creation research ($n = 31$).

Limitations	Issues	Research gaps
Exclusive examination of WCC ($n = 12$) or LCC ($n = 19$)	Conceptual issues: (a) Sweet spot of co-creation (b) Matching logic of WCC and LCC	Call for investigations into the optimal co-creation level and the psychological processes shaping the co-creation sweet spot (Gligor & Maloni, 2022; Stokburger-Sauer et al., 2016)
Sole reliance on cross-sectional analyses ($n = 31$)	Methodological issues: (c) Temporal dynamics in customer co-creation effects (d) Revenue dynamics of service innovations	Call for longitudinal studies examining customer co-creation effects across pre- and post-adoption stages (Heidenreich et al., 2015; Heidenreich & Handrich, 2015; Jain et al., 2021; Sarmah et al., 2017; Vermehren et al., 2022)

Abbreviations: LCC, level of co-creation; WCC, willingness to co-create.

integrated into the adopter's regular activities (Talke & Heidenreich, 2014). In the context of digital service innovations, this integration often involves not only sustained engagement with the initial service but often also necessitates the adoption of updates (Kübler et al., 2018) and successive digital innovations (Xiao & Spanjol, 2021).

During the pre-adoption stage, when customers become aware of a service innovation and evaluate it, their intention to use the service innovation is influenced primarily by their idiosyncratic characteristics, which also strongly influence perceptions of innovation attributes. During the post-adoption stages, customers' decision to continue using a service innovation is influenced more by the innovation's characteristics than by other factors, like customer characteristics (Talke & Heidenreich, 2014). Supporting these notions, findings by Evanschitzky et al. (2015) and Chou et al. (2010) suggest that adopter-specific variables primarily determine the initial trial of service innovations, whereas service-specific variables mainly determine their continuous usage. Considering that similar patterns also may apply to the adopter-specific variable of WCC and the service-specific variable of LCC, we subsequently differentiate between WCC and LCC's effects during the pre- and post-adoption stages.

3.2 | Effects during the pre-adoption stage

Referring to the service-dominant logic's core principles (Vargo & Lusch, 2004), the important role of customers' willingness to co-create in initial adoption of service innovations during the pre-adoption stage becomes evident. According to service-dominant logic, value is defined as value-in-use, which customers create based on their inputs in terms of resources, processes, and outcomes during interactions with service providers (Grönroos & Voima, 2013; Morosan, 2018; Perks et al., 2012). Following this line of reasoning, value can be created in use only when the customer becomes active (Vendrell-Herrero et al., 2018). Thus, customers' willingness to co-create represents a core prerequisite for value creation in terms of service-dominant logic, as value can be maximized only when both the service provider and customer interact as co-creators (Clauss et al., 2019). When customers are willing to co-create, they are provided with superior economic benefits, like increased goal achievement and greater control, as well as relational benefits accruing from more empathy from the service provider concerning customer needs (Chan et al., 2010; Claycomb et al., 2001; Heidenreich et al., 2015; Shanmugam & Durugbo, 2015). This leads to the development of more personalized and customized services, highly valued by customers (Franke et al., 2008; Kristensson et al., 2004; Magnusson, 2009). Customers with high willingness to co-create not only perceive co-creation's benefits in adopting a service innovation to be greater, but also are willing to engage actively with the service provider to reap these benefits. Therefore, their likelihood of adopting a new service increases through their willingness to leverage co-creation potential.

Consistent with this theoretical proposition, numerous studies offer empirical evidence underscoring the pivotal role of willingness to co-create in shaping customers' adoption behavior during the pre-adoption stage (Handrich & Heidenreich, 2013; Jain et al., 2021; Sarmah et al., 2017). For example, Heidenreich and Handrich (2015) demonstrated that willingness to co-create exerts a significant positive effect on the intention to adopt digital service innovations. Similarly, Neghina et al. (2017) found evidence that customers' intrinsic motivation to co-create enhances co-creation intentions and the adoption of professional and generic services. In light of these insights, we propose:

H1. The effect of willingness to co-create on usage intention during the pre-adoption stage is positive.

Based on service-dominant logic (Vargo & Lusch, 2004) and expectation-disconfirmation theory (Oliver, 1977; Venkatesh & Goyal, 2010), theoretical rationales for the level of co-creation's influence on initial adoption of service innovations during the pre-adoption stage can be derived. According to service-dominant logic, customers play a pivotal role in service delivery as they actively participate in the process of creating value (Vargo & Lusch, 2004). Therefore, it is crucial to consider whether the co-creation process met their expectations (Gligor & Maloni, 2022; Grönroos & Voima, 2013). According to expectation-disconfirmation theory (Oliver, 1977), customer expectations function as a reference point, and any deviation from these expectations in firm performance may result in negative customer reactions (Gligor & Maloni, 2022; Venkatesh & Goyal, 2010). Similarly, customers may establish a reference point for their expected co-creation level in the value co-creation process. Failure to meet the expected level of co-creation may result in negative responses, while its alignment with customers' perceived level of co-creation leads to positive reactions (Gligor & Maloni, 2022).

During the pre-adoption stage, customers' beliefs and expectations are shaped primarily by indirect experiences (e.g., affect and cognition; Karahanna et al., 1999) and the adopter's inherent characteristics (Talke & Heidenreich, 2014). Considering that willingness to co-create, as inherent customer disposition, cognitively determines to what extent customers are motivated to co-create value during service provision and consumption (Heidenreich & Handrich, 2015; Jain et al., 2021; Savitha et al., 2022), it seems reasonable to assume that customers' expectations on an appropriate co-creation level prior to usage are derived primarily from their willingness to co-create. More specifically, customers with high (low) willingness to co-create also expect a service innovation with a high (low) level of co-creation. Thus, drawing on expectation-disconfirmation theory, we can infer that the level of co-creation's effect on customers' adoption behavior for service innovations can be explained by a matching logic between both constructs. Specifically, if the level of co-creation and the willingness to co-create are in alignment, customers are more likely to adopt the service innovation. Conversely, if a mismatch occurs between both constructs, they are more likely to reject it.

While empirical evidence for the proposed matching logic is lacking in the literature, prior research provides some anecdotal empirical evidence to substantiate the theoretical propositions made. More specifically, Stokburger-Sauer et al. (2016) and Gligor and Maloni (2022) uncovered an inverted, U-shaped relationship between the degree of co-creation and customer responses, indicating that while increased co-creation

levels can be advantageous, a threshold exists beyond which additional co-creation results in negative effects. According to Gligor and Maloni (2022), the optimal co-creation point, referred to as the sweet spot, is achieved when the actual level of co-creation aligns with customer expectations. Beyond this sweet spot, exceeding co-creation expectations results in misalignment, potentially triggering adverse customer reactions.

As the expected level of co-creation during the pre-adoption stage is derived from customers' willingness to co-create, individuals with a high willingness to co-create may desire more co-creation, while those with a low willingness to co-create may desire less. Therefore, we hypothesize that a higher level of co-creation has a positive effect for individuals with a high willingness to co-create but a negative effect for individuals with a low willingness to co-create. Accordingly, we hypothesize:

H2. The effect of the level of co-creation on usage intention during the pre-adoption stage depends on the willingness to co-create:

H2a. In case of high willingness to co-create, the effect of the level of co-creation on usage intention during the pre-adoption stage is positive.

H2b. In case of low willingness to co-create, the effect of the level of co-creation on usage intention during the pre-adoption stage is negative.

3.3 | Effects during post-adoption stages

Innovation-decision models from adoption theory (Rogers, 2003) indicate that adopter-specific variables, like customers' willingness to co-create, are crucial in influencing initial adoption during the pre-adoption stage. However, their significance decreases in determining continuous usage during the post-adoption stages (Chou et al., 2010; Evanschitzky et al., 2015). The theory of belief updating (Bolton, 1998; Hogarth & Einhorn, 1992) may be helpful in explaining the diminishing significance of willingness to co-create during post-adoption stages. According to the theory of belief updating, individuals constantly adjust their opinions as soon as new information is presented (Bolton, 1998; Kim & Malhotra, 2005; Slovic & Lichtenstein, 1971). Kim and Malhotra (2005) employed the theory of belief updating in their longitudinal model on continued IS use and confirmed that user evaluations of services undergo a sequential updating mechanism during the adoption process. Accordingly, when

implementing a service innovation, customers engage in an anchoring and adjustment process that feeds on available information (Hou & Ma, 2011).

Prior to initial usage, customers have a rather low information level and little knowledge about the particular service innovation's characteristics (Arts et al., 2011; Murray, 1991; Wood & Moreau, 2006; Young, 1981). Based on this lack of information, inherent adopter-specific variables, like the customers' willingness to co-create, are the main drivers of customers' initial usage of a service innovation. Once the customer puts the service innovation into use, the information level rises over time during the post-adoption stages (Ratten, 2014). Consequently, service-specific characteristics, which feed on available information, increase in relevance when a customer is deciding whether or not to continue using the digital service innovation (Evanschitzky et al., 2015; Wangenheim et al., 2017). Thus, willingness to co-create as an adopter-specific variable should be particularly important as a driver of usage intentions during the pre-adoption stage and for initial usage in the post-adoption stages. However, over time, as customers accumulate more service-specific information and experience through usage during the post-adoption stages, willingness to co-create should lose its relevance for continuous usage. Although no empirical evidence is available on the varying effect of willingness to co-create on customer adoption during the post-adoption stages, studies in related research fields provide evidence supporting our proposition. Evanschitzky et al.'s (2015) study demonstrated that adopter-specific variables, like technological anxiety, play a vital role in the initial trial of service innovations, but their significance in determining continuous usage diminishes over time. Thus, we propose:

H3. The effect of willingness to co-create on continuous usage during the post-adoption stages is positive, but decreases over time.

As previously discussed in the development of Hypothesis 2, customers' expectations on appropriate co-creation levels during the pre-adoption stage are based on their intrinsic motivation to co-create. Prior to adoption, customers' beliefs and expectations primarily are shaped by indirect experiences (Karahanna et al., 1999), as well as the adopter's inherent characteristics (Talke & Heidenreich, 2014), due to the lack of direct usage experience. However, during the post-adoption stages, direct usage experiences are gained such that customers may change their anchor for forming expectations based on these experiences (Gupta et al., 2020; Karahanna et al., 1999). As a result, willingness to co-create may lose

its significance as an anchor for customer expectations about appropriate co-creation levels, and the proposed interaction between willingness to co-create and level of co-creation may become less relevant. Thus, the relationship between level of co-creation and customer adoption behavior during the post-adoption stages may be influenced more by feedback mechanisms due to past usage experiences.

Self-perception theory (Bem, 1967) may be helpful in shedding light on these feedback mechanisms and on whether and how co-creation levels affect usage during the post-adoption stages. According to self-perception theory, individuals understand their own attitudes, emotions, and internal states by interpreting them from their observable behavior and the contexts in which these behaviors occur (Bem, 1972). Transferred to the co-creation context, self-perception theory suggests that due to their co-creation experience during the post-adoption stages, customers form their expectations toward appropriate co-creation levels. More specifically, the very act of co-creating a service together with a service provider will serve as a basis for future evaluations of co-creation levels and its effect on customer adoption behavior (Kim & Malhotra, 2005). For example, a customer who has adopted a service innovation during the pre-adoption stage may respond to the question about an appropriate level of co-creation as follows: "I did co-create the service in the past; therefore, I think I like co-creation and, thus, would rather prefer a high co-creation level." Taken together, self-perception theory suggests that the more co-creation that occurs, the more favorable the customer evaluations and subsequent intention to continue using the service innovation (Kim & Malhotra, 2005). Thus, during the post-adoption stages, level of co-creation should affect customer adoption behavior positively, an effect that is expected to increase over time, particularly as customers accumulate more experience with co-creation activities.

While there is no direct empirical evidence for the aforementioned proposition, the common theoretical assumptions of service-dominant logic (Vargo & Lusch, 2004) offer some support. More specifically, a common assumption of service-dominant logic is that value in service delivery can be maximized only through co-creation (Clauss et al., 2019). Accordingly, customer benefits received from using a service innovation are intertwined strongly with collaboration activities' intensity between the customer and service provider (Chan et al., 2010; Claycomb et al., 2001; Heidenreich et al., 2015). Thus, the relative advantage of a service innovation is determined strongly by the level of co-creation employed in service provision and consumption. As prior studies suggest that the effect of

relative advantage on customers' adoption behavior increases over time, being the strongest for continuous usage in later stages of the adoption process (Arts et al., 2011; Yang et al., 2012), we propose a similar effect pattern for the level of co-creation:

H4. The effect of the level of co-creation on continuous usage during the post-adoption stages is positive and increases over time.

H5. The interaction effect of willingness to co-create and the level of co-creation on continuous usage during the post-adoption stages is positive, but decreases over time.

4 | RESEARCH MODEL AND EMPIRICAL STRATEGY

To test our hypotheses—which propose differing influences for willingness to co-create, level of co-creation, and the interaction of the variables throughout the adoption process—we employed a longitudinal research model to capture data on the adoption process through a pre-adoption stage and various post-adoption stages (Rogers, 2003; Talke & Heidenreich, 2014). As our

conceptual development focused on a customer-specific disposition (willingness to co-create) and perceptions of service characteristics (level of co-creation), we surveyed a panel of consumers at different points in time. In addition to the pre-adoption stage, we captured three post-adoption stages to account for changing customer perceptions and behavior throughout the adoption process. Accordingly, our research model and data set involve four different points in time. As the level of co-creation and usage intensity were expected to change throughout the adoption process, these variables appeared repeatedly in the research model with different temporal notations—level of co-creation in t_1 to t_4 , as well as continuous usage in t_2 to t_4 (i.e., in all usage stages). Willingness to co-create appeared only once in the model, as it is an adopter-specific disposition that is relatively stable over time and does not depend on changing experiences with a particular service (Handrich & Heidenreich, 2013). Usage intention also only appeared once, as it was relevant only during the pre-adoption stage. Within the pre-adoption stage, we tested how willingness to co-create, level of co-creation (in t_1), and their interaction affected intention to use a service. During the post-adoption stages, we analyzed the effects of both constructs (t_2 – t_4), and their interaction on continuous usage (t_2 – t_4). Figure 1 summarizes our research model.

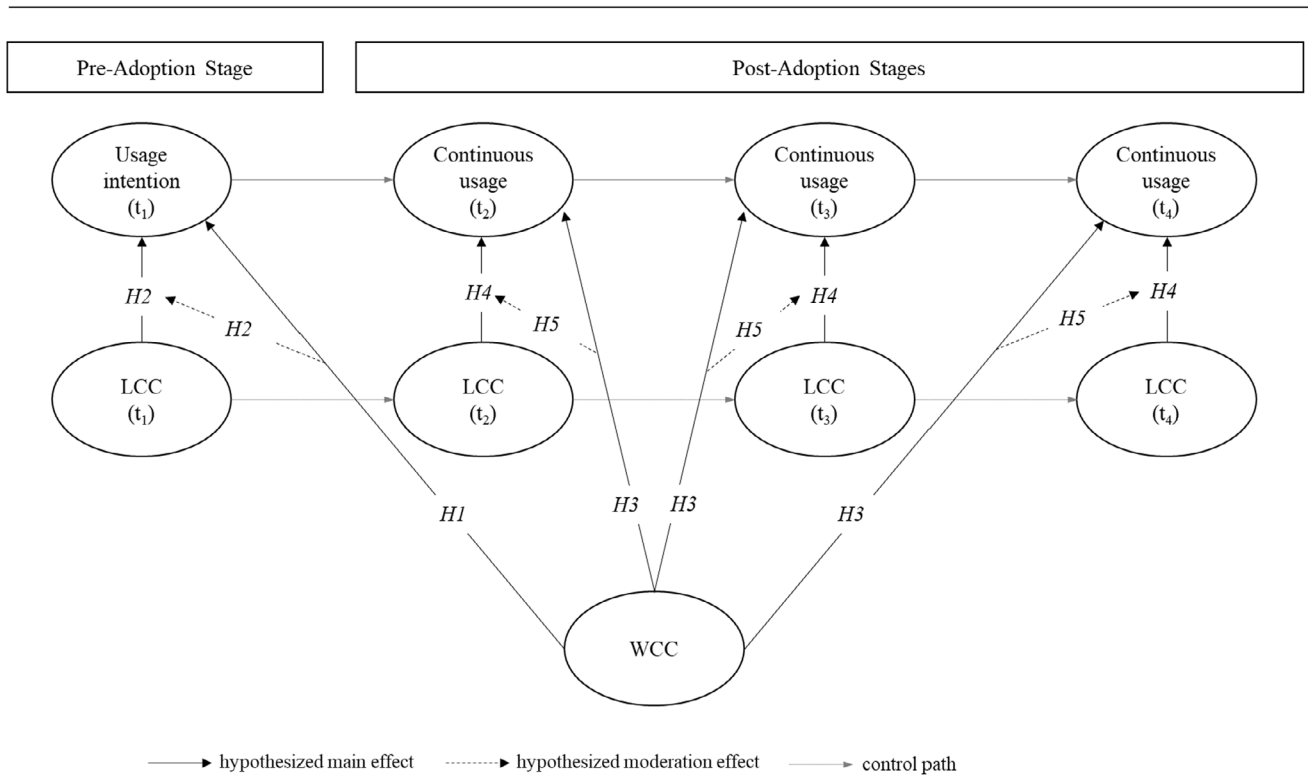


FIGURE 1 Research model. LCC, level of co-creation; WCC, willingness to co-create.

5 | DATA

5.1 | Research setting and sample

We selected smartphone applications (apps) as our research object for several reasons. First, they are recognized widely as a prime example of digital services (Heidenreich & Handrich, 2015); thus, they are applied regularly in studies on customer co-creation (Jang et al., 2021; Roy et al., 2022; Savitha et al., 2022; Vermehren et al., 2022). Second, mobile apps are popular, making them highly relevant for both companies and customers (Kamboj & Gupta, 2020). They are utilized for communication, entertainment, and shopping, among other purposes, providing a natural platform for studying customer co-creation and adoption behavior within the digital service context. Third, mobile apps enable a personalized and customized experience for customers (Lim et al., 2021). Mobile devices' accessibility and ease of use allow customers to interact with apps anytime and anywhere, enabling real-time co-creation of digital service. This renders mobile apps an ideal research platform for investigating how customers co-create and tailor digital services to suit their individual needs.

For the selection of adequate apps for our study, we followed the procedures that Heidenreich and Spieth (2013) suggested. During the first step, a large set of new apps (i.e., apps that were just about to be introduced to the market or recently had been introduced to the market) was identified by scanning both the Apple App Store and Google Play. During the second step, we consulted five experts in the area of mobile apps (three professors with expertise in technology management and digital marketing, as well as two practitioners with experience in mobile commerce) and asked them to rate the collected apps with respect to product newness and innovativeness. This step ensured the apps' newness with our study participants, ruling out distortion effects due to product familiarity and previous usage experiences. Subsequently, we selected the four apps with the highest ratings—Sleep Bot, Moment Cam, Moves, and Aging Booth—to ensure an effective and efficient survey design.

Finally, two different versions of an online survey were developed: one for the pre-adoption stage and one for the post-adoption stages. The pre-adoption survey (t_1) began with a filter question in which we asked participants whether they possessed a smartphone and were able to install an app on it. Participants who answered “no” were excluded from the survey. We then introduced the four selected apps using the original descriptions from the app stores to explain their purpose and features. Subsequently, we asked participants to choose which of the four apps they were most likely to use. Afterward, we requested participants to evaluate their chosen app with respect to the

anticipated co-creation level and their intention to use the app.¹ Furthermore, we questioned participants to evaluate their general willingness to co-create and other personal characteristics (e.g., age, gender, income), which we used as covariates and to control for potential panel attrition and common-method biases (see below).

Within the three post-adoption online surveys (t_2 = after 2 weeks, t_3 = after 4 weeks, t_4 = after 8 weeks), we asked participants to report their perceived level of co-creation and continuous usage of the app. Within these surveys, we also administered control questions to ensure that participants had installed the chosen app (e.g., participants had to navigate through the respective app and solve a requested task correctly). Participants who failed to complete the task correctly were eliminated from the study.

We commissioned a professional online panel provider to conduct data collection from April to June 2016 in Germany. The company contacted potential candidates via email, offering a small monetary incentive for participation (t_1 = € 5.55; t_2 = € 1.85; t_3 = € 1.90; t_4 = € 1.90). Overall, 1098 participants participated in the panel study's first survey. Our final sample comprised 352 participants who completed all four surveys (net response rate = 32.1%). The average age within this final sample was 40.02, with 47.2% of participants being female. The most commonly reported education level was “finished vocational education” (28.9%), followed by “university degree or other graduate degree” (28.4%) and “high school diploma” (23.9%). Furthermore, 41.2% of the participants reported an annual income exceeding € 35,000.

5.2 | Measures

The measurement of the independent and dependent variables was conducted using established scales in the pre-adoption and the post-adoption versions of the survey. Participants' willingness to co-create was measured using Handrich and Heidenreich's (2013) scale items in the pre-adoption survey (t_1), which applies an operationalization as a second-order construct, comprising the first-order dimensions of customization, effort, and information sharing. Level of co-creation was measured in each survey wave (t_1 – t_4) using items adopted from Heidenreich et al. (2015). We used three items from a scale by Kulviwat et al. (2007) to measure the dependent variable usage intention in the pre-adoption survey (t_1). To measure continuous usage during all post-adoption stages (t_2 – t_4), we developed four items based on Lane (2000) and Hamilton et al. (2011). Thus, usage

¹We controlled for the influence of the app choice on the model's endogenous variables with dummy variables.

TABLE 2 Item formulations, indicator loadings, composite reliability, and average variance extracted.

Items	t_1			t_2			t_3			t_4		
	Std. Load.	CR	AVE	Std. Load.	CR	AVE	Std. Load.	CR	AVE	Std. Load.	CR	AVE
<i>Willingness to co-create (WCC)</i>		0.96	0.67									
Customization (WCC dimension)	(0.84)	0.95	0.86									
1. I would like to adapt apps to meet my needs	0.93											
2. It would be advantageous to customize apps to fit my personal preferences.	0.92											
3. I would like to configure apps based on my ideas	0.93											
4. I would like to personalize apps in some way	0.93											
<i>Effort (WCC dimension)</i>	(0.89)	0.96	0.88									
1. To learn how apps work, I would exert a lot of energy	0.94											
2. To learn how apps work, I would spend much time	0.96											
3. To learn how apps work, I would try very hard	0.91											
4. To learn how apps work, I would put a lot of effort	0.94											
<i>Information sharing (WCC dimension)</i>	(0.91)	0.94	0.85									
1. I would provide personal information to use apps	0.91											
2. If necessary I would give personal information to make apps work	0.92											
3. To make apps work I would be willing to release personal data	0.94											
4. In order to make apps work I would be willing to provide personal information, if necessary	0.91											
<i>Level of co-creation (LCC)</i>		0.90	0.71		0.70	0.63		0.82	0.73		0.85	0.74
1. I have to spend a lot of time and energy to use the app properly	0.91			0.79			0.84			0.82		
2. The app offers me many options to customize its use to my needs	0.68			0.71			0.84			0.84		
3. I have to provide a lot of personal information to use the app properly	0.91			0.87			0.87			0.92		
<i>Usage intention</i>												
That I will use the app is...		0.95	0.90									
1. Likely/unlikely (r)	0.94											

TABLE 2 (Continued)

Items	t_1			t_2			t_3			t_4		
	Std. Load.	CR	AVE	Std. Load.	CR	AVE	Std. Load.	CR	AVE	Std. Load.	CR	AVE
2. Possible/impossible (r)	0.95											
3. Imaginable/ unimaginable (r)	0.96											
<i>Continuous usage</i>												
Since the last survey I have used the app...				0.98 0.93			0.98 0.94			0.98 0.95		
1. Very rarely/very often				0.97			0.97			0.98		
2. Very little/very intensively				0.96			0.98			0.97		
3. Very irregularly/very regularly				0.97			0.96			0.98		
4. Almost not at all/every day				0.96			0.98			0.97		

Note: Standardized loadings of the dimensions of the WCC second-order construct are displayed in brackets.

intention measures the likelihood of customers putting a certain service innovation into use, while continuous usage measures usage intensity level after having put a service innovation into use. For all items, we used seven-point Likert or semantic differential scales. Table 2 displays all measurement items.

6 | DATA ANALYSIS AND RESULTS

6.1 | Methodological procedure

We used partial least squares (PLS) structural equation modeling (SEM) to test our research model. PLS-SEM is increasingly used to estimate longitudinal models, offering various advantages over co-variance-based SEM (e.g., higher suitability for complex models, lower sample size requirements; Roemer, 2016). We used SmartPLS 4 with a path-weighting scheme to estimate path coefficients and nonparametric bootstrapping with 5000 replications to obtain significances (Hair et al., 2012; Ringle et al., 2022).

6.2 | Measurement model evaluation

First, we evaluated the measurement model, which comprises the level of co-creation (measured in four points in time: t_1 – t_4), usage intention (measured in t_1), continuous usage (measured in three points in time: t_2 – t_4), and willingness to co-create (measured in t_1). To estimate willingness to co-create—which is a molecular second-order construct (reflective first-order, reflective second-order; Jarvis et al., 2003)—we used the repeated indicators approach (Chin et al., 2003). As all latent variables in our

model were measured with reflective indicators (or dimensions), we evaluated the measurements with regard to indicator reliability, internal consistency reliability, convergent validity, and discriminant validity (Hair et al., 2012).

All indicators but one registered loadings above the 0.7 threshold, thereby exhibiting sufficient indicator reliability. The one indicator (I^2 of LCC in t_1) that registered a loading below this threshold (0.68) was maintained as the loading was still within an acceptable range (above 0.4), and eliminating it would have endangered content validity (Hair et al., 2012). In support of internal consistency reliability and convergent validity, composite reliability scores were >0.7 , and AVE values were greater than 0.5 (see Table 2). Table 3 presents latent variable correlations, means, and standard deviations.

In testing for discriminant validity, we employed two approaches—the Fornell–Larcker criterion (Hair et al., 2012) and heterotrait-monotrait (HTMT) approach (Henseler et al., 2015; Voorhees et al., 2016). In these analyses, we did not include the second-order construct willingness to co-create, but only its first-order dimensions, as the second-order construct is reflected conceptually by its dimensions, and in the research model, the second-order variable contains the same items as the first-order dimensions (see above). In support of discriminant validity, our analysis found that the Fornell–Larcker criterion was met for all variables. Thus, the AVE values of each construct are greater than any squared correlation with another construct. In the HTMT analysis, all ratios for the multi-item constructs pass the conservative threshold of 0.85, which further indicates discriminant validity. Table S2 presents the detailed results from the discriminant validity tests.

TABLE 3 Descriptive statistics and correlations.

	M (SD)	1	2	3	4	5	6	7	8	9	10	11
1. WCC	4.42 (1.21)	1.00										
2. LCC _{t1}	3.75 (1.39)	0.12	1.00									
3. LCC _{t2}	4.00 (1.19)	0.30	0.24	1.00								
4. LCC _{t3}	4.03 (1.33)	0.24	0.27	0.37	1.00							
5. LCC _{t4}	3.85 (1.34)	0.21	0.28	0.39	0.37	1.00						
6. Usage intention _{t1}	5.50 (1.43)	0.34	-0.03	0.04	0.13	0.00	1.00					
7. Continuous usage _{t2}	3.65 (1.69)	0.35	0.12	0.30	0.26	0.26	0.30	1.00				
8. Continuous usage _{t3}	3.29 (1.80)	0.28	0.08	0.28	0.37	0.33	0.19	0.58	1.00			
9. Continuous usage _{t4}	2.97 (1.83)	0.22	0.09	0.24	0.26	0.47	0.08	0.51	0.65	1.00		
10. Age	40.02 (12.02)	0.06	0.05	0.06	0.09	0.05	0.07	-0.03	-0.04	-0.01	1.00	
11. CMV marker variable	3.63 (1.06)	-0.09	0.09	0.04	-0.01	0.12	-0.12	0.11	0.09	0.11	-0.20	1.00

Note: Correlations $\geq |.12|$ are statistically significant ($p < 0.05$, two-tailed).

Abbreviations: LCC, level of co-creation; WCC, willingness to co-create.

6.3 | Common-method variance

In our empirical design, independent and dependent variables were measured based on the same data source: self-reports from consumers. This poses a risk that common-method variance (CMV) may distort results. We applied a priori techniques (i.e., procedural remedies) and post hoc methods (i.e., statistical remedies) to limit and control for CMV. We employed several procedural techniques in the study design to limit CMV resulting from implicit theories, consistency motifs as well as social desirability. To begin, we informed participants about the critical role of their contributions to the research, highlighting that their unique opinions were essential and that no specialized knowledge was needed to answer the questions. Furthermore, we organized the survey so that independent and dependent variables appeared on distinct pages of the online questionnaire. Third, we rewarded participation with a small monetary incentive to enhance motivation and promote conscious answers (Podsakoff et al., 2003).

Furthermore, we statistically controlled for CMV using the marker variable approach (Lindell & Whitney, 2001). A CMV marker is a variable that is measured on the same scale as the model's central variables, but is theoretically unrelated. Thus, when this marker is related statistically to focal variables in the model, the relationship can be attributed largely to CMV. We chose the five-item perceived (life) stimulation scale as a CMV marker, which was, like our focal variables, measured on a seven-point scale (Heidenreich & Kraemer, 2016; Helm, 2001). This marker variable was used as a covariate in our structural model, which allowed us to parcel out CMV. The data analysis revealed that the CMV marker was correlated only weakly with the model's latent variables (all

$r \leq |0.12|$) and that including the marker did not change the estimation results significantly.

6.4 | Endogeneity

There is a risk of bias in the results of our research model due to endogeneity, which happens when a predictor variable is correlated with the unexplained residual of an outcome variable (Hill et al., 2021). In particular, it is conceivable that simultaneity (or reciprocal causality) exists in the relationship between level of co-creation and continuous usage, which would cause endogeneity and bias estimates (as our model does not account for it). Thus, whereas we hypothesized that the level of co-creation affects continuous usage, the latter and resulting familiarity with a service also may affect to what extent customers perceive that a service requires co-creation. Following the procedure proposed by Hult et al. (2018), we employed the Gaussian copula approach to test whether endogeneity likely affected our model. Thus, we first tested whether the variables were distributed non-normally, which is a prerequisite for the approach. After confirming nonnormality in the distributions, we tested whether the Gaussian copulas affected the paths within our model. As these effects were not significant, and the approach did hence not detect endogeneity issues, we proceeded with our initial PLS model (Hult et al., 2018).

6.5 | Attrition bias

Our empirical design, which comprised multiple survey waves, had the potential for attrition bias, as not all

participants who filled out the first survey participated in the remaining three surveys and, thus, were not included in the final sample. Panel attrition (i.e., nonresponse during a panel study's duration) is not necessarily a problem, but attrition bias may distort results when participants' decision to finish or depart a study is related to study-specific characteristics (Winer, 1983). For instance, if high-income individuals are more likely to depart a study, and income is related to outcome variables (e.g., continuous usage), systematic attrition biases arise.

We followed recommendations from the current literature and applied the Heckman correction procedure to control for biases resulting from systematic panel attrition (Hulland et al., 2018; Kraemer et al., 2020). First, using the sample from the first survey ($N_{t1} = 1098$), we estimated a probit selection model in which we included gender, income, education, and agreeableness as determinants of the decision to depart prematurely (coded as 0) or finish (coded as 1) the study.² All determinants significantly predicted (for $p < 0.10$) the decision to finish the study (i.e., to participate in all surveys). Second, using the estimates from the probit selection model, we calculated the inverse Mills ratio and subsequently integrated it as a control variable in the structural model.

6.6 | Structural model and hypothesis testing

Subsequently, we evaluated the structural model, testing whether it was affected by multicollinearity and whether it has predictive value. As all variance inflation factors (VIFs) are well below the common threshold of 5 (the highest VIF in our model was 2.16), multicollinearity is not a concern. As the Q^2 values of all central variables were greater than zero, it can be concluded that the model has predictive value. Furthermore, an average R^2 of 0.34 among the usage variables (usage intention, continuous usage_{t2-4}) indicates that the target variables in our model are well-explained (see Table S3).

In testing our hypotheses, we viewed path coefficients and their respective significance levels at different points in time and, thus, at different stages in the adoption process. In support of H1, we found that willingness to co-create positively influenced usage intention ($\beta = 0.32$, $p < 0.001$) during the pre-adoption stage (t_1). With H2, we predicted that in the case of high willingness to co-create, the effect of level of co-creation on usage intention

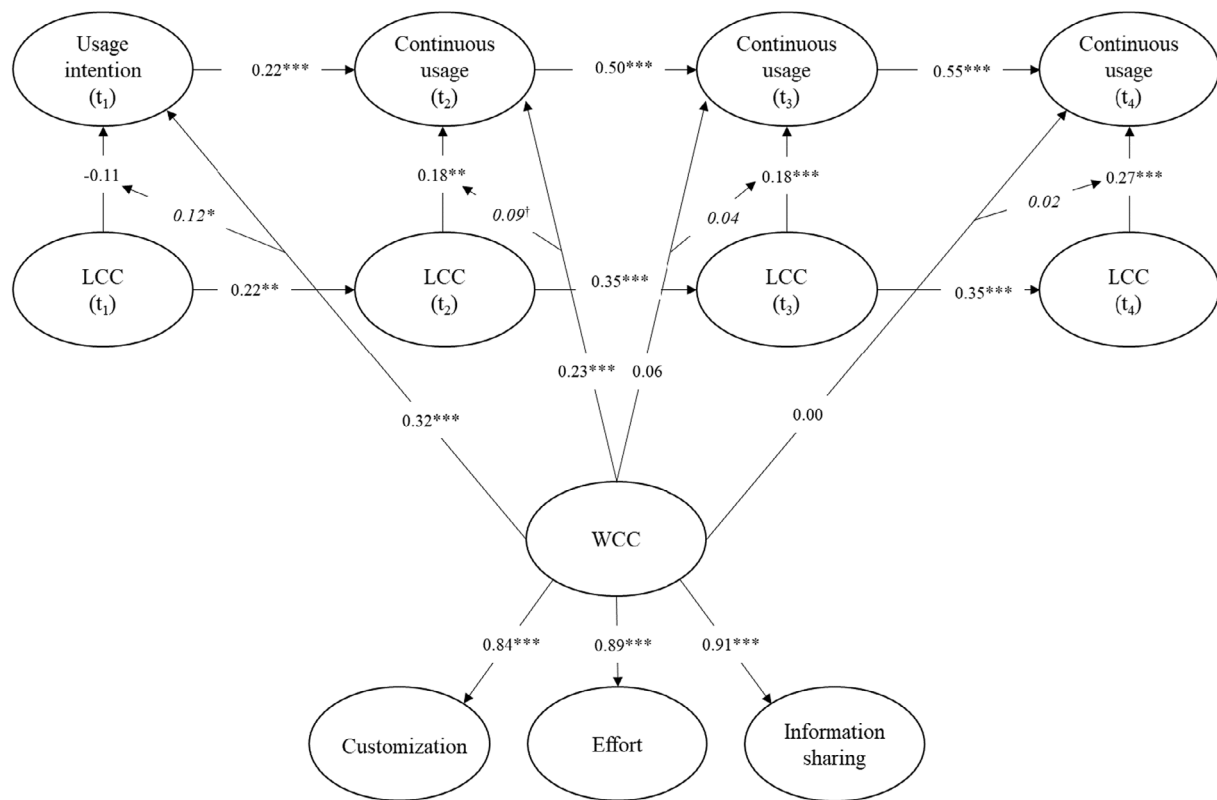
during the pre-adoption stage is positive, whereas it is negative in the case of low willingness to co-create. As the main effect of level of co-creation on usage intention in t_1 is not significant ($\beta = -0.11$, *ns*) and the interaction effect of both constructs on usage intention is significant and positive ($\beta = 0.12$, $p < 0.05$), our results support this prediction. Thus, at medium levels of willingness to co-create, the effect of level of co-creation on usage intention is 0 (as the direct effect is not significant). If willingness to co-create increases by one standard deviation, the effect of level of co-creation on usage intention increases by the size of the interaction term ($0 + 0.12 = 0.12$) and, thus, is positive. The opposite holds for lower willingness to co-create (i.e., a decrease by 1 SD). Here, the level of co-creation negatively affects usage intention ($0 - 0.12 = -0.12$). These findings suggest that individuals with a high willingness to co-create demonstrate higher usage intentions as the level of co-creation increases (H2a), while individuals with a lower willingness to co-create demonstrate higher usage intentions as the level of co-creation decreases (H2b). Therefore, the results support the idea that individuals seek an alignment between both constructs.

With H3, we predicted that willingness to co-create positively influences continuous usage, which decreases over time (i.e., in the later stages post-adoption stages). Supporting this hypothesis, willingness to co-create positively influences continuous usage in t_2 ($\beta = 0.23$, $p < 0.001$), while the effects on continuous usage were not significant during the later post-adoption stages (t_3 : $\beta = 0.06$, *ns*; t_4 : $\beta = 0.00$, *ns*). H4 posits that level of co-creation's effect on continuous use during the post-adoption stages is positive and increases over time. We can confirm this hypothesis, as level of co-creation's effect on continuous usage was positive in t_2 ($\beta = 0.18$, $p < 0.01$) and became stronger during later phases (t_3 : $\beta = 0.18$, $p < 0.001$; t_4 : $\beta = 0.27$, $p < 0.001$). H5 proposed that willingness to co-create and level of co-creation's interaction effect on continuous usage is positive during the post-adoption stages, but decreases over time. We can support this hypothesis, as the interaction exerts a marginally significant positive effect on continuous usage in t_2 ($\beta = 0.09$, $p < 0.10$), which becomes insignificant during the later post-adoption stages (t_3 : $\beta = 0.04$, *ns*; t_4 : $\beta = 0.02$, *ns*). Figure 2 and Table 4 summarize the results.

6.7 | Additional analysis: Matching logic

One of our central assumptions that we stated in H2 is that the effect of level of co-creation on usage intention during the pre-adoption stage depends on the customer's

²Agreeableness is one of the Big 5 personality dimensions and describes the tendency to be cooperative, trusting, and kind (Devaraj et al., 2008); agreeableness was measured with a 3-item scale adapted from Rammstedt and John (2007) as well as Schupp and Gerlitz (2014).



Covariates: Age, perceived stimulation (common method variance marker), inverse Mills ratio, app dummy variables

FIGURE 2 Structural model results (standardized coefficients). Path from covariates are not displayed for clarity (see Table 4 for all path coefficients); LCC, level of co-creation; WCC, willingness to co-create. †Significant at $p < 0.10$, * significant at $p < 0.05$, ** significant at $p < 0.01$, ***significant at $p < 0.001$.

willingness to co-create. We further proposed that this interplay follows a certain matching logic such that individuals with high willingness to co-create prefer high co-creation levels, and individuals with low willingness to co-create prefer low levels of co-creation. We tested this proposition using (simple) interaction terms in our main analysis. This method is suited to test the assumption underlying this matching logic and, indeed, revealed that the direction of the effect of level of co-creation on usage intention depends on the customer's willingness to co-create. However, due to its linear nature, this traditional approach in moderation analysis may provide an incomplete picture of the effects of the interplay between both constructs. Thus, it is conceivable that different kinds of matches and mismatches may result in differences in customers' usage intentions. Thus, a match at high levels of both constructs may lead to different results than a match at low levels of both constructs. Or else a mismatch with willingness to co-create exceeding the level of co-creation may lead to

different consequences than a mismatch with level of co-creation exceeding willingness to co-create.

To examine how matches/mismatches between willingness to co-create (WCC) and level of co-creation (LCC) affect outcomes, we conducted a response surface analysis. This approach plots a polynomial regression's results three-dimensionally, providing nuanced insights into how the interplay between two predictors affects an outcome variable (Edwards, 2002; Shanock et al., 2010). First, we conducted a polynomial regression analysis of the pre-adoption stage with the two predictors (WCC, LCC_{it}), an interaction term of the predictors ($WCC \times LCC_{it}$), and quadratic terms of the predictors (WCC^2 , LCC_{it}^2) as independent variables.³ Second, the coefficients from this analysis were used to calculate the slopes and curvatures of a line of perfect agreement (indicating predictor fit effects) and a line of incongruence (indicating predictor misfit

³Predictor variables were centered to reduce multicollinearity (Edwards, 2002).

TABLE 4 Standardized path coefficients and significances.

Path			Coeff.	t	p
<i>Main effects</i>					
WCC	→	Usage intention _{t1}	0.32	6.02	0.000
WCC	→	Continuous usage _{t2}	0.23	3.45	0.001
WCC	→	Continuous usage _{t3}	0.06	1.04	0.299
WCC	→	Continuous usage _{t4}	0.00	0.04	0.969
LCC _{t1}	→	Usage intention _{t1}	-0.11	1.07	0.284
LCC _{t2}	→	Continuous usage _{t2}	0.18	2.95	0.003
LCC _{t3}	→	Continuous usage _{t3}	0.18	3.45	0.001
LCC _{t4}	→	Continuous usage _{t4}	0.27	4.72	0.000
<i>Interaction effects</i>					
LCC _{t1} × WCC	→	Usage intention _{t1}	0.12	2.06	0.039
LCC _{t2} × WCC	→	Continuous usage _{t2}	0.09	1.92	0.055
LCC _{t3} × WCC	→	Continuous usage _{t3}	0.04	1.08	0.279
LCC _{t4} × WCC	→	Continuous usage _{t4}	0.02	0.44	0.660
<i>Control paths</i>					
LCC _{t1}	→	LCC _{t2}	0.22	2.96	0.003
LCC _{t2}	→	LCC _{t3}	0.35	5.51	0.000
LCC _{t3}	→	LCC _{t4}	0.35	5.35	0.000
Usage intention _{t1}	→	Continuous usage _{t2}	0.22	4.26	0.000
Continuous usage _{t2}	→	Continuous usage _{t3}	0.50	9.98	0.000
Continuous usage _{t3}	→	Continuous usage _{t4}	0.54	11.74	0.000
Age	→	LCC _{t2}	0.04	0.76	0.448
Age	→	LCC _{t3}	0.05	1.17	0.243
Age	→	LCC _{t4}	0.04	0.83	0.409
Age	→	Usage intention _{t1}	0.05	0.96	0.335
Age	→	Continuous usage _{t2}	-0.05	1.06	0.289
Age	→	Continuous usage _{t3}	-0.06	1.32	0.188
Age	→	Continuous usage _{t4}	-0.01	0.17	0.867
Inverse mills ratio	→	LCC _{t2}	-0.13	2.25	0.024
Inverse mills ratio	→	LCC _{t3}	-0.16	3.01	0.003
Inverse mills ratio	→	LCC _{t4}	-0.07	1.28	0.200
Inverse mills ratio	→	Usage intention _{t1}	0.10	2.12	0.034
Inverse mills ratio	→	Continuous usage _{t2}	-0.03	0.69	0.493
Inverse mills ratio	→	Continuous usage _{t3}	-0.13	2.80	0.005
Inverse mills ratio	→	Continuous usage _{t4}	-0.06	1.52	0.129
Perc. stimulation (CMV marker) _{t1}	→	LCC _{t2}	0.01	0.15	0.878
Perc. stimulation (CMV marker) _{t1}	→	LCC _{t3}	-0.02	0.35	0.724
Perc. stimulation (CMV marker) _{t1}	→	LCC _{t4}	0.13	2.28	0.023
Perc. stimulation (CMV marker) _{t1}	→	Usage intention _{t1}	-0.08	1.38	0.167
Perc. stimulation (CMV marker) _{t1}	→	Continuous usage _{t2}	0.14	2.23	0.025
Perc. stimulation (CMV marker) _{t1}	→	Continuous usage _{t3}	0.04	0.66	0.510
Perc. stimulation (CMV marker) _{t1}	→	Continuous usage _{t4}	0.02	0.47	0.639
App 1 (sleepbot) dummy variable	→	LCC _{t2}	0.34	2.05	0.041

(Continues)

TABLE 4 (Continued)

Path			Coeff.	<i>t</i>	<i>p</i>
App 1 (sleepbot) dummy variable	→	LCC _{<i>t</i>3}	-0.27	1.70	0.090
App 1 (sleepbot) dummy variable	→	LCC _{<i>t</i>4}	0.00	0.02	0.986
App 1 (sleepbot) dummy variable	→	Usage intention _{<i>t</i>1}	0.24	1.43	0.153
App 1 (sleepbot) dummy variable	→	Continuous usage _{<i>t</i>2}	0.09	0.63	0.529
App 1 (sleepbot) dummy variable	→	Continuous usage _{<i>t</i>3}	-0.24	1.87	0.062
App 1 (sleepbot) dummy variable	→	Continuous usage _{<i>t</i>4}	0.16	1.35	0.177
App 2 (moment cam) dummy variable	→	LCC _{<i>t</i>2}	0.42	2.48	0.013
App 2 (moment cam) dummy variable	→	LCC _{<i>t</i>3}	-0.16	1.02	0.306
App 2 (moment cam) dummy variable	→	LCC _{<i>t</i>4}	0.05	0.30	0.762
App 2 (moment cam) dummy variable	→	Usage intention _{<i>t</i>1}	-0.04	0.20	0.839
App 2 (moment cam) dummy variable	→	Continuous usage _{<i>t</i>2}	0.10	0.63	0.527
App 2 (moment cam) dummy variable	→	Continuous usage _{<i>t</i>3}	0.02	0.13	0.898
App 2 (moment cam) dummy variable	→	Continuous usage _{<i>t</i>4}	0.09	0.74	0.458
App 3 (moves) dummy variable	→	LCC _{<i>t</i>2}	0.24	1.46	0.146
App 3 (moves) dummy variable	→	LCC _{<i>t</i>3}	-0.14	0.92	0.357
App 3 (moves) dummy variable	→	LCC _{<i>t</i>4}	0.10	0.64	0.520
App 3 (moves) dummy variable	→	Usage intention _{<i>t</i>1}	0.14	0.83	0.406
App 3 (moves) dummy variable	→	Continuous usage _{<i>t</i>2}	-0.08	0.50	0.618
App 3 (moves) dummy variable	→	Continuous usage _{<i>t</i>3}	0.01	0.08	0.934
App 3 (moves) dummy variable	→	Continuous usage _{<i>t</i>4}	0.13	1.07	0.283

Note: App 4 (aging booth) is reference category.

Abbreviations: LCC, level of co-creation; WCC, willingness to co-create.

effects) (Shanock et al., 2010). These estimates then were used to plot the response surface pattern, which indicated the outcome variable's level at different combinations of the predictor variables (Edwards, 2002). Panel 1 of Figure 3 displays the results from this analysis, in which darker shades of gray in the pattern indicate higher usage intention levels.

The results indicate that matches/mismatches of both constructs crucially impacted the outcome. Individuals who displayed a high willingness to co-create and perceived that the co-creation level required by the service was also high had the highest intention to use the service. This result was predictable based on our initial moderation analysis. Furthermore, in accordance with the assumption of a matching logic, the combination of a low willingness to co-create and a low level of co-creation also led to a relatively high usage intention. Interestingly, customers' usage intentions differed substantially for the two mismatch conditions. When the level of co-creation exceeded willingness to co-create, customers clearly signaled the lowest adoption intentions. However, when willingness to co-create exceeded the level of co-creation, customers signaled relatively high usage intentions,

similar to the case of a match at low levels of both constructs. This indicates that individuals with high willingness to co-create are generally willing adopters, which is also supported by our SEM analysis, in which willingness to co-create exerted a crucial (direct) effect on usage intention.

We also have conducted a response surface analysis for the post-adoption stages (t_2 - t_4) with continuous usage as the dependent variable (see Figure 3, panels 2-4). As indicated by the results from our SEM analysis, the interaction between both constructs exerted only a minor influence on continuous usage in t_2 and no influence in t_3 and t_4 . In t_2 , continuous usage was shaped mainly (and equally great) by the direct effect of each construct, whereas in t_3 and t_4 , the level of co-creation exerted a dominant effect on continuous usage. Notably, also in t_3 and t_4 , individuals with a high willingness to co-create demonstrated ceteris paribus decisively higher continuous usage than those with a low willingness to co-create, even though this variable did not directly affect continuous usage during these stages in the SEM model. This result can be attributed to carry-over (i.e., time-lagged) effects of willingness to co-create during the earlier stages

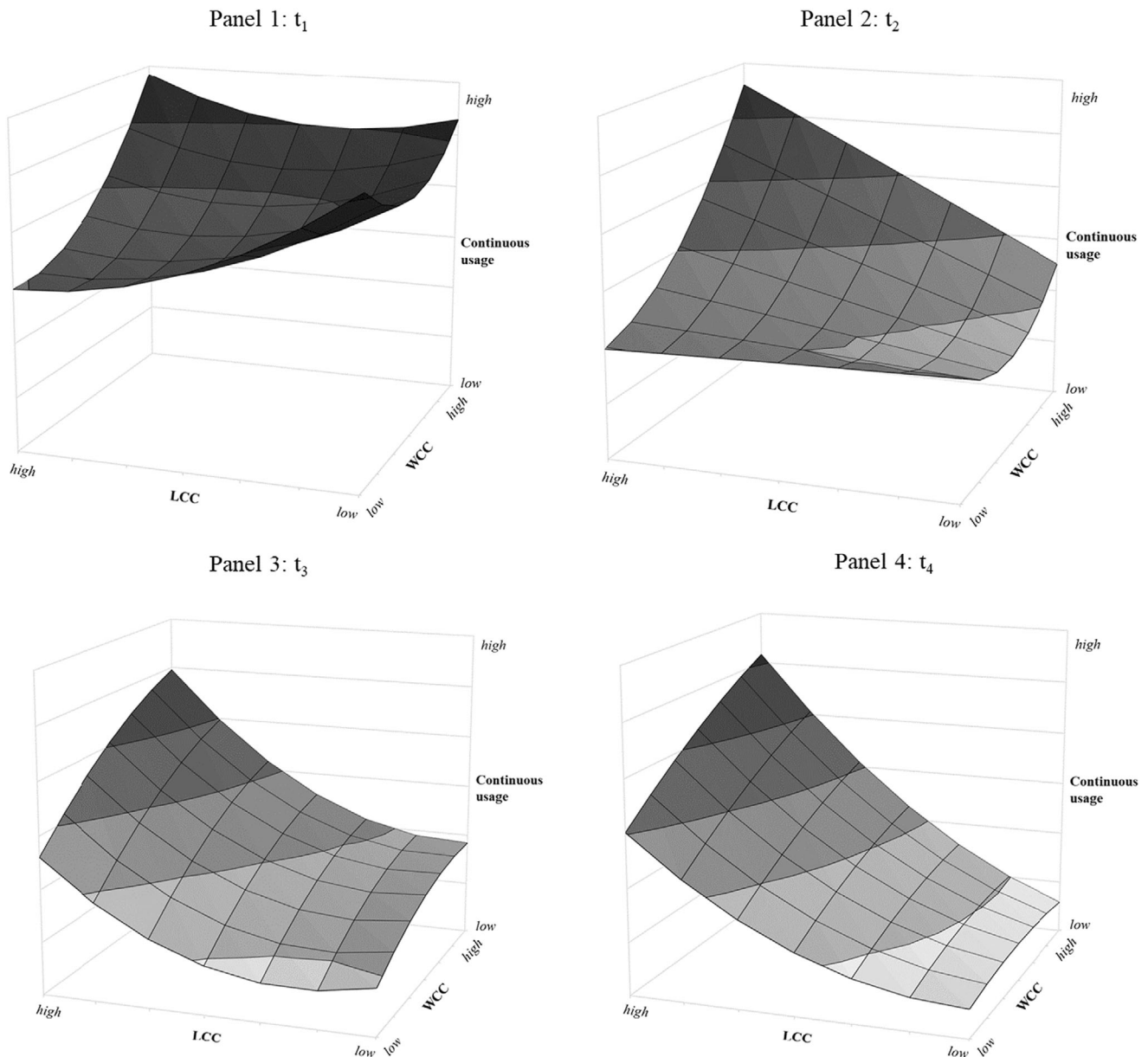


FIGURE 3 Response surface analysis results. LCC, level of co-creation; WCC, willingness to co-create.

of the adoption process. Thus, willingness to co-create affects usage intention in t_1 and continuous usage in t_2 , which (directly or indirectly) affect continuous usage in t_3 and t_4 .

7 | DISCUSSION

This study aimed to investigate whether and how the willingness to co-create and the level of co-creation affect adoption of digital service innovations over time using innovative mobile applications as research context. Based on data from the first longitudinal study conducted in this research context, we applied PLS-SEM and response

surface analysis with polynomial regression to investigate both construct's differential impact on adoption behavior during the pre- and post-adoption stages, as well as possible interaction effects between these two constructs over time. Our study's results contained insightful findings.

First, our findings from the SEM analysis in the context of mobile applications are consistent with those of previous research emphasizing the important role of customer co-creation in the adoption of service innovations (Chan et al., 2010; Chua & Sweeney, 2003). Our results show that both constructs have a significant impact on the adoption of innovative mobile applications in both the pre- and post-adoption phases. More specifically, the findings related to willingness to co-create during

the pre-adoption stage are in line with the results of Heidenreich and Handrich (2015), Jain et al. (2021), and Sar-mah et al. (2017), confirming the construct's important role for customers' intention to adopt. Furthermore, our results build on Neghina et al.'s (2017) findings by demonstrating that willingness to co-create leads not only to a higher probability of customer engagement in co-creation activities, but also to stronger adoption intention and initial continuous usage of the particular digital service innovation.

However, our results from the post-adoption stages further demonstrate for the first time that this strong and positive effect on adoption intention and initial continuous usage of mobile applications diminishes over time. Still, the positive effects of willingness to co-create during the pre-adoption and early post-adoption stages carried over to the later stages. To sum up, our findings on the effects of willingness to co-create during the post-adoption stages confirm suggestions from prior research that adopter-specific variables exhibit strong effects during early stages in the adoption process, but lose their relevance in determining customer adoption behavior during later stages (Chou et al., 2010; Evanschitzky et al., 2015; Talke & Heidenreich, 2014).

The findings related to the level of co-creation during the pre-adoption stage, provide further evidence of the existence of a co-creation sweet spot that recently was discovered by studies focusing on possible detrimental effects of high co-creation levels on customer behavior (Gligor & Maloni, 2022; Stokburger-Sauer et al., 2016). However, our findings go beyond previous research in this area by illuminating the underlying reasons for this co-creation sweet spot and negative effects beyond that optimal point. More specifically, our findings during the pre-adoption stage indicate that the effect of co-creation levels on customer adoption behavior is contingent on the level of customers' willingness to co-create. High levels of the customers' willingness to co-create lead to a positive effect of the level of co-creation, while low levels result in a negative effect. Accordingly, the significant interaction term during the pre-adoption stage represents the first empirical evidence of our proposed matching logic between willingness to co-create and the level of co-creation. However, during the post-adoption stages, the interaction effect between both constructs weakens, and the level of co-creation instead exhibits a consistently positive effect on continuous adoption, which strengthens over time. This finding in the context of innovative mobile applications aligns with previous research indicating that a service's relative advantage, which is linked closely to the degree of co-creation, is the primary driver of continued usage during later adoption stages but extends this finding to co-creation contexts (Arts et al., 2011; Yang et al., 2012).

Second, the findings from the response surface analysis revealed additional nuanced insights into the proposed matching logic during the pre- and post-adoption stages. During the pre-adoption stage, the combination that resulted in the greatest usage intention was a high willingness to co-create combined with a high anticipated level of co-creation. Similarly, customers with low willingness to co-create signaled comparably high usage intentions when they anticipated a low co-creation level during the pre-adoption stage. The corresponding results further substantiate the proposed matching logic, such that value co-creation match in terms of an anticipated co-creation level that aligns with the customers' willingness to co-create leads to the most favorable conditions for customer adoption of digital service innovations, such as mobile applications. This finding is in line with assumptions from expectation-disconfirmation theory (Oliver, 1977), as well as prior research in co-creation contexts, suggesting that meeting customers' expectations in the co-creation process leads to the most favorable customer reactions (Gligor & Maloni, 2022), but delivers the first empirical evidence of this causal mechanism.

Furthermore, and in line with our proposed matching logic, the results also confirmed that a positive mismatch during the pre-adoption stage (i.e., the customer's anticipated level of co-creation is higher than the willingness to co-create) substantially weakens intention to use the mobile application. This finding supports previous research indicating that exceeding the pre-allocated time and effort for co-creation with a service provider can lead to stress and negative customer reactions (Chan et al., 2010; Gligor & Maloni, 2022). One exception to the proposed matching logic during the pre-adoption stage is the case of a negative mismatch (i.e., when the customer's anticipated level of co-creation is lower than the willingness to co-create). Contrary to our expectations, the results indicate that the combination of a high willingness to co-create and low levels of co-creation also leads to relatively high usage intention during the pre-adoption stage. A possible explanation for this unexpected finding might be that customers with a high willingness to co-create are generally very willing adopters of innovative digital services, as these kinds of services offer increasing technical possibilities that principally make customer involvement in the service provision process easier (Kleijnen et al., 2007).

While the proposed matching logic was crucial during the pre-adoption stage, its relevance diminished during the subsequent post-adoption stages. Here, both constructs positively contributed to continuous usage. The positive influence of the level of co-creation resulted from growing direct effects during the post-adoption stages, while positive effect of customers' willingness to co-create evolved mainly due to indirect effects through

the construct's positive influence during the pre-adoption and early post-adoption stages. Accordingly, during the post-adoption stages, continuous usage tended to be high for combinations with high levels of both constructs, medium when only one of the constructs was high, and low when both constructs were low. Thus, even customers with a low willingness to co-create valued high co-creation levels once they gained usage experience, as willingness to co-create loses its relevance as an anchor for forming expectations on an appropriate co-creation level. This finding aligns with self-perception theory (Bem, 1967), which suggests that the more co-creation is experienced during service usage in the past, the more positive the customer evaluations and intention to continue using the service innovation in response to increasing co-creation levels. The findings thus advocate reconsidering the exclusively beneficial role attributed to co-creation, aiming to overcome the pro-co-creation bias of prior studies. These studies, based on their positive findings on customer co-creation, assumed that co-creation is universally perceived as beneficial by all customers (Grissemann & Stokburger-Sauer, 2012; Sugathan et al., 2017a, 2017b; Xu et al., 2014). In contrast to this perspective, our findings in the mobile application context emphasize the critical importance of tailoring the degree of co-creation in digital service innovations according to the intrinsic willingness of customers.

8 | IMPLICATIONS

8.1 | Theoretical implications

Research on customer co-creation has predominantly concentrated on either customers' willingness to co-create or the level of co-creation as the sole driver of innovation adoption in terms of initial purchase or single application at one point in time (Grissemann & Stokburger-Sauer, 2012; Jain et al., 2021; Sarmah et al., 2017; Xu et al., 2014). However, research on possible interactions and on the differential influence of both constructs on customer adoption behavior over time using longitudinal data remained neglected. This study aimed to contribute to the research field by shifting the focus to a combined investigation of both constructs using a longitudinal approach that cross-fertilizes service-dominant logic and adoption theory to explain customer adoption of digital service innovations in the context of mobile applications over time. In doing so, we answer the calls made by prior research for longitudinal studies on how customer adoption behavior is affected by co-creation generally (Hoyer et al., 2010) and by willingness to co-create and the level of co-creation specifically

(Heidenreich et al., 2015; Jain et al., 2021; Sarmah et al., 2017; Vermehren et al., 2022). The corresponding findings from our empirical study contribute to the current understanding of co-creation and innovation adoption in three major ways.

First, our study is the first to investigate each construct's longitudinal effects on innovation adoption behavior. The corresponding findings thereby contribute to service-dominant logic (Vargo & Lusch, 2004) and adoption theory (Rogers, 2003) alike. According to service-dominant logic, value can be created in usage only by the customer becoming active (Vendrell-Herrero et al., 2018). Therefore, it is crucial, from the service-dominant logic perspective, to identify the drivers that motivate customers to engage initially in co-creation during digital service provision and to sustain their co-creation behavior over time during service consumption (Neghina et al., 2017). However, due to the lack of longitudinal studies that offer differential insights into the drivers of co-created service usage during pre- and post-adoption stages, corresponding empirical evidence was scarce. Our study's findings shed light on prerequisites for value creation in terms of service-dominant logic during the pre- and post-adoption stages. With respect to the pre-adoption stage, customers' willingness to co-create represents the core prerequisite for value creation, but during the post-adoption stages, the level of co-creation became the core prerequisite for value creation.

This finding also contributes to adoption theory by providing further empirical evidence of adopter- and innovation-specific variables' relative importance during customer adoption processes (Rogers, 2003). Our study's results highlight that willingness to co-create, as an adopter-specific variable, pursues similar effect patterns on customer adoption behavior as predispositions like risk aversion (e.g., Laukkanen et al., 2008; Mani & Chouk, 2018) or passive innovation resistance (e.g., Heidenreich & Kraemer, 2016; Koch et al., 2021). More specifically, willingness to co-create is highly important for the initial usage of digital service innovations, but declines in importance for subsequent continuous service usage after initial adoption. However, the effect pattern of the level of co-creation as a service-specific variable is comparable with other innovation attributes, like relative advantage (Yang et al., 2012) or ease of use (Evanschitzky et al., 2015). While the level of co-creation is not decisive during the customer's initial contact with the digital service innovation, its impact becomes positive and even essential for continuous usage during the post-adoption stages. Thus, the common effect pattern of adopter- and innovation-specific factors assumed by innovation-decision models (Nabih et al., 1997; Talke & Heidenreich, 2014) is also

applicable for customer adoption behavior in co-creation contexts.

Second, the empirical validation of our proposed matching logic between both constructs offers the first explanation for the mixed findings regarding the co-creation levels and customer behavior during the pre-adoption stage as well as the discovered co-creation sweet spot (Gligor & Maloni, 2022; Stokburger-Sauer et al., 2016). Our findings indicate that the level of co-creation generally exerts neither a positive nor negative effect on usage intention during the pre-adoption stage. Instead, the effect is contingent upon customers' willingness to co-create. In line with expectation-disconfirmation theory (Oliver, 1977; Venkatesh & Goyal, 2010), our proposed matching logic suggests that customers are more likely to adopt the digital service innovation if both constructs are aligned. Conversely, if both constructs are mismatched, they are more likely to reject it. Relying on this matching logic, the inverted U-shaped relationship between level of co-creation and customer behavior—and, thus, the co-creation sweet spot—can be explained (Gligor & Maloni, 2022; Stokburger-Sauer et al., 2016). A common assumption in psychological research is that psychological traits and variables are distributed normally across the population (Ahmetoglu & Chamorro-Premuzic, 2017; Goldhaber & Startz, 2017; Mayer, 1960). Considering that willingness to co-create also represents a psychological variable, it seems reasonable to assume that most people will congregate around the average in terms of their willingness to co-create (Ahmetoglu & Chamorro-Premuzic, 2017). Based on our proposed matching logic, the expected level of co-creation prior to usage is derived from customers' willingness to co-create, so it also congregates around the average. Accordingly, the probability of adoption among all customers is likely to increase as anticipated co-creation levels gets closer to medium levels. However, once the anticipated level of co-creation matches the average customer's expected (i.e., medium) co-creation level, further increases can affect adoption negatively. Thus, across all individuals, increasing the level of co-creation positively impacts customer behavior up to a certain point, that is, medium levels of co-creation. However, beyond that co-creation sweet spot, further increases in co-creation lead to negative effects.

While a match between both constructs is generally beneficial, as described above, it is important to consider that the two different types of mismatches, namely negative mismatch (i.e., willingness to co-create > level of co-creation) and positive mismatch (i.e., willingness to co-create < level of co-creation) elicit very different consequences in the adoption process. Thus, while customers with a high willingness to co-create generally still

are inclined toward adopting digital services such as mobile applications with low co-creation levels, customers with a low willingness to co-create are very resistant toward services that appear to require high levels of co-creation. This asymmetry in the matching (or mismatching) logic between both constructs provides interesting initial insights that indicate that the willingness to co-create can be viewed as a mental capacity (Pascual-Leone & Baillargeon, 1994). It is slightly dissatisfying for customers when this capacity is not fully utilized, but it is very unpleasant when the capacity is exceeded (or threatened to be exceeded).

Third, our findings provide first empirical insights into the nuanced dynamics of co-creation across the customer journey, offering a refined perspective on the concept of a co-creation “sweet spot.” Our analysis extends beyond the recognition that more co-creation naturally leads to better outcomes, by elucidating how and why the optimal degree of co-creation varies across the customer journey. This approach responds to the call by Stokburger-Sauer et al. (2016) for a deeper understanding of co-creation's optimal levels.

For the pre-adoption stage, our investigation reveals that the notion of a universally optimal level of co-creation might be a simplification. Instead, we find that the co-creation sweet spot seems individualized, contingent upon each customer's unique willingness to engage in co-creation activities. This insight is significant because it shifts the focus from seeking a universally optimal level of co-creation to recognizing the importance of tailoring co-creation efforts to individual customer profiles. By leveraging existing research on psychological variables' normal distribution (Ahmetoglu & Chamorro-Premuzic, 2017; Goldhaber & Startz, 2017; Mayer, 1960), we propose that a moderate level of co-creation is generally most effective in eliciting positive responses during the pre-adoption stage.

Transitioning into the post-adoption phase, our findings illuminate the evolving nature of co-creation dynamics across the customer journey. Here, the direct experience of customers with a service shifts the psychological underpinnings of their expectations, reducing the primacy of initial willingness to co-create in determining the optimal level of co-creation. Drawing from Bem's self-perception theory (Bem, 1967), we highlight how feedback from early usage experiences significantly influences customers' perceptions and preferences concerning co-creation intensity. The experience of engaging in the co-creation process can recalibrate customer expectations, often leading to an increased appreciation for deeper co-creation involvement due to the positive reinforcements from initial co-creation experiences (Kim & Malhotra, 2005). Thus, in the post-adoption

stages, a heightened level of co-creation, informed by positive prior experiences, emerges as more effective in eliciting favorable customer responses. Taken together, our results illustrate that the “sweet spot” for co-creation is not static but varies across the adoption process—from a moderate level during pre-adoption to a heightened level in post-adoption stages. This contributes to co-creation theory by demonstrating the fluidity of the co-creation “sweet spot” across different stages of the customer journey, emphasizing the importance of adapting co-creation strategies based on evolving customer experiences and feedback.

8.2 | Managerial implications

Continuous customer engagement is critical for companies to commercialize digital service innovations successfully (Chan et al., 2010; Handrich & Heidenreich, 2013; Meuter et al., 2005). This study contains valuable implications for aligning service design and supportive marketing efforts during a digital service launch to motivate initial adoption and to ensure continuous usage. Based on our findings, marketing strategies can be derived to engage and retain customers during the pre-adoption and post-adoption stages. Additionally, they suggest effective combinations of pre- and post-adoption marketing actions based on the matching logic identified.

8.2.1 | Know your customer

To foster initial adoption and ongoing use of digital innovations such as mobile applications, providers must gain a deep understanding of their target market's willingness to co-create through comprehensive market research before launching innovations. Having identified the level of customers' willingness to co-create in their target markets, focusing on segments with a high willingness to co-create can expedite service diffusion. Customers in these segments, often early adopters and opinion leaders, can influence other customers' adoption decisions with their positive experiences and recommendations. For example, providers of cloud-based collaboration platforms, may initially target customers who exhibit a strong willingness toward co-creation. These customers can play a pivotal role in not only maximizing the intended impact of the service but also in influencing and persuading others to join and utilize the platform. A concrete strategy could involve offering early access to the tool for these segments, perhaps through a closed beta program that allows for direct feedback and co-creation of features. This approach not only garners valuable insights for refining the service but also builds a community of

committed customers who feel a sense of ownership over the development of the tool. Offering incentives, such as discounts, free upgrades, or exclusive access to new features, can encourage customers with high willingness to co-create to share their positive experiences with others. Likewise, these customers also can be invited to participate in referral programs, in which they can earn rewards for referring their friends and family to the service. For instance, the successful referral scheme implemented by Dropbox, which awarded additional storage to both the referrer and the referred, stands as a model that can be adapted. Such programs can leverage these customers' high on willingness to co-create efficiently to turn other people into willing adopters of the service, ultimately leading to widespread adoption and increased revenues.

8.2.2 | Motivate customers to co-create

While prioritizing segments with high willingness to co-create is most effective, service providers may need to expand their reach to other segments to achieve high market shares or tap into lucrative markets. A practical example where it is necessary to also target customers with low willingness to co-create could be seen in the context of a user-generated content platform, such as a custom merchandise online store, where customers design their own products. While the platform's core customer base may actively enjoy creating unique designs, broader market segments might hesitate due to the perceived complexity of the co-creation process or doubts about their ability to master it. To engage such segments with low willingness to co-create, service providers should boost customer motivation through targeted marketing. While willingness to co-create is not service-specific and rather a general motivation for co-creation, research suggests that marketing communication can temporarily affect the effects of customer dispositions on adoption behavior (Heidenreich & Kraemer, 2016). This allows service providers to use targeted advertising for extrinsic co-creation motivation enhancement. For instance, advertisements can highlight the benefits of co-creating with the service or minimize the disadvantages associated with it. For maximizing benefits, ads may utilize benefit comparison (Ziamou & Ratneshwar, 2003) to emphasize how engaging in co-creation leads to a superior, customized service outcome compared to fully abstaining from co-creation activities. Referring back to the example of a custom merchandise online store, this could involve side-by-side comparisons of customer-designed products versus standard off-the-shelf items, highlighting the added personal value and uniqueness of co-created goods. For minimizing disadvantages, service providers should recognize that

customers with low willingness to co-create may feel uncertain or lack confidence in their ability to contribute to the service delivery process. Hence, employing mental stimulation in ads (Feiereisen et al., 2008) may encourages customers to envision themselves effortlessly using the service innovation. Referring back to the example of a custom merchandise online store, this might include video tutorials or animated walkthroughs that demonstrate how customer can easily navigate the design interface, use templates, and apply customization options without needing any prior design experience.

8.2.3 | Adjust service offerings' design to match the customer during their journey

Our findings highlight the necessity for service providers to tailor service design and marketing communication strategies to meet specific requirements throughout the adoption process. This approach is crucial for effectively engaging customers at various stages of their journey with a digital innovation. To engage new customers in the pre-adoption stage, companies should offer different versions of their digital innovation—ranging from basic to advanced—that allow customers to choose the level of co-creation that best matches their willingness to co-create. For customers with low levels of willingness to co-create, service providers should offer a basic version, minimizing co-creation requirements (e.g., by hiding or deactivating certain co-creation features) and employ marketing communication highlighting that service usage demands relatively little effort and time. In the case of a smart home lighting system, for example, this basic version could include pre-configured lighting scenes for common activities (e.g., reading, dining, waking up) that can be activated with simple commands. To incentivize deeper engagement with the system's co-creation features, the provider might introduce a rewards program where customers can earn points for experimenting with different lighting settings. These points could be redeemed for discounts on future product purchases or exclusive access to new lighting features. For customers displaying high willingness to co-create, service providers should offer an advanced version with a wide variety of co-creation options and highlight these options during every step of the marketing process. Referring again to the smart home lighting system, this could involve innovative features like adaptive lighting that adjusts according to the time of day, weather conditions, or even the customers' moods, detected through integrated sensors or wearable technology. Marketing for this advanced package should focus on the system's

innovative capabilities and its potential to dynamically transform the home environment based on individual customer preferences.

During post-adoption stages, service providers should elevate co-creation levels by introducing new options with additional customization possibilities (e.g., by unlocking new features through successive digital innovations; Xiao & Spanjol, 2021) and guide customers in using these options (e.g., through tutorials) to keep effort as low as possible. Referring again to the smart home lighting system, this could involve the ability to create and save unique lighting scenes, integrate the lighting system with other smart home devices (e.g., thermostats, security systems), or equip GPS functionality from a smartphone app to automatically adjust lighting based on the customer's location. Over time, service providers can additionally leverage customer feedback and engagement data to improve and expand co-creation options. This can include offering exclusive customization features, early access to new co-creation options, and opportunities for co-creation collaboration with other customers. This strategy ensures all customers can enjoy the system's fundamental functionalities while offering avenues for enhanced engagement and personalization as their interest in co-creation increases.

In situations with limited resources, where providing various versions or configurations of the digital innovation is unfeasible, it is advisable to launch with an initial offering that requires minimal co-creation. This approach is recommended because the drawbacks of not fully meeting customers' co-creation expectations during pre-adoption stages are significantly less severe than the repercussions of exceeding their willingness to co-create.

9 | LIMITATIONS AND FUTURE RESEARCH AVENUES

As is customary in research, it is important to acknowledge certain limitations when interpreting the results of this study. First, the data in our longitudinal study is exclusively drawn from consumers residing in Germany. While the sample is likely representative of other Western countries with similar cultural contexts, the generalizability of our results beyond Germany remains uncertain. Thus, future research may determine whether our findings hold when the research model is investigated with other populations in different cultural settings.

Second, our study focused on four mobile apps as research objects to control for intervening effects that may be associated with any single service (Heidenreich & Spieth, 2013; Im et al., 2003). While mobile apps are

viewed widely as a prime example of digital services and often are applied in research on customer co-creation (Heidenreich & Handrich, 2015; Morosan, 2018; Sarmah et al., 2017), focusing on one service category limits generalizability to other contexts. In particular, it would be worth investigating whether our results differ for more complex digital service innovations, like blockchain-based services, digital health platforms, telemedicine services or fintech platforms. Although the directional effects of co-creation on usage behaviors are anticipated to be consistent across different digital innovations, the intensity of these effects is likely to be more significant in the context of complex digital services. For example, engaging with a fintech platform such as Trade Republic may demand a higher initial willingness to co-create than what is observed with simpler mobile applications covered in our study. Investigating how a service's characteristics (e.g., complexity, associated risks) shape both construct's effects on the continuous adoption of the service represents an interesting question for future research.

Third, our study focused on willingness to co-create as an adopter-specific variable and level of co-creation as a service-specific variable that determine customer adoption behavior over time. Yet, prior research also has indicated that service provider characteristics might affect customers' service evaluation and subsequent adoption (AlHinai et al., 2010; Rao Hill & Tombs, 2011). Consequently, future research could investigate whether and how service provider characteristics, like reputation or image, may affect causal mechanisms proposed in our adoption model over time.

Fourth, in analyzing both construct's effects, we relied on the constructs' aggregated scores (e.g., we did not examine whether different types of co-creation activities exert different effects). However, it is conceivable that customers are willing to engage in particular types of co-creation while being hesitant to engage in other co-creation activities. For instance, customers might cherish a service that requires substantial time and effort for customization, whereas they might be wary of a service that requires extensive sharing of personal information. To gain more insights into different co-creation activities' effects, future studies could conduct a more detailed analysis that accounts for the influence of various facets of both constructs and their interactions.

Fifth, in our study, we decided to use perceptual measures instead of behavioral ones to operationalize continuous usage. While using behavioral data may provide a more objective measure of continuous usage, individual characteristics and circumstances can affect interpretation of such data. More specifically, using a mobile app five times per month can be relatively frequent for

customers who seldom use mobile applications or have tight schedules due to working conditions. However, for customers who generally use mobile applications frequently, using a mobile application five times per month would be less significant. Considering that our main focus was on how co-creation promotes continuous usage of service innovations in terms of usage intensity, which is relatively high compared with a customer's average mobile app usage intensity, we deem perceptual measures of continuous usage as more fitting in our research context. Still, future studies may try to replicate our findings using behavioral data.

Sixth, the present study was centered on examining the impact of customer co-creation on the usage intensity of a specific digital innovation. For future research, an avenue worth exploring involves shifting the focus toward the adoption likelihood of updates (Kübler et al., 2018) and examining how the interplay between the level of co-creation and customers' intrinsic motivation to co-create may shape this dynamic. Additionally, in line with the central managerial implication of our study, which advocates tailoring the degree of co-creation in digital service innovations according to the intrinsic willingness of customers, future research could explore whether successive digital innovations as modifications to an existing digital product over time that incorporate new features or capabilities (Xiao & Spanjol, 2021), are effective in retroactively adjusting the level of co-creation based on customers' willingness to co-create.

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The authors have read and agreed to the Committee on Publication Ethics (COPE) international standards for authors.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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